RESEARCH REPORT

1. Name: Michael Babokhov （ID No.: SP15001 ）

2. Current affiliation: Department of Biology, Tufts University

3. Research fields and specialties:

Biological Sciences

4. Host institution: Shimane University Faculty of Medicine

5. Host researcher: Dr. Takeshi Urano

6. Description of your current research

All living organisms must decode the information stored in their genomes to produce proteins that are critical to growth and survival. The first step in this process is known as transcription. The DNA is read by a suite of enzyme complexes to produce an RNA transcript in an organized set of steps. This RNA transcript is then used in the production of proteins.

My research is focused on understanding how the enzyme complexes involved in transcription are formed and regulated to produce the RNA transcript. More specifically, I work with the RNA Polymerase II enzyme – the key player in transcription that reads DNA to produce RNA. RNA Polymerase II stands out from the rest of the transcription machinery due to a long repeating structure that extends like a chain from the body of the enzyme. This chain plays a vital role in holding the transcription machinery together with RNA polymerase II. However, the role of the individual repeating units of the structure (the links of the chain) remains poorly understood. My research seeks to directly understand the individual roles of the RNA Polymerase II repeats. Which repeats are important and which are dispensable? Are repeats used specifically or are they redundant? How are other transcription-related enzymes organized at the repeats?

The ultimate goal of this work is to better understand how a process as complicated and significant as transcription is organized at the biochemical level. This knowledge can then be applied to developments in medicine and biotechnology.

7. Research implementation and results under the program

Title of your research plan:

Discovering novel functions of protein repeats critical to gene expression

Description of the research activities:

In line with the goals of my current research, I set out to understand the specific roles of the RNA Polymerase II repeats using the fission yeast model organism. This was my first time using the fission yeast system. Consequently, the primary research activity was receiving training in the genetics and cellular biology of fission yeast RNA polymerase II. I carried out genetic manipulation and cellular analysis of a variety of fission yeast strains to create a novel assay to study RNA polymerase II in fission yeast. In addition to this training, I also gained experience working with genetic sequencing. Furthermore, this collaborative research will continue following the end of the Summer Program with the aim of biochemically characterizing the newly constructed fission yeast strains and comparing the findings to parallel experiments in budding yeast.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I had a fantastic time travelling to various cultural sights in the Chūgoku region with Hiroshima being the most striking. My Japanese speaking skills improved notably thanks to daily interactions with my colleagues in the lab and the immersive experience will help in my goal for Level N1 of the Japanese-Language Proficiency Test. Professional visits to labs in the University of Fukui and the University of Hokkaido provided further insights into research at Japanese Universities.

9. Advisor’s remarks (if any):

In this stay, Mr. Michael Babokhov learned some experimental skills that are essential for his current research, and in my impression, he enjoyed everything he experienced both in and outside the lab. With his excellent Japanese conversation skills and his depth of knowledge on Japanese culture, his stay had also been a valuable experience for the lab members.

RESEARCH REPORT

1. Name: Jennifer Marie BEALS （ID No.: SP15002 ）

2. Current affiliation: St. Cloud State University, St. Cloud, Minnesota, USA

3. Research fields and specialties:
Biological Sciences

4. Host institution: Tokyo Gakugei University

5. Host researcher: Prof. Shigeki MAYAMA

6. Description of your current research

My current research is an investigation of the origin and evolution of the first group of motile. While significant effort has been made conducting DNA and evolutionary studies of other diatom lineages, very little effort has been made to sequence the DNA and understand the evolution of the first motile group.

The origin and evolution of the diatom raphe, which is responsible for motility, will be investigated by constructing morphological and molecular phylogenies of early raphid and pre-raphid diatoms. Diatoms within the subclass Eunotiophycidae are accepted as the first raphid diatoms, however the first raphid genus is still a point of contention. Taxa will be selected from all genera within the subclass Eunotiophycidae. The number or taxa used within each genus will vary according to the diversity within each group so that most specific morphological variations will be represented. A detailed morphological character matrix will be constructed and taxa will be coded into the matrix for phylogenetic analysis. Additionally, an effort will be made to gather live materials for as many taxa as possible. These live cells will be used for live observations and cultured for DNA analysis. This expansion of molecular and morphological knowledge will be essential to the study, as there is molecular sequence data in GenBank for less than 1% of the described Eunotia species, and no data at all for any other genera within the subclass. Additional care will be taken to choose appropriate araphid (pre-raphid) outgroups for analysis, as well as other more recently evolved raphid taxa.

7. Research implementation and results under the program

Title of your research plan: Investigating the origin and evolution of locomotion in the microalgae diatoms

Description of the research activities:

I conducted sampling activities at several sites in Japan in a targeted effort to collect taxa within the diatom genus *Eunotia*. Cells were isolated from these samples to start monoculture lines via asexual diatom division. Multicellular cultures were also started to observe diatom sexual reproduction in an effort to observe taxa across their entire size range. Samples were also cleaned and mounted for both light and scanning electron microscopy. Preliminary observations suggest that one or more of the taxa collected are new records for species occurrences in Japan. I also visited the diatom collections in the Botany and Geology Departments of the National Science Museum in Tsukuba to meet with the diatom researchers and tour the collections there.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I found my summer research experience very productive and rewarding. The collections that I made will be invaluable to my thesis research. The training that I received from Prof. Mayama on both culturing techniques and fine details of morphology within the group of diatoms that I am studying will play a key role in my future research. Additionally, discussions with Prof. Mayama on evolutionary hypotheses within diatoms have given me guidance on potential taxa to include in my analysis and will give me additional insight for analysis of my results.

I also was able to experience Japanese culture and enjoy discovering new foods during my research experience. I visited places within the Tokyo region, climbed Mt. Fuji, and visited Sapporo with other summer research fellows. I also enjoyed hearing about culture, festivals, and celebrations from Prof. Mayama and other students in his lab.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Zachary S. BITTNER （ID No.: SP15003）

2. Current affiliation: Rochester Institute of Technology

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Japan Atomic Energy Agency

5. Host researcher: Dr. Shin-Ichirio SATO

6. Description of your current research

Photovoltaics (PV) is an enabling technology for space exploration, and the lifecycle of the technology employed needs to be well characterized and well understood before the full system can be designed. A major concern for the longevity of satellites in Medium Earth orbit (MEO), or orbital radii from 1.8 to 2.5 times the Earth's radius(R_e) is the high energy radiation effects from passing through the Van Allen belts where charge particles are trapped by the Earth's magnetic field.

State-of-the-art high-efficiency III-V photovoltaic technology (PV) relies on a triple junction lattice-matched design using the InGaP/(In)GaAs/Ge material system, which is asymptotically approaching efficiencies of 31%. The efficiency in this system is limited by the relatively low current generation of the (In)GaAs subcell— an effect exacerbated by the displacement damage caused by radiation. My researcu focuses on the application nanostructures such as quantum dots (QDs) or quantum wells (QWs) to tune the bandgap of a semiconductor material, increasing current generation, without changing the effective lattice constant of the material in order to improve overall efficiency to a maximum of 47%. An ancillary benefit of adding QDs is that it may improve the overall radiation tolerance of the device, improving end-of-life efficiency.

7. Research implementation and results under the program

Title of your research plan:

Investigation of Radiation Tolerance of Novel Semiconductor Materials for Space Power

Description of the research activities:

For this project, two sets of samples were grown. The first set, single-junction strain balanced quantum dot solar cells (QDSCs), included strain-neutral solar cells and compressively strained solar cells. The second sample set were full triple junction solar cells, both with and without quantum wells.Samples were irradiated in JAEA's TIARA facility. An electron beam was used to irradiate the triple junction solar cells, and a proton beam was used to irradiate the single junction solar cells. In-situ electrical measurements were taken for both sample sets, and I made two trips to Tsukuba JAXA to use a close-match solar simulator to test the triple junction solar cells using a spectrum mimicking that of the Sun seen in Earth orbit. I have been working on developing device models and analyzing data from the experiment. I plan to present the final results at the 11th International Workshop on Radiation Effects on Semiconductor Devices for Space Applications in Gunma, Japan in November

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Nathan Buerkle (ID No.: SP15004)

2. Current affiliation: University of Chicago

3. Research fields and specialties:
Biological Sciences

4. Host institution: SOKENDAI

5. Host researcher: Michiyo Kinoshita

6. Description of your current research

Nervous systems play an integral role in producing phylogenetically diverse behaviors.. However, little is known about brain evolution and how altering the complex and intricate organization of neural circuits can give rise to adaptive behavior rather than deleterious effects. The evolution of tetrachromatic vision from a trichromatic ancestor in the Japanese yellow swallowtail butterfly, *Papilio xuthus*, presents an excellent opportunity to study neural evolution because the utilization of color opponency across insects and vertebrates makes it a tractable and relatively simple computation to assess within a comparative framework. Although evidence suggests that seeing red in addition to ultraviolet, blue, and green is ecologically valuable, the evolution of a red photoreceptor for insects is rare. This indicates that evolving this novel sensory dimension could be evolutionarily constrained, and understanding the neural changes necessary for tetrachromatic vision could potentially reveal basic principles underlying mechanisms of behavioral evolution. My project aims to identify the basic color computations in the butterfly brain and compare my results to those of other insects.

7. Research implementation and results under the program

Title of your research plan: Investigating the evolution of color vision in the Japanese yellow swallowtail butterfly (*Papilio xuthus*)

Description of the research activities:

The goal of my project was to assess the color coding properties of visual neurons in the butterfly brain using intracellular electrophysiology to record the responses to monochromatic light stimuli. I used approximately the first half of the summer program learning basic physiology techniques and anatomy. These experiments were primarily conducted by recording from photoreceptors because it is an easier preparation for learning the fine motor skills required for electrophysiology.

During the second half of the program, I began recording from the medulla, a major site of visual processing that accounts for nearly half of the entire butterfly brain. Intracellular recordings that maintained a good quality for the five minutes necessary to complete the stimulus set were then filled with neurobiotin and processed for anatomical reconstruction. The stimuli used were a combination of motion stimuli in four directions (up, down, left, right) and a series of monochromatic light stimuli. Unfortunately, most of the cells I successfully recorded from were large, direction selective cells, which do not allow me to accurately determine the spectral tuning of these cells. In the future I intend to maintain an ongoing collaboration with my host lab to additionally incorporate extracellular recording, behavior, and computational modeling to answer my question about the evolution of neural circuits.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The project I proposed involves many steps to obtain a single piece of good data. None of these steps were particularly difficult, but becoming consistently good enough at them so I could successfully finish all the steps for a single butterfly was quite hard. I look forward to continuing to collaborate with my host researcher.I really enjoyed my time with my host lab and was invited to several cultural events and many lunches and dinners with my host and with other students at SOKENDAI. Two of my favorite cultural experiences was attending a summer festival with my host near her home and climbing Mount Fuji with other JSPS fellows.

RESEARCH REPORT

1. Name: Leonardo CALLE （ID No.: SP15005 ）

2. Current affiliation: Montana State University

3. Research fields and specialties:

Interdisciplinary and Frontier Sciences

4. Host institution: Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

5. Host researcher: Prabir K. Patra

6. Description of your current research

Gaseous carbon in the atmosphere plays a large role in regulating global temperatures. However, plants use carbon dioxide (gas) and convert it to solid building blocks for growth, ultimately removing gaseous carbon from the atmosphere and providing short and long-term storage, reducing its effect on global temperatures. We use a simulation model to track carbon through the Earth's geochemical cycle and provide estimates of carbon dioxide emissions to the atmosphere from land use change activities such as de-forestation, forest degradation, and forest regrowth. However, our estimates of carbon emissions are simulations, so we are unsure of their accuracy. This project's main objective is to benchmark our simulated carbon emissions against observations of atmospheric carbon dioxide from a satellite that is operated and owned by Japan, the Greenhouse Gases Observing Satellite (GOSAT), which is first of its kind.

Dynamic Global Vegetation Models (DGVM) simulate exchanges of carbon between the land (live plants, litter, and soil) and the atmosphere, and includes factors that affect the plant's efficiency to exchange carbon, such as weather (short-term) and climate (long-term patterns in precipitation and temperature), available sunlight, and competition from other plants. The carbon dioxide (CO_2) fluxes from seven independent DGVMs will be combined with fossil fuel emissions (for control of ancillary terrestrial CO_2 fluxes) obtained from a separate dataset, and together they will be used as boundary conditions for forward runs in an atmospheric chemistry-transport model, developed by the host scientist. The simulated CO_2 fluxes from the atmospheric chemistry-transport model will then be benchmarked to GOSAT observations and evaluated for accuracy. A regional gridded, and GOSAT-derived, dataset of CO_2 fluxes from land use change, for the years between 2009 to the present, will be created.

7. Research implementation and results under the program

Title of your research plan:

BENCHMARKING CARBON DIOXIDE EMISSIONS FROM A CARBON-CYCLE SIMULATION MODEL AGAINST OBSERVATIONS OF ATMOSPHERIC CARBON DIOXIDE FROM SPACE

Description of the research activities:

The following research was performed in a 9-week period at the JAMSTEC facilities with supervision by the host researcher. The research first required preparation of the carbon dioxide fluxes in a format suitable for computer simulation. **Week 1:** Data preparation was conducted using multiple computer programming languages, one of which (*Fortran*) was learned by the researcher during this time period. **Week 2:** With the help of the host researcher, the carbon dioxide fluxes were then simulated in time and space. The finalized simulation resulted in a time-series dataset of carbon dioxide concentrations for the entire globe at 3-hourly intervals for all years between 2002-2012. **Weeks 3-5:** (a) The GOSAT observations and the finalized simulated data were prepared into a format suitable for analysis, and (b) the researcher created visualizations of the data in graphs, plots, and animations. **Weeks 5-7:** The researcher learned and applied mathematical techniques to decompose the datasets into different important signals that were present in the data; prior to this analysis this information was hidden in the data as noise. **Weeks 8-9:** A statistical framework was developed to guide the remaining portions of the research, which will be conducted at the researcher's home institution. The finalized data products and an outline of a manuscript for publication of the research findings were discussed, and target journal and timeline for publication were agreed upon.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Much of my positive experiences in Japan have been from my daily interactions with colleagues, both at the workplace and after work hours. I am hopeful that these friendships and collegial relationships will last beyond my stay in Japan.

9. Advisor's remarks (if any):

I extremely pleased to host Leo in JAMSTEC. He has exceeded all expectations.

RESEARCH REPORT

1. Name: Matthew Cha （ID No.: SP15006）

2. Current affiliation: University of California, Davis

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: The University of Tokyo

5. Host researcher: Prof. Yasuyuki KAWAHIGASHI

6. Description of your current research

My current research is the study of quantum phases of matter. Recently, physicists discovered new quantum phases classified by topological data. For example, in the classification of two dimensional quantum phases we study the behavior of anyonic excitations. The anyons correspond to some topological quantum field theory. A fundamental feature of gapped topological quantum phases is robustness to noise. Our main research goal is a mathematically rigorous study of the stability of anyons in two dimensional topological quantum phases.

The mathematical framework we work with is that of a quantum spin system. A quantum spin system prescribes a C*-dynamical system as a low temperature approximation to some physical quantum many-body system. At low temperature, a quantum many-body system is well described by states at the bottom of the spectrum. These states correspond to different superselection sectors of the algebra of observables, which carry the physical interpretation of particle sectors. In the framework of local quantum physics, Doplicher, Haag and Roberts show the anaylsis of superselection sectors recovered the entire particle physics. A current research goal is to implement a similar analysis of superselection sectors for a large class of quantum spin systems.

Recently, with motivation coming from quantum computation, there have been many quantum spin systems discovered which correspond to some topological quantum field theory. This started with the work of Alexei Kitaev in 1997 who produced a two dimensional quantum spin system which had non-abelion anyons described by the quantum double of a finite dimensional Hopf algebra. A current research goal is to work out a rigorous superselection theory for these models.

7. Research implementation and results under the program

Title of your research plan:

Stability of Anyons in Topological Phases of Matter

Description of the research activities:

Our research started with the review of the algebraic theory of anyons which are modular tensor categories. We focused our attention of the representation theory of the quantum double of finite groups, working out the fusion rule and S-matrix for many as examples for many groups. This preliminary work was necessary to understand the Kitaev's quantum double models.

We discovered that in the toric code which is the quantum double model for the group of two elements, the anyon states were ground states in the thermodynamic limit. We made substantially progress in generalizing this result to any quantum double model. The main idea of the proof is the find a boundary condition which allows one anyon in an anyon pair to condensate to the boundary and understanding the algebra of ribbon operators.

We showed that in a perturbed toric code, it is necessary to use an asymptotic superselction rule to recover all relevant superselection sectors. In particular, it is not enough to consider a cone like superselection rule as considered by the original Doplicher, Haag and Roberts analysis.

With, Professor Yoshiko Ogata of the University of Tokyo, we initiated a study of Haag duality in matrix product states and projected entangled pair states. In many cases, proving Haag duality is a starting point in developing the superselection theory. Although Haag duality is already known for gapped one dimensional systems, we hope that our analysis can lead to a proof for a large class of two dimensional systems.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The research environment at the University of Tokyo was great. Professor Yasuyuki Kawahigashi made sure I had access to all needed resources.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Natalie CLARK （ID No.: SP15007）

2. Current affiliation: North Carolina State University, Raleigh, NC USA

3. Research fields and specialties:

Biological Sciences

4. Host institution: RIKEN Center for Sustainable Resource Science

5. Host researcher: Dr. Keiko SUGIMOTO

6. Description of your current research

Development in multicellular organisms requires not only the production of specialized cell types but also mechanisms of coordination among them. Stem cells are ultimately the source of all cell types, and the balance between self-renewal and differentiation of their progeny regulates organ growth. Transcription factors (TFs) and cell-to-cell signaling have a key role in coordinating these processes; however, how these transcriptional networks and signaling pathways control plant development is not completely understood. Our goal is to predict gene regulatory networks important for stem cell identity and maintenance in the *Arabidopsis thaliana* root. To this end, we obtained a transcriptomic profile of all of the stem cell populations in the *A. thaliana* root using Fluorescence Activated Cell Sorting (FACS) coupled with RNA sequencing (RNA-seq). From these data, we were able to identify genes that may have an important role in stem cell identity and/or maintenance. To infer the relationships between these genes of interest, we developed a computational pipeline that can infer Gene Regulatory Networks (GRNs) from transcriptomic data. We are currently using this pipeline to predict networks involved in stem cell identity and maintenance. We will then choose the most important genes in these predicted networks for further experimental study.

7. Research implementation and results under the program

Title of your research plan:

Identifying gene regulatory networks that control root hair growth in *Arabidopsis thaliana*

Description of the research activities:

Root hairs are outgrowths on plant roots that are responsible for absorbing water and nutrients from the soil. Thus, understanding the genes that control root hair growth and development can help scientists engineer plants that are able to survive in nutrient-deficient soils. One gene that could potentially be an important regulator of root hair development is the trihelix transcription factor GT2-LIKE-1 (GTL1). GTL1 and its close homolog, DF1, have also been shown to regulate root hair growth. However, their direct targets in the root remain unknown. Thus, we used a computational pipeline in conjunction with transcriptomic data to predict downstream targets of GTL1 and DF1 that have known roles in root hair development.

I developed the computational pipeline, which combines clustering, regression tree inference, and a directionality algorithm to predict Gene Regulatory Networks (GRNs). Our pipeline predicts that both GTL1 and DF1 regulate known root hair development genes, including ROOT HAIR DEFECTIVE SIX-LIKE4 (RSL4). We were able to experimentally validate most of the predicted relationships through Chromatin Immunoprecipitation (ChIP). Of these validated relationships, our pipeline predicted that RSL4 is the most important direct target of both GTL1 and DF1. Thus, we performed additional experiments, including quantitative PCR (qPCR) to measure RSL4 expression levels in GTL1 and DF1 overexpression and mutant lines. Based on results from these experiments, we now hypothesize that GTL1 and DF1 repress root hair growth through directly binding RSL4.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

During my stay in Japan, I was invited by Dr. Hiro Tsukagoshi at Nagoya University to give a talk at a plant biology seminar. This professional visit allowed me to visit Nagoya and see the place where my grandmother lived as a child. My homestay family took me to Kamakura and Enoshima. I visited many areas of Tokyo and Yokohama on the weekends. I also took a weekend to visit Kyoto.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Joel R. COOPER （ID No.: SP15008 ）

2. Current affiliation: University of South Florida

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Nagoya University

5. Host researcher: Prof. Yasuhisa HASEGAWA

6. Description of your current research

Mechanical properties of cells are extremely important to both tissue engineering and the study and detection of various diseases. In order to develop new ways to repair or replace damaged tissues and organs, researchers in tissue engineering must know the mechanical properties of both individual cells and tissues. Additionally, diseases, like cancer, affect the mechanical properties of native cells. Studying these changes in mechanical properties can lead to the development of early detection devices and new drug delivery mechanisms. This research project is aimed towards developing a new method to characterize the mechanical properties of individual cells. This new method uses the capabilities of an atomic force microscope (AFM) to either compress or actuate individual cells. By compressing the cell, the AFM will readout a stiffness value which is a convolution of cell and AFM cantilever beam stiffness. Similarly, actuating the cell will lead to a natural frequency which is a combination of the cell's and beam's natural frequencies. Cellular mechanical properties can then be isolated using the beam mechanical properties which were previously experimentally derived.

7. Research implementation and results under the program

Title of your research plan:

New Method for Characterizing Mechanical Properties of Biological Cells

Description of the research activities:

During my stay at Nagoya University this summer I learned two new microscopy techniques: Atomic Force Microscopy (AFM) and Environmental Scanning Electron Microscopy (ESEM). I also learned how to operate the nano-manipulation devices within my host lab's ESEM to measure certain mechanical properties of cells. Using this newly acquired knowledge, I experimentally measured the stiffness of living yeast cells to obtain "control" values for yeast cellular stiffness. These values will be used to evaluate the accuracy of cell stiffness measurements obtained using the AFM when I come back to continue this research from October to June.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I thought the program was an amazing experience both scientifically and culturally. The home-stay at the beginning of the program was invaluable in introducing the day-to-day life of people in Japan. During my stay I participated in many cultural experiences. Some of the highlights include: climbing Mt. Fuji, exploring the many shrines and temples of Kyoto, and of course experiencing the many types of delicious Japanese cuisine. I am very thankful for this experience and I will definitely be coming back for research.

9. Advisor's remarks (if any):

N/A

RESEARCH REPORT

1. Name: Jasmine M. CORBIN （ID No.: SP15009）

2. Current affiliation: University of California, Davis

3. Research fields and specialties:

Biological Sciences

4. Host institution: Osaka University

5. Host researcher: Prof. Kazuhito FUJIYAMA

6. Description of your current research

Plant cell suspension cultures are being investigated as a safe, cost-efficient, and scalable platform for the production of human therapeutic proteins. However, a major barrier for commercialization of this technology is the difference in the N-glycosylation of proteins produced by humans and plants: the presence of plant-specific glycan structures can reduce the drug's efficacy and potentially cause an unwanted immune response. My thesis project involves production of a highly N-glycosylated recombinant human therapeutic protein, butyrylcholinesterase (BuChE), in a transgenic rice cell suspension culture. This protein is a native human enzyme that acts as a bioscavenger against organophosphorus nerve agents. Currently, the most accepted source of BuChE is expired human blood plasma, though its low availability and high cost of purification limit its use. Recombinant BuChE produced in a transgenic plant cell suspension culture is a promising alternative to the plasma-purified protein, so long as the potential downsides of plant-specific glycan structures can be overcome. The first step to addressing this problem is to determine which glycans are present on the plant-made protein to evaluate its potential efficacy and strategies for glycan modification.

7. Research implementation and results under the program

Title of your research plan: Characterization of a plant-cell produced drug for the treatment of nerve agent exposure

Description of the research activities:

The goal of this work was to characterize the glycan profile of rice cell culture-produced BuChE using the unique protocols, equipment, and expertise Dr. Kazuhito Fujiyam's research group at Osaka University. However, I was unable to successfully purify the protein before arriving in Japan. Instead, I performed the same analysis on BuChE from two alternative sources: native equine (horse) BuChE, which serves as an important control for my own experiment, and recombinant human BuChE produced in *Nicotiana benthamiana* (tobacco) plants, which is also being studied by my research group as an alternative source of the protein.

The proteins were run in an SDS-PAGE gel, and the bands containing BuChE were cut from the gel. These bands were then subjected to in-gel digestion with various proteases and analyzed using liquid chromatography–mass spectrometry. The resulting data is currently being processed using bioinformatics software and databases of known species-specific glycan structure. Knowledge of the glycan structures and site occupancy will later be used to further understanding of the effects of plant glycosylation patterns and to enable in vitro glycan humanization of the plant-made BuChE.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Alex Corrion (ID No.: SP15010)

2. Current affiliation: Michigan State University

3. Research fields and specialties:
Biological Sciences

4. Host institution: Nagoya University

5. Host researcher: Prof. Yasuomi Tada

6. Description of your current research

Interestingly, plant disease epidemics worldwide cause devastation around the globe resulting in a loss of crop production that can be equated to $60 billion in the US alone and over $200 billion globally. Under the direction of Dr. Brad Day, at Michigan State University, we are interested on understanding how plants respond to pathogenic attack at the molecular level. To do this we have selected the model system of *Arabidopsis thaliana* and *Pseudomonas syringae* pv. tomato, which had been established as the model system for understand molecular plant-microbe interactions. In this system, it has been shown that the during pathogen infection, a key resistance regulator is required for the activation of disease resistance. This regulator has been named NDR1 (Non-Race Disease Resistance 1) and has been shown to be required for the activation of a specific class of disease resistance proteins. However the molecular mechanisms governing how NDR1 is activating in immune signaling remain elusive. My research focuses on the identification of new novel interacting proteins that are essential downstream regulators of immune signaling. During the course of my PhD, I utilized co-immunoprecipitation methods couple with mass spectroscopy to identify candidate interacting proteins. Using current plant based protein expression methods the verification of potential candidate proteins can be extremely difficult and time consuming. However, by learning a novel PCR based *in vitro* transcription/translation system in the Tada Lab at Nagoya University in Japan. I hope to identify new novel proteins involved in host resistance to bacterial pathogens. Additionally, we aim to provide a better understanding of how this knowledge can help aid in the worldwide fight to feed the ever-growing population.

7. Research implementation and results under the program

Title of your research plan: Identification of essential protein machinery of the plant disease-signaling pathway.

Description of the research activities: In the laboratory of Dr. Yasuomi Tada, they have developed a novel method using *in vitro* transcription and translation to produce stable plant proteins used for protein-protein interaction studies. My time spent in the Tada Lab has allowed me to harness this technique for use in my studies for the identification of novel proteins involved in the disease signaling network of plant innate immunity. During my time at Michigan State University I have identified a list of unknown candidate interacting proteins that have yet to confirmed as true interactors. Using the power of the novel *in vitro* transcription/translation system developed by the Tada Lab I was able to create stable proteins and confirm the previously published dimerization of NDR1 (Knepper *et al.* 2010), and additionally have identified a new novel interacting partner of NDR1 that was previously undiscoverable as a key component of the disease signaling network in *Arabidopsis*. We hope that the utilization of this novel technique allows us to further unravel the disease signaling network in *Arabidopsis* via specific protein-protein interactions. Additionally, these result may aid in the development of crops that obtain the ability to resist a variety of plant pathogens and therefore increase the yield to feed the ever growing world population.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Naveed DAVOODIAN （ID No.: SP15011）

2. Current affiliation: City University of New York and the New York Botanical Garden

3. Research fields and specialties:

Biological Sciences

4. Host institution: National Museum of Nature and Science

5. Host researcher: Prof. Kentaro HOSAKA

6. Description of your current research

Gyroporus is a group of ectomycorrhizal fungi with representatives on every major continent except Antarctica. They mutualistically associate with an array of plant species, including members of Pinaceae, Myrtaceae, Phyllanthaceae, and many other plant families. As mycorrhizal symbionts in forest ecosystems, they facilitate critical nutrient exchanges within and across biological kingdoms. In addition to their roles in these essential symbioses, *Gyroporus* species are important as wild edible mushrooms. Consumed primarily in countries where mushroom foraging is a significant cultural pastime, most species are known edibles. However, at least one species (*G. ammophilus*) is toxic, having previously been misidentified as an edible taxon that is superficially similar. Cases like this, where a lack of information regarding species limits can have serious consequences, highlight the need for careful systematic studies.

Despite a long history of formal recognition and research, finer details regarding *Gyroporus* diversity have yet to be elucidated. This is primarily because many of the taxa represent widespread species complexes, complicating studies on the genus. For my dissertation, I am using classical taxonomic and modern phylogenetic approaches to discover new species and infer relationships within *Gyroporus*. Morphological, molecular, and biogeographic data are providing novel insights into the evolution of these fungi and their relatives. For phylogenetic study, protein-coding nuclear and mitochondrial genes are being utilized. In this regard, particular emphasis is placed on nuclear *rpb2* and mitochondrial *atp6*. Specimens are being sampled on a global scale, with recent fieldwork emphasizing Australia, North America, and East Asia.

Japan continues to be a fruitful landscape for *Gyroporus* research. The country harbors a diverse set of *Gyroporus* species, including *G. longicystidiatus*, originally described from and apparently endemic to Japan. Specimens in Japanese herbaria and new collections from field sites in Japan have provided valuable samples for this investigation.

7. Research implementation and results under the program

Title of your research plan:

Diversity and evolution of *Gyroporus*, a globally distributed group of ectomycorrhizal fungi

Description of the research activities:

Morphological study has been conducted on critical specimens from Japanese herbaria, especially specimens housed by the National Museum of Nature and Science and the Tottori Mycological Institute. Type material of *Gyroporus longicystidiatus* Nagasawa & Hongo was included in these examinations. Additionally, new collections of *Gyroporus* have been made from field sites in Japan. Representative taxa collected at these sites include *Gyroporus* cf. *castaneus*, *Gyroporus* cf. *punctatus*, and *Gyroporus* aff. *cyanescens*. Specimens will be deposited in Japan at the National Museum of Nature and Science, with duplicates sent to the New York Botanical Garden.

Over 30 specimens have been DNA sequenced across two loci (*atp6* and *rpb2*). These sequences will be added to an existing *Gyroporus* sequence database. Additional specimens and loci and will be sequenced and added in upcoming months, as this international collaboration will be ongoing.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

From both a scientific and cultural perspective, I had an excellent time in Japan. My host researcher, Dr. Hosaka, provided critical scientific as well as cultural guidance. Dr. Hosaka's suggestions and insights maximized my experience of Japan's unique language, landscape, and cuisine. Additionally, the efforts of JSPS as well as my host family during orientation greatly enhanced my experience in Japan.

9. Advisor's remarks (if any): Naveed has completed his program with very much satisfactory results. He has obtained DNA data from most of Japanese species in the mushroom groups he is interested in, mostly from the materials he has from the other countries, and the specimens housed at National Museum of Nature and Science (host institute). In addition, throughout his field collecting with me, he has collected additional materials for his research. I am fully happy with his results, and I believe the results will add new knowledge of fungal diversity in Japan.

RESEARCH REPORT

1. Name: Rachel F.L. Diamond （ID No.: SP15 012 ）

2. Current affiliation: Emory University

3. Research fields and specialties:

Social Sciences

4. Host institution: Primate Research Institute of Kyoto University

5. Host researcher: Tetsuro Matsuzawa

6. Description of your current research

Humans think about numbers along a mental number line. It is unclear how much these spatial representations are caused by cultural training, such as learning to read from left to right. Because nonhuman animals have not learned to read, they are a good model to investigate spatial representations in the absence of culture. I am investigating the evolutionary basis for the spatial organization of sequences by testing chimpanzees on touchscreen computer tasks. The chimpanzees at the Primate Research Institute of Kyoto University have extensive experience ordering numerals. If chimpanzees organize order using space then their performance on a spatial memory task will decrease if they have to perform a concurrent ordered task. This performance decrement will be greater for the order task than other non-ordered control tasks.

7. Research implementation and results under the program

Title of your research plan: A Comparative Test of the Spatial Hypothesis for the Mental Representation of Order in Nonhuman Primates

Description of the research activities:

I developed a training protocol for the chimpanzees and wrote a computer program in Visual Basic. This first spatial memory program was designed to train chimpanzees to touch a white square in an array of blue squares and then touch that same location after a delay when all squares were blue. The program was adjustable so that we could increase the number of blue squares and the length of the delay. After chimpanzees were >80% correct in a 48-trial session with 3 blue squares and a 2000ms delay they were moved onto test trials.

In all test trials, animals would first see one white square and 3 blue squares and have to touch the white square. After touching the white square one of several types of tests appeared: number tests, motor control tests, and matching to sample control tests. During number test trials the chimpanzee had to touch either one or two numbers in ascending order before seeing the spatial memory test. During motor control test trials instead of one or two numbers a single target would appear on the screen and the chimpanzee would have to touch it before seeing the test array. Finally in the matching-to-sample test, after touching the white square chimpanzees saw a clipart image that they would touch and then 2 more clipart would appear. They had to touch the matching clipart to the first before going on to the test with blue squares. The chimpanzees completed a series of test sessions with different test types intermixed across sessions. 6 chimpanzees reached the training criterion and moved onto test sessions. The chimpanzees that finished training showed a clear effect of order on their spatial memory. They performed worse on the spatial memory test after ordering numbers than after touching a target that has no order. This supports the hypothesis that nonhuman primates use space to organize order just as humans do and this is an evolutionarily ancient mechanism.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): While in Japan I visited many temples and castles in several cities. I saw Kyoto, Osaka, Nagoya, and Hiroshima. I also got to rural southern Japan and saw the birthplace of Japanese primatology. I also attended the Primate Society of Japan annual meeting. I learned a lot about scientific research in Japan. I also learned about Japanese history and culture. I tried as many different foods as I could, and I enjoyed almost all of them.

9. Advisor’s remarks (if any):

After MS Rachel Diamond came to our institute, she immediately showed high scientific conduct, and successfully conducted an experiment investigating cognitive abilities of chimpanzees. She has strong motivation and enthusiasm to carry the research. In order to accomplish it she deeply considers the research topic in the light of previous findings in a logical manner. Through this supervision, I have been always impressed by her skills, intelligence and enthusiasm for research and I have had the pleasure of working with her.

RESEARCH REPORT

1. Name: Emily A Ellis （ID No.: SP15013）

2. Current affiliation: University of California Santa Barbara

3. Research fields and specialties:

Biological Sciences

4. Host institution: AIST, Tsukuba

5. Host researcher: Dr. Yasuo MITANI

6. Description of your current research:

I study a group of ostracod crustaceans in the family Cypridinidae that use light (bioluminescence) to attract mates in the Carribean Sea. In my thesis, I am working to understand how bioluminescence has affected this groups' diversification by creating a phylogenetic tree of relationships. Here in Japan, there is a wide diversity of bioluminescent ostracods, but instead of utilizing bioluminescence for mating purposes, they use bioluminescence in a defensive display against predators. From our preliminary phylogeny, we have determined that Carribean cypridinids are nested within these defensive displaying cypridinids. To understand diversification of Caribbean cypridinids, extensive understanding of the entire family is required.

7. Research implementation and results under the program

Title of your research plan:

Evolutionary origins of complex male signals and female response in bioluminescent ostracods

Description of the research activities:

We traveled to Shimoda Marine Research Center on the Izu Peninsula where we collected 13 species of cypridinid ostracods from 7 genera, including 5 new species (2 of those being new bioluminescent ostracods). We also traveled to Misaki Marine Biological Station and collected 7 species of cypridinid ostracods from 4 genera, including 1 new species of bioluminescent ostracod. These animals will be used to create a family-level phylogeny of Cypridinidae to understand how bioluminescence has affected the diversification of this group and when bioluminescence evolved.

Our second goal in this fellowship was to understand the evolution of female preference in this group. It is well established that Carribean females are attracted to blue light, but it is unknown what type of response non-mate signaling bioluminescent ostracods have towards blue light. Females were presented with simulated bioluminescence and their response was recorded. We have preliminary data to show that non-mate signaling cypridinids are not attracted to blue light, but instead are attracted to the 'bioluminescent' probe once the blue light is gone. In other words, the female travels toward the probe only after the bioluminescence disappears. We suggest that this makes sense in a 'Safe Zone' hypothesis where it may be favorable to travel to an area once fish have been scared away from it. It may also represent an evolutionary pathway towards females being attracted to blue light, with the first step as being attracted to the area of light production.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): I had great experiences traveling to and within my field-site stations, the Izu and Miura Pensiulas. Most of my cultural experiences were done here, including incredible culinary experiences! I was fortunate enough to have three extremely hospitable hosts who taught me everything from Japanese language, history, culture, and etiquette. I really enjoyed learning about the culture from these Japanese scientists. I also had opportunities to travel within Tokyo to Akihabara, Asakusa, Ueno Park, and Shinjuku, which were all very exciting places to explore.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Justin Estee （ID No.: SP15014 ）

2. Current affiliation: Michigan State University

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: RIBF RIKEN, Wako campus

5. Host researcher: Hiroyoshi Sakurai, Tadaaki Isobe

6. Description of your current research

One of the future goals in the nuclear science community is to understand the asymmetric contribution to the nuclear Equation of State (EoS) which relates pressure, energy, and temperature of nuclear matter. The EoS is important for understanding the physics of everything from nuclei to neutron stars. At the Radioactive Ion Beam Factory (RIBF), at RIKEN, Wako campus, we plan to study the nuclear EoS using heavy ion collisions of radioactive isotopes. My research currently involves studying such collisions with a new Time Projection Chamber (TPC), the SpiRIT TPC. This TPC has been built to efficiently measure light charged particles resulting from such collisions which will place important experimental constraints of the EoS.

This detector system is large and its function is complex. There are many things one must consider when interpreting the data. In the fall of 2015 the commissioning beam time has been scheduled. It becomes necessary for us to make sure the detector and the software is performing to intended specifications before the commissioning time. This project aims to understand the performance and limitations of the SpiRIT TPC by analyzing cosmic data. These cosmic tracks will give an idea of the software track reconstruction performance, progress, and detector limitations.

7. Research implementation and results under the program

Title of your research plan:

Performance of the SpiRIT Time Projection Chamber

Description of the research activities:

Upon arrival at my institution I helped install half of the electronics onto the TPC. We were able to successfully take cosmic ray data. Cosmic rays provide a good test for the TPC as they mimic the particles we are interested in measuring, namely pions. Since the scattering of such a high energy cosmic tracks are negligible in our detector volume, the tracks can be assumed to follow straight trajectories. Under this assumption, we can fit lines to the observed tracks in the software. Large deviations from these fitted lines give us an idea of systematic errors in our detector. Also statistical deviations from the fit give us information on the limitations of our detector for determining the spatial locations of the tracks. The position resolution of the detector determines the momentum resolution. This momentum resolution will impact the identification of the particle species in the end.

From this analysis we noticed that there are large deviations in the tracks near the walls of the gas volume. These deviations we can attribute to a mistuning of a resistor which causes distortions in the tracks. Simulations of the electric field verify the field uniformity depends on this resistor value. I was able to develop a calculator for determining the right value of this resistor and install the correct resistor.

I found the amount of charge absorbed by impurities in the gas is around a 1% effect consistent which literature on this type of absorption. I also started investigating the spatial resolution and the preliminary results appear to be consistent with expectations.

The software and electronics for this TPC are new. It was critical that in preparation for the fall commissioning experiment to verify we can take data and analyze it quickly. I was able to help verify that the software is working and is able to analyze and display the data quickly for experimental use.

It was clear the cooling system for the electronics needed to be solved and finalized before the experiment this fall. We now have constructed a simple, inexpensive, design that is able to cool the electronics uniformly to below 35 degrees Celsius. This is about 10 degrees below the maximum for the electronics. This improves the previous design by about 5 degrees.

Near the end of my stay the rest of the electronics were delivered and I was able to mount the full electronics.

RESEARCH REPORT

1. Name: Kelly R. FINN （ID No.: SP15015 ）

2. Current affiliation: University of California Davis

3. Research fields and specialties:

Biological Sciences

4. Host institution: Kyoto University Primate Research Institute

5. Host researcher: Dr. Andrew MACINTOSH

6. Description of your current research

Fractals (complex patterns that are self-similar at different scales) are ubiquitous in nature and help systems remain efficient and stable, but little is known about these patterns in relation to animal behavior. This research investigated the fractal complexity of Japanese Macaque behavior patterns in relationship to parasite infection and an animal's social behavior. Fractal patterns in behavior help us understand how animals allocate energy to specific activities, a fundamental feature of behavior theoretically linked to the ability to adapt to environmental variability or changes. This research aimed to measure whether behavioral complexity is altered by manipulating helminth parasite load with anthelmintic treatment. By altering an internal energetic constraint we expect the emergent pattern of activity to vary. In addition, we will compare behavioral complexity to an individual's social behavior to understand how individual health, individual behavior, and social structure are linked in primate society.

7. Research implementation and results under the program

Title of your research plan:

Social Networks, Fractal Complexity, and Parasites in Japanese Macaques

Description of the research activities:

To examine how the energetic costs of parasite infection affect organizational complexity of behavior, fractal analyses will be run on binary sequences of activity (locomotion) that were collected during focal-follows of macaques of varying health states. Research was conducted on Koshima Island, where about 95 provisioned free-range Japanese macaques live. A subset of adult females (half with parasites and half treated for parasites) was observed during varying behavioral states and varying times of day. Fecal samples were collected to measure parasite load and validate the anthelmintic treatment. In addition, grooming and proximity data will be integrated using computational network tools to examine the relationship between individual behavior and social network.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

There were many weather setbacks (typhoons), and at one point I even began a side project measuring wave patterns when I was unable to reach the island. However, it possibly my most rewarding research experience ever, camping on Koshima, hiking through the forest to follow monkeys, and working alongside researchers at the Primate Research Center in Inuyama and field staff at Koshima. I was also able to attend two primatology conferences during my time in Japan: the Primate Society of Japan meeting, and the Primatology & Wildlife Science Symposium, both at Kyoto University. I kept a blog about my experiences at: mandelbrotmonkey.blogspot.com. I want to come back!

9. Advisor's remarks (if any):

Conducting fieldwork at Koshima islet, Miyazaki during the typhoon season can be thought of as a high-risk, high-reward situation! Kelly proved incredibly determined and innovative during her stay in Japan, despite being denied scheduled data collection opportunities for the majority of her stay. We look forward to forthcoming data analysis, some taking us in novel directions, and continuation of our collaboration into the future.

RESEARCH REPORT

1. Name: Richard G. FREEDMAN （ID No.: SP15016 ）

2. Current affiliation: University of Massachusetts Amherst

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: The University of Tokyo

5. Host researcher: Dr. Alex FUKUNAGA

6. Description of your current research

Interaction between multiple entities is a dynamic challenge which requires making decisions of how to act based on the behaviors of others. Due to all the factors involved, many interactive computer systems, including robots, are designed for a specific domain and cannot be generalized to other frameworks or environments. Artificial intelligence can address these issues by combining research done in decision making and problem solving (referred to as planning) with research regarding learning user activities and patterns (referred to as plan, activity, and intent recognition). My current research explores how each of these areas may be integrated to create a general interactive computer system which may be used in a variety of domains.

At the University of Massachusetts Amherst, my focus has recently been concentrated on integrating the different forms of recognition. In particular, plan recognition is a higher-level field of study which, given a (possibly incomplete) list of actions taken, tries to identify the overall task that the actions aim to solve. However, human activity is not always available at this level of discretely defined actions. Unlike a computer screen where the choices of icons to click and keys to press are easy to manage, humans acting in the real world have numerous ways to maneuver and interact with their surrounding environment which must be interpreted by sensors. These sensors only return readings of some measurable value such as position (camera tracking), pressure, etc., and activity recognition strives to classify these readings as an action. Most systems pipeline them to perform activity recognition on sensor data and then use the extracted actions to perform plan recognition. My research is trying to perform both processes simultaneously since they share similar information which wastes computing resources when done separately.

7. Research implementation and results under the program

Title of your research plan:

Revising Plan Recognition as Planning Algorithms for Use in Real-Time Interaction

Description of the research activities:

In 2010, Ramírez and Geffner showed that plan recognition can be formulated as a planning problem by considering the observer as the problem solver who has observation actions. However, the game theoretic assumption that the observed actor is rational produced poorer predictions at early stages of observation since they were nearsighted towards simple tasks. Furthermore, despite the use of planning to solve the recognition problem, planning is not used to develop a response.

To address these issues, we developed several novel techniques which have been submitted for review at a national artificial intelligence research symposium. These techniques include temporal adjustments of the Bayesian prior distribution to account for more complex tasks at earlier stages of execution and observation, measuring the 'necessity' of goal conditions over the distribution of tasks to determine which responsive actions are more useful with respect to current recognition predictions, and identifying mandatory checkpoints to prune the list of possible tasks to predict and specify the goals for responsive behavior. Over the summer, I worked with my host researcher and an undergraduate student in the lab to begin implementing these variations for experimental validation.

To run these tests, we needed to develop a new domain since most researchers study plan recognition and planning independently. We chose to implement a multiplayer cooperative version of the game Sokoban. The game's engine has been fully implemented and is able to communicate using internet connections with computer-controlled characters. We have begun to implement the proposed methods and will run experiments as soon as the code is ready. This work will be continued after the JSPS Summer Program as there is a large potential for both this new domain and the research problems regarding such interactivity.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I was fortunate to have many opportunities to explore Tokyo and observe the daily lives of people in Japan. As one of the countries with the best technology, seeing how computer and robot interfaces are present and used in ordinary situations helped me to better understand the relationships that may exist between people and their devices. This first-hand experience will serve as a guide to future research questions and challenges to address. I even had a chance to meet Pepper, a child-sized humanoid robot home companion for sale in cell phone stores. Not only did I experience these modern aspects, but the summer festivals, fireworks displays, temples, and historical sites introduced me to Japan's long history and traditional cultures which are still present in modern society.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Mark N. Furtado (ID No.: SP15017)

2. Current affiliation: Iowa State University

3. Research fields and specialties:
Engineering Sciences

4. Host institution: Chiba University

5. Host researcher: Dr. Fumio Yamazaki

6. Description of your current research

Prior to beginning the EAPSI program, my research focused on the resilience of infrastructure networks to disasters (earthquakes especially). The research included calculating at the social costs due to disasters, prioritizing repair goals and selecting mitigation techniques to prevent loss. All this however focuses of actions that can be taken before a disaster or after a sizable time following an event. The time immediately following a disaster, which is a chaotic period with many time critical decisions to be made, is understudied as it pertains to resilience. The goal of the research conducted during the EAPSI program is to discover how to leverage existing technologies in order to make informed decisions after an earthquake event.

Various remote sensing techniques were explored to see how they could be applied to disaster response. Aerial, satellite and other forms of remote sensing has been studied in recent years in order to detect damage after natural disasters. High resolution Lidar, an imaging technology that can create topographical map using lasers, was found to be particularly useful during the study. Lidar can be used to determine elevation along a roadway and the study uses this information to predict if a roadway will be closed. Novel techniques were created to test how likely a road is to be drivable and uses that information in selecting routes for emergency response as well as estimating the probability of disconnects in infrastructure networks. Using remote sensing has the advantage over visual inspection in that it can be performed quicker over a large area and can observe difficult to access areas.

7. Research implementation and results under the program

Title of your research plan:

Utilization of Remote Sensing Techniques in Post-Earthquake Decision Making

Description of the research activities:

Using high resolution Lidar from the 2010 Haiti earthquake, roadway elevations for the affected region could be extracted. Then, satellite images for the same area were analyzed. Inaccessible roads were identified visually and their roadway profiles were compared against those of accessible roads. It was observed that accessible road profiles could easily be fitting with a polynomial line curve while the inaccessible roads couldn't. This information was used to find a threshold goodness of fit below which, roadways are likely to be inaccessible and a probability of road accessibility can then be found automatically given any elevation profile.

We were then able implement these probabilities into a model that would help emergency vehicles such as ambulances select their path to their destination. The heuristic used would simulate the roadway damage repeatedly, close roadways based on their probability of failure, then determine the expected travel time at every point in the network. The driver would then crawl through the network following the points with the least travel time until they reach their destination.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

There is possibly no better place to conduct this type of research than in Japan. The threat of earthquakes is ever present. The most impactful portion of my time was a trip made to the Sendai area. The area was near the epicenter and experienced extreme effects due to tsunamis. Entire portions of the coast were leveled with only memorials and debris remaining which reminds the public of the losses seen by natural disasters

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Randall Wayne GLADEN （ID No.: SP15018）

2. Current affiliation: University of Texas at Arlington

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Tokyo University of Science

5. Host researcher: Prof. Yasuyuki NAGASHIMA

6. Description of your current research

At the University of Texas at Arlington, positrons are used in the Positron Surface Laboratory to probe the surfaces of materials by the method of Positron-annihilation-induced Auger Electron Spectroscopy. This method characterizes materials in a very surface-selective manner by guiding mono-energetic positrons to the surface of a particular sample, and detecting the energies of the electrons that are emitted by measuring the time between their emission and their detection.

The positron beam at the Tokyo University of Science is used for a different purpose, however. Here, the positrons will be bound with electrons to create positronium. This positronium will then be diffracted from the surfaces of particular materials for characterization. The beamline consists of a positron source and a solid neon moderator to create a mono-energetic continuous beam of positrons. These positrons are then guided to a positron trap, which collects positrons from the source, decreases their energy, and then releases them as a small mono-energetic “bunch”. This packet continues to a buncher, which further reduces the time width of the bunch. Once emitted from the buncher, the positrons are accelerated towards thin film of sodium-coated tungsten. While traveling through the tungsten, a fraction of the positrons will bind with two electrons to create a negative positronium ion. Finally, one electron will be photo-detached from this ion using a high-intensity laser which is synched with the timing of the bunched positrons. Afterwards, the positronium will be diffracted from the surface of materials and the results are then used to characterize the material with very little damage to the surface. Considering that positronium is the lightest composite particle that may be diffracted from a surface and that it is also neutral, this experiment should give results very different from previous diffraction methods, and also provide experimental value to theoretical work involving the diffraction of positronium.

7. Research implementation and results under the program

Title of your research plan:

A Variable-Energy Neutral Particle Beam for the Study of Solid Surfaces

Description of the research activities:

The positron beam was nearly complete by the beginning of the summer program. After the addition of two sets of steering coils (coils of wire used to generate a magnetic field in order to shift the beam in a particular direction) were determined to be required, a significant amount of time was needed to optimize the location and diameter of the beam by varying the parameters of the axial magnetic field Helmholtz coils, the two sets of steering coils, the focusing magnet, and the positron trap settings. Once the optimization was complete, the construction of the final chamber in which the positronium diffraction would take place was begun. The summer program ended during this construction, and the construction itself was estimated to be completed within two weeks after the end of the program.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The summer program was an essential step needed to continue positron research in Japan in the future, as well as re-spark my desire to learn more about the Japanese culture, history, and language. After visiting several historical sites such as Nikko, Kyoto, Kawagoe, and Nara, I was able to immerse myself in my love of Japanese history and culture. Professor Nagashima provided me with many opportunities that I couldn't have gotten elsewhere. The amount of knowledge I have acquired in and outside of the lab is invaluable, and I believe that my experiences in Japan have helped me grow and evolve as a researcher and as a person.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Robert J. GOUGELET (ID No.: SP15019)

2. Current affiliation: University of California – San Diego

3. Research fields and specialties:

Social Sciences

4. Host institution: Center for Information and Neural Networks (CiNet), National Institute of Information Communications and Technology (NICT)

5. Host researcher: Dr. Daniel CALLAN

6. Description of your current research

My current research involves the use of non-invasive electrophysiology methods such as electroencephalography (EEG) and magnetoencephalography (MEG) to investigate the neural activity of human brain regions in the form of local neural oscillations reflected in periodic changes of the miniscule electric and magnetic fields emanating from such brain regions. Of particular interest are phase dynamics of oscillations falling in specific frequency bands. An increased presence of theta oscillations in the 3-8 Hz and alpha oscillations in the 8-12 Hz ranges have been implicated in increased attention to auditory and visual sensory input, respectively. The phase dynamics of these oscillations are beginning to be uncovered, wherein the peaks and troughs of these oscillations correspond with periods of excitation and inhibition of neural activity in the underlying neural population sources, suggesting a functional role of these oscillations in coordinating precise spike-timing relationships across brain regions, including during sensorimotor integration.

The goal of this research program was to investigate the role of neural oscillations in mediating sensorimotor integration in an aviation pursuit task using a neuroergonomic approach to experimental design, such that experiment design features are readily extendable to real-world situations. Sensorimotor integration is an important cognitive function in aviation, in particular, due to the numerous illusions afflicting pilots likely from aberrant sensorimotor integration. Thus, the plan was to implement a realistic aviation pursuit task wherein subjects fly a plane and follow a flying target at different speeds and distances, thereby manipulating sensorimotor integration as a function of distance, while measuring MEG, EEG, and functional magnetic resonance imaging (fMRI). The experiment was then to be extended to a six degree-of-freedom motion platform flight simulator while subjects wear a wireless EEG device. We predicted neural oscillatory phase interactions will reflect our manipulations of sensorimotor integration.

7. Research implementation and results under the program

Title of your research plan:

Neuroergonomic multimodal neuroimaging during an aviation pursuit task

Description of the research activities:

The research conducted during the JSPS fellowship started with designing and implementing an experiment using the flight simulation software X-Plane. X-Plane provides a robust back-end interface for controlling flight dynamics and progression of the experiment using C plugins and UDP commands sent from an experimental control computer running a Java multithreaded program. This experiment was designed to investigate sensorimotor integration as measured via multimodal neuroimaging methods such as fMRI, MEG, and EEG. Subjects were tasked to pursue a target plane at programmatically manipulated distances and speeds. We expected sensorimotor integration to increase when the subjects flew close behind the target plane, and decrease when far behind. An additional component to the task was added wherein subjects were tasked with detecting an auditory stimulus presented at their hearing threshold. This provides an extra opportunity to investigate inattentional deafness in the context of neural oscillations. Behavioral, MEG, combined EEG/MEG, and fMRI data were collected from 30 subjects, divided into experienced and inexperienced pilot groups. One subject also flew the task in the motion platform flight simulator. These data will provide unprecedented converging forms of evidence to understand the spatial and temporal characteristics of neural oscillations in this unique aviation task.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I had the wonderful opportunity to work with Japanese human subjects directly, providing daily exposure to a unique social interaction between subject and experimenters. I also had the pleasure to work with the operators of the MEG and MRI devices at the new and prestigious CiNet. These individuals are very dedicated to their research, and navigating the nuances of social science research in Japan with them was a very rewarding experience, providing an interesting view of cross-cultural collaboration.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Casey Grenier (ID No.: SP15020)

2. Current affiliation: University of New Hampshire

3. Research fields and specialties:
Chemistry

4. Host institution: Keio University: Department of Applied Chemistry

5. Host researcher: Dr. Daniel Citterio

6. Description of your current research

Measuring the amount of vitamin E present in blood is difficult because of the complex nature of blood. The proposed chemical sensor would utilize an aqueous, non-covalently crosslinked network, molecularly imprinted polymer (MIP) as an ink. Which, unlike other types of MIPs, solid polymer particles, can be dispersed through a fine nozzle to be printed onto paper based substrates. The key challenge that must be overcome is creating an MIP that is both aqueous and presents a strong and selective binding affinity for vitamin E. MIP will be formulated and printed onto paper so that vitamin E levels can be measured using a fluorescence response indicator. An aqueous MIP ink as a sensor array will be a reproducible and universally stable analytical tool that is capable of performing measurements for an in home setting or in developing countries with minimal resources. Creating such a technology could have multiple uses in many different fields as a new class of chemical sensors.

Polymerizing in the presence of vitamin E, template molecule, allows for the polymer to self-assemble the functional monomer around the template molecule specifically to that compound. The polymer matrix is thus formed around the template molecule forming a molecularly imprinted site. The template molecule is then removed, via dialysis, and now the polymer is ready to be printed on to paper and be used as a chemical sensor for that template molecule. The template molecule will rebind to its templated site within the polymer allowing us to selectively sense for this compound.

Currently, the research goal is to optimize the fluorescence capability of the fluorescence monomer that was created for a strong fluorescence response that can be seen with the naked eye.

7. Research implementation and results under the program

Title of your research plan: Inkjet Printed Paper Based Sensor for Vitamin E

Description of the research activities:

The polymer formulation was optimized upon arrival to Keio University by increasing the percentage of non-covalent crosslinks. This increase allowed for stronger binding constants of the polymer in solution. A fluorescence monomer was then designed and synthesized that would allow a fluorescence reaction to occur in the presence of organic solvent and be quenched in the presence of water. This system was decided upon because of the polymers functionality of the various co-monomers within the polymer, the characterization of the aqueous polymer in the presence of vitamin E, and the insolubility of vitamin E in water. Once the polymer binds with vitamin E it was observed that the polymer would shrink in size and eventually collapse on itself and fall out of the aqueous solution, depending on the amount of vitamin E bound. With the polymer being hydrophobic in the collapsed form, this allowed the fluorescence monomer to now give a fluorescence signal based on the amount of vitamin E bound in the presence of organic solvent. This was observed in solution and on paper; however, the use of instrumentation was needed to verify and was not as profound as in solution.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The Japanese students were very patient with me and this allowed for a successful lab experience and project. I cannot thank my host lab enough for all that they have done and taught me this summer. The Suzuki/Citterio group is truly a special group of people that are skilled in their craft and continue to make advancements in their field.

Of the many cultural experiences that I had, the same is true with all of them. The Japanese are a welcoming and kind culture that is as proud as they are humble of their great country.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Neysa Grider-Potter （ID No.: SP1021 ）

2. Current affiliation:

Arizona State University

3. Research fields and specialties:

Biological Sciences

4. Host institution: Osaka University, Suita

5. Host researcher: Dr. Yoshihiko NAKANO

6. Description of your current research

Obligate bipedalism distinguishes the human lineage from that of all other extant primates. How the head and neck adapted to this radical change in locomotor mode remains understudied. The neck functions in two critical ways: it maintains postural stability during locomotion and allows for a mobile visual field. The aims of my research are to measure cervical form and neck function in quantifiable manners in order to better understand the form-function relationship and the evolution of neck within the hominin lineage.

7. Research implementation and results under the program

Title of your research plan:

Neck posture and the functional morphology of the gibbon cervical spine

Description of the research activities:

The neck functions in two critical ways: it maintains postural stability during locomotion and allows for a mobile visual field. The proposed study will test the hypotheses that form of the neck bones (i.e. cervical vertebrae) is adapted to maintaining 1) posture during locomotion and 2) head and neck mobility. In collaboration with Drs. Yoshihiko Nakano and Ryosuke Goto at the University of Osaka, kinematic and range of motion studies were conducted with a gibbon (*Hylobates lar*). This ape has a vertical trunk coupled with a horizontal neck, the condition likely found our early ancestors, making it the ideal model primate.

The gibbon was filmed during two forms of habitual locomotion (brachiation and bipedal walking) with head and neck movement evaluated using motion analysis software, FrameDIAS IV. Radiographs of maximum ranges of motion were taken and these will be used to measure range of motion of the gibbon neck. Gibbon cervical form was quantified using skeletal specimens at the Primate Research Institute of Kyoto University using a Microscribe M. Data collected there will be analyzed using Rhinoceros 3DM. Kinematic data have been analyzed using R, but preliminary results suggest the code is not producing accurate values and needs to be fixed. Once the radiographs and vertebral morphology are analyzed and the R code is fixed, these functional measures of posture and mobility will be related to specific aspects of cervical vertebral form.

I also had the opportunity to conduct a secondary project looking at the neck muscular anatomy of gibbons (*Hylobates lar*) and Japanese macaques (*Macaca fuscata*). Four primates were dissected. Their muscular anatomy was described and the movement possible at spinal joints was quantified using a Microscribe M. These data will be used to calculate the different forces produced by the muscles of interest in the two primate species.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I had a delightful time in Japan and I'm sorry to leave. My host researchers were very kind and gracious. I had a great time travelling around the Osaka-Kyoto area and my host lab took me many places.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Alex Hagen （ID No.: SP15022 ）

2. Current affiliation: Pennsylvania State University

3. Research fields and specialties:
Mathematical and Physical Sciences

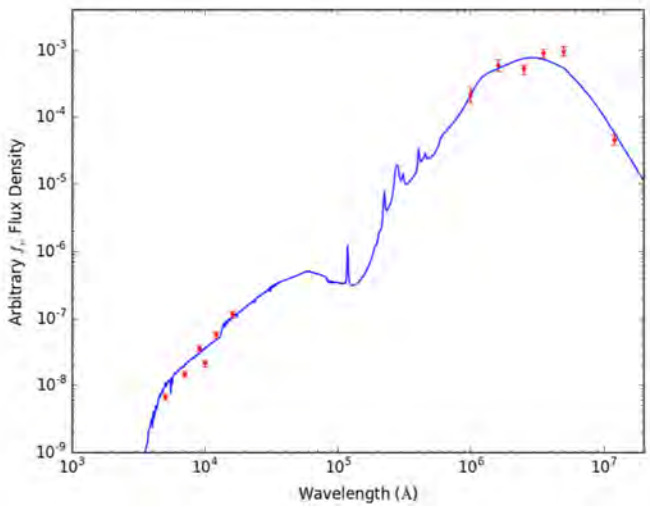
4. Host institution:
Institute for Cosmic Ray Research, The University of Tokyo

5. Host researcher:
Prof. Dr. Masami Ouchi

6. Description of your current research

My research focuses on understanding how galaxies form and evolve in the early universe. In particular, I study the small, faint, low-mass galaxies that will eventually form into Milky Way sized galaxies. While difficult to study due to their small and faint nature, understanding these small galaxies is very important since a majority of galaxies in the universe are small and faint.

I am particularly interested in the physical and morphological properties of these galaxies; I use advanced stellar population models and Markov Chain Monte Carlo statistics to compute the posterior distributions of physical parameters by comparing models of the galaxy brightness in each band to the actual observations. The figure below shows an example of a model in blue compared with the observations in red.



The reason I chose to come to the Univ. of Tokyo was to work with Prof. Ouchi and has students, due to their observations and expertise in radio astronomy observations of high-redshift galaxies. As in the Figure above, emission from dust heated from hot, young stars, dominates the galaxy emission at long wavelengths. Understanding this more deeply is why I came to the Univ. of Tokyo.

7. Research implementation and results under the program

Title of your research plan:

Understanding Physical Properties of High Redshift Galaxies

Description of the research activities:

Prof. Ouchi's group at the University of Tokyo has observations of faint galaxies detected in many different wavelengths, from the rest-frame UV to radio. Different areas of a galaxy's spectrum are sensitive to different physical parameters, so this dataset is a great opportunity to understand the physical properties of faint galaxies. In particular, the radio observations of the Univ. of Tokyo team are some of the most sensitive in the history of astronomy, so this is a particularly cutting edge and important set of observations to work on.

I built software to model the physical parameters of both the stellar and dust properties of these galaxies. This modeling is showing that this set of galaxies is a hitherto unknown population of dust-rich, low-mass galaxies that formed within the first few billion years after the Big Bang. This is an unexpected population of galaxies, as most dusty galaxies were thought to be much more massive. We will continue to study this set of galaxies and plan to write up our findings into a journal article in the next few months.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Trevyn Hey （ID No.: SP15023）

2. Current affiliation: Alfred University

Alfred, New York 14802, USA

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: National Institute for Materials Science

5. Host researcher: SASAKI Takayoshi

6. Description of your current research

My current work involves exfoliating layered MnO_2 systems into single layer nanosheets and processing them into 3D ceramic macrostructures with high porosity and surface area. These flocculated systems can be used for various surface-activated processes. For the MnO_2 system, pseudocapacitative charge storage is of interest. This requires understanding of the nanosheet structure, as well as what effects the exfoliation process has on the final product.

Layered materials can be synthesized a number of ways. My current research focuses on phases derived from solid state synthesis. The layered phase is ion-exchanged in acid to replace the layering alkali ions with protons and water, which begins to swell the structure. From there, bulky organic molecules can be used to further swell and delaminate the individual layers. In conjunction with mechanical agitation, this results in a suspension of single-layer nanosheets with organic molecules on the surface.

From the suspension of nanosheets, films and structures can be assembled by attaching the sheets to a substrate or by adding ionic species to the suspension, causing the nanosheets to flocculate. The structure of the final product is very dependent on the method of formation, and it may be possible to tune the structures by using different processing parameters.

7. Research implementation and results under the program

Title of your research plan:

Ceramic Nanostructures for Enhanced Energy Storage

Description of the research activities:

Using techniques developed in Dr. Sasaki's lab, nanosheets of varying compositions were synthesized and characterized. Compositions studied were TiO_2, hydrothermally grown MnO_2, and MnO_2 grown by traditional solid state methods. These systems were ion exchanged and exfoliated to form nanosheet suspensions. The systems were carefully characterized using SEM, AFM, and XRD to investigate the layered nature of the system and examine the exfoliated nanosheet suspensions.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I had a wonderful time this summer in Japan. I traveled from Tokyo to Kumamoto and back, seeing so many great sights and enjoying much of Japanese culture and food. My favorite part was the Japanese traditional architecture, particularly the castles. I met many fun and interesting people along the way. My host lab was full of nice and smart students and researchers who were very happy to help me fit in.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Garrett Blake Johnson （ID No.: SP15024 ）

2. Current affiliation:

Hawaii Institute of Marine Biology, University of Hawaii- Manoa.

46-007 Lilipuna Road. Kaneohe, Hawaii 96744 United States

3. Research fields and specialties:

Biological Sciences

4. Host institution: University of the Ryukyus

Molecular Invertebrate Systematics and Ecology Laboratory, Graduate School of Engineering and Science, 1 Senbaru, Nishihara, Okinawa 903-0213, Japan

5. Host researcher: Professor James D. Reimer

6. Description of your current research:

Most coral ecosystem research has focused on shallow reefs less than 30m depth, though photosynthetic corals extend to 165m in many areas. This disparity is due to the physiological limitations of conventional scuba that confines researchers to the shallows (Pyle 1999). Reef habitats from 30 – 165m depth, known as Mesophotic Coral Ecosystems (MCEs), are tropical light-dependent communities that extend to the bottom of the photic zone (Lesser *et al* 2009). Remarkably MCEs account for two-thirds of zooxanthellate coral habitat, yet remain almost entirely unexplored. In particular the relationships between shallow and deep communities are unknown; MCE fish populations may overlap with those of shallower reefs, as suggested by the Deep Reef Refugia Hypothesis (DRRH), making MCEs a potential refuge from environmental stress (Riegl & Piller 2003; Pyle 1999). Mesophotic Coral Ecosystems of Japan were first described off the coast of Okinawa in 1972, though little information on their occurrence and abundance has been documented since (Ohara *et al.* 2013).

My research in Okinawa was to examine two current hypothesis regarding relatonships between deep and shallow reefs. **H1:** Invertebrates and fish larvae are genetically well mixed between shallow and MCEs. Species occurring in both shallow reefs and MCEs are siblings or recruitment between the two zones is evident.

H2: Distinct vertical zonation exists for populations and gene flow. No recruitment is evident of fish and invertebrate populations from shallow. The answer will present itself within a few weeks when analysis is completed, however I think I may have found the answer. At least for reefs of Okinawa.

Title of your research plan: Examining the Deep Reef Refugia Hypothesis: Assessing the connectivity of invertebrate and fish larvae between Mesophotic (30m-100msw) and shallower reefs (<30m) of Southern Japan.

Description of the research activities:

A series of dives to 60m were performed to conduct standard fish abundance and diversity transects. Upon decent to 60m a trasect tape was carried and two 25m X 5m transects were performed at each depth, from 60m to 10m in 10m depths. increments. It appears that fish populations between shallow reefs and the upper portion of the Mesophotic Zone (60m) are indeed genetically well mixed. I observed many of the same species in the 60m zone that were also present at shallower, depths. However, there is a statistically significant relationship between depth and the number of herbivorous species present. This could be expected as it is well documented that as depth on the reef increases, the number of herbivorous species increases.

In addition to assessment of general fish population structure along a depth gradient, I also have neared completion on a publication of new technology I developed for subsea instrument recovery (in collaboration with my host supervisor Professor. J.D. Reimer.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I thoroughly enjoyed the entirety of my stay in Japan. It is a beautiful place full of wonderful people and great culture. The summit of Fuji-san with JSPS friends was a highlight of my summer. Memories I made here and research experiences are ones I will never forget.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Skylar Johnson （ID No.: SP15025 ）

2. Current affiliation: Washington State University

3. Research fields and specialties:

Biological Sciences

4. Host institution: Tsukuba University (and RIKEN Yokohama)

5. Host researcher: Dr. Miyako Kusano

6. Description of your current research

This EAPSI project proposed a collaborative effort to investigate a possible regulatory role of flavin cofactors by directly looking at the metabolome of plants with altered flavin contents. Finding that cofactor availability can modulate metabolic pathways in plants as it does in bacteria may be useful to engineering plants which are more resistant to environmental stresses in the field.

Cofactors are small molecules which are important for the structural integrity and catalytic power of enzymes. Because cofactors are responsible for activating the enzymes that require them, they are essential for metabolism (all of the chemical reactions that take place in an organism). Flavins are one class of cofactor molecules. The main research objective of this project was to determine if flavin cofactor availability affects metabolism in Arabidopsis.

To meet this objective, the metabolome of plants with altered flavin contents was to be analyzed via GC-MS under the expertise and instruction of Dr. Miyako Kusano at RIKEN and Tsukuba University. The metabolome is the sum of all small molecule products of metabolism. Plants with altered flavin content were produced prior to beginning the collaboration. By comparing the metabolomes of plants with increased and decreased flavin contents to wild type, it should have been possible to determine if and how flavin cofactor content affected metabolism.

Finding that flavin content can influence the metabolic profile of Arabidopsis could aid in the production of crop plants which produce desired compounds or are more resistant to stress in the field. This project was also intended to foster international collaborations and to build connections between the scientific communities in the United States and Japan.

7. Research implementation and results under the program

Title of your research plan:

Investigating vitamin B_2 as a possible regulator of metabolism in plants

Description of the research activities:

Upon arrival in Japan, two initial experiments were planned. One would look at the metabolome of flavin biosynthesis mutants grown on soil, and one would investigate the responses of the metabolome of these plants to salt stress. Permission was later obtained for a third experiment investigating the responses of flavin biosynthesis mutants to UV light and recovery.

These experiments were set up, plants were grown, and samples were collected. Partly due to the slow pace of working with plants, samples have yet to be extracted and analyzed. This work will be completed by a permanent member of the lab, and hopefully information about the results will be shared between both collaborating labs. We look forward to continuing to collaborate to complete this project, and towards collaborating on other projects in the future.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I was not able to learn about the techniques employed in my host lab for analyzing metabolomics data, or to complete the lab work involved in the project, but I did have a very immersive cultural experience during my stay in Japan. I was glad that I was able to make friends quickly in the lab, and thankful that everyone helped me adjust to a new environment and find my way around.

9. Advisor’s remarks (if any):

Miss Johnson has joined the JSPS summer program during this summer. She adopted very well, learned how to set up experimental design for metabolomics, and learned how to do extraction and derivatization for GC-MS analysis during her stay at RIKEN and Tsukuba despite of culture gap between Japan and USA. I am impressed for her effort. Due to some problems, for instance, being delay to receive mutant seeds that were necessary for her research, she could not learn about metabolomic techniques completely.

To resolve this kind of problem, I think it is good to have a video chat before the acceptance. In addition, I’ve got sick of depression because I was too worried not to support what she wanted to learn completely during the program (it should be noted that this is one of the reasons for my sick, I know she did very well). I have to apologize for it.

RESEARCH REPORT

1. Name: Kyle KAJIHIRO （ID No.: SP15026）

2. Current affiliation: University of Hawai‘i at Mānoa

3. Research fields and specialties:

Social Sciences

4. Host institution: University of the Ryukyus

5. Host researcher: ABE Kosuzu

6. Description of your current research

The construction of an off-shore U.S. military facility in Henoko, Okinawa is at a critical juncture. The governments of Japan and the United States maintain that the construction of the Futenma Replacement Facility (FTF) in Henoko is essential to preserving regional peace and security. However, Okinawans overwhelmingly oppose the base expansion. Key issues include environmental and social impacts, land expropriation, and economic hardship; the FRF would destroy 160 hectares of coral reef and seagrass habitat, threaten the endangered Dugong, and increase the risk of accidents, noise, and crime. With the commencement of land reclamation work by the national government, protesters have engaged in a sustained civil disobedience campaign on land and at sea to disrupt construction. The intensification of the conflict between protesters and the government may be having a profound effect on Okinawan identity and politics and may have geopolitical repercussions for the whole region.

Political geographers are interested in the phenomenon of ethnic and national identity formation, how large collectivities of people coalesce into imagined communities around shared sets of cultural ideas and practices, political and economic interests, and territorial claims. Moments of acute political conflict can intensify this process.This project will investigate how the tensions between Okinawans and the Japanese national government over the expansion of a U.S. military facility may be affecting the way residents articulate and enact their local identities. This study will examine whether the galvanizing effect of the bases protests may signal an emerging trend toward Okinawan identification as a distinct national or indigenous group, as opposed to a Japanese ethnic minority, and what the broader implications of such a shift might be. It will also consider whether the polarizing effects of the conflict may accentuate differences within Okinawan society. Through interviews, participant observation, and discourse analysis of news media, this study will seek to identify emerging trends in Okinawan cultural and political identity formation in the context of the military bases controversy.

7. Research implementation and results under the program

Title of your research plan:

"Understanding the formation of local identities in relation to foreign military bases"

Description of the research activities:

This research project was guided by the following questions: How does the political conflict over the expansion of a U.S. military facility in Henoko, Okinawa relate to emerging political and cultural expressions of Okinawan identity? What key social and environmental factors are influencing the current political status of the military base expansion in Henoko? How are different Okinawan publics responding to recent developments in the military base controversy? How is the process of local identity-formation influenced by multi-scalar and translocal interactions?

Interviews: The researcher conducted 41 interviews, met representatives of 17 groups, 13 elected officials and former elected officials, and scholars from 11 universities.

Archival Research: The researcher visited 14 museums and memorial sites, and reviewed government documents, organizational literature, and news media.

Field Observations: The researcher attended 5 meetings of different citizens groups, 10 public educational events, 10 tours, and 9 demonstrations, and conducted visual surveys of 15 military bases and former bases.

Preliminary Findings: (1) The past is present: History and memory are vital elements of contemporary Okinawan cultural and political life. For many, WWII never ended and this trauma is inscribed in the landscape, politics, and social relations. (2) Okinawa's geography is both a "blessing" and a "curse"; it is seen as either a "bridge" between countries and a source of prosperity or a vulnerable and strategic location that must be secured for military power projection. (3) Okinawan identity is complex, multiple, and dynamic, characteristics of postcolonial hybridity. The opposition to the U.S. bases has forged a "fragile solidarity". While Okinawan identity and self-determination have been an effective theme for political mobilization, there does not seem to be widespread support for nationalistic or pro-independence politics.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

This was a transformative experience for the researcher. Cultural experiences in Okinawa included seeing musical performances of min'yō with sanshin, participating in eisa drumming and kachashī dancing, attending museums of natural history, cultural anthropology, and modern art, visiting traditional pottery districts, historic castles, shrines, and war memorials, visiting the Okinawan migrant community in Ōsaka, staying with a family in Ie-jima, and enjoying the many varieties of Okinawan foods and drink.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: John K. KATAHARA （ID No.: SP15027）

2. Current affiliation: University of Washington

3. Research fields and specialties:

Engineering

4. Host institution: Kyoto University—Uji Campus

5. Host researcher: Prof. Yoshihiko KANEMITSU

6. Description of your current research

The focus of my research at the University of Washington has been to discover better ways to evaluate potential solar cell materials. One appealing approach is steady state optical characterization, since the technique is contactless (can be done on films or full devices), non-destructive, and fast. In particular, I have developed a model to describe the absorption and photoluminescence (PL) spectra of materials that suffer from significant disorder that results in deviations from ideal models of absorption and emission. This absorption model has allowed us to analyze PL spectra of a diverse set of solar cell materials and quantify their potential device performance.

In addition, I have used our model of sub-bandgap absorption to calculate the thermodynamic losses of non-ideal absorption/emission on open circuit voltage and device efficiency. These calculations have led me to explore ways to reduce this sub-bandgap absorption through chemical and thermal treatments of $Cu_2ZnSn(S,Se)_4$ (CZTSSe). CZTSSe is a promising solar cell material that is nontoxic, made of inexpensive and earth-abundant materials, and amenable to solution processing (easy to scale for large volume manufacturing). However, the material suffers from a low open circuit voltage, and my studies into methods to reduce sub-bandgap absorption will facilitate improvements in device performance.

7. Research implementation and results under the program

Title of your research plan:

Illuminating fundamental material properties to enable highly efficient and inexpensive solar cells

Description of the research activities:

Through my summer research project with EAPSI, I have explored the transient optical characteristics of promising solar cell materials. I prepared various solution-processed films of $Cu_2ZnSn(S,Se)_4$ (CZTSSe) and exposed them to different chemical and thermal treatments in an effort to passivate defects and improve the ordering in the materials. The suite of optical tools in the Kanemitsu laboratory has afforded me a unique opportunity to test the effects of these treatments on carrier recombination in solar cells and bare films. Results from transient absorption spectroscopy suggest that addition of lithium to CZTSSe films reduces the density of defects lying at shallow levels that contribute to bandtails, creating a gap between deeper defects and the band edge that reduces recombination. In addition, a moderate thermal treatment (75C for three days) shifts the range of energies where defects are suppressed. These data highlight a route to reduce losses in CZTSSe films and will lead to improvements in open circuit voltage and efficiency in solution-processed, inexpensive, and earth-abundant CZTSSe devices.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

My labmates were kind enough to guide me through the crowds of the Gion Matsuri and Kyoto Tanabata. In addition I was able to attend the Nagasaki Peace Ceremony and pay my respects to the atomic bomb victims with another EAPSI fellow.

RESEARCH REPORT

1. Name: Alyson Kuba （ID No.: SP15028 ）

2. Current affiliation: Nova Southeastern University

3. Research fields and specialties:

Biological Sciences

4. Host institution: Tropical Biosphere Research Center University of the Ryukyus

5. Host researcher: Dr. Saki Harii

6. Description of your current research

Coral reef ecosystems support thousands of marine species and provide coastal communities with food, shoreline protection, and a source of income from fishing and tourism industries. However, coral reefs worldwide are experiencing degradation due to many stressors, including ocean warming. As oceans warm, corals are exposed to temperatures outside of their normal range and can lead to coral bleaching. Bleaching occurs when a coral expels the symbiotic algae living inside its tissues, causing the coral to turn white. The symbiotic algae are essential to a coral since they provide the coral with nutrients to support up to 100% of their metabolic needs. Previous studies show that bleaching negatively impacts adult corals and their reproduction. However, it remains unclear how corals respond to bleaching conditions at different stages of their life cycle. Corals have a complex life cycle in which the adult coral grows by asexual reproduction and once it reaches maturity it reproduces sexually by producing free-swimming larvae. The larvae disperse and then settle onto the substrate and metamorphose into a juvenile coral. Coral populations recover from disturbances through asexual and sexual reproduction; however, as increased temperature affects coral reproduction, larval survival and dispersal potential, and juvenile survival and growth, the transgenerational effects of bleaching will dictate the future rates of recovery. My current research investigates the impact of bleaching conditions at different stages of the coral life cycle. Specifically I assess adult coral fecundity, larval survival, larval settlement and dispersal, and juvenile survival and growth under bleaching conditions.

7. Research implementation and results under the program

Title of your research plan: Transgenerational Effects of Bleaching: Impacts on and Beyond Coal Reproduction.

Description of the research activities:

During the EAPSI program I conducted four experiments to assess the impacts of bleaching at different stages of the coral life cycle. In the first project, adult corals kept at ambient temperature spawned as normal; however, corals bleached a week prior to spawning did not spawn and samples taken a day before spawning revealed that bleached corals no longer contained any eggs. In the second experiment, the survival of coral larvae at elevated temperature did not differ from those in ambient conditions. However, larvae in elevated temperature settled sooner than larvae in ambient, meaning that larvae under elevated temperature may have reduced dispersal. In the third experiment, juvenile corals kept at elevated temperature had a higher mortality, grew faster, but contained less symbionts than juvenile corals kept at ambient temperature. In the last experiment, larvae and juveniles from bleached and healthy corals were kept at both ambient and bleaching conditions. Bleached colonies released fewer larvae; however, there was no difference in survival and growth between juveniles from healthy or bleached colonies.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I enjoyed conducting my research in Japan. I was able to learn from experts in my field and successfully perform multiple experiments.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Jessica E. LECLAIR （ID No.SP15029）

2. Current affiliation: University of California Santa Barbara

3. Research fields and specialties:

Social Sciences

4. Host institution: Kyoto University

5. Host researcher: Professor Yukiko UCHIDA

6. Description of your current research

With rapid globalization, more people face challenges of working and communicating across cultures. In such interactions, misunderstandings may lead to unintended insults. Understanding how people might respond when insulted is important, especially as responses may vary across cultures (Leung & Cohen, 2001). Aggressive responses may be acceptable in some cultures, while seen as inappropriate in others. This project examines cultural differences in how people respond to insults and considers how being focused on avoiding negative outcomes versus gaining positive outcomes alters behavioral responses to insults. This research aims to contribute to developing culturally sensitive ways of communicating and behaving and is conducted in collaboration with Dr. Yukiko Uchida, an expert in cross-cultural understanding at the Kokoro Research Center of Kyoto University, Japan.

Existing work on cultural differences in insult responses has largely focused on regional variation, especially within the United States, and has used extreme insult situations, including swearing and name-calling (e.g., Cohen et al., 1996). The present study sought to examine cultural differences in insult responses by using a minor everyday-type of insult. Further, the research investigated the effect of manipulating approach-avoidance motivation on insult responses. An approach motivation orients towards opportunities for gain, while an avoidance motivation orients towards preventing loses. Based on previous findings, suggesting that avoidance orientation may be more consistent with responses in face cultures (e.g., East Asia) while approach orientation may be more consistent with honor-type responses, we examined how manipulating approach-avoidance may impact responses to insults across cultures.

7. Research implementation and results under the program

Title of your research plan:

EAPSI: Characterizing cultural differences in responses to personal insults

Description of the research activities:

We collected responses from 60 Kyoto University students. In the lab, participants wrote essays to swap for feedback with a virtual partner (believed to be another participant in the study). All participants received negative critical feedback on their essay from the virtual partner, and then had a chance to send feedback to the partner. In preliminary analyses, we found that after the insult, some participants edited their feedback to be more critical of their partner's essay. In general, most students wrote polite and positive feedback. Data analysis of the written feedback is ongoing. In addition, we asked participants about their emotions before and after the insult. As predicted, negative emotions increased after the insult and positive emotions decreased. Further, we found that orienting students to thinking about avoiding negative outcomes versus approaching positive outcomes appeared to alter positive emotion responses. For Japanese students oriented towards negative outcomes, there was a smaller decrease in positive emotions after the insult, compared to Japanese students oriented towards positive outcomes. This pattern may reflect the chronic orientation in Japanese culture to avoiding negative outcomes.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): During my stay, I enjoyed getting to know my labmates and colleagues. I learned from them about the academic working environment in Japan, as well as life outside of school. I particularly enjoyed an afternoon at a shaved ice shop in Kyoto! In addition, I had a chance to participate in a traditional Japanese mortar and pestle (suribachi and surikogi) cooking class. We made sesame tofu (goma-dofu) by hand, which was a unique and fun experience.

9. Advisor's remarks (if any):

NA

RESEARCH REPORT

1. Name: Henry LEGETT （ID No.: SP15030）

2. Current affiliation: Purdue University

3. Research fields and specialties:

Biological Sciences

4. Host institution: Doshisha University

5. Host researcher: Prof. Shizuko HIRYU

6. Description of your current research

The current research is focused on investigating the behavioral ecology of *Buergeria japonica*, a stream breeding tree frog found in the Ryukyu Archipelago and Taiwan. This species exhibits unique mating behaviors including synchronized and unsynchronized acoustic signals, and visual signals in the form of leg stretching and arm waving. These unique behaviors make this species an ideal system to begin addressing deeper questions in the fields of animal behavior and animal communication. In this study we aim to investigate the reproductive strategies of male *B. japonica* and the selective pressure imposed by the eavesdropper (predator) community on this system. This study was conducted on Iriomote Island of the Okinawa prefecture from June 18th to August 1st, 2015.

Research aims:

a. Describe the natural chorusing behavior of *B. japonica*, including the collection of video and audio recordings of different mating signals— advertisement calls, territorial calls, and visual signals.
b. Describe the natural acoustic environment, including audio recording from *B. japonica* calling sites by waterfalls and streams.
c. Describe male-male interactions and territorial behavior within *B. japonica* choruses.
d. Investigate male *B. japonica* behavioral responses to acoustic playbacks of advertisement and territorial calls.
e. Using sound-to-light devices, investigate the spatial and temporal dynamics of *B. japonica* choruses.
f. Using sound-to-light devices and acoustic playbacks, investigate *B. japonica* call synchronization.
g. Describe the eavesdropper (predator) community on Iriomote Island, including the collection of frog-biting midge and mosquito species using frog-call traps and video collection of possible bat predation.

7. Research implementation and results under the program

Title of your research plan:

Behavioral ecology and reproductive strategies of Japanese stream treefrogs (*Buergeria japonica*)

Description of the research activities:

This research was conducted in collaboration with Dr. Ikkyu Aihara and Dr. Shizuko Hiryu of Doshisha University with the goal of investigating the spatio-temporal structure of frog choruses. During the initial stages of the project we identified unique behavioral displays in Japanese stream treefrog (*Buergeria japonica*) choruses, including synchronization of advertisement calls and visual displays. Following this discovery, we conducted a series of experiments in order to investigate the behavioral ecology of this species. The experiments included:
-Observing male frog responses to acoustic playbacks of different call types. (Sample size: behavioral responses of 30 frogs).
-Collection of spatio-temporal data of natural chorus behavior. (Sample size: 16 video recordings from 2 sites).
-Recording advertisement call synchronization to acoustic playbacks. (Sample size: synchronized responses collected from 18 frogs).
-Classification of the eavesdropper (predator) community. (Sample size: frog-biting midges and mosquitoes were collected from 6 sites around the island; each site was samples 5 times. Video recordings of bat responses to acoustic playbacks were recorded from 6 sites).

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

This program was an incredible experience both personally and scientifically. The freedom given to me in terms of time and budget allowed me to conduct research and make discoveries that were more valuable than anything I had originally proposed. On Iriomote Island I was exposed to community of scientists from not only Japan by around the world. Other experiences I had while in Japan:

-exploring temples in Karamakura
-visiting Sankeien Garden
-having meals with rice and sugarcane farmers on Iriomote Island.

RESEARCH REPORT

1. Name: Nelson E. LOURENCO (ID No.: SP15031)

2. Current affiliation: Georgia Institute of Technology (Atlanta GA USA)

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Japan Aerospace Exploration Agency (Sagamihara Campus)

5. Host researcher: Dr. Kazuyuki HIROSE & Dr. Daisuke KOBAYASHI

6. Description of your current research

While many electronic applications such as general computing and consumer electronics are designed for stable ambient conditions, there is a growing need in the aerospace and space exploration industries for microelectronic platforms that are robust within extreme environments. Furthermore, as applications such as global telecommunications, weather radar, and satellite navigation (GPS) incorporate advanced in-orbit electronics, it is pertinent to understand how these systems operate within a dynamic and potentially hazardous environment. Silicon-germanium heterojunction bipolar transistor (SiGe HBT) technology has garnered significant attention in the commercial and government sectors due to its ability to leverage the superior current drive, low-noise performance (both 1/f and broadband), and device matching characteristics of SiGe HBTs with low-cost silicon manufacturing into a single SiGe BiCMOS platform. These SiGe design platforms are ideally suited to combine high-performance RF/mm-wave and precision analog circuit with on-chip, high-speed digital interfaces.

Wide ambient temperatures and exposure to ionizing radiation can degrade electronics and generate errors, which if unchecked, can lead to a catastrophic system failure. My PhD research is centered on understanding and addressing key reliability concerns for silicon-based electronics within these extreme environments. Currently, I am investigating novel techniques for improving the transient response of SiGe HBTs from high-energy radiation strikes. My previous work has demonstrated that laboratory-based, pulsed-laser systems are essential tools to properly understand the complex transient phenomena within advanced electronics and recommend effective mitigation strategies. The Japan Aerospace Exploration Agency (JAXA) is currently in development of a pulsed-laser, optical dosimetry system at the Institute of Space and Astronautical Science (JAXA Sagamihara campus). The proposed research was focused to assess the current status of this system, obtain transient signatures on test samples, and suggest new methods to improve the system's capability for device and circuit characterization.

7. Research implementation and results under the program

Title of your research plan:

Modeling of Radiation Effects for Advanced Silicon-Based Electronic Systems within Extreme Environments

Description of the research activities:

The work performed falls into the areas of non-linear optics, semiconductor physics, and radiation effects. Part I of the project focused on a thorough analysis of JAXA's pulsed-laser two-photon absorption (TPA) system. After the initial characterization, a modified system topology and work plan was developed to improve the alignment and diagnostics capabilities of the pulsed-laser system. This new configuration would allow for precise, real-time beam profiling which is crucial for sensitive, nanometer-level measurements.

Part II focused on linear (single-photon absorption) and non-linear (two-photon absorption) measurements using InGaAs and Si photodiodes as well as SiGe HBTs in order to 1) ascertain the system's optical parameters and 2) investigate the transient response of state-of-the-art SiGe technologies. Preliminary results from this work and subsequent analyses at the Naval Research Laboratory (NRL) will be targeted for publication in the IEEE Transactions on Nuclear Science (IEEE TNS).

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Excellent program. I think it could be improved by increasing the program length. It is difficult to complete substantial PhD-level research in a short time period (10 weeks).

- Participated in dinner party with host family (learned to make Okonomiyaki)
- Participated in JAXA cooking party (Karaage, Nabe, Takoyaki, Tonjiru)
- Climbed Mt. Fuji and visited multiple Shinto shrines throughout Japan
- Went to Yokohama (Minato Mirai) fireworks and Aichi Dai-Chochin festivals

9. Advisor's remarks (if any):

1. Good scientific achievements: He has improved our laser system successfully.

2. Good cultural and academic exchanges: In addition to the above listed ones, he had a presentation to JAXA students highlighting differences in student life between the USA and Japan, and a technical tour of the JAEA Takasaki laboratory. He also helped guide a visit of another JSPS summer program fellow to ISAS/JAXA.

RESEARCH REPORT

1. Name: Sean-Thomas B. LUNDIN （ID No.: SP15032）

2. Current affiliation: Colorado School of Mines

3. Research fields and specialties:

Engineering Sciences

4. Host institution: The University of Tokyo

5. Host researcher: Prof. Shigeo Ted OYAMA

6. Description of your current research

This project involves the purification of hydrogen from streams containing nitrogen using palladium membranes. Specifically, the inhibition of hydrogen transport by adsorbed nitrogen species. Palladium is well known to absorb a large quantity of hydrogen into its metal lattice, and it is this aspect that allows it to be used as a gas separation membrane. Essentially, any hydrogen in a mixed gas stream will dissolve into the palladium and transport to the far side, making the dense palladium metal a perfectly selective membrane. Absolutely no other gases are able to permeate assuming fabrication is ideal.

However, this transport relies on the ability of hydrogen to interact with the surface of palladium, meaning that other adsorbed gases have the potential to inhibit the transport of hydrogen. The research goals of this project are to better understand any potential surface effects nitrogen may have on the palladium surface. Practical applications for the separation of hydrogen from nitrogen include the purification of ammonia decomposition streams in hydrogen carrier/storage scenarios or the purification of gasification streams where air is used as an oxidant.

7. Research implementation and results under the program

Title of your research plan:

Purification of hydrogen-nitrogen binary gas mixtures for effective use of ammonia as a hydrogen storage material

Description of the research activities:

The summer research primarily consisted of a transfer of technical knowledge from the Colorado School of Mines research lab to the University of Tokyo lab. Palladium membrane fabrication involves electroless plating of palladium onto porous ceramic supports, which means that a dense thin (< 5 μm) layer of palladium must plate over support pores. This fabrication technique can present unique challenges depending on the starting ceramic support, so the primary work was to find a way of using the materials at Tokyo so that future work can continue here. At this point, a graduate student from the Tokyo lab will continue fabricating and testing membranes post-summer.

In addition to fabrication, membranes were tested using hydrogen and nitrogen mixtures to see if flux inhibition could be observed. This behavior was previously reported in the literature, but after several experiments no effects were observed in the Tokyo lab. The primary experiment consisted of an equimolar hydrogen-nitrogen feed gas exposed to the palladium membrane at 723 K and a total pressure differential of 1.0 atm. Hydrogen flux through the membrane was measured over time and this value remained constant for several hundred minutes. The literature suggested that after a short time the flux would begin to decline due to competitive adsorption of nitrogen onto the palladium surface, but this was not observed here. Instead, a constant flux was observed, indicating no negative effects of nitrogen on membrane performance. The work will continue in an effort to write a rebuttal paper to the currently reported literature, but the primary conclusion from this summer is that flux inhibition could not be reproduced under these conditions.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The program was overall very fun and I experienced many aspects of Japanese culture that I would otherwise have missed. I got to meet my host father from the first weekend again during the trip, which to me shows the success of the homestay aspect of the program. In addition, my labmates at the university were all very friendly and included me on several activities around the city. I could not ask for a better experience and I hope the program continues in its current form.

9. Advisor’s remarks (if any): N/A

RESEARCH REPORT

1. Name: Thomas James MATARAZZO （ID No.: SP15033）

2. Current affiliation: Lehigh University

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Kyoto University

5. Host researcher: Prof. Masayoshi NAKASHIMA

6. Description of your current research

Thomas MATARAZZO received a Ph.D. in Structural Engineering from Lehigh University in May 2015. His dissertation focused on the formulation of mathematical models and statistical methods for efficiently extracting information from sensing networks with mobile sensors (as opposed to fixed sensors). More specifically, a framework was constructed for modal identification, i.e. estimation of natural vibration properties (natural frequencies) of a structural system, from data recorded by moving sensors. Sensor network data contains information that is unique to the structural system under consideration, and is necessary to verify its expected performance and identify potential structural damage or other deficiencies. Fixed sensor networks have dominated the practice of structural health monitoring; mobile sensors have never before been applied for this purpose.

The advancement of sensor technologies and the development of approaches for processing new types of data efficiently are motivated by both an improvement in observed structural information and a reduction in network setup efforts. The central hypothesis of the work was that mobile sensors simultaneously record data in time while moving in space, so that few sensors collect data containing dense, less-restricted spatial information, and provide a more cost-effective solution than a dense array of static sensors. The application of mobile sensor networks requires fewer setup efforts, encouraging more frequent data collection, and up-to-date structural health reports.

The tools developed in this work are also appropriate for other types of new sensor data formats such as: data from failed sensor networks (incomplete data), big data (measurements from a very large number of sensors), or dynamic sensor network data (fusion of data between various sensors within the network). The information within such datasets is crucial and also applicable for a rapid condition assessment immediately following a natural disaster, such as an earthquake.

7. Research implementation and results under the program

Title of your research plan: Quantifying Effects of Sensor Network Reliability on Modal Identification of a Steel Building

Description of the research activities: Thomas actively participated in research meetings with Dr. NAKASHIMA, Dr. KURATA, and group members to learn about their projects and finalize the testing procedure for his experiment in the structural lab. A research plan to measure the vibrations of a three-story structure using a sensor network was developed. The group conducted five phases of dynamic tests and successfully acquired the structural response data required for subsequent analyses. Preliminary data analyses support hypothesis regarding how the location of the sensors and the reliability of the sensor network affect the accuracy of modal identification results. Substantial conclusions and contributions will be organized into articles to be proposed for publication in scientific journals and international conference proceedings. Additionally, Thomas assisted a colleague with the construction of test specimens and sensor deployment in the structural lab. Throughout the program, Thomas helped another colleague revise a paper for submission to a peer-reviewed academic journal and assisted other members with their research presentations and conference papers.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): Thomas gained highly valuable professional and personal experiences this summer. In addition to befriending Japanese students and learning about Japanese language and traditions, Thomas participated in Gion Matsuri, Tenjin Matsuri, Lake Biwa Fireworks, and had the opportunity to observe daily life in Kyoto, Shirahama, Osaka, and Tokyo. Thomas will continue to work with Dr. NAKASHIMA's research group and learn about Japanese life and culture starting October 2015, when he begins a JSPS postdoctoral fellowship.

9. Advisor's remarks (if any): I always try my best to offer to my students and post-docs a research atmosphere having an international flavor and urge them to exchange, both technical and social, in English. Upon the arrival, Thomas understood this and placed a great deal of efforts to nurture and strengthen this atmosphere. His open-minded, generous approach is worthy of mention, and I do appreciate this on behalf of my group.

RESEARCH REPORT

1. Name: Kyle M. MCELHINNY （ID No.: SP15034 ）

2. Current affiliation: University of Wisconsin - Madison

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: National Institute for Materials Science

5. Host researcher: Prof. Kenji SAKURAI

6. Description of your current research

My current research is driven by the desire to develop new functionality in materials through the control of the structure and dynamics of heterogeneous electronic interfaces. These interfaces are particularly complex, containing a wide diversity of structures which span length scales from nanometers to mircometers. Additionally, these interfaces are dynamic, changing their structure depending on time and the environmental conditions. Recent experimental and theoretical results by our collaborators have demonstrated that the interfacial structure including the configuration of molecules at the interface can influence the electronic and vibration phenomena at the interface.

The ability to reconfigure the structure of the monolayer dynamically through the use of external stimuli would enable precise control over charge transfer dynamics, electronic energy levels, dipole moments or polarizations, and vibrational phenomena at the interface. Mechanisms through which these properties can be modified include using molecules with multiple stable configurations and dynamic manipulation of the local chemical environment. Dynamic control of molecular conformation would allow charge transfer mechanisms and rates to be manipulated. However, there is currently insufficient structural insight available to enable this control.

This research aims to study the static and dynamic structure of an optically driven structural reconfiguration of azobenzene-containing organic monolayers. Azobenzene containing molecules can undergo photisomerization process which always them to externally driven to two different structural states. X-ray reflectivity is a surface sensitive x-ray technique capable of resolving the out-of-plane structure of the interface and monitoring the photoisomerization dynamics of the films. Specifically x-ray reflecitivy provides information about the films density, thickness, and roughness. In this research we use x-ray reflectivity to studying the static and dynamic structure of optically-driven, azonebenzene-containing organic monolayers on an oxide substrate.

7. Research implementation and results under the program

Title of your research plan: Optically driven structural reconfiguration of azobenzene-containing organic monolayers

Description of the research activities: Samples of an azobenzene containing monolayer were deposited on silicon and quartz substrates using Langmuir-Blodgett technique. X-ray reflectivity was used to probe the structure of films of different monolayer coverage. Additionally, the samples were exposed to blue and UV light to isomerize the films. Samples of different monolayer coverage showed the expected trend of a reduced visibility with reduced coverage. However, films prepared on different days showed a different structure. It is currently unknown if this is due to sample fabrication inconsistencies or transport from the USA to Japan. Samples exposed to blue and UV light did not show the expected isomerization between the trans and cis states. Rather, intense UV exposure caused what appears to be an irreversible structural change in the film. It is possible that the isomerization occurs and reverse before the x-ray scan can observe the change. This could be influenced by the humidity, which has been shown in other work to reverse the isomerization process. The origin of the permanent change is not yet well understood, but is possibly a change in the chemistry of the molecule.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): I think this experience has been one of most exciting and important times in my life. I feel I have grown both personally and professionally as a result of this program. One of my goals to improve my own ability to understand and communicate with individuals and researchers from cultures outside my own It took a while, but I feel that I have really improved in that area. It has been fun and enlightening to immerse myself in the Japanese culture. The Japanese people and my host research group have been very kind and generous. Thank you for allowing me to participate in the JSPS summer program.

9. Advisor's remarks (if any): First of all, I would appreciate the NSF and the JSPS, because the present program was truly fruitful. We will definitely continue communications and further collaboration, because he has done very well. One reason of his success might be because of his very good preparation before starting the present program. He had a short stay at our lab in March this year. He saw our experimental setups, and discussed the details of experimental time plans. I was impressed very much

by his well-organized, careful plans. He brought some instruments from the US with him. He also brought his samples. During his stay here, he asked his colleagues in the US university to send further samples as well. In addition to ordinary measurements, and the data analysis, he has a very good skill in the instrumentation, which is extremely important in some new research fields. He was able to prepare his own small electric circuits for the experiments, and he was trying to develop some computer codes to control the instruments as well. Though the present staying period was too short to reflect fully his ability to his research, I would emphasize that he was ambitious in the research. Some of our lab's students had a good influence from him. His staying was beneficial in such aspects as well.

RESEARCH REPORT

1. Name: Kathleen F. MCKEE （ID No.: SP15035）

2. Current affiliation: University of Alaska Fairbanks

3. Research fields and specialties: Mathematical and Physical Sciences

4. Host institution:

Aso Volcanological Laboratory, Institute for Geothermal Sciences, Graduate School of Science, Kyoto University, Kumamoto, Japan

5. Host researcher:

Takahiro OHKURA, PhD and Akihiko YOKOO, PhD

6. Description of your current research

The lowermost portion of large eruption columns is the momentum-driven, fluid flow portion known as a volcanic jet. The perturbation of the atmosphere from this region produces a sound known as jetting or jet noise. Recent work has shown that this volcanic jet noise produced by a volcano has similar characteristics as the sound from jet and rocket engines. The study of volcanic jet noise has gained much from laboratory jet engine studies; however, jet engines have been engineered to reduce noise thereby limiting their use as a comparison tool to the complex, ever-changing volcanic jet. Previous studies have noted that fumaroles produce jet noise without further detailed investigation. The goal of this work is to enhance our understanding of large-scale volcanic jets by studying an accessible, less hazardous fumarolic jet. We aim to characterize the acoustic signature of fumaroles and evaluate if fumarolic jets scale to that of large volcanic jets. To investigate this, we deployed a 6-element acoustic array at two different locations along the edge of the crater wall at Aso Volcano, Japan from early July through mid-August 2015. Approximately two months before this deployment, the pyroclastic cone within Aso's crater partially collapsed into the vent. The cone was constructed during both ash venting and strombolian-style explosive activity in the last year. After the deployment, on July 13 a new small vent opened on the southwest flank of the pyroclastic cone. The vent is several meters in diameter and has consistent gas jetting which produces audible jet noise. To better capture the acoustic signature of the gas jetting we moved the array to the southwestern edge of the crater. The array is 230 meters from the vent and is positioned 54 degrees from the vertical jet axis, a recording angle usually not feasible in volcanic environments. Preliminary investigations suggest directionality at the source and the influence of topography along the propagation path as evidenced by a reduction in power and decrease in correlation between certain array elements.

7. Research implementation and results under the program

Title of your research plan:

ANALYSIS OF FUMAROLE ACOUSTICS AT ASO VOLCANO, JAPAN

Description of the research activities:

When I arrived at Aso Volcanological Laboratory (AVL) rainy season was in full swing. This delayed our efforts to deploy an array of 6 microphones at the summit of Naka-dake, the active vent at Aso volcano. While we waited for a good weather window, my hosts provided me with a dataset to work on. I began a collaborative investigation into the characteristics and source location of two different types of infrasound signals recorded at Aso volcano: explosions and the partial collapse of the pyroclastic cone. At the beginning of July we were able to deploy my microphones. In mid-July, a new, small vent opened at the crater, which produces the type of sound in which I am interested. We then moved the array closer to the new vent, because the original location was not picking up this new source of sound. We returned a couple days later to collect the recently recorded data to see if the array in its new location had detected the sound produced by the new vent. It did! We recorded another 10 days of data at the new site and then retrieved the instruments. During my remaining time I worked on the two different datasets and presented my preliminary results to the researchers at AVL.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

This was a great experience for me both professionally and personally! The data I collected and research I did will directly contribute to my PhD. The professional contacts I made can only positively affect my career. I hope to return to Japan to do more collaborative research and my hosts at AVL have invited me to return.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Nicole A. MCNABB （ID No.: SP15036）

2. Current affiliation: College of Charleston

3. Research fields and specialties:

Biological Sciences

4. Host institution: National Institute for Basic Biology

5. Host researcher: Prof. Taisen IGUCHI

6. Description of your current research

American alligators (*Alligator mississippiensis*) exhibit temperature-dependent sex determination (TSD), in which incubation temperatures during a thermosensitive period (TSP) in embryonic development determine sex of the embryo. Estrogen signals also play a critical role in TSD. A single exposure to exogenous estrogen during TSP overrides the effects of temperature, and leads to skewed sex ratios by inducing ovarian development at a male-producing temperature. Reptile species that exhibit TSD, like alligators, have been used as sentinel species to investigate chronic exposure to environmental contaminants including endocrine disrupting contaminants (EDCs). During the 2010 Deepwater Horizon oil spill in the Gulf of Mexico, COREXIT® EC9500A was applied to the surface water and at the wellhead to disperse the oil. As a graduate student at the College of Charleston, my research has focused on estrogen-like activity of COREXIT and the effects of exposure on TSD in alligators. Using luciferase reporter gene assays, COREXIT demonstrated estrogenic activity *in vitro* by inducing transcription via alligator estrogen receptor 1 (ESR1). To pursue this, alligator eggs were exposed to COREXIT during TSP to investigate the potential endocrine disruption and effects on gonadal development.

7. Research implementation and results under the program

Title of your research plan:

Investigating Endocrine Activities of Oil Dispersant COREXIT® EC9500A in Diamondback Terrapins and *Daphnia*

Description of the research activities:

The diamondback terrapin (*Malaclemys terrapin*) is a turtle species native to the eastern and southern U.S., including the Gulf of Mexico coast. Along with alligators, *M. terrapin* is a reptile species that exhibits TSD. During my time in the Iguchi Lab, we examined the estrogen-like activity of COREXIT in terrapins. We successfully cloned and sequenced the two estrogen receptor (ESR) forms, ESR1 and ESR2 from diamondback terrapins. Using these ESR sequences, I assembled phylogenies to compare ESR homology and examine relationships among reptile species. Luciferase assays were performed with the terrapin ESRs. Known ESR agonists, 17β-estradiol and bisphenol A (BPA), induced transactivation of ESR1 and ESR2 on a small scale, but COREXIT did not display activation of the terrapin ESRs. Along with the ESRs, we also cloned and sequenced transient receptor potential V4 (TRPV4) from *M. terrapin*. TRPV4 is a cation channel that responds to temperature stimulation and plays a critical role in alligator TSD. *M. terrapin* TRPV4 can now be used in future experiments to focus on the mechanism of thermosensitivity in TSD. While working in the Iguchi Lab, I had the opportunity to work with *Daphnia* (water fleas) for the first time. We performed a 21-day reproduction test for COREXIT in *Daphnia magna*, during which we recorded toxicity and number of offspring released. Significant differences in survivorship were observed in the COREXIT 10 ppm and 100 ppm treatment groups.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Although the Iguchi Lab and Guillette Lab (home institution) have collaborated for years, I was able to experience a completely different lab culture. I loved working with everyone in the Iguchi Lab. My favorite day was our lab summer fishing trip in the mountains. I also had the experience to travel all over Japan to Aomori, Yokohama, Tokyo, Kyoto, Niigata, Sapporo, and Mt. Fuji. I absolutely loved the summer program, and I never want to leave Japan.

9. Advisor's remarks (if any): As mentioned above, Nicole showed a great success of gene cloning and assays in our lab. She will bring back cloned genes and repeat experiments to accumulate more data for her thesis and keep good memories with us. She also had a great time with members in our lab and also with other new friends in Japan. We are so happy to have Nicole in our laboratory even for a very short time for research.

RESEARCH REPORT

1. Name: Luri Robert MIDDLETON （ID No.: SP15037 ）

2. Current affiliation: University of Pennsylvania

3. Research fields and specialties: Engineering Sciences

4. Host institution: Hokkaido University

5. Host researcher: Prof. Ryusuke NOZAKI

6. Description of your current research

Global energy consumption increases every year and consequently substantial research efforts have been devoted to improving next-generation energy solutions to keep up with demand and improve efficiency. Currently, there is intense interest in acid-containing and ion-containing polymers as this class of polymers could enable the next generation of batteries, thin film capacitors, and proton exchange membranes in fuel cells. The goal of this project is to gain fundamental understanding of the coupling between ion motion and polymer dynamics in a model ion-containing polymer system. To optimize the ion transport kinetics, a performance bottleneck in these critically important to applications, one must understand the nature of this coupling.

Interest in ionomers and other polymers with acid, ionic and polar groups is fueled by these polymers' ability to selectively transport charged species. Dielectric relaxation spectroscopy (DRS) will be used to investigate the various relaxations in a series of homologous acid copolymers neutralized with metal salts such as lithium. DRS will measure relaxations on the timescales of ion conduction and polymer motion. This technique will be combined with a recently synthesized category of acid copolymers with high levels of molecular control during synthesis to probe the coupling of motion between polymer and ion.

7. Research implementation and results under the program

Title of your research plan: Elucidating the Role of Ionic Aggregate Structure on Polymer Dynamics for Charge Transport Applications

Description of the research activities: A series of ion-containing precise copolymers were prepared and characterized to understand phase transitions, nano-scale morphology, backbone dynamics and mechanical relaxations. These data were collected at the University of Pennsylvania and at Hokkaido University. The combination of these data is expected to provide a more complete view of how polymer structure and dynamics are affected by the presence of electrostatic interaction between polymer chains and ions. I shadowed group members to learn how to prepare, operate the instruments and test samples. I attempted to characterize the copolymers with the technique I learned from the Nozaki lab, dielectric relaxation spectroscopy (DRS). During this time I learned about many potential issues including surface roughness effects, contaminant air dynamics, resonance of the fixture and multiple electromagnetic wave reflections. Moving forward we to extract data through fitting models of the fixture resonance and the multiple reflections. Additionally dynamics data at lower frequencies were examined (10Hz-100MHz) and lower temperature ranges (283-363K°) were explored to capture slower dynamics involved in ionomer dynamics.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): I was fortunate to have been able to experience many parts of Japanese culture in the two months I spent in Hokkaido. I lived in a share house and given a glimpse into a normal Japanese person's lifestyle. We cooked, ate, cleaned and spent time together. I also enjoyed the lab group events including outdoor barbeques with the physics department and the Nozaki research group. The students and I prepared the food ahead of time, cooked together and enjoyed the beautiful outdoor scenery in Hokkaido.

9. Advisor's remarks (if any): It is my pleasure to say that Mr. Robert MIDDLETON has spent valuable days not only for the scientific research but also for understanding Japanese culture and language.

RESEARCH REPORT

1. Name: Benjamin Minkoff （ID No.: SP15038 ）

2. Current affiliation:

University of Wisconsin-Madison

3. Research fields and specialties:

Biological Sciences

4. Host institution: Hokkaido University

5. Host researcher: Drs. Taichi Takasuka and Hisanori Bando

6. Description of your current research

Phosphorus is the eleventh most abundant chemical element on the planet, and essential to life. Phosphate esters, compounds that contain a carbon-oxygen-phosphorus bond, make up the backbones of DNA, RNA, and are also a component of the molecular energy carrier ATP, and have been well studied. Less studied are organophosphanates, compounds which contain a direct carbon-phosphorus bond. Organophosphonates are thought to have predominated on primitive Earth, when atmospheric oxygen levels were likely lower than today. More recently, organophosphonates have been noted for their importance as commercial products, from antibiotics to fungicides, and in providing nutrients for organisms living in extreme environments. Understanding organophosphonate breakdown and utilization is thus important for understanding environmental phosphorus cycling. Recently, a species of thermophilic cyanobacteria living in hot springs in Yellowstone National Park, USA was reported to be able to break down organophosphonates, even though they lack canonical breakdown pathways. Work will be conducted with Professors Hisanori Bando and Taichi Takasuka, at Hokkaido University, to make and test the ability of enzymes from these cyanobacteria proposed to be able to break down these compounds. It is possible that they have the ability to break down organophosphonates in a way that has never been described before.

7. Research implementation and results under the program

Title of your research plan:

Exploring activity of newly-discovered enzymes from thermophilic cyanobacteria

Description of the research activities:

We set out to test cell-free expression and enzymatic activity of enzymes proposed to be responsible for breakdown of organophosphonates, naturally occurring molecules that contain a carbon-phosphorus bond. Currently, 1 of 7 has successfully been cloned into a cell-free expression plasmid, but has yet to be expressed or have it's putative activity tested. Additionally, the genes are being put into an overexpression vector for classic *in vivo* overexpression for potential crystallization. This was done by an undergraduate under my guidance throughout the duration of my summer. Both of these will be projects future students in the lab will continue once the Summer JSPS time period has ended, or one that can be picked up as a post-doctoral project upon completion of PhD at the home university.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I could not have had more fun this Summer, and will likely come back to Japan to pursue further research, likely with Dr. Takasuka. Upon graduation, I plan to apply for the JSPS postdoc fellowship. I was located in Sapporo and the city, food, weather, sights to see, and people could not have been more amazing. I am extremely grateful to JSPS for this opportunity.

9. Advisor's remarks (if any):

Ben had made great progress on the project since his arrival at Hokkaido University, and also he helped other projects by guiding several Japanese and international undergraduates in my laboratory. In addition, he involved in the undergraduate course that I taught at Hokkaido U, and he helped students to write an essay and to give a presentation in English. Overall, his performance in the past two months was excellent.

RESEARCH REPORT

1. Name: Shabnam MOHAMMADI （ID No.: SP15039 ）

2. Current affiliation: Utah State University

3. Research fields and specialties:
Biological Sciences

4. Host institution: Kyoto University

5. Host researcher: Prof. Akira MORI

6. Description of your current research

Although toads are defended by potent cardiotonic steroid toxins known as bufadienolides (BDs), bufophagy (toad-eating) has evolved independently among several lineages of snakes. The mechanisms that provide resistance to BDs in these snakes are complex and unresolved. The toxins exert their effect by binding to and disabling their target protein, the sodium-potassium pump. Preliminary comparisons of genetic sequences coding for the binding site on this protein have revealed that mutations that provide resistance to binding occur in a wider range of species of snakes, including some that are not bufophagous. My research is focused on resolving the mechanisms and physiological trade-offs of cardiotonic steroid resistance in bufophagous snakes, and determining the extent of evolutionary convergence in the underlying mechanisms. To understand the origin and retention of a trait, especially when it persists in descendants for which it is no longer adaptive, it is essential to determine the physiological trade-offs involved with possessing the trait. Therefore, it is necessary to combine genetic screens with physiological and functional assays. My current research directly addresses this issue. In Japan, I have been collecting specimens of *Rhabdophis tigrinus* and a sympatric non-resistant species and conducting a series of physiological experiments on live snakes. I have also been collecting fresh tissues for in vitro assays at my home institution. These experiments include comparisons of relevant physiological responses to cardiotonic steroids, including cardiac contractility, hormone levels, and physical behavior. The results of these experiments will reveal potential physiological costs of resistance to toad toxins. Tissue samples will be used to quantify tissue-specific sensitivity to cardiotonic steroid exposure. At my home institution, I have been surveying many species of resistant and non-resistant snakes. Adding the Japanese species, *Rhabdophis tigrinus*, to my sample

breadth provides comparisons with a further specialized adaptation. *Rhabdophis tigrinus* is a species of snake that is not only resistant to cardiotonic steroids, it has also evolved the ability to redeploy these toxins obtained from their diet for their own defense, and females can even pass this defense on to their offspring.

7. Research implementation and results under the program

Title of your research plan:

Investigating the mechanisms of toxin resistance in specialized toad-eating snakes.

Description of the research activities:

Live snakes were collected from the field in various parts of Kyoto and nearby Prefectures. A total of 89 snakes were collected: 68 Japanese tiger keelbacks (*Rhabdophis tigrinus*) and 21 four-lined rat snakes (*Elaphe quadrivirgata*).

Snakes were randomly assigned to three experiments. The first experiment tested each snake's hormonal response to cardiotonic steroid exposure. Twenty-four Japanese tiger keelbacks (cardiotonic steroid-resistant species) and 10 four-lined rat snakes (non-resistant species) were used in this experiment. The experiment consisted of two data collection days within a span of two weeks. After the snakes were weighed and measured, they were placed in their terraria and left to acclimate for one week. On the eight day, blood was drawn from each snake for measurement of baseline hormone levels, and then a mass-adjusted dose of control solvent with no cardiotonic steroids was injected in the body cavity. After 30 minutes, blood was drawn a second time for measurement of dose-response hormone levels. The control blood samples measure the hormone responses of snakes to being handled and injected. Following the second blood draw, video cameras were set up to record any behavioral responses that the snakes might be exhibiting for five consecutive hours. A collaborating graduate student at Kyoto University is conducting this behavioral aspect of the experiment. Following the videotaping, the snakes were left to acclimate for an additional week. On the 15th day, these procedures were repeated with a mass-adjusted dose of cardiotonic steroid. All blood samples were centrifuged

to separate blood cells from plasma, which contain the hormones. The plasma samples were stored in a -20°C freezer and will be shipped to my home institution, Utah State University (Logan, UT, USA) to be assayed in the fall of 2015.

The second experiment tested each snake's cardiac response to cardiotonic steroid exposure. Twenty-one Japanese tiger keelbacks were used for this experiment. Each snake was connected to a heart monitor, allowed to acclimate for an hour, and its heart rate was recorded for 20 minutes for a measurement of baseline heart rate. At 21 minutes, each snake was given either a mass-adjusted control or cardiotonic steroid injection, and the heart rate was recorded for 80 minutes following. The results from this experiment will be analyzed at Utah State University in the fall of 2015.

The third experiment simply involved collecting fresh tissue samples from snakes to be assayed for cardiotonic steroid sensitivity. Tissue samples collected included brain, heart, skeletal muscle, liver, gut, and kidney. Nine Japanese tiger keelbacks and six four-lined rat snakes were used for tissue collection. These tissues were immediately stored in -80°C upon dissection and will be shipped to Utah State University (Logan, UT, USA) to be assayed in the fall of 2015.

All remaining snakes were either used or will be used by other members of my research group at Kyoto University.

The research at Kyoto University was an overall success. Although most of the results will not be available until samples are sent to the US and assayed, the experiments were conducted and completed successfully.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The best cultural experience of my stay in Japan this summer involved eating as many different types of food as I could. I really enjoyed trying different regions dishes. I also really enjoyed visiting the various and numerous shrines and temples. Some of the remote areas had some of the most beautiful shrines and it felt very magical to walk peacefully through them.

9. Advisor’s remarks (if any)

RESEARCH REPORT

1. Name: Andrew Mongue （ID No.: SP15040 ）

2. Current affiliation:

University of Kansas, Department of Ecology and Evolutionary Biology

3. Research fields and specialties:

Biological Sciences

4. Host institution: National Institute of Agrobiological Sciences

5. Host researcher: Hideki SEZUTSU

6. Description of your current research

I study the evolution of reproductive traits in butterflies and moths. At the University of Kansas I use the monarch butterfly to answer the question of why butterflies and moths produce sperm with no DNA and no chance to fertilize eggs. Evolutionary theory posits that organisms should minimize wasteful expenditure of resources, yet nearly all butterflies and moths make large quantities of this apparently useless cell type. It seems likely that these cells must play some non-fertilizing role and there are several hypothesized roles yet their function has remains undetermined. I have designed a set of experiments to elucidate the potential function(s) of DNA-lacking sperm cells, but these experiments require greater manipulative control of my study organism.

7. Research implementation and results under the program

Title of your research plan:

Adapting Japanese silkmoth rearing techniques to answer evolutionary questions

Description of the research activities:

I have spent the summer learning advanced research protocols from silkmoth experts at Japan's National Institute of Agrobiological Sciences. Silkmoth biologists here have vast knowledge of organismal biology, in particular methods to store sperm and ovaries indefinitely, artificially inseminate and transplant reproductive organs between insects. These techniques allow for precise researcher control of insect reproduction as well as long term preservation of genetic diversity. I have practiced these methods for the last two months and am prepared to bring them back to the University of Kansas. In the short term I will adapt these silkmoth techniques to monarch butterflies and in the process investigate the evolutionary importance of DNA-lacking sperm cells. Once these advanced reproductive techniques are established, I can attempt to optimize them for use in conservation of the steadily declining North American population of monarch butterflies.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I think my Japanese speaking ability has greatly increased in these two months. Whether from talking to labmates or strangers on trains, every day has been good practice. I would be remiss not to mention the incredibly variety of new foods to experience, all of which I tried: from sea urchin to puffer fish. Takoyaki (batter-fried octopus) is a new favorite food of mine. Climbing Mount Fuji, watching an FC Tokyo soccer game, and going to the Mitama Matsuri lantern festival all stand out to me as wonderful instances of experiencing different aspects of Japanese culture.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Lourdes Maria MORALES-VILLAVERDE (ID No.: SP15041)

2. Current affiliation: University of California, Santa Cruz (UCSC)

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Nagaoka University of Technology (NUT)

5. Host researcher: Professor Muneo KITAJIMA

6. Description of your current research

My research at UCSC focuses on facilitating blind people to independently create well-formatted documents. My focus at NUT was researching the influence that travel destination information from enterprise (e.g. travel agencies) and consumers (e.g. prior visitors) can have on travelers through the design of a proof-of-concept website that will provide travel destination information from both sources.

7. Research implementation and results under the program

Title of your research plan:

Attracting Travelers by Providing Information from Enterprise and Consumers: Development and Evaluation of a Proof-of-Concept Webpage

Description of the research activities:

1. Understanding the project that I was to collaborate in by helping:
    a. Input and analyze data from a survey on travelers' habits when traveling and planning trips.
    b. Write a paper (in English) on the results from the survey, the existing research on the matter of attracting travelers and their decision-making process when deciding on travel destinations, future work regarding this project, etc.
2. Developing a low-fidelity prototype of a webpage to attract and help potential visitors of the Echigo-Tsumari Art Field (ETAF) as a proof-of-concept since it will provide information of travel destinations from both enterprise (in this case the ETAF) and consumers (in this case prior visitors of the ETAF).
3. Iterating over the design of the webpage by working closely with my host and stakeholders (in this case, staff from Ospock which is an organization that is working on helping the ETAF attract more visitors).
4. Designing a preliminary user evaluation of the design. This included drafting survey questions, (after they were translated to Japanese) creating a paper and online survey, and drafting the user evaluation protocol (i.e. test plan).
5. Running preliminary user evaluations of the webpage design with three potential users (i.e. visitors of the ETAF) by conducting an onsite survey on the design of the webpage. The survey included imagines and descriptions of the main features of the webpage design so that we could determine how to improve the design and estimate which features will be helpful.
6. Improving the design of the webpage based on the preliminary user evaluations and submitting a final design to my host and the stakeholders (along with the evaluation protocol for future evaluations.)

RESEARCH REPORT

1. Name: Emily L. MUNGER （ID No.: SP15042）

2. Current affiliation: Kent State University

3. Research fields and specialties: Biological Sciences

4. Host institution: Primate Research Institute, Kyoto University

5. Host researcher: Dr. Katsuki NAKAMURA

6. Description of your current research

Learning and memory processes are believed to be similarly organized between humans and nonhuman primates. Therefore, a greater understanding of human learning may be achieved through behavioral and cognitive studies in nonhuman primates. With age, humans display a decline in cognitive function and an increased susceptibility to neurodegenerative diseases such as Alzheimer's disease (AD). AD in humans is marked by increased deposition of extracellular β-amyloid (Aβ) plaques and intercellular neurofibrillary tangles. These pathological markers of AD eventually lead to cell death and consequently, the decline of cognitive function. AD is the most common cause of dementia in humans and is characterized by a progressive decline of memory, language difficulties, and impairments in planning and abstract thought. Therefore, the development of a nonhuman primate aging model may provide greater insights into cognitive decline both with age and with pathology.

Common marmosets (*Callithrix jacchus*) have recently been proposed as a new model for the analysis of age related cognitive decline and potentially, neurodegenerative diseases. Histological studies have shown age related Aβ pathology in this species making them a potentially good model to explore the effects of Aβ deposition on cognitive function. However, the effects of aging are not well understood in this species. Therefore, the effects of aging on cognitive function are currently being assessed in a group of elderly common marmosets through the use of visual discrimination and reversal learning tasks. Both of these cognitive tasks are often used to assess prefrontal functions such as perseveration. The prefrontal cortex is also one region severely affected by AD. Therefore, this present research is working to enhance knowledge of the mechanisms of aging through the use of a nonhuman primate model.

7. Research implementation and results under the program

Title of your research plan: Learning and Memory in Aged Common Marmosets

Description of the research activities:

To assess the effects of aging on learning and memory, three elderly marmosets took part in visual discrimination and reversal learning experiments. Before testing could begin, each marmoset was trained to associate touching a visual stimulus on a digital computer screen with a food reward. After completion of touch training, experimental testing could begin. The marmosets first completed visual discrimination tasks. In visual discrimination, two abstract images are presented on the screen. One image, if touched, will provide a food reward while the other will not. Therefore, the monkey must learn to make the association between the correct stimulus and the reward. Once the monkey reached the preset criterion, a new visual discrimination task was presented. After the third visual discrimination task, reversal learning was introduced. In reversal learning, the food reward is now associated with the opposite stimulus as compared to the previous visual discrimination.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): My summer in Japan was remarkable; not only did I gain valuable skills to further my academic and research career, I met many amazing people and experienced the rich Japanese culture. I was able to travel during my brief time in Japan and see many stunning shrines and temples. I even got the chance to attend a fireworks festival. I had many new experiences trying the cuisine and thoroughly enjoyed trying as many Ramen shops as possible. Overall, my summer research fellowship in Japan is something I will cherish for years to come.

9. Advisor’s remarks (if any):

1. Name: Devin M. O'Brien （ID No.: SP15 043 ）

2. Current affiliation: University of Montana

3. Research fields and specialties:

Biological Sciences

4. Host institution: National Institute of Basic Biology

5. Host researcher: Teruyuki Niimi

6. Description of your current research

Using frog legged beetles (*Sagra femorata*) as a model system, I am working to further elucidate the relationship between fighting success and mating success in animal weapon systems. Often, we assume that, because males with the largest weapons tend to win the most fights, they also mate with the most females. While this is surely the case for a many weapon systems (such as the Japanese Rhinoceros Beetle, see Hongo, 2007), it is not the case of all systems. There are a number of weapon systems that have yet to be explored in detail, such as the frog legged beetle, and in some of these systems evidence suggests that there may be discrepancy between fighting success and mating success. That is, males with the largest weapons win the most fights, but they do not mate with the most females.

Using a combination of classic field observations and more modern techniques (such as flow through respirometry, comparative biomechanics, and RNA interference) I am working to better understand what factors could be limiting mating success and causing this discrepancy between males that win the most fights and males that mate with the most females.

7. Research implementation and results under the program

Title of your research plan:

The evolution and development of animal weapons: have hindleg weapons reached their limits?

Description of the research activities:

For my JSPS summer fellowship, I observed frog legged beetles in their natural habitat for one breeding season. During this time, I worked to determine which beetles in the population had the highest fighting success and mating success. This was achieved by painting numbers on the backs of individual beetles and following them throughout the breeding season. I observed how often individuals participated in fights, won the fights they participated in, and successfully mated. Once this information was collected, I worked to relate these metrics of success back to specific morphological features, such as body size and weapon size.

In addition to field observations, I measured the weapon strength and metabolic rate of frog legged beetles.

To measure weapon strength, I constructed a small force transducer (a series of circuits that can be used to measure force) and measured the maximum force each beetle could produce using its hindleg weapons. Over 200 beetles were measured to determine how maximum squeezing force changes as a function of weapon size.

To quantify metabolic rate, I used flow through respirometry to measure how much oxygen was consumed and carbon dioxide was produced by individual beetles over the course of one hour. Approximately 60 beetles were measured to determine how metabolic rate changes as a function of weapon size.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The majority of my work took place in a small park that is frequently visited by the people of Matsuzaka. Because of this, I was able to regularly interact with local citizens. I was provided with great opportunities to discuss American and Japanese culture, the local customs of Matsuzaka, and even share snacks with a few of the regular passersby.

9. Advisor’s remarks (if any):

The study described here is excellent and Devin’s work while in Japan was well executed.

RESEARCH REPORT

1. Name: Uchechi OKEKE (ID No.: SP15044)

2. Current affiliation: Michigan State University

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Institute of Materials Research at Tohoku University

5. Host researcher: Professor Mitsuo NIINOMI

6. Description of your current research

The PhD dissertation research involves understanding the processing-microstructure-property relationships of friction stir welded Al 2139-T8. This understanding can be used to optimize the processing conditions to obtain desired microstructures for optimizing the important properties of this material in targeted applications. Al 2139 is a Cu-based Al alloy with an attractive mixture of strength and toughness and will most likely be used in aerospace applications. Fusion welding of Cu-containing Al alloys results in solidification cracking, which is unacceptable for structural components. However such alloys can be friction stir welded, and research conducted at Michigan State University (MSU) has demonstrated that the welded region is weaker than the base metal region. In an effort to understand the processing-microstructure-property relationships of this alloy, the friction stir welded region will undergo post-weld heat treatment (PWHT) and the base metal region will undergo high pressure torsion (HPT) to improve performance for aerospace applications. This work will be performed in collaboration with Professor Mitsuo Niinomi at the Institute for Materials Research (IMR) at Tohoku University.

7. Research implementation and results under the program

Title of your research plan:

Understanding the Effects of High Pressure Torsion and Post-Weld Heat Treatment on Processing-Microstructure-Property Relationships of Friction Stir Welded Aluminum Alloy 2139-T8

Description of the research activities:

HRTEM imaging and diffraction patterns were acquired on base metal samples that were prepared at Michigan State University (MSU). Three orientation variants of needle-shaped nano-precipitates were discovered. TEM EDS was performed on numerous precipitates (~5 nm in thickness) and composition variation was found within some of them. Further literature review and XRD analysis needs to be conducted to confirm the phase of these structures.

HPT experiments were carried out at Toyohashi University of Technology. Upon further discussion with IMR personnel, Dr. Hakan Yilmazer, the original testing parameters of the experiment were changed to N=1, 2, 4, and 8 with a pressure of 5 GPa. I made a mistake and instinctively polished my samples after testing to prepare them for EBSD and TEM analysis; I needed to measure the thickness beforehand so that I could calculate the strain across the sample diameter. There may be another alternative to calculating strain but it requires more education on this technique on my behalf and more experimentation (XRD analysis). I also over polished two samples of the N=8 rotation but with the guidance of Dr. Yilmazer, I was able to wisely and resourcefully manage the remaining sample. EBSD analysis and hardness testing were performed on the tested samples. TEM and STEM have been conducted and the results need to be analyzed. Tensile testing is in progress.

Although HPT experiments were given a higher priority, PWHT on most of the samples have been completed. Hardness testing will be completed here since the machine set-up is favorable for large the dimensions of the samples.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): During my stay, I have worn a beautiful kimono and two yukatas. In Yokosuka, I attended my host family's daughter's hip hop class and performance, saw the U.S. Navy ships, and was welcomed at a party for me and two other JSPS fellows. I was able to visit Ito and Kawazu in the Shizuoka Prefecture and see three waterfall. I also participated in a guided tour of Tokyo. My research group held a welcome party for me and I attended the IMR annual beer party which included food, games, and entertainment.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Matthew O'Kelly (ID No.:SP15045)

2. Current affiliation: University of Pennsylvania

3. Research fields and specialties:
Engineering Sciences

4. Host institution: Nagoya University

5. Host researcher: Prof. Shinpei KATO

6. Description of your current research

Reliable and provably safe autonomous systems remain a grand challenge of engineering because of their ability to perform hazardous jobs, increase task efficiency, and prevent accidents attributable to human error. Despite these promises, realizations of such systems cannot be put into general service because, '*there is a lack of plan verification and validation methods for safety and performance that prevents all but relatively low levels of autonomy from being certified for use*'. Thus, ensuring the safety of scenarios involving autonomous systems will require a decision control framework for plan verification and execution that interfaces tightly with sensing, online estimation, vehicle control and human intervention. Our current research effort afforded an opportunity to test recent theoretical advances in autonomous driving scenario verification on a state-of-the-art autonomous vehicle.

Prior to the summer at Nagoya University, we formalized the notion of a driving mission as an ordered sequence of scenarios. The exact sequence is not known ahead of time; rather, the evolution and decisions of the other autonomous agents in the environment will motivate the decisions of the ego vehicle. Moreover, it is clear that some scenarios, like traffic lights, will be encountered more than once, albeit with minor site-specific differences. The key observation is that the diversity of scenarios is, to a first order of approximation, finite. That is, there is a recognizable, finite set of scenario types that is sufficient to describe most autonomous navigation missions. The remaining variability among scenarios can be parameterized: e.g., the number of cars at a roundabout, the current speed limit, or even information describing feasible trajectories of the ego-vehicle. As we further developed the semantics of the scenario verification language it became clear that it was necessary to implement algorithms for *local planning* and *trajectory generation* in order to *parameterize* ego-vehicle motion.

7. Research implementation and results under the program

Title of your research plan:

EAPSI: Autonomous system Plan verification and Execution framework (APEX)

Description of the research activities:

Our first step was to create formal proofs of the safety of driving scenarios using delta-reachability analysis. These proofs are sufficient for the verification of bounded time safety properties of a particular scenario on a specific road network (*ie* a lane change on a straight road). As the summer progressed, we implemented algorithms to parametrically describe ego-vehicle motion. Such *local planning methods* are essential for executing complex behaviors such as obstacle avoidance and lane change maneuvers. Key results thus far are: (1) Realization of a parallel trajectory generation algorithm suitable for online use (2) Interface of the algorithm to multiple open source robotics frameworks including ROS (3) Creation of a visualization and simulation environment for urban autonomous driving (4) Design, testing and validation of a complete planning package on a fully autonomous Toyota Prius (5) Refinement of APEX DSL semantics to reflect more realistic system architecture (6) Ability to parameterize vehicle trajectories for verification based on road geometry (7) Progress towards release of an open source APEX tool.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I'm very grateful for the opportunity to study in Japan and I am thankful to have had supportive and knowledgeable advisors at Nagoya University especially: Prof. Shinpei Kato, Prof. Yoshiki Ninomiya , Prof. Eijiro Takeuchi, and Prof. Yuki Yoshihara.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Christopher E. PETOUKHOFF （ID No.: SP15046）

2. Current affiliation: Rutgers University

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: Okinawa Institute of Science and Technology

5. Host researcher: Prof. Keshav DANI

6. Description of your current research

Polymer solar cells are emerging as a low-cost, renewable energy source that have the potential to be fabricated using low energy-intensive processes, giving polymer solar cells very short energy payback times. However, polymer solar cells are significantly less efficient than other photovoltaic technologies, so there is a great need to improve the efficiency of polymer solar cell devices. Metallic nanostructures, which are capable of supporting surface plasmons, or strongly coupled light-charge density oscillations, have been shown to improve the efficiency of polymer solar cells when incorporated into devices. The focus of my thesis has been on designing and fabricating metallic electrodes comprised of an array of Ag nanoparticles capable of coupling into various surface plasmon modes, with the goal of improving absorption in the photoactive layer of the polymer solar cell.

One of the mechanisms by which metallic nanoparticles improve polymer solar cell efficiency is by scattering light incident on the nanoparticles, particularly at the surface plasmon resonance wavelength. The scattering is useful for increasing the distance the light travels through the photoactive layer of the device. We have recently investigated the interaction between the scattering from Ag nanoparticle arrays with various absorber layers and have identified ubiquitous coupling between scattering objects in close proximity to absorber materials, resulting in pronounced resonant modes called “absorption-induced scattering.” Understanding the underlying physical mechanisms by which metallic nanostructures interact with the photoactive layer of polymer solar cells is critical in order to logically design metallic nanostructures that can lead to improved solar cell efficiency. The next stages of my thesis involve investigating the influence that metallic nanostructures have on the electrical properties of polymer solar cells, in addition to fabricating solar cell devices incorporating metallic nanostructures and measuring device efficiency.

7. Research implementation and results under the program

Title of your research plan:

Investigating the ultrafast charge dynamics in polymer solar cells incorporating nanostructured silver electrodes.

Description of the research activities:

We have investigated the influence that Ag electrodes comprised of Ag nanoparticle arrays have on the charge population and optical properties of a polymer:fullerene blend, which is used as the photoactive layer of polymer solar cells. We used a technique called transient differential reflectometry to study the charge population dynamics within the polymer:fullerene layer in the presence of our Ag nanoparticle arrays. We investigated the influence of the addition of different ultrathin interfacial layers (< 5 nm thick) between the nanoparticle arrays and the polymer:fullerene active layer on the charge dynamics and have observed a significant increase in the population of charges with the addition of MoS_2 interlayers in combination with our Ag nanoparticle arrays. We have also characterized the steady-state optical properties from polymer:fullerene films in the presence of our Ag nanoparticle arrays, with and without an MoS_2 interlayer, and have observed enhanced absorption and photoluminescence, which suggests that these heterostructures can be useful for improving polymer solar cell efficiency.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

My stay in Japan has been an amazing experience, and has given me a greater perspective on the research infrastructure and lifestyle in Japan. I am extremely grateful for having been awarded this opportunity to conduct research in Japan through the NSF and JSPS.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Ken C. Pradel （ID No.: SP15047）

2. Current affiliation: Georgia Institute of Technology

3. Research fields and specialties:

Engineering Sciences

4. Host institution: National Institute for Materials Science

5. Host researcher: Dr. Naoki Fukata

6. Description of your current research

My research focuses on the growth and characterization of p-type zinc oxide (ZnO) nanowires. While there is a lot of research in ZnO for optoelectronics due to its low cost, direct bandgap, and piezoelectric properties its one glaring weakness is the difficulty in doping it. ZnO is naturally n-type due to the presence of defects during growth, and attempts to make it p-type have been largely unstable. If stable p-type ZnO can be realized, it will open the doors to new generations of electronics such as LEDs and photovoltaics. It was recently discovered that antimony (Sb) can act as a p-type dopant in ZnO. Not only that, it has demonstrated an unprecedented stability of 18 months, and can be grown using a low temperature solution based method. This last point is especially novel as it allows ZnO to be easily integrated into flexible electronics.

Using this system, I have been developing a variety of ZnO nanostructures such as ultra-long wires or densely packed films. By further modifying the solution, I have been able to produce p-n junctions both in a planar configuration, and with core-shell structures. Despite the changes in primary charge carrier type, the material remains piezoelectric, allowing for continued work in the field of piezotronics, whereby the material's piezoelectricity can be used to control the flow of charge through it, allowing for strain sensing and other logic operations.

7. Research implementation and results under the program

Title of your research plan:

p-ZnO/n-Si Nanowire Heterojunction Structures for Enhanced Optoelectronics

Description of the research activities:

Recently developed stable p-type ZnO nanowires were integrated with silicon nanostructures to create a heterojunction structure. As silicon is a well-studied and widely commercialized material, doing so will allow the scope of the material to be broadened. Zinc oxide nanowires were grown on an array of ordered silicon nanowires in order to produce a “pine cone” structure. These structures were looked at using electron microscopy, and it was found that the p-type nanowires filled in the space between the silicon densely backfilling the structure. X-ray diffraction confirmed the presence of zinc oxide and that it was growing in a myriad of directions. The electronic properties of the heterojunction structure was measured as was its response to ultraviolet light of varying intensity and wavelength. Strong photoresponse was observed, showing that the optical properties remain intact despite the change in carrier type.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

This has definitely been one of the most fulfilling experiences of my graduate career. During my time here, I made a variety of contacts, both academic and non, and I expect to keep in touch with them into the future.

9. Advisor’s remarks (if any):

Ken did fine work during his summer here at NIMS. His work has strengthened the bond between our groups in Japan and the United States, and we expect to have continued collaborations with his group.

RESEARCH REPORT

1. Name: Austin Ford Ramsey (ID No.: SP15048)

2. Current affiliation: North Carolina State University

3. Research fields and specialties:

Social Sciences

4. Host institution: Nagoya University

5. Host researcher: Dr. Tadashi Sonoda

6. Description of your current research

Our research examines factors that cause Japanese farmers to exit the farm sector. We use aggregate data at several levels: town and prefecture. The majority of the data is available from 1985 to 2010 in five year intervals. Like previous literature, the theoretical model is a simple representation of the farm operator's problem of maximizing expected discounted utility subject to several constraints. Specifying net farm exits as the dependent variable, we assume that the theoretical model may be simplified to a set of reduced form equations. Other authors estimate similar reduced form equations by ordinary least squares. Because of the multilevel structure of the Japanese data, we use a Bayesian hierarchical model estimated via Hamiltonian Monte Carlo to capture the predictive importance of several exogenous factors associated with net exit rates.

7. Research implementation and results under the program

Title of your research plan:

Productivity and Exits from Farming

Description of the Research Activities:

Our research draws on a number of data sources including the Agricultural Census, Population Census, and Survey of Farm Management and Economy. Because of these many sources of data, a majority of my time was spent in acquiring and cleaning the data. It was also necessary to run estimation algorithms several times. We found that the extent of off farm labor in a town is associated with net exit rates. Our analysis shows that there are possible threshold effects in this regard. Towns with farmers deriving a majority of their income from off farm sources are more likely to have a significant portion of exits. The share of farmers with less than half of their income coming from off farm work is negatively associated with exit rates; small amounts of off farm income stabilize occupation migration. As expected, towns with a large population of elderly farmers are more likely to experience many exits from the sector. However, towns with many farmers in their forties and fifties experience less exits. At the prefecture level, high levels of unemployment keep farmers on the farm. Government acreage control programs did not have any noticeable effect on the rate at which farmers leave farming.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I was able to visit several different regions of Japan as part of this fellowship. Some of these regions were comparatively rural, such as Yamaguchi Prefecture. While I did not collect any data on these trips, seeing many rural communities firsthand gave me a more balanced view of the Japanese farm sector. I enjoyed the many products of the summer oranges that I was able to experience in Hagi.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Shiva RAZAVI (ID No.: SP15049)

2. Current affiliation: Johns Hopkins University School of Medicine

3. Research fields and specialties:

Engineering Sciences Biological Sciences
(multidisciplinary research)

4. Host institution: University of Tokyo/Kanagawa Academy of Science and Technology

5. Host researcher: Dr. Shoji TAKEUCHI/Dr. Koki KAMIYA

6. Description of your current research

The white blood cells (neutrophils) in the immune system are capable of 1. sensing the entrance of an external substance (pathogen) in the blood stream, and 2. walking towards the pathogen to engulf it and ultimately clear it from the body. It is known that the neutrophils register the pathogen location through sensing the chemicals that are secreted in the blood around the area where the pathogen resides. However the exact mechanism of sensing and migration of neutrophils is not clearly understood.

My research takes a bottom-up, synthetic cell biology approach to understand the mechanism of neutrophil function. My research goal is to fabricate an artificial cell that encapsulates the minimum number of biological material (mainly proteins and lipids) that are needed for a cell to sense a chemical and move towards it. To this end, I fabricate the artificial cells using an inverted emulsion technique. I also obtain the protein material needed by expressing the proteins of choice in large volumes (~ 12 L) of bacteria and isolating the protein target from these bacterial cells.

7. Research implementation and results under the program

Title of your research plan:

Engineering Artificial Cells that Can Move Towards a Chemical Target

Description of the research activities:

I have been working on two primary research areas:

1. Using a cell-free transcription/translation system (known as *in vitro* transcription/ translation) to be able to put the DNA in a test tube and have the protein expressed in the same tube. This will allow me to bypass the need to insert the DNA in bacteria and culture large volumes of it in order to obtain the desired protein. In Japan I have been able to use the cell-free protein synthesis system to express the desired proteins, however the expression level using this system has been very low. Either further optimization of this method for my proteins are needed, or I might need to revert back to using bacterial culture to obtain the proteins in the amounts desired.

2. The second aspect of research involved using the microfluidics jetting method to create this liposomes that are the size of the cell, have the same lipid composition as the cell, and can encapsulate biological content that can give them certain functionality. I have been able to use the state-of-the-art jetting method in my host lab. I have learnt how to machine each of the parts needed to assemble the microfluidics chamber, and have created artificial cells using this method.

In parallel I have also been testing the lipid composition of the artificial cells I make in the U.S.. Using the fluorescent markers available in my host lab I can verify the lipid content of the artificial liposomes fabricated.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

1. The research experience in Japan has been rather transformative. Being in a lab that is a world expert in making synthetic lipid membranes has exposed me to a wealth of research articles and ideas that was otherwise unbeknownst to me. This has given me a new insight in setting the remainder steps of my thesis project. 2. How the lab in Japan is run and the amount of commercially available products in the lab are very different from my lab in the U.S. where many of the reagents are homemade. 3. The lab work hours have been particularly rigid in comparison to the U.S. where I could stop by the lab anytime to set up an experiment. This restriction in my work hours was rather difficult to manage given the nature of biological experiments that sometimes do not flow as planned and might require attention at times outside of the regular schedule. That has required some degree of adaptation to the new work hours and I understand that various labs within Japan have different policies in this regard. 4. My adviser, Dr. Kamiya, and the labmates have been very attentive, kind, and generous in making my project succeed and I have been very grateful for that.

Overall the cultural experiences have been many and unfortunately all do not fit within this space. I can just attest to the fact that it was a wonderfully precious opportunity that I truly cherish, an experience that has enriched my academic and personal life both.

9. Advisor's remarks (if any):

Ms. Shiva has done a good job and a lot of experiment. She learned many methods for creating an artificial cell model in our laboratory. She will use the method in her project. I hope that she keeps contact with me and laboratory members in terms of research as well as friendship.

RESEARCH REPORT

1. Name: Krishna D. REDDY （ID No.: SP15050 ）

2. Current affiliation: University of South Florida (Tampa, FL, USA)

3. Research fields and specialties:
Biological Sciences

4. Host institution: National Institute of Physiological Sciences (Okazaki, Aichi, Japan)

5. Host researcher: Prof. Masaki FUKATA

6. Description of your current research

Protein lipidation is a process that regulates the spatiotemporal distribution of molecules essential to transmitting signals between neurons. This process is facilitated by protein acyltransferases (PAT), of which there are 23 in mammals. As a graduate student at the University of South Florida, my research involved elucidating the biochemical characteristics of zDHHC9, a PAT which is suspected to be one of the primary regulators of lipidation in the brain. At the National Institute of Physiological Sciences, I worked to determine the importance and function of zDHHC9 in the context of the brain using state-of-the-art techniques in cell biology. The overall aim of this project is to increase understanding of learning, memory, and motor function on a cellular and molecular level.

7. Research implementation and results under the program

Title of your research plan: Regulation of Neuronal Communication by Protein Lipid Modifications

Description of the research activities:

zDHHC9 is much more highly expressed in the mouse brain than in the lungs, kidney, stomach, liver, and heart. This relative difference is similar to that of its lipidated target H-Ras, an important molecule for synaptic transmission. zDHHC9 is consistently expressed at similar levels throughout mouse brain development, whereas H-Ras expression increases with mouse age. Our data indicates that zDHHC9 itself is lipidated in the brain, which is an exciting new avenue for understanding zDHHC9 regulation.

zDHHC9 was found to localize in all three major compartments of the neuron: the Golgi, the dendrites, and the axons. Time-lapse imaging of wild-type zDHHC9 revealed dynamic localization throughout the entire neuron (Golgi, axons, dendrites). However, a nonsense mutation of zDHHC9 (R298*) implicated in intellectual disabilities is only localized to the Golgi without dynamic localization throughout axons and dendrites, suggesting that proper localization of zDHHC9 is required for proper neuron function.

As I have extended my stay for 10 days past the closing ceremony, several experiments are ongoing. I aim to evaluate the effects of zDHHC9 knockout on the localization and lipidation state of four candidates (H-Ras, GluA2/3, PSD-95, SNAP25). zDHHC9 will be immunoprecipitated from rat brain to determine regulatory proteins. Finally, the effects of synaptic activity on dynamic localization of zDHHC9 will be determined.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): My EAPSI experience in Japan was undoubtedly valuable for my scientific and personal development. In the Fukata laboratory, I was surrounded by an exceptionally supportive and invigorating environment. I learned several techniques which will be useful in my career as a scientist, such as primary neuron culture, super-resolution microscopy, and time-lapse imaging. Using these techniques, I was able to gain insight regarding the role of zDHHC9 in the neuron, which will prove valuable to my dissertation research. I will also train members of my home lab in these techniques. It was an incredible scientific experience, and the new perspectives I have gained will undoubtedly benefit my ultimate goal of becoming an academic scientist.

I was also fortunate to experience a lot of what Japan has to offer culturally. I visited cities such as Nagoya, Osaka, Kyoto, Nara, Hiroshima, Fukuoka, Sapporo, Tokyo, Yokohama, Niigata, Hakone, and Kamakura. I sampled the local delicacies and visited famous landmarks that each area had to offer. I also went events such as a sumo wrestling tournament, a baseball game, a fireworks festival, and even climbed Mt. Fuji.

Overall, I am proud of what I accomplished in Japan, both scientifically and culturally. The memories I have made will stay with me for my entire life, and I hope I am lucky enough to have another experience like this someday.

9. Advisor's remarks (if any):

Krishna has made a lot of progress in his proposed research, "Regulation of Neuronal Communication by Protein Lipid Modifications". First of all, he efficiently and precisely learned the procedure of primary culture of rat hippocampal neurons and performed time-lapse imaging using GFP tagged palmitoylating enzyme, zDHHC9. Recently, zDHHC9 was reported as a causative gene for X-linked intellectual disability. He discovered that zDHHC9 protein with a human mutation behaved differently from wild-type zDHHC9. Also, he generated and has been characterizing several important tools for zDHHC9; 1) knockdown vector with reporters and 2) CRISPR/Cas9 vectors, which should be useful for clarifying the patho/physiological roles of zDHHC9 in neuronal development and synaptic functions. Surely, we can develop future collaboration on this matter. I am convinced that this summer program gave us super-precious opportunity to develop future collaboration with Dr. Deschenes' lab, where Krishna belongs, and create the new field / direction in protein palmitoylation. In addition to his outstanding scientific ability, Krishna has been very friendly and kindly interacted with my lab members. Thanks to him, we both learned and understood mutual cultures very deeply. I greatly appreciate the JSPS's support for his stay.

RESEARCH REPORT

1. Name: Nicholas Rosa (ID No.: SP15051)

2. Current affiliation: Georgetown University

3. Research fields and specialties:

Mathematical and Physical Sciences Chemistry

4. Host institution: Hokkaido University

5. Host researcher: Prof. Yasuchika Hasegawa

6. Description of your current research

The next generation of electronic devices rests upon two advances in the materials used in their construction: new materials with novel properties and shrinking devices to the nanoscale. Magnetic semiconductors are an exciting but poorly-understood class of materials that display a number of interesting effects desirable for modern electronics applications. In these materials, the electronic, optical, and magnetic properties are highly coupled, leading to a strong interdependence among them. This interdependence allows for control of all of these properties based upon changes in only one. For example, when in a magnetized state, these materials exhibit a large change in their electrical resistance or interaction with polarized light. Understanding how to make these materials and how to control the properties on the nanoscale is an important first step in harnessing them for use in devices from displays to hard drives to processors and quantum computers.

For understanding the fundamental properties of magnetic semiconductor nanomaterials, an excellent model system is the europium chalcogenides: oxide (EuO), sulfide (EuS), selenide (EuSe), and telluride (EuTe). All of these materials are indirect bandgap semiconductors that display a range of magnetic behavior from ferromagnetic in EuO and EuS to metamagnetic in EuSe to antiferromagnetic in EuTe. Recently, nanostructures of the europum chalcogenides have been synthesized by the PI's home research group at Georgetown University and the research group of Yasuchika Hasegawa at Hokkaido University, where the PI will work under this award. These nanostructures are an ideal platform to study the fundamental behavior and coupling exhibited on the nanoscale. Toward this understanding, this project will investigate the synthesis and characterization of cation and anion doped EuS and EuSe nanostructures as a means to control electronic, optical, and magnetic properties by controlling composition.

7. Research implementation and results under the program

Title of your research plan:

Understanding and Controlling the Properties of Magnetic Semiconductor Nanomaterials based on Europium

Description of the research activities:

This research has resulted in the successful synthesis of cube-shaped nanoparticles of EuS, EuSe, and $EuS_{1-x}Se_x$ ($0 \leq x \leq 1$). These nanomaterials have been characterized by powder X-ray diffraction (PXRD) to determine the crystal structure, TEM to observe morphology and size, UV-visible spectroscopy to determine the optical properties, and magnetic circular dichroism (MCD) to investigate the magneto-optical properties. Further magneo-optical properties are being investigated by Faraday rotation. Magnetic characterization will be performed at the PI's host institution (Georgetown University) using SQUID magnetometry.

The second portion of the proposal, cation doping with Pb and Cd, could not be performed due to unforseen circumstances in the laboratory. Instead, the magneto-optical properties of calcium selenide (CaSe) and strontium selenide (SrSe) nanoparticles doped with europium were investigated. A synthetic route to these materials was developed that yielded good crystallinity and morphology by PXRD and TEM characterization. These materials were found to be luminescent under UV and blue light stimulaiton. These materials are currently being investigated by MCD, Faraday rotation, and will be characterized via SQUID magnetometry at Georgetown University. This work represents not only the first synthesis of CaSe and SrSe nanoparticles using solution methods but also the first report of solution-processable luminescent CaSe and SrSe phosphors.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

This was an incredibly rewarding experience both scientifically and culturally for both the PI and the host laboratory. The researchers anticipate two publications as a result of this research. Additionally, the host laboratory and the PI's laboratory will continue collaboration for the foreseeable future in both of these areas. Personally, the PI got a chance to explore an amazing country, sample many delicious foods (ramen, soup curry, hotate, uni, kani, etc.), experience the natural beauty of many sites (Shiretoko, Cape Kamui, Daisetsuzan, Fijisan), and forge friendships that span the globe.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Wilbur H. RYAN （ID No.: SP15052）

2. Current affiliation:

Florida State University

3. Research fields and specialties:

Biological Sciences

4. Host institution: Hokkaido University

5. Host researcher: Matthew DICK and Hiroshi KAJIHARA

6. Description of your current research

The problem of when and why organisms use sexual reproduction remains a fundamental and unanswered question in biology. For my doctoral research, I am using the globally distributed sea anemone *Diadumene lineata* to study what factors influence the evolution of diverse reproductive strategies. Individuals of this species can use both sexual and asexual processes for reproduction. In the United States, I have found that this tradeoff can be mediated by temperature and have demonstrated population level differences in the relationship between temperature and the balance of reproductive mode across the latitudinal range of this species. The next logical step of this research is to compare these relationships across independent coastlines, in order to understand the adaptive potential of these observations. This comparison also provides an opportunity for understanding the role of population connectivity in structuring the patterns of variation in different locations. Japan offers a particularly interesting comparison since this species is thought to have colonized the United States from Japan by way of human transport.

7. Research implementation and results under the program

Title of your research plan:

Comparing the geographic patterns of reproductive strategy in an exotic sea anemone between its native Japanese and invaded U.S. ranges

Description of the research activities:

Seven out of the ten weeks were spent finding, collecting and measuring anemones at several field sites across the species range in Japan with the help of the excellent staff at a variety of marine labs. Some specimens were preserved for genetic analysis while others were dissected to establish a body size to gamete production relationship for each population or were grown in a “common garden” to compare asexual reproductive behavior among populations. The remaining three weeks were spent at Hokkaido University developing a protocol for the extraction, amplification and sequencing of the COI “barcoding” gene as a first step toward comparing the genetic population structure within and between Japan and the US. This portion of the project was made possible by the expertise and generous assistance of the faculty and staff of the Biodiversity I Lab at Hokkaido University.

Each of the components of the project had success and many elements will be continued upon return to the United States. A working protocol for generating COI sequence data from preserved tissue was developed and has already produced useful data. Preliminary results of the field collection and culturing data suggest a surprising amount of variation in asexual reproductive behavior, including a form of reproduction entirely absent in the American sample and previously undocumented in several of the Japanese sites. Interestingly, this variation is not arranged in a predictable way along a latitudinal gradient and will require further analysis to understand and integrate into the framework of established knowledge.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): Over the course of 10 weeks in Japan, I have visited 23 field sites spanning more than 10^{o} latitude, worked with the staff of seven different biological institutions and befriended fellow researchers from more than 22 countries. I have traveled by boat, bus, train and foot through some of the most stunning landscape possible and engaged wholeheartedly with the people and places I have encountered all along the way. I leave Japan with a deeper understanding of my own scientific work and a much greater appreciation for both the diversity and comradery of the global scientific community

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Heather Sauder （ID No.: SP15053 ）

2. Current affiliation: Iowa State University

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Kyoto University

5. Host researcher: Dr. Hiromichi Shirato

6. Description of your current research

Flexible structures, such as long-span bridges, can be susceptible to large amplitude vibrations and catastrophic failures above specific wind speeds. Consequently, there is a need to be able to analyze potential structures efficiently in order to ensure safety of design through wind tunnel testing while not taking too much time. Previous methods of extracting aerodynamic functions for specific cross sections involves testing at several winds speeds and produces functions in frequency domain which does not work for winds that are transient in nature. A method was developed to extract time domain rational functions through wind tunnel testing at Iowa State University in 2012, but has only been used in that laboratory with specific section model cross sections and the efficacy of the method needs to be evaluated. This method has been applied to a bluff rectangular cross section and a streamlined cross sections (2012) as well as a wind turbine blade airfoil. The functions extracted from these wind tunnel tests can be used to predict the aerodynamic loads or the response of a structure in any given wind environment.

7. Research implementation and results under the program

Title of your research plan:

Investigating Dynamic Loads and Response of Bridges and Moving Vehicles Subjected to Extreme Wind Gusts

Description of the research activities:

The research conducted through the East Asia Pacific Summer Institute (EAPSI), sponsored by NSF and JSPS, was aimed toward evaluating the efficacy of a rational functions extraction method through wind tunnel tests conducted in the Bridge Engineering Laboratory at Kyoto University. This research looked at data for four different section models with two separate types of data. First, pressure from three different rectangular section models was used to determine the aerodynamic loads which is how the rational function method has been applied at Iowa State University. Second, load cell data with inertial force subtracted was used for a cylindrical cross section consisting of four small rods with different spacing. Finally, a user-friendly code was developed to allow for the implementation of this method in a future study, later in 2015, on a suspension bridge to be constructed in Vietnam. This method was found to not be applicable for the moving vehicle analysis.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I am very grateful for having the opportunity to conduct research in a foreign country and enjoyed the opportunity to immerse myself in the culture. There are still more things I would like to see and do in Japan, but I have learned a lot from Japanese culture and hope to take some of that back with me

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Tawny N. SCANLAN （ID No.: SP15054 ）

2. Current affiliation: University of California-Davis

3. Research fields and specialties:

Biological Sciences

4. Host institution: Tokyo University of Marine Science and Technology

5. Host researcher: Dr. Goro YOSHIZAKI

6. Description of your current research

The establishment of novel technologies for the long-term storage of fish genetic resources has become critical as aquatic species around the world are experiencing rapid declines due to a variety of factors. Recent advances in stem cell transplantation between fish species have been applied to produce functional gametes, both sperm and eggs, providing an innovative system for preserving genetic resources in fish. This technology coupled with cryopreservation techniques for fish spermatogonia could be a powerful tool in preserving valuable genetic resources for fish.

Cryopreservation pertains to the freezing, low temperature storage, and thawing of living cells and tissues. Cryopreservation can be accomplished by either slow-freezing or the ultra-rapid process known as vitrification While a slow-freeze method for spermatogonia has been developed, the major disadvantages include variable cell recovery, due largely to formation of ice crystals inside cells that causes sublethal and lethal cell damage, and is relatively high cost and labor intensive. Development of a vitrification protocol is desirable since vitrification is fast and the process avoids trauma to cells by eliminating intracellular ice formation and instead creates a glass-like (vitreous) state, resulting in high viability. A combination of spermatogonial vitrification and transplantation could provide an inexpensive, more convenient approach to preservation and magnification of fish genetic resources that we expect will result in real-world applications of this technology for aquaculture and conservation of endangered fish.

7. Research implementation and results under the program

Title of your research plan:

Vitrification of Rainbow Trout (*Oncorhynchus mykiss)* Whole Testes to Maintain Reproductive Stem Cell Developmental Potential

Description of the research activities:

Determine the effects of a combination of cryoprotectant agents (CPAs) on spermatogonia stem cell (SSC) survival and function after whole testes exposure. Permeating and non-permeating CPAs will be used in combination to investigate how these CPAs interact and effect SSC survival. Copper with whole testes will be plunged into liquid nitrogen (LN_2) and then placed in a 1.2mL cryovial for storage in LN_2. Gonads from immature *Gfp*+ rainbow trout will be used as donor tissue because the high ratio of SSC:maturing sperm in these fish allows for higher extraction efficiency of SSCs. Following treatment and vitrification, testes will be thawed and dispersed using trypsin and DNase. The cell population will then be quantified using fluorescence flow cytometry cell sorting to evaluate viability of cells in each treatment. Bright green fluorescence (+*Gfp*-vasa) will indicate viable transgenic germ cells while injured germ cells will exhibit no fluorescence because of cell lysis and loss of expressed *Gfp* protein from these cells. **RESULTS:** The optimal protocol for vitrification of rainbow trout whole gonads is 3.3x extender+0.2M trehalose+20% fetal bovine serum+15% DMSO+15% ethylene glycol, equilibrated for 20 minutes. The optimized protocol resulted in 69.84% +/- 7.75 (average+/-SEM) as compared to other treatment groups.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

During my stay in Japan I was able to partake in many cultural experiences. These experiences included attending Japanese baseball and soccer games, renting a karaoke room, visiting the Shinjuku Gyoen National Garden and tsujiki fish marker, camping, climbing Mt. Fuji and also experiencing two different summer festivals- Hanabi and Mitami Matsuri. Other culture experiences included visiting an animal reproduction laboratory at Utsunomiya University and going sight seeing in Nikko where we visited Oya stone museum, Kogan waterfall and the Toshogu Shrine. Another aspect of the cultural experience was sampling the local Japanese cuisine. The food adventure included everything from upscale fugu and yakinuki restaurants to a street stand selling takoyaki or getting dinner at the local 7-11.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Ruth Siboni (ID No.: SP15055)

2. Current affiliation:

University of Oregon, Institute of Molecular Biology

3. Research fields and specialties:

Biological Sciences

4. Host institution: Osaka University

5. Host researcher: Dr. Masanori Takahashi and Dr. Masayuki Nakamori

6. Description of your current research

In the Berglund Lab at the University of Oregon, we focus on the molecular mechanisms delineating Myotonic Dystrophy (DM1). DM1, an autosomally inherited disorder, is caused by a CTG repeat expansion mutation in the untranslated region of the DMPK gene. When transcribed into CUG RNA, these expansions are capable of binding to and sequestering an important family of splicing factors known as the MBNL family. As a result of this sequestration, numerous MBNL-mediated splicing events then go on to be improperly spliced, thus resulting a patient pathology. The main focus of my dissertation focused on small molecules which are capable of reducing CUG RNA levels with a high level of specificity for the repeat RNA. Previously, our lab demonstrated that the bis-benzamidine pentamidine was able to reduce CUG RNA levels significantly when compared to none-treated controls. Most importantly, this molecules reversed the splicing defects associated with DM1 mis-splicing in these models. Over the course of my doctoral work, I've examined a total of 15 pentamidine-related analogues for their ability to reverse mis-splicing *in cellulo* over a quantifiably non-toxic range. Furthermore, I characterized a molecule, actinomycin D, which is structurally distinct from the bis-benzamidine family but also serves to strongly decrease CUG repeat levels with some specificity.

7. Research implementation and results under the program

Title of your research plan: Identifying the Splicing Regulation Mechanism of Two MBNL1-mediated Events in Human and Mouse

Description of the research activities:

While my doctoral research focused primarily on small molecules characterization and analysis, a number of questions remained about the variations observed in MBNL sensitivity and response between different events. Therefore, a colleague in our lab, Dr. Stacey Wagner, created an inducible MBNL cell line which allows for the relatively amounts of required MBNL to be examined between different splicing events. This system has allowed our lab to examine a number of commonly employed minigene events in vivo. However, we were curious about some of the novel events identified by Dr. Nakamori in his latest publication on DM1 patient data. Before arriving in Japan, I created two "minigene" constructs that would be conducive to the study of their alternative splicing patterns in response to MBNL inducibility. Cells were shipped to Japan prior to the beginning of the summer. The first two weeks of the JSPS fellowship were spent establishing the cell line in the Nakamori lab, validating the inducibility of MBNL, and establishing minigene control systems. From there, I spent the next part of the summer collecting samples for each of the two minigenes in triplicate, testing a 12 point MBNL induction range that would allow for ample analysis of the MBNL-mediated splicing effects. Then final part of the summer involved creating and optimizing a method by which to reverse transcribe the collected RNA and amplify the DNA so that we could visualize the effects using electrophoresis. While this could still use some further "fine-tunning", I was able to acquire preliminary data for both events that I studied, LDB3 and CACNA1S.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):My time in Japan was nothing short of incredible! On weekends, I took trips to Nara, Koya-san, Kobe, Mt. Fuji, Kyoto, and Tokyo! I tried many different types of Japanese foods and became acquainted with quotidian Japanese life through visiting my labmates homes.

9. Advisor's remarks (if any)

RESEARCH REPORT

1. Name: Max D. STEIN （ID No.: SP15056）

2. Current affiliation: University of Florida

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Kanazawa Institute of Technology

5. Host researcher: Professor Yoshitaka Morimoto

6. Description of your current research

Max Stein's research is focused on the application of magnetic abrasive finishing (MAF) too difficult to machine workpieces. This includes workpieces constructed of difficult to machine materials, or workpieces with complex or irregular geometries. MAF can be applied to such workpieces to achieve surface roughness values as low as a single nanometer. This processes works by using a magnetic field to manipulate magnetic particles and abrasive particles to remove small amounts material from the workpiece surface. The magnetic particles are used to transmit force to the abrasive particles, which results in material removal. Force is usually generated by rotating the magnetic field or workpiece about a central axis to create relative motion between the workpiece and the particles. The amount of particles used, the size of particles used, the characteristics of the applied magnetic field, and the relative velocity between the workpiece and particles all contribute to the amount of force generated, which is directly related to the final characteristics of the polished surface.

His current research focuses on the application of MAF hybrid-tools, a new type of dual-phase technology capable of both grinding and polishing without the need to change tools or machines, and the automation of MAF on complex workpieces through the use of computer controlled machinery.

7. Research implementation and results under the program

Title of your research plan:

Combination of Non-Axisymmetric Curved Surface Turning and Magnetic Abrasive Finishing

Description of the research activities:

While at the Kanazawa Institute of Technology, several steps were taken to implement magnetic abrasive finishing (MAF) using Professor Morimoto's non-axisymmetric curved surface turning (NACS-Turning) machine. First, the capabilities of the machine were assessed. Using this information, a mounting device for the MAF tool was designed and fabricated. The functioning of this mount was confirmed using a cylindrical workpiece. Next, with the help of Professor Morimoto's graduate students, a tool path was generated so that MAF could be implemented on the final workpiece. Finally, the NACS-Turning machine was used to apply MAF a non-axisymmetric workpiece composed of D2 (SKD 11) hardened tool steel. The effect of the polishing on the workpiece were confirmed using an optical profilometer. As a result of these activities, the combination of NACS-Turning and MAF into a single machine was realized.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Being able to live in Japan as a normal student was a valuable experience. It provided insight into the lives of Japanese students that very few foreigners ever get to see. This experience has given new meaning to the phrase "to truly understand someone, you must walk a mile in their shoes," as well taught the importance of what can be learned from international collaboration in science.

9. Advisor’s remarks (if any):

Max Stein devoted himself to the study of our joint theme. I am deeply impressed by Max’s sincere attitude to address the collaborative research with our staff. We will continue our joint study for the next few years and present papers of our achievements.

RESEARCH REPORT

1. Name: Stephanie Su （ID No.: SP15057）

2. Current affiliation:

University of Michigan, U.S.A.

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Osaka University, Japan

5. Host researcher: Taku Yamanaka

6. Description of your current research

Our current living visible world is mainly composed of matter rather than antimatter. However, the super symmetry, under the modern dominant theory of particle physics, the Standard Model, suggests that the Big Bang created equal amounts of matter and antimatter. In the elementary physics study, charge-parity (CP) symmetry violation is responsible for this matter-antimatter asymmetry phenomenon. The KOTO experiment studies a rare decay of a neutral particle – Kaon. The Standard Model has a clean calculation of the branching ratio of this rare decay. This particular decay mode is a CP violating decay, and the branching ratio can be used to calculate the strength of the CP violation directly. By measuring the branching ratio of this neutral Kaon decay mode, we can eliminate many currently established theoretical models and perhaps find new physics.

The neutral Kaon will decay into one pion and two neutrinos. The pion will further decay into two photons. Neutrinos cannot be detected by the detector. The missing neutrinos give rise to missing transverse momentum. Therefore, we can observe the rare decay event by searching for two photons with large transverse. However, a neutron event generated upstream of the detector or inside the calorimeter could possibly appear to be the same as two photons with large transverse momentum. The neutron events have been the major backgrounds to the rare neutral Kaon decay that KOTO experiment is probing.

7. Research implementation and results under the program

Title of your research plan:

Neutron Events Study of Kaon Decays for Matter-Antimatter Asymmetry in Our Universe

Description of the research activities:

My graduate studies, prior than joining this program, have been focusing on the data acquisition system for the KOTO experiment, which is essential towards the high rate data taking. Other than the neutron studies I proposed for the program, I have also been working on the data quality check on the experimental runs occurred in April and June this year, in preparation for analysis followed in late summer and fall this year.

Secondary neutral beamline goes into our detectors from the proton accelerator. To identify neutron events, I searched for events that generate single cluster on the calorimeter and nothing on all the other veto detectors. In this way, we are able to identify the event we selected did not go through particle decay inside the detector decay region. To distinguish such neutron events from a huge timing window of high rate background events, I studied the timing distribution for each detector, for a total of 13 detectors, as well as the energy deposit on the detectors. I applied energy and timing veto to determine the window for neutron events selection. Eventually I was able to obtain single cluster event (neutron events) and study the cluster shapes of these events using the May 2013 run data. The experiment run data taken in this year contains at least eight times larger of the statistics compared to May 2013 run. I finished the data quality check and the data is currently undergoing the last stage of detector calibration production process. Further indepth studies of the cluster shape can be done and more progress will be made after finishing detector calibration for the April and June run in 2015. The statistics would be at least 8 times greater than my current study, which will allow verification of more neutron event samples on my project.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

My experience during the JSPS program has be tremendously invaluable. Within the limited time of 10 weeks, the amount of knowledge I acquired of the experiment and the progress I have made on the research studies are significantly greater than what I could have achieved in the U.S. The communications between Japanese colleagues and other foreign researchers, as well as the ability to access the research facility allowed me to advance my research project. Besides my research studies, Japanese culture I experienced was priceless. Though I have been in Japan before, experience I have had was nowhere close to what the program provides, especially the first week of orientation. I am grateful to have this opportunity. I am looking forward to see the implementation of my research project to the experimental run occurred this year, as well as potential future collaboration.

RESEARCH REPORT

1. Name: Victor Nicholas SZCZEPANSKI （ID No.: SP15058）

2. Current affiliation: New Mexico State University

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Kyushu University

5. Host researcher: Dr. Makoto Yokoo

6. Description of your current research

I am working with a group in Dr. Yokoo's lab to develop new techniques for determining if a game theory strategy in a repeated game model is in a particular type of equilibrium called 'Resilient Finite State Equilibrium' or RFSE. RFSE is a useful property for a set of strategies because it provides the optimal strategy and ensures that all players will continue using the RFSE strategy - it is in all players' best interest to continue using the RFSE strategy, and deviating will only hurt the deviating player.

To determine if a given set of strategies are in RFSE, we translate the repeated game model into a Partially Observable Markov Decision Process (POMDP). A POMDP models an agent facing an environment that may change non-deterministically and may only be partially observable. We can think of a repeated game in a similar way – the agent in a repeated game has a belief about the state of the opponent(s), and the state of the opponent in the next game depends on the opponent's strategy (unknown to the agent) and the agent's action in the current game. For example, the players may be competing stores in a shopping mall and should decide what price to set for their goods. A store cannot know what price the other store will set, but may have a belief about what it will be, and how the other store will react to this store’s price changes.

Using a technique developed in Dr. Yokoo's lab, we can convert a repeated game model into a POMDP. Then we can use a POMDP solver to find the optimal strategy for that POMDP – if the strategy is the same as our input strategy, then we say the strategy is in RFSE. This is particularly important since determining if a set of strategies constitute a pure strategy equilibrium is a known hard open problem.

We are currently working on implementing more efficient POMDP solvers so that we can solve larger problem and developing a new repeated game to POMDP translator to produce a more efficient POMDP model than the current translator produces.

7. Research implementation and results under the program

Title of your research plan:

Detecting resilient repeated game strategies using Partially Observable Markov Decision Processes.

Description of the research activities:

My research has three main outputs:

- A modified version of Anthony Cassandra's pomdp-solve program that is extended to include extra inputs for initial POMDP solutions and test beliefs, and to implement a new stopping condition for detecting RFSE.
- An implementation of Atsushi, YongJoon, et. al's repeated game theory to POMDP translator (called gt-to-pomdp) described in "Automated Equilibrium Analysis of Repeated Games with Private Monitoring: A POMDP Approach", AAMAS 2012
- A novel POMDP solver (called PDHS) implementing the general framework described in "Solving POMDPs by Searching in Policy Space" by Eric Hansen, 1998.
    - Additionally implements functions from "Online Planning Algorithms for POMDPs" by Ross, Pineau, et. al, JAIR 2008.

Source code is made available at https://github.com/acgs/pomdp-solve-5.4-YokooLab and https://github.com/acgs/PDHS.

We have also begun theory-driven work on improving Atsushi et. al's translator, but no formal output has been generated yet.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Working in Dr. Yokoo's lab was very productive, and I greatly enjoyed working with the other members of my group. The format for discussing research is a bit more formal than in the US – every week we essentially make a presentation to our research group. This was a good way for me to focus on what I was working on, and to learn about what the others were working on. The post-docs of the lab were also very help. Overall, it was a very positive experience.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Sarah A. ULRICH （ID No.: SP15059）

2. Current affiliation: Virginia Tech

3. Research fields and specialties:
Interdisciplinary and Frontier Sciences

4. Host institution: Kyushu University

5. Host researcher: Keiko SASAKI and Satoshi HATA

6. Description of your current research

My current research is an interdisciplinary blend of geosciences, civil and environmental engineering, and materials science. During the summer program, my project pursued two tracks: 1) the fabrication of a novel form of Mn-oxides to extract lithium from seawater, and 2) an atomic-scale comparison of Mn-oxides formed by different microorganisms, including fungi and bacteria. Together these two tracks offer insights into better ways to use naturally occurring minerals for resource recovery and water treatment, as well as understanding biological mineral formation and structures.

This first focus of this summer's work has been on using a biogenic pathway to form a lithium-ion sieve from birnessite, a layered Mn-oxide. In this project, the fungus *Paraconiothyrium* sp. was used because it is a robust Mn-oxidizer. Biogenic formation of Mn-oxides is preferred to purely synthetic methods because it requires fewer chemical inputs. In addition, biogenic birnessite formed by *Paraconiothyrium* sp. can be used to make lithium-ion sieves that are more effective at recovering lithium than those formed in a purely chemical fashion.

Also, high-resolution transmission electron microscopy (HR-TEM) observations were made of the lithium-ion sieve, its biogenic birnessite precursor, and an additional birnessite formed by a Mn-oxidizing bacteria. Data gathered about the lithium-ion sieve will be used to help understand the factors controlling resource recovery by Mn-oxides. In addition, observations of the two different types of birnessite will help to understand the formation and crystal structure of biogenic minerals. Traditionally, birnessite has been described in the literature as "poorly crystalline," even though few researchers have been able to clearly image biogenic Mn-oxide crystal lattices. These new images will provide insights into the nanoscale distribution of crystallinity, which previous bulk analysis have neglected. Initial HR-TEM observations of the fugal and bacterial birnessites show markedly different structures. These images are being coupled for the first time with

electron energy loss spectroscopy (EELS) to investigate the relationships between Mn oxidation state, sample thickness, and crystallinity.

7. Research implementation and results under the program

Title of your research plan: Transmission electron microscopy observations of biogenic Mn-oxides, and their implications for resource recovery and mineral formation

Description of the research activities:

- Biogenic formation of birnessite from *Paraconiothyrium* sp. fungus
- Formation of a lithium-ion sieve through calcination of biogenic birnessite
- Fabrication of lithium-ion sieve into alginate beads for practical usage
- High resolution transmission electron microscopy imaging of biogenic birnessite (fungal and bacterial) to investigate distribution of crystallinity within the mineral
- Electron energy loss spectroscopy of biogenic Mn-oxides to investigate elemental valence state, as it relates to crystallinity and sample thickness

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

In addition to providing me with access to cutting edge researchers and world-class microscopy labs, the JSPS summer program gave me the opportunity to experience Japan in a way that would have been impossible during a shorter visit. I was able to travel fairly extensively on the island of Kyushu during the weekends to visit sites of geologic, as well as cultural and historical interest. Luckily, I was able to visit some of the active volcanos, including Aso-san and Mt. Unzen to better understand the geologic history of Japan. It was also interesting to see how these geologic features affected the development of culture in Japan, especially with respect to agriculture, art, and pottery manufacture.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Kevin L. WARD (ID No.: SP15060)

2. Current affiliation: University of Florida

3. Research fields and specialties:
Engineering Sciences

4. Host institution: Japan Aerospace Exploration Agency (Tsukuba)

5. Host researcher: Dr. Satoshi MATSUMOTO

6. Description of your current research

When stacked multi-fluid systems are periodically accelerated in a direction perpendicular to the fluid interfaces, complex patterns on the interfaces will develop as a result of resonance between the imposed oscillation frequency and the natural frequency of the system. This resonance leads to deflection and growth of the interfaces once the acceleration exceeds a critical threshold, a phenomenon known as Faraday instability. Theoretical research at the University of Florida, along with experimental research at the Japan Aerospace Exploration Agency (JAXA) allows for the derivation and validation of theoretical stability calculations for the development of flow patterns generated by Faraday instability in electrostatically oscillated systems. Preliminary experiments have been conducted, successfully generating Faraday instability in a water-air system using an apparatus available at JAXA in Tsukuba, Japan. Building on preliminary experiments, a new experimental cell that allows for more efficient visualization, as well as the realization of a stress-free sidewall boundary condition necessary for the calculations has been created.

My current research involves the experimental mapping of stability curves utilizing the new experimental cells for comparison to a linear stability analysis on the system to be undertaken at the University of Florida. A preliminary theoretical model has been derived, but this model fails to address some of the underlying physical phenomena present in the system. Future work will include the expansion of the model to rigorously account for these additional phenomena. After the completion of the model validations for this system, I will conduct studies in order to shed light into the pathway to the pattern's breakup or stabilization once the critical acceleration is surpassed using weakly non-linear calculations. Applications of the research include enhanced mixing in microfluidic devices, a deeper understanding of liquid sloshing dynamics, space enabling operations, droplet movement, and enhancements to a wide array of processes through utilization of pulsatile forcing. The motivation for the project is to gain a further understanding of the physics of pattern generation due to oscillatory forcing in fluid systems. This understanding can then be applied to an extensive range of fields in order to enhance a multitude of processes.

7. Research implementation and results under the program

Title of your research plan: Pattern Formation on Electrostatically Forced Liquid-Air Interfaces

Description of the research activities: During the JSPS Summer Program, I conducted experiments using newly designed experimental cells with the apparatus available at JAXA. The purpose of these experiments was to find the critical thresholds at which Faraday instability would ensue for multiple electrostatically forced systems. All of the experiments were conducted using water-air systems, and four distinct geometries were tested throughout the course of the program. I was able to map stability curves over a large range of frequencies for all four of the systems tested. These stability curves show the point at which the system will become Faraday unstable at a given forcing frequency if the amplitude of forcing is gradually raised, and also the shape of the pattern that will arise on the interface as a result of this forcing. In addition to generating the stability curves, I was able to conduct experiments to determine the dependence of the instability on the sidewall boundary conditions, as well as the method of forcing. I examined the use of purely AC forcing, as well as AC forcing with underlying DC components. I also derived a simplified model for the stability conditions that will be built upon when I return to the University of Florida to compare to the experimentally produced stability curves. Lastly, I was able to generate high quality videos of multiple Faraday modes for comparison to the shapes predicted by theory.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): I was able to experience many different regions in Japan before the program started. My travels included Kyoto, Kobe, Nara, Osaka, Tokyo, Hiroshima, Miyajima, and Zao. The homestay also provided me with a unique look into the life of an average Japanese family, and I found it to be a culturally enriching experience. I was able to enjoy multiple onsen throughout Japan, as well as traditional Japanese foods and festivals. I really enjoyed my time in Japan and will strongly advocate the JSPS Summer Program to my peers at the University of Florida. The program allowed me to obtain data necessary for the completion of my PhD, and I am honored to have received the opportunity to conduct research alongside the world-class research staff at JAXA.

9. Advisor's remarks (if any): Kevin's research activities were excellent. He firmly assessed the nature of the physical phenomena of interest, and has the ability to build a physical model to analyze it. Moreover, he accomplished the experimental generation of data to verify his models due to well-designed experiment through JSPS summer program 2015. In addition, he was learning Japanese culture actively. I hope that he becomes a talented person who can play an active part globally based on his experience in Japan.

RESEARCH REPORT

1. Name: Timothy Westlake (ID No.: SP15061)

2. Current affiliation: Cornell University

3. Research fields and specialties:

Biological Sciences

4. Host institution: RIKEN Yokohama

5. Host researcher: Ken Shirasu

6. Description of your current research

Salicylic acid (SA) is a vital plant hormone that plays a central role in immune signaling and abiotic defense responses. The hormone elicits a cascade of effects via direct binding and redox changes that induces large scale changes in transcription and protein activity. We have identified two SA binding proteins, thimet oligopeptidase 1 (TOP1) and thimet oligopeptidase 2 (TOP2). TOP1 and TOP2 are two zinc-dependent metalloendopeptidases that have been previously been thought to function in oxidative-stress related processes. Prior studies suggest that TOPs' oligomerization and peptidase activity are redox-regulated. My research aims to determine the key regions in the proteins that dictate the perceptivity of the peptidases towards the cellular redox state. Furthermore, my studies aim to determine whether any redox-dependent post-translation modifications occur on TOPs and elucidate their functional significance.

7. Research implementation and results under the program

Title of your research plan: Investigating the redox regulation of plant thimet oligopeptidases

Description of the research activities:

Protein-protein interactions of TOP1 and TOP2 were thought to be regulated by redox-sensitive bonds. To investigate the redox-sensitive, redox reagents were incubated with the peptidases and the interactions were assess via western blot and/or gel filtration.

In order to verify the redox-regulated post-translation modifications of TOP1 and TOP2, mass spectrometry and antibody detection techniques were utilized. If the peptidases became modified by the antioxidant glutathione in a process called s-glutathionylation, the interaction could be detected by these two independent techniques.

To investigate the activity of the peptidase, a synthetic substrate was utilized. The cleavage of the substrate could emit a fluorescent signal that was detected by a microplate reader.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I had a fantastic time in Japan and made several friends with the researchers in my institute. I was very fortunate to be able to come to this country and join the lab for the summer. I am very thankful for being able to stay a few extra weeks longer.

I have hiked and travelled to over 12 waterfalls during my stay. During these travels, I was able to explore more rural side of Japan. It was a great experience to see the country side.

I was able to travel and trek through three mountains including Fujisan. It was a very rewarding experience.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Andrew S. WESTOVER (ID No.: SP15062)

2. Current affiliation: Vanderbilt University

3. Research fields and specialties:

Engineering Sciences

4. Host institution: The University of Tokyo

5. Host researcher: Prof. Shigeo MARUYAMA

6. Description of your current research

Carbon nanotubes (CNT) are one of the most exciting novel materials discovered in the last few decades. This is in part due to their immense mechanical strength 100 times greater than steel, their high electrical and thermal conductivity, and high surface area. Because of these fantastic properties CNT have been suggested for a wide range of applications. Unfortunately these applications for the most part have not been realized. One major reason for this is that although CNT are incredibly strong, the connection between the CNT and the surfaces they are grown on is in general very weak. This research aims to explore the effect of different surfaces on the strength of the connections between the growth surfaces and the CNT.

My research consists of two parts. First the growth of CNT films on Si and Quartz substrates, and then transferring these CNT films to various different surfaces. The second step involves mechanical testing of the strength of adhesion of the CNTs to the underlying surfaces. We perform these mechanical measurements using a micromanipulator attached to a scanning electron microscope (SEM). As the micromanipulator comes in contact with the CNT film we measure the increase in the force required to scratch the sample. This allows us to calculate the energy of adhesion. Using these methods we can compare the strength of the connections between CNTs and various different substrates.

This research lays the foundation upon which future research can both accurately test the strength of CNT-surface adhesion, and build on this technique to better understand what factors influence this adhesion strength, and how to improve the strength of adhesion between these CNT films and various surfaces.

7. Research implementation and results under the program

Title of your research plan:

Improving the Connections Between Carbon Nanotubes and the Surfaces They are Grown On

Description of the research activities:

In order to develop high quality testing we used microscratch testing of CNT films on various surfaces. Microscratch testing is where a probe, similar to a needle was used to scratch CNT films while measuring the force required to make the scratch. We used these scratch tests to both measure the force of adhesion of CNT films in the original state, when transferred to other surfaces and when heated at various temperatures.

Using these scratch testing techniques, we were able to determine that CNT films grown on different substrates have different adhesion strengths, with films grown on Quartz having more strength than films grown on Si. We also found that by transferring CNT films from the surface they were grown on to another surface we were able to double the adhesion strength of the CNT to the surface. Finally we found that heating CNT films transferred to Si had little to no effect on the adhesion strength.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

This was a wonderful program. I really enjoyed interacting with Japanese scientists and building collaborations and friendships with the people here.

I was also able to participate in a number of cultural events including Hanabi taikai, on-sen, and visiting o-tera, and jinjas. I also thoroughly enjoyed eating all of the wonderful Japanese food.

9. Advisor's remarks (if any):

Andrew has worked very efficiently in our lab., and also at 2 different labs. in our Department. With his impressive communication skills, we are starting new collaboration works within our department as well as with his home University.

RESEARCH REPORT

1. Name: Dane WILBURNE (ID No.: SP15063)

2. Current affiliation: Illinois Institute of Technology

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Institute of Statistical Mathematics

5. Host researcher: Prof. Satoshi Kuriki, Prof. Hisayuki Hara

6. Description of your current research

I am currently studying the structure and complexity of Markov bases associated to a variety of Poisson and logistic regression models. These statistical models are commonly used for modeling phenomenon in the physical and social sciences. Markov bases are algebraic objects associated to discrete log-linear statistical models that allow one to carry out otherwise intractable statistical procedures. As such, it is important to compute Markov bases and assess their complexity for as wide a range of models as possible, which is the goal of my research.

7. Research implementation and results under the program

Title of your research plan:

MARKOV BASES FOR MULTINOMIAL LOGISTIC REGRESSION

Description of the research activities:

This summer, I worked on deriving and proving complexity bounds for Markov bases of various classes of Poisson and logistic regression models. In several instances, we managed to formulate conjectures about and obtain computational evidence for these bounds. In a few small cases, we have provided proofs that the conjectured bounds are correct. We have also made partial progress toward a proof of the bounds for the general case for two particular models. We also established connections between the configuration matrices of some models and generalizations of so-called primitive partition identities. The research experience has given me a long list of problems for future research, and I plan to continue working on these problems after leaving Japan.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I will forever cherish my cultural and social interactions in Japan. The people in Japan have been, without exception, incredibly kind and accommodating. Every person I encountered has gone out of their way to make me feel welcome, and for that I am deeply appreciative.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Matthew W. Wolf （ID No.: SP15064 ）

2. Current affiliation: University of Michigan

3. Research fields and specialties:

Chemistry

4. Host institution: Nara Institute of Science and Technology

5. Host researcher: Dr. Takashi Matsuo

6. Description of your current research

Iron-containing heme proteins catalyze a wide variety of reactions in biology, including the binding and activating oxygen to react with many different molecules in the body. These reactions are important for respiration, metabolism of drugs and toxins, and breaking down hydrocarbons, among other functions. Although there has been much research focused on trying to understand these reactions, little is still known about the reactive 'iron-oxo' intermediates that are crucial in these mechanisms due to their short lifetimes and high reactivity. My research is focused on investigating these intermediates by preparing artificial metalloenzymes from small, stable heme proteins. We can take well-studied heme proteins such as the oxygen storage protein myoglobin (Mb), remove the native iron cofactor, and introduce other cofactors such as ruthenium, rhodium, and iridium porphyrins. By forming stronger metal-oxo and metal-peroxo bonds, these new cofactors in Mb may stabilize the reactive oxygen intermediates to allow for easier study. In addition, we can stabilize these intermediates through steric and hydrogen-bonding interactions by mutating key residues in the active site of Mb. Combining these two approaches to Mb modification will allow us to study metal-oxo and metal-peroxo intermediates by a variety of spectroscopic methods, including UV-vis, circular dichroism, resonance Raman, and electron paramagnetic spectroscopy. Thus far, several different modified myoglobins have been prepared and characterized. Initial studies on the reaction between these proteins and oxo transfer agents such as hydrogen peroxide and *meta*--chloroperoxybenzoic acid have begun. The reactions between these stabilized intermediates and several different organic substrates will be studied as well to better understand the mechanism of substrate oxidation and oxygenation. Measuring the turnover frequency and total turnover number will allow us to directly compare the reactivity of our modified myoglobins to native oxygenases and peroxidases.

7. Research implementation and results under the program

Title of your research plan:

Modifying proteins to investigate key intermediates in oxygen binding enzymes

Description of the research activities:

At the Nara Institute of Science and Technology, Dr. Matsuo and I prepared several artificial proteins by taking wild-type myoglobin and the H64A and H64D mutants of myoglobin, removing the heme cofactor, and adding rhodium porphyrins to these apo-proteins. We characterized these proteins by UV-vis spectroscopy. We attempted to add ruthenium porphyrins to these proteins as well, but we had trouble removing the bound carbon monoxide, and could not obtain pure ruthenium myoglobin. Taking the rhodium proteins, as well as the rhodium porphyrin, we added the oxidant *meta*--chloroperoxybenzoic acid and studied the rate of the reaction between the oxidant and the protein by UV-vis and stopped-flow spectroscopy. We also studied the reactions between the rhodium-oxo species and the organic substrates thioanisole and styrene. The products of the reactions were investigated by gas chromatography, and it appeared that all of the initial added substrate was consumed. Finally, we also prepared the H64V myoglobin mutant to use in future studies upon my return to Michigan.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I truly enjoyed my 2-month stay in Japan. I've learned a lot about different biochemical techniques and about preparing artificial proteins. I also got a chance to better understand the differences and similarities between research in Japan and the U.S., and I have a better appreciation for doing research abroad. I've also traveled around Japan a bit, particularly in the Kansai region, and I've enjoyed Japanese food, people, nature, and culture. I would recommend a research stay to anyone who is able to do so.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Lengxob YONG （ID No.: SP15065）

2. Current affiliation: East Carolina University

3. Research fields and specialties:

Biological Sciences

4. Host institution: Idenken-National Institute of Genetics

5. Host researcher: Dr. Jun Kitano

6. Description of your current research

The overarching research goal was to investigate how processes related to sexual selection might contribute to the evolution of colorful phenotypic diversification in medaka fishes (*Oryzias* sp). While the original proposal involved behavioral experiments, it was slightly modified upon consulting with the NSF program officer. Here, the PI investigated variation in genes related to color vision, i.e. opsins, and whether they might explain the evolution of color polymorphism in medaka species of southeast Asia.

In most animals, opsin genes mediate how a receiver visually perceives a colorful signal in an environment by adjusting the eye's spectral sensitivity to certain wavelengths (blue, green, and red). Further, variation in their expression levels and amino acid sequence (i.e. mutations) can lead to spectral shifts in the opsin's sensitivity, affecting how one perceives color. These molecular changes underlie the evolution of visual systems, allowing some species to become visually adapted to their respective photic environments. Further, this also relates to how colorful signals within a species are perceived and might evolve, where for instance females in a given photic environment might be more visually sensitive to red color, and thus might prefer to mate with conspicuously red males—thereby leading to the evolution of red color morphs. Consequently, variation in visual sensitivity and systems between medaka fish species might explain how color variation within this fish genus has evolved.

To tackle this hypothesis, we tested whether variation in visual opsins contribute to medaka color diversification by aiming to understand whether 1) mutations at key amino acid positions and 2) the expression levels of certain opsin genes are associated with color morph variation.

7. Research implementation and results under the program

Title of your research plan:

Sequencing the transcriptome of eye tissue to test for differences in opsin gene expression and sequence between polymorphic medaka species.

Description of the research activities:

Eye tissue samples were collected from 44 medakas (22 species; 1 male and 1 female), which originated from different sources, including the field (Sulawesi, Indonesia), the National Institute of Basic Biology, and Higashiyama zoo. RNA was extracted and cDNA libraries were prepared for sequencing on an Illumina Mi-seq platform. We then mapped the reads of all individuals to the medaka reference opsin genes (SWS1, SWS2a, SWSb, RH1, RH2a, RH2b) to obtain expression levels for each gene. Then, opsin genes were analyzed using sequence alignment programs to pinpoint potential amino acid sites with mutations that might contribute to visual spectral shifting. The future plan will be to continue contributing to the research beyond the NSF EAPSI/JSPS Summer program.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

With Dr. Kitano, I visited the Higashiyama zoo, from which we collected samples for the study. During some weekends, I visited the Izu peninsula, Hiroshima, and Kyoto. This cultural exchange has allowed me to interact with several fish geneticists, which has opened the door for establishing international collaboration with Japanese medaka/zebrafish researchers.

9. Advisor's remarks (if any):

'Lenny Yong worked very hard and obtained RNAseq data from 22 species within such a short period of time. These data provide fundamental information for the future research in my lab. I hope that some of these works will be published in the near future with him as one of the authors.'

RESEARCH REPORT

1. Name: Ross Booton （ID No.:SP15102 ）

2. Current affiliation: University of Sheffield

3. Research fields and specialties:

Mathematical and Physical Sciences

Biological Sciences

4. Host institution: Kyushu University

5. Host researcher: Prof. Yoh Iwasa

6. Description of your current research

My research is focused on colony collapse disorder (CCD) in honey bee colonies, and the methods for predicting this. CCD is devastating and could have serious implications for humans, through honey bees role in pollination. Hence there has been much research interest in this problem, from both empirical approaches and theoretical work. The field of mathematical biology can provide new insights into the problem by using the tools of mathematics and applying it to biological systems. We make assumption based mathematical models in the form of ordinary differential equations (ODEs) and try to calculate when the system will crash. We compare the results of the models with real empirical studies and make conclusions about the system based on this.

7. Research implementation and results under the program

Title of your research plan:

Colony collapse disorder: The sudden change in the dynamics of the hive.

Description of the research activities:

We added more realism to the current models of honey bee collapse. We predict that increasing stress across the hive can result in a sudden switch in the dynamics, which leads to collapse. We can use the model to predict how much stress a hive can take before completely collapsing.

I learnt so much from my advisor, and really enjoyed the collaboration. The experience I have gained will be invaluable to me at this early stage in my career. Also, I enjoyed starting a new mathematical biology project with another member of the lab. We will work together again soon, and will certainly continue the collaboration when I return to the UK.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I really enjoyed living in Fukuoka, on Kyushu island. I enjoyed exploring the island and visiting traditional onsen towns. My host and Japanese colleagues were very welcoming and I enjoyed the environment in the office. The home stay experience was fantastic, and a real insight into Japanese life. I enjoyed eating lots of wonderful Japanese food, and overall the time I spent living and working in Japan has been incredible!

9. Advisor’s remarks (if any):

It was a very nice experience for us to have you in our laboratory. You gave two seminars during your two months stay, presenting the initial problem you planned to tackle and the outcome of your study. You were also invited by other graduate students to work on a new project, the modelling of life history timing of unexpected density-dependence of diapausing fraction, which we hope will develop into an interesting new theory, and I hope you might have an opportunity to visit us again in the future.

RESEARCH REPORT

1. Name: Helen Davidge (ID No.: SP15103)

2. Current affiliation: The Open University

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Institute of Space and Astronautical Science – Japan Aerospace Exploration Agency

5. Host researcher: Professor Hideo Matsuhara

6. Description of your current research

What were the first luminous objects in the Universe after the Big Bang? How did galaxies form and evolve? Multi-wavelength data is required to answer these questions, and mid-infrared data is key. Organic molecules (polycyclic aromatic hydrocarbons) and silicate dust features are observed in the mid-infrared, making it an important wavelength range to fully understand galaxy formation and evolution. The Japanese infrared space telescope AKARI is the only satellite able to observe deeply in the mid-infrared.

I commenced my research by using the standard AKARI pipeline developed at ISAS as a basis, to create a pipeline optimised for processing extragalactic deep field images, to find the most distant and faintest objects observed using AKARI.

On my previous two weeks visit to ISAS (February 2015) we discussed improvements to my pipeline. Implementing these corrections, I am now ready to use my pipeline to process AKARI images. I will test different theoretical galaxy evolution models, indicating how galaxies have evolved over cosmic time; and compare the flux of the galaxies found in AKARI images to the flux from the same galaxies observed by other telescopes at different wavelengths. Multi-wavelength data is vital to fully understand galaxy types and evolution. I will conclude my PhD research by using the AKARI extragalactic deep fields I have processed, to measure how much of the cosmic infrared background, which contains starlight from the whole of the cosmic history, is resolved by the AKARI galaxies.

7. Research implementation and results under the program

Title of your research plan:

Studying Galaxy Evolution using the Japanese Infrared Space Telescope AKARI

Description of the research activities:

During my time at ISAS/JAXA I had almost daily meetings with AKARI team members. We discussed AKARI instrumental effects, different ways of processing AKARI data and shared computer code. We have combined our knowledge and expertise to produce science results, which we will continue to analyse after my stay in Japan. Using my AKARI data, we have produced galaxy number counts, which agree with published data. These are a useful tool to differentiate between different galaxy evolution models. I am now at a point where I am able to fully analyse my data results. At the Department of Astronomy (Tokyo University Hongo Campus), ICRR and IPMU (Tokyo University Kashiwa Campus) I presented my work using AKARI. I now know a much larger network of scientists working with AKARI data, who will be invaluable in advising me on my PhD work. Once back in the UK, I will continue the collaborations created during my time as a JSPS summer fellow.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

While in Japan I have made the most of my time here, conduction research, exploring the country, learning about Japan's culture and language. I feel privileged to have been able to discover more about Japan than most tourists, by attending a weekly Japanese adult Ballet class, meeting up several times with my host family from the orientation week and by socialising with fellow scientists from ISAS and Sokendai. I have also enjoyed exploring Japan on the Shinkansen using the JR Pass, and visited Tokyo most weekends. The highlights of my trip have been visiting Himeji Castle and watching Hanabi in Yokohama.

9. Advisor's remarks (if any):

I am grateful to host Ms. Helen Davidge this time; not only for Helen but also for students and postdocs in our research group at ISAS, because the presence of students from abroad stimulate the science activities and contribute so much to improve their communication skill. As her work is still in progress, we will continue the collaborative works by having regular online meetings in order to assist Helen to write her PhD thesis.

RESEARCH REPORT

1. Name: Maxine GEE （ID No.: SP15104 ）

2. Current affiliation: University of York

3. Research fields and specialties:

Humanities

4. Host institution: Waseda University Graduate School of International Culture and Communication Studies

5. Host researcher: Dr Nori MORITA

6. Description of your current research

My current research focuses on a specific subgenre of science fiction in Anglo-American film and Japanese anime which I have labeled 'posthuman noir.' It exists at the intersection of science fiction and film noir; examples of which are—Blade Runner (R. Scott, 1982) Gattaca (A. Niccol, 1997), and Dark City (A. Proyas, 1998), and anime such as Ghost in the Shell (M. Oshii, 1995), Serial Experiments Lain (R. Nakamura, 1998), Ergo Proxy (S. Murase, 2006) and Darker Than Black (T. Okamura, 2007). I examine the fears and possibilities afforded by the technological modification of humanity and how human nature is preserved or perpetuated through these changes. In posthuman noir these concerns are presented through adopting elements found in the traditional film noir corpus and adapting or subverting them to explore and validate the continuation of a humanist standpoint.

I also address cross-cultural creative relations in a world in which culture is becoming increasingly globalised. My research examines the ways different cultures explore these fundamental issues of human nature. Both Anglo-American film and Japanese anime are informed and shaped by their respective cultures and yet there are more similarities in their use of posthuman noir to address these questions then differences. This extends into an examination of the storytelling methods used by Britain, America and Japan, especially focused on screenwriting.

I explore my research questions through the dual approach of creative and theoretical work. I am developing screenplays that speak to and challenge the ideas at the core of posthuman noir from the writing perspectives of America, Britain and Japan.

7. Research implementation and results under the program

Title of your research plan:

An Investigation into Japanese Screenwriting Methods

Description of the research activities:

While on the JSPS fellowship I examined Japanese methods of screen storytelling through interviewing a range of professors, students and professional writers across the genres of anime, film, television, theatre and art house cinema. I conducted 21 interviews which focused around key storytelling areas such as character, story, structure and theme to try and ascertain if there are patterns which are particular to Japanese storytelling or if film, as it has been argued, is a global language which transcends national boundaries.

What I discovered is that contemporary Japanese screenwriting is a negotiation between more traditional Japanese ideas of story, character, structure and theme, and the adoption of Anglo-American screenwriting methods. Despite the shift in teaching toward American screenwriting methods, trends that are particularly important to Japan continue to underpin Japanese writing: for example a more passive/reactive protagonist, structures that might be considered cyclical rather than linear, and a focus on stories about groups without clearly defined leaders. These differences are rooted in Japan's cultural, philosophical and societal constructions .

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

During my stay in Japan I was fortunate to meet many wonderful, warm and generous people from those on my home-stay, to the writers I interviewed to the locals I met on my travels. I saw kabuki twice and was stunned by the performance story craft; I was deeply moved by the peace park at Hiroshima and enthralled by the summer matsuri and Bon Odori dancing. Japan has been incredibly inspiring for my writing and I am so grateful.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Benjamin M. LOWE （ID No.: SP15105 ）

2. Current affiliation: University of Southampton

3. Research fields and specialties:

Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Prof. Toshiya SAKATA and Prof. Yasushi SHIBUTA

6. Description of your current research

Recent advances in nanotechnology have led to the development of a large range of electronic devices with applications across the physical, chemical and biological disciplines. Biosensors represent a class of electronic devices which involve a complex interplay between aspects of all these disciplines. Field Effect Transistor Biosensors (BioFETs) are an active area of research as they are a promising new type of pH and biomolecule sensor which is capable of single-molecule sensitivity. Their low-cost and simple fabrication process means that these sensors have great potential as, for example, point-of-care medical devices.

Whilst it is known what factors may influence BioFET response, the complex interplay between the ion dynamics, biomolecule dynamics and charging at the device surface results in a device response that remains difficult to fully understand and predict. A key limitation pervading the literature is the assumption that mean-field approximations for ion dynamics are appropriate for describing the relevant physics. This work will address some of these limitations using Molecular Dynamics simulations to explore ion dynamics at the silica-water-bio interface.

Of particular interest for this current research is the role that bivalent Mg^{2+} ions play at this important interface. Physiological samples often contain bivalent cations such as Mg^{2+} and they are known to play an important role in biological function and have been shown to have utility at increasing BioFET sensitivity. Despite their importance, monovalent (Na^{+}) electrolyte is often assumed in the relevant literature, and so this work will investigate the effect of Mg^{2+} on this interface by analyzing Mg^{2+} dynamics and

solvation structure at the silica-electrolyte interface and at the biomolecule-electrolyte interface.

This work has also began an ongoing collaboration between my UK research group and Japan to continue our study of this poorly understood interfacial system.

7. Research implementation and results under the program

Title of your research plan:

Investigation of Ion Dynamics at the Silica-Water-Bio Interface using Molecular Dynamics

Description of the research activities:

The empirical computational model used in this work (Molecular Dynamics forcefield) was first tested and validated by comparison to experimental and literature data. The Mg^{2+} system was characterized and contrasted to the Na^{+} system which has been previously investigated in this group via analysis of structural and dynamic properties. Mg^{2+} ions were found to have significantly different coordination kinetics and structure, in agreement with literature.

Molecular dynamics simulations were performed for silica-electrolyte systems composed of 1:1 NaCl+$MgCl_2$ solution. 200 mM and 1 M ionic strength systems were contrasted with the same systems including a DNA biomolecule in order to emulate a biosensing experiment. The dynamics of this system's ion coordination, and surface electric field were analysed. These results provide the first fully atomistic description of the electric field at this technologically important interfacial system, and quantified the effect of Electric Field fluctuations as a function of time. This is relevant to the interpretation of experimental biosensor response.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

This placement has been invaluable in fostering a new and important collaboration between my UK research group and Japan. I am especially grateful to have been given the opportunity to learn about the research going on at the University of Tokyo, and have found it both an extremely useful and rewarding experience. This collaboration has also provided the opportunity to begin relevant experimental work for comparison to the simulation work performed.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Philip Mousley （ID No.: SP15106 ）

2. Current affiliation: University of Warwick and Diamond Light Source

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: SPring-8 synchrotron, Japan Atomic Energy Agency beamline BL11XU [short stay at Anan national college of technology]

5. Host researcher: Dr. Masamitu Takahashi, [Prof. Shiro Tsukamoto]

6. Description of your current research

I am a joint PhD student with the University of Warwick and the I07 beamline at the Diamond Light Source, the UK's national synchrotron radiation facility. I07 is the X-ray diffraction (XRD) beamline dedicated to investigations of surfaces and interfaces.

My current work focuses on combining magnetic and semiconducting materials for use in a new type of electronic devices called spintronics. I grow thin layers (~100nm) of these materials using a technique called molecular beam epitaxy (MBE) and study how the atomic structure of the surface develops during the formation of a magnetic/semiconducting interface. The growth and study of these samples requires ultra-high vacuum (UHV) conditions, around $1x\ 10^{-13}$ atmospheric pressure. XRD is a powerful tool for investigating atomic structures, but because X-ray scattering from the tiny amount of material in the few atomic layers around the surface or interface is very weak, ultra-high intensity X-ray beams produced at synchrotron radiation sources are required.

I have investigated the growth of MnSb on indium gallium arsenide (InGaAs) substrates via MBE and identified a set of optimum MBE growth conditions. I am also analyzing I07 surface x-ray diffraction data from samples of MnSb grown on GaAs in order to identify surface reconstructions of the MnSb, which can affect the electronic properties. As part of this work I am helping develop the software used for the complex data reduction needed for quantitative surface XRD analysis.

7. Research implementation and results under the program

Title of your research plan:

The study of the formation of spintronic interfaces

Description of the research activities:

During my stay at Spring-8 I worked on optimizing the equipment settings required for the first stage of a two stage growth process for GaN nanowires. The research team at Spring-8 will use these optimized settings to continue the research project, growing samples using the full two stage methodology and hopefully obtaining XRD data from these samples in the near future. I also had the opportunity to help out with several other XRD experiments. This gave me valuable experience in using the XRD equipment, which is also applicable to other similar experimental setups at international synchrotron facilities.

During my 2 weeks at Anan national college of technology I learned how to operate the combined molecular beam epitaxy and scanning tunneling microscope chamber. After being taught how to use the equipment I conducted an initial investigation into the growth of Indium on monolayer graphene samples. I will be taking these samples back to Warwick university for further analysis, and will look at continuing this research maintaining the collaboration between the two research groups.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I have really enjoyed my time here in Japan, and I managed to fit in some sightseeing alongside conducting my research. Some highlights were the Japanese gardens in Okayama, a coastal bike ride in Takamatsu, the Tenjin matsuri in Osaka and swimming at Kitanowaki beach. On my final day in Anan I got to experience a truly authentic Japanese restaurant, followed by the more modern tradition of karaoke which were both fantastic experiences. I have also met a lot of people working in my research area, which I am sure will provide many chances for research collaborations in the future.

9. Advisor’s remarks (if any):

In situ X-ray diffraction during the growth of nitride nanowires is one of the research projects that the advisor and his colleagues have just set out. The fellow actively worked at this project and made a notable contribution to it. The first step for this kind of work is optimizing growth conditions for the targeted sample structures. Within a limited time of his stay, he has come quite close to successful growth of gallium nitride nanowires after several times of trial growth. In the meantime, he has been actively involved in other X-ray experiments with our group members.

Seemingly, the isolated environment of SPring-8, which is located in a rural area 30-60 minutes away from nearby cities by car, has not been too boring to the fellow. I hope that staying on SPring-8 cite provided him with an opportunity to learn what Japanese rural towns are like and helped him understand Japan in varied aspects, together with short trips to the cities of Osaka and Takamatsu in his spare time.

RESEARCH REPORT

1. Name: Evan MURPHY （ID No.: SP15107）

2. Current affiliation: The University of Nottingham

3. Research fields and specialties: Biological Sciences

4. Host institution: Kobe University

5. Host researcher: Prof. Hidehiro FUKAKI

6. Description of your current research

Plant and crop research is a field of science fundamental to providing solutions and answers to the mounting problems of an ever growing global population. Our current research revolves around investigating, mapping, and enhancing overall root architecture in the model species *Arabidopsis thaliana* with an aim to translating that knowledge to crop species (ie. rice, oilseed rape, maize, wheat etc...). Enhancing root architecture would in turn improve the plants ability to mine nutrients from the soil, increase water absorption rates, and help adapt to ever changing climate conditions. In *Arabidopsis thaliana,* lateral (branching) root development commences from well-orchestrated asymmetric cell divisions in the pericycle cell layer of the primary root. The main focus of my research at the University of Nottingham aims to investigate the elements underlying the numerous factors regulating the cell expansion, division, and signaling processes that all contribute to lateral root development. Among these elements, we have discovered that the family of small signaling peptides known as RALFs (RAPID ALKALINIZATION FACTORs) play a large role in the regulation in the number of initiation sites of lateral root primordia, as well as the restriction of overall cell length in the root. My recent data suggests *RALF34* acts downstream or in parallel to the lateral-rootless *SOLITARY-ROOT* (*SLR*) gene that Professor Fukaki discovered in 2002. Current research is focusing on the gene regulatory networks surrounding a small clade of the RALFs and observing how higher order mutants have an impact on the overall size, organisation, and development of the lateral roots. Cellular tools are being developed to be able to visualise *in vivo*, in living cells, where these

small proteins, or *peptides*, function.

7. Research implementation and results under the program

Title of your research plan:

Investigating the Role of the Small Secreted Peptide RALF34 During the Early Events in Lateral Root Development

Description of the research activities:

The research performed at Kobe University consisted of utilising new equipment, techniques, and strategies to observe *RALF34* during the early stages of lateral root development. Initially I screened my *ralf* mutant plants to observe that their *phenotypes* (observable characteristics) were the same under new growth conditions. I then performed a variety of assays utilising these mutant lines, such as RNA extractions and gravitropic experiments. The data from these experiments lead to unexpected but exciting results which will follow on to future interesting projects. I then used high resolution confocal microscopy to visualise the expression of my gene of interest, *RALF34*, in both a spatial and temporal manner. Furthermore, I applied several chemicals, the plant hormone auxin and its transport inhibitor NPA, to observe a more detailed effect on how this gene is involved in the early stages of lateral root development, compared to the auxin response marker *DR5*. To analyse the role of RALF34 in the auxin pathway I performed qPCR genetic analysis on genes in the *ralf34* mutant background. I also crossed my fluorescing *pRALF34* line with key auxin mutants to observe potential upstream regulatory roles. This research experience has been extremely rewarding as a scientist, and these data will help build a genetic framework of the role *RALF34* plays during lateral root development.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Living in Japan for nearly 3 months has been an incredibly enriching experience both as a scientist and adventure seeker! I am lucky to have had the opportunity to travel quite a lot and see this beautiful country's shrines, castles, temples, and history. More than that, everyone I have met along this journey, from Kobe University to Sokendai, my Host family, the JSPS fellows, and all the Japanese locals along the way, have been warm, friendly, and kind, and have made this a truly unforgettable experience!

9. Advisor's remarks (if any):

As a foreign researcher of the JSPS summer program 2015, Mr. Evan Murphy has performed his research in my laboratory (Hidehiro Fukaki Lab, Graduate School of Science, Kobe University) for about two months (Jun 17th –August 16th). He could perform many experiments and observations on his biological research project using a model plant, Arabidopsis thaliana, and obtained unexpected but interesting results on lateral root development in plants. These will be helpful for his future research.

I think that he had a lot of experiences in Japan, and enjoyed not only the scientific

discussion with me and the lab members but also many kinds of Japanese cultures. I believe that this experience in Japan is fruitful for him scientifically and culturally.

RESEARCH REPORT

1. Name: Edward Alexander NEAL （ID No.: SP15108 ）

2. Current affiliation: Queen Mary, University of London / University of Southampton

3. Research fields and specialties:

Chemistry

4. Host institution: Kanazawa University

5. Host researcher: Prof Tomoki OGOSHI

6. Description of your current research

Supramolecular Chemistry focusses on the formation and study of large assemblies of ring-like molecules (*macrocycles*), axle-like molecules, metals and ligands.[1] These have a range of potential applications in sensing, novel materials, catalysis and elaborate molecular machines, with these functions derived from how the components interact or move, whether in response to stimuli or otherwise. My research concerns the formation of *rotaxanes*, in which macrocycles are held over an axle in the form of a washer on a bolt, with stoppering groups to prevent the macrocycle slipping off.

During my research at QMUL and Southampton, I have been investigating the outcomes of the *Active-Template CuAAC Rotaxanation* reaction, in which a metal catalyst, bound in a macrocycle, forms an axle from two components through the centre of the ring. As well as incorporating a single ring on an axle (a *[2]rotaxane*), the reaction was found to sometimes incorporate two rings on the same axle (*a [3]rotaxane*).[2] Screens of reaction conditions allowed the latter to be made in up to *50%* yield and the former in near-quantitative yield. Altering the macrocycle revealed a key interaction, that allowed a mechanism to be proposed for the formation of the [3]rotaxane product.

From this, I am currently pursuing the effects of different rings to make novel structures.

1. E. A. Neal and S. M. Goldup, *Chem. Commun.*, 2014, **50**, 5128-5142.
2. E. A. Neal and S. M. Goldup, *Chem. Sci.*, 2015, **6**, 2398-2404.

7. Research implementation and results under the program

Title of your research plan:

Towards Water Soluble, Stable Cu^{I} Complexes Through the Combined Properties of Bipyridine-Based and Pillararene Macrocycles

Description of the research activities:

The aim of the research was to incorporate the bipyridine macrocycles of my previous work and the Pillararenes of Prof Ogoshi[3] – which can be made water-soluble – into a rotaxane structure. Previous work has afforded a rare Cu^{I} triazolide species in the centre of rotaxanes, which are unusually water-stable.[4]

After successfully making and purifying some Pillararene macrocycle under the guidance of the group, stopper molecules to hold them were designed, made and purified. The interaction of one candidate with the Pillararene was analysed by variable temperature NMR and synthesis of the rotaxane target attempted. Analysis suggests two novel products may be present, although the purification is continuing.

3. T. Ogoshi, T. Aoki , R. Shiga , R. Iizuka , S. Ueda , K. Demachi , D. Yamafuji , H. Kayama and T.-a. Yamagishi *J. Am. Chem. Soc.*, 2012, **134**, 20322–20325.
4. J Winn, A. Pinczewska and S. M. Goldup, *J. Am. Chem. Soc.*, 2013, **135**, 13318–13321.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I have thoroughly enjoyed my time in Japan, from orientation to homestay to research.

I find the group mentality amazing, a far contrast from the solitude of thesis writing, and am in awe of the support I have received from the group here. I owe Prof. Tomoki Ogoshi a great debt of gratitude for his support when things have been challenging and taking me to the serene Shirakawa-go.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Karwei So （ID No.: SP15109）

2. Current affiliation: University of Oxford

3. Research fields and specialties:

Materials Science

4. Host institution: Bio-Nano Electronics Research Centre, Toyo University

5. Host researcher: Professor Toru Maekawa

6. Description of your current research

My current research is on the production of carbon nanotubes (CNTs) filled with magnetic metals. These materials are envisioned to be promising candidates for applications in fields ranging from biomedical to microscopy and data storage.

CNTs are a 1D tubular nanomaterial in which carbon atoms are bonded to one another in an sp^2 fashion to form a honeycomb structure. They have already gained extensive interest due to their outstanding properties, including their immense mechanical strength and high thermal and electrical conductivity. The addition of magnetic properties to this impressive portfolio of characteristics broadens the array of applications for which CNTs are suitable, resulting in a material with the potential to revolutionise technology as we know it.

Thus far, my research focus has been on upscaling and improving the production of Fe-filled CNTs, Fe/Co-filled CNTs and Co-filled CNTs synthesised using chemical vapour deposition (CVD). For CNTs production using CVD, both a carbon and a catalyst source are required. The volatile carbon source breaks down and forms the CNTs by diffusing through the catalyst particles. A metallocene ($(C_5H_5)_2M$), where M is a metal in the +2 oxidation state, e.g. Fe, Co or Ni) containing both the carbon and catalyst source is used as a precursor. This is placed in a two-stage furnace, which allows for the sublimation and pyrolysis of the precursor in each furnace, respectively.

A range of parameters and synthesis conditions were investigated to obtain the optimal synthesis conditions to produce CNTs filled with metals of not only high quantity, but also high quality. The next step is to investigate the magnetic properties of the produced filled CNTs, and establish how growth conditions influence the magnetic properties. This work was conducted at the Bio-Nano Electronics Research Centre, in Toyo University.

7. Research implementation and results under the program

Title of your research plan:

Investigating the influence of synthesis parameters on the magnetic properties of CNTs filled with magnetic metals

Description of the research activities:

Superconducting Quantum Interference Device (SQUID) measurements were carried out to determine the magnetic properties, such as saturation magnetisation, coercivity and magnetic remanence, on Fe-filled CNTs produced using different growth conditions as well as Co-filled CNTs, Fe/Co filled CNTs and magnetic buckypapers samples. Magnetic measurements were conducted at 300 and 4 K. This data was collated to identify trends between synthesis conditions and magnetic properties.

High Resolution Transmission Electron Microscopy (HRTEM) images were taken for the different types of filled CNTs, to visualise the filling. Energy Dispersive X-ray Spectroscopy (EDX) maps were used to analyse the elemental distribution. X-ray Diffraction (XRD) and X-ray Photoelectron Spectroscopy (XPS) data was collected to examine the state of the Fe filling inside the CNTs.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The past 2 months conducting research in Japan has been a wonderful, inspirational experience. Everyone was exceptionally welcoming and not only was I able to obtain valuable results from my time here; I met many amazing people and experienced Japanese culture and lifestyle. I gained some great memories over my time here, and I would come back in a heartbeat!

9. Advisor's remarks (if any):

Magnetic carbon nanotubes are very important from both scientific and technological points of view. Ms Karwei So developed her original methodology for synthesising magnetic carbon nanotubes and investigated thoroughly their magnetic properties and biocompatibility. She carried out the study cooperating with other Japanese researchers and students without any difficulty, which shows her flexibility in understanding foreign cultures and customs as well as her research ability. We will continue the present collaborative research to utilise the new materials particularly in the field of biomedicine as, for example, nano vehicles for drug delivery, nano agents for bioimaging and nano media for hyperthermic treatment of cancer cells.

RESEARCH REPORT

1. Name: Neil J. STEWART （ID No.: SP15 110）

2. Current affiliation: University of Sheffield, UK

3. Research fields and specialties:

Mathematical and Physical Sciences & Medical, Dental and Pharmaceutical Sciences

4. Host institution: Osaka University, JP

5. Host researcher: Professor Atsuomi KIMURA

6. Description of your current research

Quantitative assessment of lung function during disease can be challenging due to disease complexity and heterogeneity and limitations of applicable imaging methods. Computed tomography, the gold-standard lung imaging tool, is unsuitable for supplying quantitative data in heterogeneous diseases with co-existing pathologies, and involves ionizing radiation, constraining longitudinal studies of disease progression or treatment response. Nuclear scintigraphy allows depiction of pulmonary ventilation and perfusion, but lacks spatial resolution required to appropriately assess disease heterogeneity. Conventional magnetic resonance imaging (MRI) of the lungs is constrained by the low proton density and complex magnetic environment in the lungs. Recently, hyperpolarized noble gas MRI with helium-3 and xenon-129 has been developed as an investigative, non-invasive probe of lung function, with excellent spatial resolution and sensitivity to disease heterogeneity. Techniques have been implemented to analyze specific aspects of lung function, from visualizing alveolar ventilation, to mapping gas diffusion, to assessing lung microstructure and gas exchange. My current research comprises the establishment and improvement of hyperpolarized xenon-129 MRI (HPXeMR) methods, in particular: appraising the dynamics of pulmonary gas exchange; formulating mathematical models of the gas exchange process; optimizing xenon-129 imaging protocols for depiction of pulmonary ventilation. In the UK, we have applied these improved methods to the evaluation of chronic pulmonary disorders, including interstitial lung diseases characterized by poor gas exchange, and obstructive lung diseases with impaired ventilation. These disorders often have unknown etiology or no known cure, with a poor prognosis and high death rate.

7. Research implementation and results under the program

Title of your research plan:

Quantifying the sensitivity of hyperpolarized xenon-129 magnetic resonance imaging (MRI) methods for assessment of lung disease progression and treatment response

Description of the research activities:

HPXeMRI for assessment of treatment response has not been demonstrated. Current studies have been limited to single time-point scans, or preliminary preclinical investigations of disease progression. The purpose of this work was to perform an extensive longitudinal study to: a) assess the sensitivity and robustness of HPXeMRI to early stage lung disease, and b) evaluate the efficacy of a novel treatment applied to a mouse model of disease. 20 wild-type mice were divided into 3 groups: 5 healthy (control) mice; 7 mice instilled with porcine pancreatic elastase (PPE) to induce emphysema; 8 mice instilled with PPE and subsequently treated with ethyl pyruvate (EP) for 3 weeks. Hyperpolarized ^{129}Xe MRI was performed over 3 weeks (daily for 1 week, then once or twice weekly). The regional volume turnover of gas in the lungs, "fractional ventilation", was quantified to infer ventilation status, related to alveolar size and structure. In addition, the efficiency of gas exchange was mapped across the lungs. Histological analysis of mouse lungs is currently in progress. Preliminary analysis suggests that ventilation function was not significantly decreased in emphysematous mice, with some fluctuations due to inaccuracies in the measurement procedure. Gas exchange function was observed to reduce and eventually plateau after 1-2 weeks in diseased mice, whilst in EP mice, function decreased for 5 days but returned to the level of control mice after 2-3 weeks. A spectrum of disease was induced by PPE administration and certain mice were more receptive to treatment than others. One mouse from each of the PPE and EP groups showed complete functional loss in one lung; the EP mouse recovered but the PPE mouse did not. We believe the primary anti-inflammatory action of EP can counteract the swelling of alveolar tissue characteristic of emphysema, however it is unclear whether the benefit of EP is temporary or if complete recovery is feasible. This will be explored in future work and EP will be compared to other novel drugs to delineate the precise drug action. In this study, a protocol for assessing disease progression and treatment response in a mouse model of emphysema has been demonstrated for the first time. The protocols introduced here are fully non-invasive and readily applicable to other diseases and treatments.

8. Please add your comments, including any cultural experience during your stay in Japan:

I would like to express immense gratitude to my supervisor and colleagues in Osaka University, and to JSPS for giving me this fantastic opportunity. My Japanese cultural experience: the people are friendly, fun and helpful; the food is absolutely gorgeous, from fast-food gyuudon and ramen, to high-end sushi and hotpot; the country is beautiful, from bustling mega-cities, to ornate shrines, to spectacular scenery, to festivals bringing the whole country together. Possibly the best experience I had was participating in Awa Odori – a famous dancing festival in Tokushima, I was able to be absorbed in the wonderful atmosphere around the whole city.

9. Advisor's remarks (if any): N/A

RESEARCH REPORT

1. Name: Adam David Sproson （ID No.: SP15111）

2. Current affiliation: Durham University

3. Research fields and specialties:

Interdisciplinary and Frontier Sciences

4. Host institution: Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

5. Host researcher: Dr. Katz Suzuki

6. Description of your current research

The present-day open ocean seawater $^{187}Os/^{188}Os$ value of ~1.06 reflects the balance between unradiogenic (low $^{187}Os/^{188}Os$ ratios) mantle-derived osmium (Os) and radiogenic (high $^{187}Os/^{188}Os$ ratios) continental Os. However, generally unradiogenic Os released by anthropogenic activities has been detected in coastal sediments, lakes and estuaries from sources such as sewage sludge, catalytic convertors, ore smelting, fossil fuel burning and biomedical research.

Despite recent studies, direct measurements of natural and anthropogenic Os in estuarine and coastal waters are few, due to the extremely low concentrations of Os in seawater (90fg in 100ml of seawater). However, we have shown in previous studies that macroalgae (seaweed) concentrates Os from seawater, whilst maintaining the same isotopic composition. As seaweed is generally found in marine coastal settings, its Os isotopic composition could be used to reflect variations in local Os and therefore trace the course and effects of locally produced pollution, becoming a useful environmental indicator.

This research focuses on measuring the Os concentration and isotopic composition of seaweed from Japanese estuaries and coastal waters to ascertain the influence of anthropogenic sources of Os especially in heavily polluted sites near the Tokyo, Osaka and Nagoya metropolitan areas. If the natural budget of Os has been disturbed by human activity, then Os isotopes could be a valuable tracer for the hydrological cycle, similar to Pb from leaded gasoline usage before 1978 or tritium from atmospheric atomic bomb testing in the early 1960s.

7. Research implementation and results under the program

Title of your research plan:

Tracing anthropogenic sources to the ocean using the osmium isotopic composition of macroalgae

Description of the research activities:

During my time in Japan I conducted several field excursions. Macroalgae (seaweed) was collected near heavily polluted metropolitan areas such as Tokyo and Osaka Bay. Samples were also collected from more pristine waters surrounding Boso, Noto and Izu peninsulas, to be compiled with other store-bought samples from Hokkaido. These regions were selected to test if macroalgae from polluted regions could detect osmium isotopes from anthropogenic processes when contrasted to cleaner more open ocean settings.

Isotopic measurements conducted so far suggest macrolagae from Tama River - which runs through the Tokyo metropolitan area- records an anthropogenic signal similar to that measured in sediments from the same river. In contrast, macroalgae from deeper waters near Hokkaido record Os isotope values similar to that of the open ocean.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The JSPS summer program gave me a great chance to explore Japan. During my stay I visited Yokohama, Tokyo, Nikko, Chuzenji, Kawagoe, Hakone, Fukuoka, Kanazawa, Matsumoto, Kamikochi, Hiroshima, Miyajima and Okinawa. Some of the highlights include seeing the unique castles and temples around Japan, and immersing myself in the various festivals and firework displays that occur throughout summer.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Vincent ALBERGE （ID No.: SP15201）

2. Current affiliation: Université de Strasbourg

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: Osaka University

5. Host researcher: Ken'ichi OHSHIKA

6. Description of your current research

For any fixed oriented closed surface of genus greater than 1, we can associate the Teichmüller space. This space classifies in some sense conformal structures (or hyperbolic structures) on such a surface. Depending on the point of view we use to define the Teichmüller space, there exist many different compactifications. I am interested in three of them; the Gardiner-Masur one, the Thurston one and the Teichmüller one.

Recently, I was interested in the asymptotic behaviour of conformal structure deformations, namely the horocyclic deformations. Horocyclic deformations are defined by a point in the Teichmüller space and a projective class of a measured foliation which determines the direction. By definition, these deformations converge in the Teichmüller compactification to the direction. I showed that some horocyclic deformations converge in the Gardiner-Masur compactification (and also in the Thurston one) if the directions are well chosen. Thus, I planned to prove that for a particular direction, there is no convergence.

Using the theory of the geometric intersection number, we can define the reduced Teichmüller compactification and also the reduced Thurston compactification. Recently, Miyachi (Osaka University) extends the notion of geometric intersection number to the Gardiner-Masur boundary. This extension allowed him to define the reduced Gardiner-Masur compactification. It is interesting to note that these three reduced sets are identical and then it is natural to compare topologies. It is also natural to consider some rigidity problems.

7. Research implementation and results under the program

Title of your research plan:

On reduced compactifications of Teichmüller space.

Description of the research activities:

First, with Prof. Ohshika and Prof. Miyachi we tried to prove that the horocyclic deformation does not converge in the Gardiner-Masur boundary if the direction is given by a rational foliation. Unfortunately, it seems to be a very difficult and technical question. We can just prove that any cluster points of this deformation are different to the direction.

However, if we consider convergence in the reduced Gardiner-Masur compactification, then we can show that the horocyclic deformation converges to the equivalence class of the given direction. As we already wrote, there are many open questions about this reduced compactification. For example, we can show that the reduced Gardiner-Masur boundary is in one-to-one correspondence with the reduced Thurston (resp. Teichmüller) boundary. We are trying to see if the bijection is a homeomorphism or not. This work is still in progress.

Finally, continuing with reduced compactifications; we are considering some rigidity problems. To be more precise, we are trying to show that every auto-homeomorphism of the reduced Thurston (resp. Gardiner-Masur and Teichmüller) boundary is induced by a unique extended mapping class (except for some exceptional cases). We are using the strategy of Ohshika when he proved that the group of auto-homeomorphisms of the unmeasured foliation space is isomorphic (except for some exceptional cases) to the extended mapping class group.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Thanks to this program I had the great opportunity to follow during one week a Workshop at the RIMS (Kyoto University) about “Geometry and Analysis of discrtete groups and hyperbolic spaces.” Moreover the funding allowed me to visit some beautiful places as the Mount Fuji and Hiroshima area. I really enjoyed my japanese stay.

RESEARCH REPORT

1. Name: Antoine CARADOT （ID No.: SP15202）

2. Current affiliation: Institut Camille Jordan, Lyon, France.

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Graduate School of Science, department of Mathematics, Kobe University, Kobe.

5. Host researcher: Pr. Masa-Hiko SAITO

6. Description of your current research

Kleinian singularities are hypersurfaces in $\mathbb{C}^3$ with an isolated singularity at the origin and they can be seen as quotients $\mathbb{C}^2/\Gamma$ with Γ a finite subgroup of $SU_2(\mathbb{C})$. They are classified using Dynkin diagrams of type A, D and E. E. Brieskorn, P. Slodowy and A. Grothendieck studied these singularities in terms of Lie theory using the adjoint quotient of a Lie algebra. Furthermore, H. Cassens and P. Slodowy built deformations and resolutions of Kleinian singularities using quiver theory and symplectic geometry. They made use of the McKay correspondence between the irreducible representations of finite subgroups of $SU_2(\mathbb{C})$ and the extended Dynkin diagrams of type A, D, E to create a quiver, and then they applied a symplectic reduction on the space of representations of this quiver. This reduction leads to the expected results.

My thesis is focused on singularities that might be described in terms of a graded structure of a semi-simple Lie algebra. A particular case of gradation on a Lie algebra is obtained with the inhomogeneous Dynkin diagrams of type B, C, F and G. P. Slodowy defined a notion of singularity associated to a Dynkin diagram of type B, C, F or G via an outer automorphism σ acting on a Lie algebra g of type A, D or E which induces a gradation $g = \oplus_{0\leq i\leq r-1} g_i$ with g_0 of type B, C, F or G. I am currently working on a generalization of H. Cassens' and P. Slodowy's results to the B, C, F and G cases. There is a McKay correspondence for the B, C, F and G cases that uses the action of a pair of finite subgroups of $SU_2(\mathbb{C})$. With this correspondence, I am trying to find an analogous result of the one of H. Cassens and P. Slodowy in inhomogeneous cases. This generalization will be a first example to help me to familiarize with the case of a gradation on g.

7. Research implementation and results under the program

Title of your research plan:

Hilbert schemes of points, resolutions and deformations of Kleinian singularities

Description of the research activities:

The research activities were focused on the use of Hilbert schemes of points to replace a result of differential geometry due to P.B. Kronheimer in the algebraic-geometric construction of H. Cassens and P. Slodowy. In order to do that, I studied thoroughly the work of Y. Ito, H. Nakajima and I. Nakamura to get a good understanding of Hilbert schemes of points and their properties.

I also participated in two summer schools: the first one was oriented towards non-Japanese graduate and undergraduate students to discover the different fields of research that are under investigation at Kobe University. The second one was a two weeks summer school on quiver theory and its applications. During the second week, I gave a 1h30 presentation of my work on Kleinian singularities. Furthermore, on August 14th I visited a professor at the International Christian University in Tokyo in order to talk about my work and I will accordingly give another presentation.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The cultural output of this stay in Kobe is incredible. It was a great opportunity to be able to spend two months in this lively city and experience the Japanese lifestyle. It was also a good occasion to speak Japanese daily and improve my skills in this language I have been learning for a few years. Finally, I met a lot of people with whom I will stay in contact and perhaps work with in the future.

9. Advisor's remarks (if any): Antoine Caradot stayed at our department of Mathematics, Kobe University for almost two months. During his stay, he attended our seminar on algebraic geometry and got contacts with professors, post doctors and graduate students in the seminar. We discussed about the simultaneous resolutions of Kleinian singularities and its relations to the study of the Hilbert schemes on points on some algebraic surfaces according to a lecture note of H. Nakajima. I hope that these discussions will give benefits to his thesis. He also participated in two summer schools in Kobe University as he mentioned in his report. In particular, in Kobe-Lyon summer school in Mathematics, we have a nice collaboration between Kobe University and Université Claude Bernard Lyon 1. He gave a 90 minutes talk on his thesis subjects. Besides Mathematics, he also enjoyed his daily life in Kobe. I hope he will come back to Kobe again.

RESEARCH REPORT

1. Name: Estelle DEGOUYS （ID No.: SP15203）

2. Current affiliation: University of Paris 8

3. Research fields and specialties:

Humanities

4. Host institution: Art Research Center, Ritsumeikan University, Kyoto

5. Host researcher: Prof. Keiji YANO

6. Description of your current research

My current research originates from a French multidisciplinary research team's work (MorphoCity), gathering "exact" sciences and humanities. This research aims to characterise and analyse streets network. It focuses on finding relevant simple laws of urban morphogenesis in order to grasp some of its key features. These simple laws are based on the notion of *simplicity distance*, which is a topological and non-metric distance between two points on the network. In other ways, this *simplicity distance* is the number of times you have to turn between these two points.

In the present research, I compare the mathematical results to the daily practice of streets network by pedestrians. By looking at pedestrians' itineraries to link two points in the city, I want to highlight the elements on which use strategies could be based in the urban streets network; such as geometric or cognitive, conscious or unconscious elements.

We assume the ways network's creation, development and resilience are due to the permanent need of moving to create links and exchange: in other ways to pedestrian strategies, on which we focus.

The ways network, if it offers enough connections, must allows us a good diversity to choose our itineraries to reach each point of a city from all other points.

We can adopt several strategies to develop an itinerary between a point A and a point B, based on different uses of the way: to go, to reach and to pass through.

There is one we have identified and defined it through itineraries descriptions that I have collected: The strategy of "simplicity".

7. Research implementation and results under the program

Title of your research plan: Pedestrians' itineraries and cities shape: Use strategies and characterisation of the urban ways network.

Description of the research activities:

The survey in Kyoto consisted in 1. Asking my way from one point to reach another; 2. Asking someone to relate me a daily route and then to indicate me this route. The collected data are consistent with my previous results in France.

When someone indicates the way to another one, he/she observes the principle of economy. He/she bases his indications of direction changing on a sequence of landmarks. These landmarks can be the street name or its location in the network as well as a shop or details of a building. This "economy" is the choice of the simplicity. It consists in an optimisation of the explication: simple to explain, simple to memorise and realise. This idea of the simplicity rests on the idea that we reason and optimise our itineraries using two main objects: the alignment (the way) and the turn (at an intersection). I can already confirm that the choice of the simplicity is contextual. In fact, we indicate a way more simple than the one we usually practise which could be more pleasant, shorter, based on circumstances. But also when we discover a new city: we develop a "mental map" based on the main roads, which are the ones that allow us to reach the whole network as simple as possible. We make use of this "basic" representation to choose an itinerary. Then, we are inclined to minimise the number of turns in favour of a good accessibility and visibility distance, to spare us to being lost even if we have to walk more.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): I was so happy to be in Japan for the fourth time, 10 years after my first trip here. The JSPS Summer Program allows me to strengthen the link I already had with Japan thanks to research. I could not expect this chance to work here, at the Ritsumeikan University, with Yano-sensei. It also allows me to discover Kyôto, which is a beautiful and nice place to live (despite the summer heat…). I hope this experience will continue after my PhD…

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Stéphanie DEVINEAU （ID No.: SP15204）

2. Current affiliation: Ecole Normale Supérieure

3. Research fields and specialties:

Chemistry

4. Host institution: RIKEN

5. Host researcher: Prof. Tahei TAHARA

6. Description of your current research

Any researcher has already experienced the unwanted dark ring left by coffee drops over an important paper or a student's document. Coffee is a suspension of insoluble particles in hot water. When a drop of coffee evaporates, the particles are transported toward the edge of the drop where they accumulate. This is called the "coffee-ring effect".

Coffee rings can be reproduced with model particles of different size and chemistry. When particles interact with other molecules in solution, the ring may disappear. I observed that some blood proteins can change the patterns of drying drops. This effect could be used in biomedical applications as a very easy way to probe harmful mutations of proteins.

However, the mechanisms leading to this new pattern are not well understood. We suspect that one key step occurs at the air/water interface of the evaporating drop. To better understand how proteins can alter this pattern, we need to specifically probe proteins at the air/water interface and to study their behavior in the presence of particles.

To probe proteins at interfaces, surface-specific spectroscopic techniques are needed. The goal of my research project at the Molecular Spectroscopy Laboratory at RIKEN is to set up an experimental device based on nonlinear optics to follow protein structure in "coffee drops".

7. Research implementation and results under the program

Title of your research plan: Study of proteins at the air/water interface by heterodyne detected vibrational sum frequency generation spectroscopy

Description of the research activities:

The experimental vibrational spectra of blood proteins at the air/water interface were successfully measured by VSFG spectroscopy. Surface denaturation of different proteins, both monomeric and oligomeric, has been investigated. Thanks to the advanced heterodyne detection system developed at RIKEN, the change of water molecule orientation at the interface following protein adsorption could be highlighted.

Upon addition of particles in the solution, the evolution of protein and water molecule orientation at the air/water interface was followed. It shows that particles change the properties of the air/water interface and brings new insights in the mechanisms of coffee ring formation with proteins.

Finally, preliminary experiments were carried out to follow protein adsorption at buried surfaces.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

My stay at RIKEN was a highly enriching experience, both for acquiring new knowledge and for meeting and working with Japanese colleagues. Outside the lab, I particularly enjoyed hiking in the mountains close to Nikko. I also recommend to attend once a kabuki play for discovering ancient but lively Japanese culture.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Johann DION （ID No.: SP15205）

2. Current affiliation: University of Nantes, FRANCE

3. Research fields and specialties:

Biological Sciences

4. Host institution: AIST, Tsukuba

5. Host researcher: Dr. Jun HIRABAYASHI

6. Description of your current research

My work as Ph.D. student in Nantes University is to synthesized new inhibitors of galectin-3 by organic chemistry. Galectins are a family of multifunctional lectins (protein which bind to sugars) and can be found in mammals, plants or mushrooms for example. Regarding humans, thirteen members of galectins are known and they are produced by almost every cells of our organism. One of the actual challenges regarding these proteins is to develop tools to have a better understanding of their functions.

That is why my lab is involved in a project which has for aim to design new inhibitors of galectin-3, which have a wide distribution in our organism. My work is to develop new inhibitors based on sugars with a high affinity and specificity for galectin-3 in order to study it in a living system.

The first part of my work consists of developing new synthesis methods based on organic chemistry in order to synthesize these compounds. After this step, new compounds have to be characterized and tested on galectin-3 to determine affinity and specificity.

7. Research implementation and results under the program

Title of your research plan:

Study of lactosamine derivatives as inhibitors of Galectins: inhibition assay and affinity analysis.

Description of the research activities:

The objective of my work at AIST Tsukuba was divided in two parts. First, I wanted to obtain a global view of “inhibition” power of new inhibitors (synthesized in Nantes University) for galectins. This can be achieved by using inhibition assay with glycan micro-array technology. When a galectin is applied to these glycan micro-arrays, it binds to glycans on the surface and produces a luminous signal which is proportional to the strength of binding. In presence of an inhibitor, the galectin binds less with the glycans of micro-array because it binds with inhibitors compounds. By comparison of these two signals, we can determine an “inhibition power” value (affinity). It was possible to classify all compounds in term of “inhibition power” for Gal-1,-3C and -7 with this process.

The second expectation was to determined the universal parameter for affinity which is the dissociation constant (Kd) by using the automated frontal affinity chromatography. Having found the best parameters, we obtained value for Gal-3C.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Everything was well organized by JSPS and the life in my laboratory for these two months was nice. I was well received by my teammates and even without speak Japanese, it was quite possible to communicate with people of my team. I spent my free time during weekend to visit Japan and especially the city of Tokyo. A nice way to discover Japan.

9. Advisor’s remarks (if any):

PhD student, Johann Dion has been involved in the JSPS summer program with the greatest interest in experiencing affinity-based glycan analysis technologies, which were developed in our laboratory. For this realization, the program is quite nicely designed for the stay of fellows about 2 months. The duration seems somewhat short if completing the intended work but adequate to learn "essence" of the above technologies as well as atmosphere of different country with different culture, history, language and foods. I believe Johann will be a nice and great scientist in France in the near future.

RESEARCH REPORT

1. Name: EHLINGER Quentin （ID No.: SP15206）

2. Current affiliation: Institut Lumiere Matiere, UMR5306 CNRS Université Claude Bernard Lyon 1 Batiment Brillouin, 10 rue Ada Byron 69622 Villeurbanne CEDEX, France

3. Research fields and specialties:

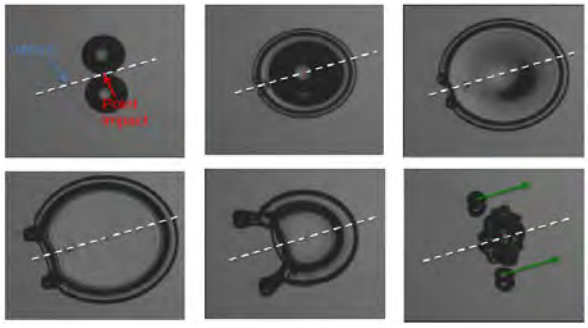
Mathematical and Physical Sciences

4. Host institution: Ochanomizu University, Tokyo

5. Host researcher: Ko Okumura

6. Description of your current research

My research studies deal with the role of microscopic details on macroscale hydrodynamic. In particular, I study the role of surface friction and roughness in the dynamic of drop impact. In particular, it has been shown that a specific microscale texture on a surface can have macroscale consequences on droplet impact. The objective of my present is to study the effect of one single defect on a substrate on satellite droplet ejection during a drop impact experiment. A millimetric droplet is released on the substrate from a known height (to control impact droplet velocity). The impact is then recorded via a high speed camera.



Chronophotography of droplet impact and satellite droplet ejection on a substrate with a single defect (blue arrow).

To study the effect of the defect, a model situation with no friction of the liquid on the substrate is considered. To do so, the droplet is heated above the so-called Leidenfrost temperature, to allow a vapor film to be created between the liquid and the substrate and preventing contact and friction with the substrate.

By careful measurements of droplet contour and by using the knowledge of the team on the characteristics of droplet impact (flow velocity and lamella thickness during spreading of the impacting droplet), hydrodynamic laws governing ejection angle are considered, depending on defect distance from the impact center, droplet impact velocity, droplet radius.

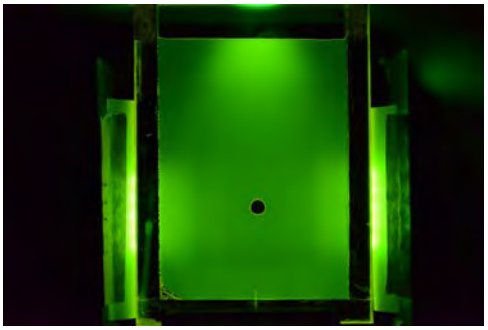
7. Research implementation and results under the program

Title of your research plan:

Air bubble rising in Silicon Oil

Description of the research activities:

I built a setup to measure the thickness of lubrication films surrounding an air bubble rising in an enclosure filled with Silicon oil. I adapted an absorbance technique used to measure the thickness of fluid lamella in drop impacts to the situation of rising air bubbles. I needed to dissolve a dye into Silicon oil, the best solution was to use a fluorescent dye and realize brightness measurements with a transversal light re-emitted by fluorescence in the observation direction. For the calibration I measure the brightness of a solution with fixed concentration of fluorescent dye at different controlled thicknesses to get the physical parameter accounting for the variations of fluorescent light with thickness of the fluid. I built several Plexiglas cells whose thickness vary from 0,5mm to 1,5mm, the expected thickness of fluid films being around 0,1mm. I had to calibrate the camera with exposure time to correct the gamma factor of photo sensors. The major difficulty was to build a setup with a lighting as homogeneous as possible, the light source being 15 UV-LEDs.



The setup has to be really stable so that the light source does not move from a series of experiment to another. I got a measurement of lubricating films thickness versus size of the bubble, for the different enclosures. Unluckily the time to build the setup was not sufficient to make a relevant series of thickness measurements with a defect stuck on one plate of the Plexiglas cell.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Thanks for JSPS to enable a program in such conditions and especially for the orientation week. The stay was a unique experience and really perfect conditions to discover Japan.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Pierre FAVIER （ID No.: SP15207）

2. Current affiliation:

Laboratoire de l'Accélérateur Linéaire, CNRS/IN2P3, Université Paris-Sud, Orsay, France

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: High Energy Accelerator Research Organization (KEK), Oho 1-1, Tsukuba, Ibaraki 305-0801, Japan

5. Host researcher: Prof. Nobuhiro TERUNUMA. Dr. Yosuke HONDA

6. Description of your current research

I am currently working on X-ray production by inverse Compton scattering for the ThomX project. In this project, 50 MeV electrons circulating in a storage ring will periodically collide with a high average power pulsed laser beam stored in a high finesse Fabry-Perot cavity. I study the importance of thermal loads induced by the laser beam on the mirrors of the Fabry-Perot cavity. Simulations are performed on Matlab for the propagation of the laser beam, and ANSYS for the thermal-induced distortions. In addition, we are currently assembling a prototype of the Fabry-Perot cavity to extensively test simulation results and various configurations of diagnostics. A lot of efforts are put in this prototype to ensure the best performances for the ThomX cavity. My present research is thus divided into simulation and experimental work. It is expected to continue this way until the end of 2015, where the construction of the ThomX machine should begin.

7. Research implementation and results under the program

Title of your research plan:

Improvement of optical cavities for future X-rays sources

Description of the research activities:

During my stay in KEK, I made a setup to control mirror's cleaning efficiency. Mirror cleaning is of great importance for high accuracy and low loss applications in optics. Here I tried different cleaning techniques and tested them on my control setup. However the main activity I conducted is related with optical cavities. An optical cavity typically consists in 2 mirrors facing each other. As the laser pulse goes inside and makes one round-trip, the following pulse comes in and overlaps with the first one. From on and on the average power stored in the cavity grows. However due to the high power, cavity mirrors heat up, get deformed, and reflect the beam in a wrong way such that the cavity can become unstable (light cannot make round-trips). Usually mirror deformations are characterized by an increase in their radius of curvature. A way to bring the cavity back to stability is thus to lower this radius of curvature. This is what I tried to do in KEK. Basically by heating the back side of a mirror, it is possible to curve the mirror in the "good direction". After many simulations I tested this scheme on a prototype cavity and it worked! I just put a Nichrome wire (e.g. a resistance) behind the mirrors. By applying a current through the wire, I was able to put it at 600°C. By looking at the variations of the circulating beam size, it was clear that the radius of curvature changed in the way I wanted.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I was pleased to come to Japan to work. I appreciated Honda-san's willing to let me do new things, especially when he let me drive an accelerator for a few tenth of minutes. I was quite free to perform my research and I appreciated that. The working days were quite longer than in France (10 am / 11 pm) but I felt OK after a few days.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Barbara GHISLAIN （ID No.: SP15 208 ）

2. Current affiliation:

PhD Student, CNRS, University of the French West Indies and Guiana, French Guiana, France

3. Research fields and specialties:

Biological Sciences

4. Host institution: Graduate School of Agriculture, Kyoto University

5. Host researcher: Prof. Keiji TAKABE

6. Description of your current research

During my PhD, I study the diversity of mechanism developed by angiosperm trees in order to upright. Generation of growth stresses allow this uprighting. Indeed a tissue called tension wood, because of the strong tensile stress it creates, is over-produced on the upper side of the leaning axis. In poplar, a model tree for tension wood studies, this tissue is characterized by the presence of cell fibers with an inner gelatinous layer called G-layer. The surprising characteristics of the G-layer are its null or low lignin content and the low cellulose microfibrils angle (MFA), almost aligned in the fiber axis. Other features, for instance a decrease of the vessel frequency, are also observed in tension wood. It is known that the tensile stress is generated by the G-layer during cell wall maturation. However, the exact mechanism has yet to be understood. Therefore, the purpose of my JSPS Summer Program was to observe the cellulose microfibrils network of the G-layer during cell wall maturation, at a nanometer scale. Technics such as Rapid Freeze and Deep Etching (RFDE) using a Transmission Electron Microscope (TEM) and rapid freeze using a Field Emission Scanning Electron Microscope (FE-SEM) were used since they allow a nanometer scale observation without perturbing the wood microstructure. However, observations with RFDE had never been carried on raw wood material. This study is consequently very innovating and the results would be of great help to confirm or infirm actual models on stress generation in tension wood.

Besides, tension wood generating high tensile stresses lacking G-layers are reported on several tropical species. My main research for my PhD is to screen tension wood diversity in the tropical rainforest (French Guiana), characterize the other forms of tension wood and propose a classification of tension wood with associated mechanisms.

7. Research implementation and results under the program

Title of your research plan:

Direct observation of the organization of the cellulose network during cell maturation in tension wood of Poplar and Simarouba using Rapid Freeze and Deep Etching (RFDE). In less scientific words: elucidate mechanism of the muscles of trees. FE-SEM was added after discussion.

Description of the research activities:

My main activity was to learn how to prepare sample to allow observation of the unaltered microfibrils cellulose network using RFDE and get skills with the TEM and FE-SEM. With RFDE, liquid nitrogen (-196 °C) fixes the specimen. When put in a vacuum, the sample remains at a very low temperature and can be cut. After a stage of etching done by increasing the temperature, the specimen is coated with metal to have a replica. This replica is isolated and then observed with TEM microscope. Every step of this method is critical and adjusting all the experimental factors to have a good replica of the maturation process shall need more months.

Although FE-SEM may be less precise, the technics fits better for a short-term study. Other microscope observations were also carried as extras to this JSPS Summer Program. One of those lead to collaboration on a publication, ready to be submitted.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Although I struggled to adapt to the work schedule (10am to later; I'd rather work starting 8am), I feel that the lab is like a family, with the sensei taking care to include everyone to the conversations during ocha-time. I still regret my Japanese to be very poor, but I enjoyed learning a few more words or expressions.

9. Advisor's remarks : Barbara has worked very hard in our laboratory. She hopes to observe the ultrastructural changes of gelatinous layer by TEM coupled with RFDE technique. Although she still could not have good results due to the difficulty of this technique and the short stay in our laboratory, she learned the principal of this technique and how to use the equipment. I am convinced that her stay in our laboratory causes future beneficial collaboration between our laboratory and her laboratory. She gave our students a good chance to explain their works in English. She enjoyed to learn Japanese culture in Kyoto. I strongly hope that she will come again to our laboratory to continue her work to observe the ultrastructure of gelatinous layer.

RESEARCH REPORT

1. Name: GIRARD Pauline （ID No.: SP15209 ）

2. Current affiliation: Laboratories CEISAM-CNRS UMR 6230 and IMN-CNRS UMR 6502, University of Nantes, FRANCE

3. Research fields and specialties:

Chemistry

4. Host institution: Osaka University

5. Host researcher: Prof. MIYASAKA Hiroshi

6. Description of your current research

My PhD research subject, entitled *"Elaboration and Studies of Photoswitchable Molecular Nanosystems"*, aims at developing innovative high-density nanoassemblies made of organic photochromes and superparamagnetic iron oxide nanoparticles for optical data storage and bioimaging applications. To achieve this aim and reach high synergy in the functionality, we have synthesized azo compounds as photochromes, functionalized with strong iron chelators, which can form self-assembled structures (nanospheres and multimers) in solution. Various core-shell hybrid nanoassemblies structured along the classical (iron oxide nanoparticle grafted with organic azo compounds) and reverse architectures (azo nanosphere coated by a shell of iron oxide nanoparticles) have been fabricated. The main questions regard the photoswitchability of the photochromes, once they are self-assembled or interacting with iron oxide nanoparticles, namely highly spatially confined. Since photoisomerization of the azo compounds occurs in the picosecond range, it is thus of utmost importance to study the dynamics of the photoreaction by means of ultrafast transient absorption spectroscopy techniques to reveal the major discrepancies between free and self-assembled azo derivatives in solution.

7. Research implementation and results under the program

Title of your research plan:

Time-resolved photophysical studies of azo compounds and hybrid nanoassemblies by ultrafast transient absorption spectroscopy

Description of the research activities:

To check if the organization inside the nanospheres and the presence of iron oxide nanoparticles modify or not the optical properties of the azo compounds, the study of the dynamics of the free and self-assembled compounds at very short time has been performed by femto second transient absorption spectroscopy. These experiments have been accomplished on the free azo compounds in two different solvents (tetrahydrofuran and dichloromethane) because it appears that the studied azo compounds create multimers in dichloromethane which could affect the optical properties, on azo nanospheres and on hybrid nanoassemblies developed according to the classical and reverse architectures.

These analyses revealed that the photoisomerization doesn't depend on the nature of the solvent and the presence of multimers. Moreover these measurements highlighted that the photoisomerization occurs even if the azo compounds are spatially confined, as in the structure of nanospheres, and also in presence of iron oxide nanoparticles, as core or shell of the nanoassemblies. The back reaction seems to be accelerated by this organization. These results show that the studied systems possess interesting optical properties and that the development of a cooperative system with magnetic and photochromic properties is possible. These conclusions represent a primordial progress for the investigation of photochromic properties of the hybrid nanoassemblies developed in my PhD.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

This stay in Japan has been an incredible experience, professionally and culturally. I could work with experts in time-resolved photophysics and learn a lot with them. Moreover I had the chance to discover this country with Japanese people who introduced to me some amazing places and with who I spent enriching moments. I also discovered some Japanese traditions and I attended some festivals, where we can appreciate the perfect mix between modern and traditional cultures. I am very grateful to JSPS to allow me the occasion to discover this beautiful country and to meet remarkable people.

9. Advisor's remarks (if any):

By using the time-resolved apparatus in our laboratory in Osaka, Pauline Girard has studied the dynamics of chemical reactions of some photochromic compounds which she prepared in France. She worked very hard and has obtained important information in the study in her PhD course. Not only in the scientific contributions, she has communicated well with students in our laboratory and all of us enjoyed her stay in the laboratory.

RESEARCH REPORT

1. Name: Pauline Méjean （ID No.: SP15210

2. Current affiliation: University of Quebec in Montreal (UQAM)

3. Research fields and specialties:

Geochemistry

4. Host institution:

University of Tokyo-Atmosphere and Ocean Research Institute

5. Host researcher:
Pr. Yuji Sano

6. Description of your current research

The earthquake on 11, March 2011 off the Pacific coast of Japan, and subsequent tsunami, triggered a series of accidents at the Fukushima Dai-ichi Nuclear Power Plant that released a mixture of radioactive substances including tritium (^3H), produced in nuclear reactors, and stored spent-fuel into the environment (Matsumo et al., 2011). The tritium released was initially in the form of tritiated water vapor, which was washed out to the atmosphere as precipitation and incorporated into the natural hydrologic cycle.

Tritium concentrations in japanese precipitations have been monitored continuously since 1961 with monthly and yearly averages of tritium concentrations in precipitation measured below 10 TU since the 1980'.

Since the accident, atmospheric, surface and oceanic water have been monitored but no groundwater data is available.

The goal of this project was twofold. First, through a series of tritium measurements in shallow aquifer and surface water, we studied the physical processes of the incorporation of tritium in the aquifer system. Second, to understand the effect of massive radionuclide dispersion into potable groundwater.

7. Research implementation and results under the program

Title of your research plan:
Fukushima Dai-ichi tritium fallout: environmental impact into groundwater systems

Description of the research activities:

A total of six water samples were collected in the discharged area of Fukushima (three from a private well and three from surface water) at three interval times (on April 21, May 5 and June 10). Tritium amounts in water samples were determined using an alternative method: the ^{3}He-ingrowth method (Clark *et al*., 1976), which is based on the measurement of the initial tritiogenic ^{3}He.

Once the water sample degassed (to avoid all helium dissolved in water) and following a minimal period of 6 weeks, the ^{3}He produced by ^{3}H contained in the water was measured by gas-source mass spectrometry at the Center for Advanced Marine Research of the Atmosphere and Ocean Research Institute (AORI) of the University of Tokyo. This method allowed calculation of the concentration of the parent (^{3}H) from the measured daughter (^{3}He) element in the same water aliquot, reducing uncertainties to use the ^{3}H/^{3}He method of datation of young groundwater.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The opportunity to work at the AORI-University of Tokyo resulted in many unique opportunities. The *in-situ* observations gave rare information on how the environment responds to strong perturbation induced by the Fukushima Dai-ichi accident. Consequences of Dai-ichi Fukushima accident were observed for the first time in term of groundwater quality available for population and agricultural activities. For my PhD, it was a unique opportunity to study the behaviour of tritium recently released into groundwater systems to improve the ^{3}H/^{3}He method and apply it to aquifers I am studying in Canada. I learned new methodology that constitutes complementary knowledge for my attached laboratory GRAM-GEOTOP.

Pr. Sano offered me the opportunity to work on another project located in Kyushu Island with the University of Kyoto providing me the opportunity to discuss with Japonese researchers and had initiated a long-term collaboration, which may possibly lead to a post-doctoral research stage in Japan.

9. Advisor’s remarks (if any)

RESEARCH REPORT

1. Name: Aurélien NEVEU （ID No.: SP15211）

2. Current affiliation:

IFSTTAR, Nantes, FRANCE

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Earthquake Research Institute, The University of Tokyo

5. Host researcher: Takahiro HATANO

6. Description of your current research

The research currently conducted concern the rupture mechanism of materials which is of interest for a wide range of applications. For example in civil engineering, the production of aggregates used in construction require crushing of massive rock piece, and the understanding of rupture properties of used materials is essential to ensure stability of structures. In soils mechanics, the microscopic origin of strength of material is not well understood and their determination is not easy to do. In geomechanics, fracture occurs at different scale by the formation of fault and is often the origin of massive rock breakage and sliding.

We study the rupture mechanism of material with the use of Discrete Element Method (DEM), which as been accepted as an effective numerical method to simulate mechanical behavior of materials. The DEM deals with elementary particles which interact at contact. We describe a rock piece as an assembly of grains surrounded by a virtual cement to model the rigid behaviour of the material. The virtual cement is represented by setting cohesive contacts between grains, and so by introducing reaction forces to prevent relative displacement of the grains. We also introduce microscopic rupture criteria to allow breakage of cohesive contacts to occur. When an external load is applied to the assembly, all the cohesive contacts store the local deformation until the stress endured reach the maximum value allowed as given by the rupture criteria. By successive breakage of cohesive contacts a macroscopic fracture will initiate and develop, which will result of the rupture of the modeled rock piece.

7. Research implementation and results under the program

Title of your research plan:

DEM study of rupture of grains during block sliding

Description of the research activities:

Many geological disasters (landslides, earthquakes,...) are initiated by the rupture of a block of rock. In the case of earthquakes, the rupture will create a fault plane in which the two blocks move with a stick-slip motion. The asperities along the fault surface create friction and lead to lock the fault (stick) and induce the accumulation of energy. The rupture of these asperities will initiate sliding (slip) and the release of a massive amount of the previously stored energy. As rupture mechanisms occur at the fault plane and influence friction between the sliding blocks, it is interesting to add the rupture of the grains which constitute the fault surface to friction models used to describe stick-slip behaviour of the block of rock.

Simulations of rupture of a piece of rock under diametrical compression has been conducted to study the effect of the size of the particle on its strength. The results

show that the critical stress decrease while increasing the size of the particle, which is in accordance with experimental observations.

The influence of the presence of initial cracks inside the material has also been studied. Indeed, in real material, initial defects (cracks, pores) induce stress concentration and influence crack path at rupture. As expected, increasing the crack density inside the sample will decrease its ability to sustain the applied load, and so decrease its strength. These results will help to better understand fracture mechanisms of material, which is of interest for the study of fault plane but also for many others applications.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): I have greatly appreciated my experience in Japan, especially the home-stay which was a wonderful introduction to the life in Japan. There are so many beautiful things to see, places to visit.... I also had the chance to climb Mt Fuji, and that was awesome! To work with Mr Hatano was a pleasure, with a lot a fruitful discussions, and I hope we will continue to collaborate in the future.

9. Advisor's remarks (if any): During his stay, Mr. Neveu worked on fracture mechanics of a grain by means of numerical simulation. As the problem is also important in earthquake physics, I enjoyed this collaboration between civil engineering and earthquake physics very much. Despite the limited time, he obtained some very interesting results as described in his report, which proves his outstanding ability in research. Overall I appreciate the summer internship program very much and wish to keep the collaboration

with Mr. Neveu.

RESEARCH REPORT

1. Name: Planade Jessica (ID No.: SP15212)

2. Current affiliation: Physique et Mécanique des Milieux Hétérogènes, ESPCI ParisTech (Ecole Supérieure de Physique et de Chimie Industrielles), France

3. Research field and specialities: Biophysics

4. Host institution: Laboratory of single-molecule cell biology, Graduate school of biostudies, Kyoto University

5. Host researcher: Naoki Watanabe

6. Description of current research

I am studying highly dynamical, dense, branched networks of a semi-flexible polymer called actin that exist within the cell as part of its "skeleton" and is essential for many processes (deformation, migration, endocytosis and exocytosis …). My work in the PMMH (Physique et Mécanique des Milieux Hétérogènes) laboratory of the ESPCI ParisTech, consists in studying, in vitro, the mechanical response of such networks under different kind of loads. I am particularly interested in better understanding the influence of the protein composition of the networks on their response.

My group developed a powerful tool to quantitatively measure the mechanical properties of in vitro reconstituted actin networks with a high throughput (Pujol et al. PNAS 2012). Superparamagnetic colloids develop a short-range dipolar attractive force when submitted to a magnetic field that will make them align. By polymerizing actin networks from their (functionalized) surface, it is possible to apply various stresses on the gel (force loading, creep, sinusoids …) while imaging the position of the colloids with a precision of a few nanometers. From the obtained curve, we are able to collect data on the elasticity, the plasticity and the viscosity of the networks. We work in collaboration with Alphée Michelot from IRTSV (Laurent Blanchoin's laboratory, Institut de Recherches en Technologies et Sciences pour le Vivant, CEA Grenoble, France), thanks to whom we are able to polymerize budding yeast's dense branched actin networks in our system (Michelot et al. Current Biol. 2010).

7. Research implementation and results under the program

During the 2 months of JSPS Sumer Program 2015, I have been experimenting two approaches to study the mechanics and dynamics of actin cytoskeleton. An in vitro approach with measurements of the dynamics of dense actin networks using yeast extracts that I brought from my laboratory in France, and an in vivo approach by measuring the actin response to a mechanical stress inside cells using the knowledge and techniques of my host laboratory on cellular single molecule microscopy.

1) In order to measure the dynamics of actin monomers, crosslinkers (Sac 6) and branching proteins (Arp2/3 protein) in my networks I had to reunite single molecule imaging conditions. The actin networks I study are very dense and do not grow far away from their substrate, so lowering the fluorescence level enough brought up some problems of auto-fluorescence of the substrate (lab-made colloids or commercial magnetic beads). Moreover, these colloids had to stay free in the solution and they were therefore undergoing a little bit of Brownian motion in x,y, and z direction. The movements in z direction are very limiting for the use of single molecule microscopy technique, so I tried to decrease that phenomenon by different methods. Eventually I could perform imaging on my networks with different conditions (composition of the networks and fluorescent probe). I am currently working on the analysis of these data, and in the case of a particularly interesting response, I would like to come back in order to finish testing different parameters and to gather enough statistical power and controls to publish these results.

2) My host laboratory is specialized in cell single molecule microscopy; therefore I got interested in trying to combine the techniques of my lab for mechanical probing of biomaterial using magnetic colloids with the recording of actin monomer dynamics inside XTC e-GFP transfected cells. My aim was to see if I could record actin cytoskeleton alteration during a load. I tried to make cell absorb magnetic colloids by endocytosis in order to apply a stress directly from the inside. By functionalizing their surface in different manners, I could obtain the incorporation of beads inside cells (difficult to confirm with 100% certitude, even using antibody staining). And by adding a magnetic field with an electromagnet I could make neighbor colloids align while imaging the actin. I could see some interesting ring-shapes structures inside some of the cells, and I am currently analyzing the movies to see if changes in these structures over time correlate with the magnetic field solicitation pattern.

8. Experience in Japan

My coworkers were all Japanese except for one, and they were all very kind and helpful, always ready to take time to guide me through a protocol or to discuss scientific results. It was very agreeable to work with them all even if sometimes the language issue would slow down the exchanges. The working hours however were quite different from what I experienced in France: much shifted towards the evening. As for the life in Japan, I was lucky enough to spend these three months in the beautiful Kyoto, and I enjoyed it very much. People were always very happy to help me discover their city and their culture, and they were also patient whenever discussion was rendered difficult by language problems.

9. Supervisor's comments (if any)

Although my laboratory has been working on the dynamics of the actin filament network formation and remodeling by using single-molecule imaging of fluorescently-labeled actin and its regulatory proteins for more than a decade, it is currently challenging to apply this approach to 3-dimensional actin networks. The applicant tried to visualize the single-molecule actin dynamics in 3-D using the experimental systems developed in her previous researches. After 2 months of elaborate experiments, she is starting getting preliminary but interesting results, with which we will make plans for future directions of our collaborative research. Especially, the data described in the section 7- 1) could provide a clue to know how individual molecules behave during the remodeling of supramolecular cytoskeletal structures in living organs. I hope that her experience in my laboratory will eventually lead to a new venue for bridging the gap between the molecular actions and the morphological regulation of life systems.

RESEARCH REPORT

1. Name: Helena POLENA （ID No.: SP15213）

2. Current affiliation: Inserm U1036 – iRTSV/CEA Grenoble

3. Research fields and specialties:

Biological Sciences

4. Host institution: The University of Tokyo

5. Host researcher: Prof. Masanori HATAKEYAMA

6. Description of your current research

Endothelium integrity is dependent upon the adhesive function of the major molecule located at endothelial adherens junctions called Vascular Endothelial (VE)-cadherin. During endothelial cell activation, like in a tumor microenvironment, the junctional complexes are subjected to cellular modifications that are at the origin of new blood vessels formation, in a process called angiogenesis. Over the last ten years, our team studies VE-cadherin structural modifications upon cytokines challenges, including tyrosine phosphorylation in its cytoplasmic domain, and cleavage of its extracellular domain in the endothelial functions. These two modifications are correlated with increased endothelium permeability and have been associated with tumor angiogenesis and other vascular diseases. Therefore, my current research aims to improve the knowledge in the vascular biology of the endothelium, focusing the mechanisms that control VE-cadherin function in the cell. For this purpose I am involved in projects trying to identify biomarkers for vascular stress by the analysis of VE-cadherin in clinical studies, in i*n vitro* 3D cell culture and transgenic mice.

7. Research implementation and results under the program

Title of your research plan:

Study of the endothelium damage by the gastric pathogen *Helicobacter pylori*

Description of the research activities:

Several studies have shown a role of angiogenesis in the pathogenicity of infectious diseases, including *Helicobacter pylori*-induced gastric carcinogenesis. Although *H. pylori* colonizes strictly within the stomach, evidence accumulates that chronic infection of *H. pylori*, especially strains producing a virulence factor known as CagA, is associated with cardiovascular diseases such as coronary heart disease and ischemic stroke. The observation raises the idea that CagA may somehow damage endothelial cells to elicit vascular injury. CagA oncoprotein, once inside the cell, has been shown to interact with partners that are physiologically associated with VE-cadherin through specific amino acids residues. Therefore, the goal of the research conducted this summer was to investigate a possible interaction of *H. pylori*-virulent factors, such as CagA, and VE-cadherin. For this purpose, cell lines expressing VE-cadherin lacking one or more amino acids in its cytoplasmic domain were constructed by mutagenesis assays, as well as the expression of both proteins in *in vitro* cultured cells for further protein analysis. Our preliminary results showed that CagA may associate to VE-cadherin during infection, contributing in this way to the pathogenicity of the disease. Further experiments using the obtained mutants are needed, in order to understand the mechanisms underlying the interaction between both proteins.

8. Please add your comments, including any cultural experience during your stay in Japan: I have had a very pleasant experience. I acknowledge all members of the lab, specially Prof. Hatakeyama for giving me this unforgettable experience, to Takahashi sensei that shared with me the molecular biology universe and for all the time and attention he spent with my work, and to Kanemitsu san for contributing to my very good daily life in Tokyo. During my stay I could participate with one lab colleague to Ikebana classes, organized by the University of Tokyo. It was really pleasant to learn such typical flowers arrangement, and I think that both teachers were really happy to pass their knowledge to a foreigner too.

9. Advisor's remarks (if any): In the present work, Dr. Helena Polena sought to investigate the effect of *H. pylori* CagA on endothelial cells, especially focusing on the function of VE-cadherin. To do so, she decided to construct expression vectors for mutant VE-cadherin molecules. These VE-cadherin mutant materials should become a powerful toll in addressing the relationship between H. pylori CagA and vascular injury. To attain the goal, Dr. Polena worked very hard in my lab during the last two months despite hot and humid summer in Tokyo. Although she had known very little about gene engineering techniques when she joined us, she enthusiastically learned it and succeeded in making several site-directed mutants of VE-cadherin. This is a really great scientific advance given that she had only less than two months. In summary, I am pleased to say that Dr. Polena satisfactorily achieved her research plan in my lab as a JSPS fellow in my laboratory.

Report

RESEARCH REPORT

1. Name: BOHNKE, Christin (ID No.: SP15301)

2. Current affiliation:

University of Toronto

3. Research fields and specialties:

Humanities

4. Host institution: Rikkyo University, Tokyo

5. Host researcher: Professor MAEDA Ryozo

6. Description of your current research

My thesis centers on German-Japanese cultural exchanges in the early 20th century. For my dissertation I am researching how post-colonial theory and German-Japanese cultural productions intersect to create a new and meaningful understanding of German-Japanese novels, films and magazines. Two questions with regard to Germany, Japan and post-colonial theory inform my work: First, how does an inclusion of a non-Western imperial power into post-colonial theory affect concepts such as hybridity, mimicry or race? Second, if post-colonial literatures and films result from the contact between an imperial center and its colonies, how can post-colonial theory be applied to the common cultural production of two former Empires?

7. Research implementation and results under the program

Title of your research plan:

Questioning hybridity: Imperialism and Space in Arnold Franck's 'Die Tochter des Samurai' and Itami Mansaku's 'The new Earth"

Description of the research activities:

I utilized my research exchange in Japan to access various archives and materials that are not accessible for me outside of Japan. Through the generous support of the Kawakita Memorial Film Institute in Tokyo I was able to see for the first time Itami Mansaku's 'The new Earth' (1937) which provided me with a deeper insight into the treatment of questions of Imperialism within Itami and Franck's works. Moreover, the screening provided me with a chance to compare Itami and Franck's films, especially with regard to how the issue of space is approached in both movies.

In addition to my work on filmic co-productions between Nazi-Germany and Imperial Japan, I researched a second aspect of German-Japanese cultural exchange. Through the support of the Japan Foundation who generously provided access to their collection, I was able to access the periodical 'Ost-Asien' as well as the novel 'Karawanenreise in Sibirien', both by the Japanese author Tamai Kisak. Tamai published 'Karawanenreise' as well as the magazine 'Ost-Asien' at the beginning of the 20th century in Germany in the German language. Through reading specific volumes of Tamai's magazine, I not only gained a deeper understanding of the political, economic and cultural exchange between Germany and Japan at the beginning of the 20th century, I also learned about forms of cultural exchange that were previously unknown to me such as the performances of a Geisha group in Germay in 1898 or the performances of the Kawakami Group in Berlin in 1902. Tamai's novel and his articles in 'Ost-Asien' will be the core of one of my dissertation chapters.

The fact that I had access to such a multitude of sources during my stay in Japan will greatly help me in completing my dissertation.

I am presenting my first results on Franck and Itami's movie at the IVG (International Conference for German Studies) in Shanghai at the end of August 2015.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

During my time in Japan I was able to attend several matsuri and fireworks as well as kabuki performances.

RESEARCH REPORT

1. Name: **Lars Bollmann** (ID No.: SP15302)

2. Current affiliation: **Graz University of Technology**

3. Research fields and specialties:

Engineering Sciences

4. Host institution: **Osaka University**

5. Host researcher: **Professor Shigeo Wada**

6. Description of your current research

Mechanics are important in many physiological and pathological processes in the human body. Many pathologies such as aneurysms or the degeneration of cartilage can be directly related to the mechanics of the involved tissue. In addition, there is growing evidence that mechanical stimuli strongly influence the functionality, morphology, differentiation, survival and behaviour of single cells. In order to understand the effect of mechanics in a biological system and on occurring pathologies entirely, it is crucial to investigate its significance across scales. That means, mechanics of cell components (e.g. the cytoskeleton), single cells, tissues and arising interactions need to be considered. The results will give new insights into the development of diseases, and may provide new approaches for treatments and prevention of pathologies.

My current research at the University of Cambridge focuses on mechanics of single glial cells in the nervous system. Traction force microscopy (TFM) is used to identify forces that are exerted by the cells on polyacrylamide gels. Variations of substrate stiffness are made within the physiological range of brain tissue. The goal is to understand how glial cells interact with their environment mechanically and how they react to changes in substrate stiffness. Additionally, changes in the actin network as a function of substrate stiffness are investigated. Actin is an important component of the cell cytoskeleton and therefore has a strong influence on the mechanical properties of the cell.

7. Research implementation and results under the program

Title of your research plan: **Investigation of different methods to compute traction stresses from experimental TFM data.**

Description of the research activities:

For TFM, images of fluorescent beads that are embedded in a polyacrylamide substrate are acquired. The contraction of the cell on the substrate surface causes deformations of the substrate and consequently leads to the displacement of embedded beads. The displacements are then used to determine the deformation field of the substrate. In a subsequent step, the traction stress field is calculated based on the deformation data and the mechanical properties of the substrate.

I compared two methods to compute the deformation field from experimental data, namely a 2D cross-correlation algorithm and an algorithm based on the Lucas-Kanada method for solving the optical flow equation. Furthermore, I implemented an algorithm in MATLAB to generate artificial bead images to investigate the influence of different parameters such as bead diameter, displacement magnitude, number of moved beads and bead-to-bead distance on the performance of the aforementioned methods. The generated deformation fields were then used to compute the traction force field using either an analytic approach (Boussinesq solution) or an inverse finite element (FE) approach. In addition, I validated both methods using input data generated by a forward FE algorithm.

8. Please add your comments, including any cultural experience during your stay in Japan

I am very grateful that I was given the opportunity to conduct my research at Osaka University this summer. It was a great experience working with Professor Wada and his co-workers. I was able to broaden my knowledge and acquired new skills. In addition, I had the opportunity to interact with many leading Japanese researchers in the field of biomechanics.

9. Advisor's remarks:

We had a good opportunity to exchange not only the research but also the culture between Europe and Japan. Lars Bollmann's research activities and his motivation had a strong impact on the Japanese students in my lab and showed them the importance of communicating with foreign researchers in English.

RESEARCH REPORT

1. Name: Lutz Alexander Brusche （ID No.: SP15303）

2. Current affiliation: University of Leeds

3. Research fields and specialties:

Social Sciences

4. Host institution: Toyohashi University of Technology

5. Host researcher: Professor Takao FUJIWARA, Ph.D.

6. Description of your current research

I research how managers of university spin-off firms in the life science sector perceive their relationship with venture capitalists. The research's focus lies on managers' perceptions of value that venture capitalists bring to the firm, and on conflicts that occur in between the two parties from the perspective of the university spin-off firms' managers. I enquire how conflicts arise and are solved, which added-values matter most and why, and additionally I try to find out how time plays into these two sides of the relationship.

Data has been collected via semi-structured interviews in the UK and Germany, exclusively from university spin-off firms operating in the life science industry due to the unique characteristics of that industry. Such are that university spin-off firms in the life science sector are in need of particularly great amounts of money, a high level of uncertainty is involved in their immature technology and the development times for the technology lie in between 10-15 years.

A conceptual framework has been developed prior to the data collection, combining an outcome and a process perspective embedded in organizational culture dimensions, relying on earlier research on forms of added-value and the nature, dimensions and resolution strategies of conflicts.

The qualitative data is currently being analysed by the use of the conceptual framework, to deliver rich context descriptions on the form of added-value and conflicts perceived, and thereby provide evidence to help drive down the high number of failing university spin-off firms. In addition, a cross-country analysis is undertaken, to ensure culturally sensitive results and take each country's distinct legal, cultural and policy situation into account.

7. Research implementation and results under the program

Title of your research plan:

Understanding University spin-off firms' relationship with venture capitalists

Description of the research activities:

While staying in Japan, I conducted in total nine interviews, five with university spin-off firms, two with venture capitalists, and two with industry experts. These interviews served a multitude of purposes in respect to the research project. The interviews with the university spin-off firms provided an insight in how these firms perceive their relationship with venture capitalists over time and in respect to added-value and conflicts. The interviews with the venture capitalists allowed to learn about perceptions from the other side of this dyad, and the interviews with the industry experts enabled me to develop an in-depth understanding of the unique characteristics of the Japanese life science industry, and the legal, political and cultural influences.

Meanwhile, several meetings with the host professor, during which I had the chance to present my research, helped to sharpen my thinking and ensure conceptual and methodological clarity.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Every single person I met in a professional as well as in an informal context was helpful and eager to help to an incredible extent, and made me feel very welcomed and comfortable to experience the many facets of Japanese culture. In addition, every form of public life is superbly organised, allowing to settle in very quickly.

9. Advisor's remarks (if any):

Mr. Brusche's attitude toward study has been the hard working and his explanation has been always very persuasive. His research question focuses on how to overcome the valley of death as initial negative profits period for biotech university spin-offs. His methodology is very useful to conceive new idea about more improved risk management.

RESEARCH REPORT

1. Name: Lisa Elaine Hammeke （ID No.: SP15305 ）

2. Current affiliation:

Master Student of East Asian Science at Ruhr-University Bochum

3. Research fields and specialties:

Humanities

4. Host institution: Kobe University

5. Host researcher: Professor Atsushi Otsuru

6. Description of your current research

My research topic examines Japanese ship newspapers (Sennai shinbun) in the context of migration and globalization during the modern history of Japan. Unlike diaries or letters of migrants, the newspapers created on boards of ships have been largely ignored by historical research. But while the former reflect subjective experiences of individual migrants, ship newspapers can be used as a source of information of the inner mechanisms of the Japanese emigration to Latin America.

The Japanese migration to Latin American countries started around the turn of the 20th century. For the duration of their journey, the Japanese migrants lived for several weeks on migration ships in a particular kind of transit area. Everyday life took place within a small, narrowly defined social space, which remained isolated from the outside world. On these migration vessels ship newspapers were produced on-board by Japanese migrants during their passage to Latin America. Stenciled on matrices and copied by the migrants themselves during the six weeks duration of the journey, the ship newspapers appeared distinguished from regular newspapers on the mainland. The first examining of ship newspapers like the “Monte-jihō” led to the conclusion that these newspapers are very informative on how the social organization and administration worked on a ship with several hundred migrants, what issues concerned the passengers and how the preparations for the arrival in the destination country evolved. It can be inferred from the content of the Japanese ship newspapers, that the newspapers were not only produced for entertainment, but even more for serving as an orientation guide and a disciplinary compass for the passengers. For my research, it was essential to collect more Japanese ship newspapers, so that I can classify them in categories, placed them in a historical and chronological context and compared the ship newspapers with each other. Based on the outcome of this, I hope to get a better understanding of the role and character of those newspapers and to draw a more comprehensive picture of the Japanese migration in the interwar period.

7. Research implementation and results under the program

Title of your research plan:

“Rites de Passage, Vie de Passage – Japanese Ship Newspapers in the 1930s”

Description of the research activities:

For my research about Japanese ship newspapers and my intended MA-thesis topic, it is essential to work with original sources, since secondary literature about this medium is almost non-existent as of yet. Therefore, my main aim during the JSPS Summer School Program 2015 in Japan was to gather resources and materials about Japanese emigration and ship newspapers which I cannot obtain in Europe.

During the stay at my host institution, the Kōbe University, I worked on my research topic under the guidance of my supervisor Professor Ōtsuru Atsushi. Professor Ōtsuru introduced me to different professors at the Kōbe University, which gave me the possibility to hold a presentation of my work in front of two seminars and discuss the topic with other researchers of Japanese migration studies. Furthermore Professor Ōtsuru introduced me to the "Kōbe Center for Overseas Migration and Cultural Interaction” which has been one of the main emigration centers in Japan during the 1930s. There I have had an open access to its museum and archive, which has been very valuable for my research. In addition, with the help of Professor Ōtsuru, I could plan a research trip to Yokohama to visit the “Japanese Overseas Migration Museum” and its archive and to the National Diet Library in Tokyo. With the help of Nemoto Takeru, a phd-Student of Professor Ōtsuru, I could find original ship newspapers from Japanese migration ships at the museum in Yokohama as well as at the National Diet Library, which was an immense progress for my research. After my return to Kōbe I could start a first classification in categories of the different volumes of ship newspapers while a group of students of Professor Ōtsuru helped me with the difficult handwriting of the newspapers. I am very grateful for the excellent supervision and support of Professor Ōtsuru and his students of the Kōbe University.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The all-day-living in Kōbe as well as the weekend trips to different places in Japan was a wonderful experience for me. I love the rich culture of Japan and the different customs which I could experience as a guest of my host family, in being together with my friends, on summer festivals and at traditional places, such as onsen and shrines and temples. The Japanese people have been very friendly and often times offered me explanation or guidance. Besides this, I am very fond of the Japanese cuisine, which is not only very rich

in variety but also healthy and delicious.

RESEARCH REPORT

1. Name: Jasmin Isabella Kajopoulos （ID No.: SP15306 ）

2. Current affiliation:

Ludwig-Maximilians-Universität München

3. Research fields and specialties:

Interdisciplinary and Frontier Sciences

4. Host institution: Osaka Prefecture University

5. Host researcher: Prof. Koichi KISE

6. Description of your current research

I explored the visual behaviour within the context of cultural backround. For that purpose, I designed an experiment that would let me investigate behaviour of people during various types of social interaction.

7. Research implementation and results under the program

Title of your research plan:

Investigating visual behaviour in different cultures.

Description of the research activities:

I trained an experimenter for several weeks on how to conduct the experiment and explained the experimental procedure. For that purpose, I translated all necessary materials, which I had previously used in Germany for the first part of my experiment, into Japanese. Afterwards, data collection commenced in collaboration with an experimenter from Japan. We used mobile eye-tracking to record subjects visual behaviour. Following this, I preprocessed the data, as well as analysed it. Then, I wrote a research report, which will be part of my Master thesis. Moreover, I prepared a presentation about the research I conducted during my time in Japan, which I held in front of the members of my host laboratory.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

As I was working in a Japanese laboratory and I was mostly in contact with Japanese colleagues, I was immersed in Japanese culture from the beginning. I also traveled to famous sight seeing spots in Kyoto, such as “Fushimi Inari” and “Nijo Castle”. During the summer one of my most treasured cultural experiences was watching the famous fireworks, “Hanabi”.

9. Advisor’s remarks (if any): -

RESEARCH REPORT

1. Name: Theresa Linderl (ID No.: SP15307)

2. Current affiliation: Institute of Physics, University of Augsburg

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Center for Frontier Science and Graduate School of Advanced Integration Science, Chiba University

5. Host researcher: Prof. Hisao ISHII

6. Description of your current research

The research of my PhD project is focused on the determination of the charge-transfer (CT) energy of organic solar cells. The typical device structure of these solar cells is a bilayer structure of an electron donating and an electron accepting material. Upon the absorption of light, charges are generated at the interface between these two materials. The energy level alignment at this interface is therefore crucial for the charge generation process and the maximum achievable open circuit voltage (V_{OC}) of the solar cell. This voltage in turn is one of the limiting factors for the over-all power conversion efficiency of the device. In organic solar cells V_{OC} is limited by the formation of charge transfer states at the donor/acceptor interface.

By using electroluminescence spectroscopy, IPCE (Incident Photon to Current Efficiency) measurements and temperature dependent measurements of the current-voltage (j-V) characteristics under illumination and in the dark it could be shown that different temperature dependent device characteristics and optical spectroscopy yield very similar values for the CT-gap at the donor/acceptor interface of organic solar cells. These methods are especially helpful since they allow the examination of the buried interface in working device structures.

By comparing the CT-energy derived by these methods to $q \cdot V_{OC}$ at room temperature an energy loss of about 0.55 eV for all investigated material systems has been determined. This energy loss is a result of radiative and nonradiative recombination events in the device.

7. Research implementation and results under the program

Title of your research plan:

Investigation of the influence of morphology and disorder on the energy level distributions of organic solar cells

Description of the research activities:

During the JSPS Summer Program 2015 I investigated the influence of morphology and disorder of organic layers on their energy level distribution by the use of low-energy ultra-violet photoelectron spectroscopy (LE-UPS) and photoelectron yield spectroscopy (PYS). Therefore I compared Diindenoperylene (DIP) and Tetraphenyldibenzoperiflanthene (DBP) that are strongly related since they consist of the same molecular backbone, but when deposited under identical conditions DIP grows crystalline and upright standing whereas DBP grows amorphous and the molecules are rather laying down. By using LE-UPS with different photon energies not only the distribution of the highest occupied molecular orbitals (HOMO) for different film thicknesses and thus the energy level diagram for the occupied states in the solar cell could be determined. Thus for both materials strong bandbending could be observed that is induced by the underlying hole injection layer. By reducing the energy of the photons further it was also possible to detect tail states of the density of states (DOS) for both materials that reach far into the bandgap region. Furthermore LE-UPS measurements with bias light of different intensity have been performed on both, pure donor layers of DIP and DBP and on device stacks in combination with the acceptor C60. The bias light induces a strong shift in the spectra of both donor materials if they are combined with the acceptor molecule, but only small shifts were found for thick pure donor layers and for thin donor layers no influence on the measured spectra could be detected. Thus the effect of illumination on the energy level distribution in working solar cells could be detected.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I would like to thank JSPS to giving me the opportunity to experience this unforgettable and enriching summer in Japan. I am truly thankful to for the cordial integration and constant help by my host researcher Prof. Hisao Ishii and the entire group. I learned a lot about new experiment techniques and the results are a good basis for intensifying and expanding our ongoing collaborations.

RESEARCH REPORT

1. Name: Andreas Nazet （ID No.: SP15308 ）

2. Current affiliation: Universität Regensburg

3. Research fields and specialties:

Chemistry

4. Host institution: Niigata University

5. Host researcher: Prof. Yasuhiro Umebayashi

6. Description of your current research

Ionic liquids are a promising class solvents with have surged a considerable amount of interest. Unfortunately information on the molecular dynamics is still not readily available for all classes of ionic liquids.

In our group we apply dielectric relaxation spectroscopy in the microwave frequency range to study the response of the matter under test to electromagnetic irradiation in the nano- to picosecond timescale. This response is expressed in terms of the complex permittivity $\varepsilon(\nu)$ giving insight into the collective dipole relaxation and its distribution as a function of frequency. Decomposing the obtained spectra allows singling out the contributions of different species and enables the determination of solvation numbers, ion pair association and relaxation mechanism of the dipolar species present in the solution. Additionally high precision measurements on viscosity and conductivity allow the determination if the observed dynamic processes are coupled or decoupled from the transport properties.

In my recent work I focused on synthesis and accurate determination of the dynamic and transport properties of a homologous series of alkylammonium formate based protic ionic liquids and obtained information on the effect of changing the alkyl chain length revealing a close coupling between the activation energies of the structural relaxation and transport processes.

Currently, I focus on the characterization of the dynamic properties of mixtures of the protic ionic liquid ethylammonium nitrate with molecular solvents. As expected, the possibility of the former to from a three dimensional hydrogen bond network influences the properties of these mixtures strongly and revealed striking similarities between water and ethylammonium nitrate in terms of the relaxation time distribution.

7. Research implementation and results under the program

Title of your research plan:

Raman Study of the Intermolecular Interactions in Binary Mixtures of Molecular Solvents with the Protic Ionic Liquid Ethylammonium Nitrate

Description of the research activities:

My research work focused on resolving the interactions between the above mentioned ionic liquid and several organic solvents (*N*,*N*,Dimethylformamide, *N*,*N*-Dimethylacetamide, Dimethylsulfoxide and Acetonitrile) as well as water by preparing concentration series and collection of Raman spectra. Unfortunately my work was delayed in the beginning due to failure in the measurement equipment. The time until it was repaired was spent in preparing a joint publication with results acquired in a former collaborative work.

Due to the delay at the beginning of the program, proper evaluation of the measurements just started but preliminary results show that the interactions between EAN and water/acetonitrile are of either very weak or similar nature due to negligible effects on the obtained spectra. The evaluation of the mixtures with DMSO still needs to be conducted due to strong overlap of the interesting bands. In the case of EAN with DMA and DMF, strong evidence for directional interactions between the cation and the solvent could be found pointing at a two state model with the formation of a supermolecular complex. Currently, ab initio calculations are performed to elucidate these findings and extract the most probable conformations of this complex.

Additionally, during my stay in Niigata I had the opportunity to teach members of my host group about dielectric relaxation spectroscopy. Due to the recent acquisition of appropriate equipment I could give them in depth instructions on usage and provide software developed in our work group for data treatment and evaluation.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The stay with my host family was my personal highlight. They gave me an insight into Japanese family life and did a memorable sight-seeing tour around Kamakura with me. In long discussions I learnt a lot about Japan, its history, culture and way of life. In Niigata I appreciated the calmer side of Japan compared with the buzzling city of Tokyo.

Exploring Niigata, traveling around Niigata-ken and paying visits to Tokyo and the recreational area of Hakone made my stay in Japan a marvelous experience. I will definitely visit Japan again.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Daniel NOLL （ID No.: SP15309）

2. Current affiliation: Goethe University Frankfurt am Main

3. Research fields and specialties:

Mathematical and Physical Sciences (Accelerator Physics)

4. Host institution: KEK, High Energy Accelerator Research Organization

5. Host researcher: Prof. Dr. Yong Ho Chin

6. Description of your current research

In modern high-intensity ion accelerators, the beam extracted from an ion source has to be transported and adapted to the first accelerating structure, typically an RFQ. This is the task of a low-energy beam transport section (LEBT). Due to the low beam velocities, space charge effects from the repulsion of the beam's charge can lead to loss of beam quality, sometimes limiting the current that can be transported. Accumulation of electrons from ionizing collision of beam particles with residual gas atoms inside the beam potential can help mitigate the effects of the beam's charge. In many cases however, the distribution of the compensation electrons do not follow the distribution of the beam, leading to aberration and emittance increase. To be able to improve modeling of LEBT sections of future accelerators, it is important to better understand the compensation process and its influence on beam transport.

My work focuses on the simulation of space-charge compensation. Models for proton impact and electron impact collisions were included into a newly developed Particle-in-Cell (PIC) code. Systems with simple geometries were investigated. These simulations usually require a large amount of processor time, typically in the order of days on tenths of processors. In the simulation of a simple beam drift, Gaussian-shaped velocity distributions were found. In this case, the electron cloud should behave like a non-neutral plasma. The simulations also predict the formation of double-layers at the edges of the simulated beams.

7. Research implementation and results under the program

Title of your research plan:

Numerical Solution of the Poisson-Boltzmann Equation for the Investigation of Space-Charge Compensation

Description of the research activities:

The electric potential and from this also the spatial distribution of non-neutral plasmas confined within some external potential can be calculated from the Poisson-Boltzmann equation: $\Delta\varphi = \eta \exp(-e*(\varphi+\varphi_{ext}) / kT)$. A solver for a nondimensionalized version of the equation was implemented using finite differences. Initially a 1d implementation was used. Convergence problems for low Debye lengths were solved by including the external charge distribution in the equation. The influence of the algorithm parameters on the convergence time was studied. For Debye lengths close to the beam size, strongly nonlinear forces at the beam edges occur. The solver was then included into a simulation package for beam transport and emittance growth studied for beams with different initial distributions. For parameters taken from previous PIC calculations, changes in the beam distribution could be reproduced qualitatively.

Work on an implementation in r-z including arbitrary geometry features was started. In the future, this will be used to study the distribution of the compensation plasma in longitudinal direction.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I very much enjoyed visiting the summer festivals in Japan, such as the Mitama festival, the Sumida River fireworks and the Nara Toukae Latern festival. Standing in line for the summit of Mt. Fuji and seeing the beautiful sunrise was a unique experience. I would like to thank my supervisor Prof. Yong Ho Chin for the invaluable discussions and his efforts for showing me the area around the laboratory.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Katharina PUETZ （ID No.: SP15310）

2. Current affiliation: University of Freiburg, Germany

3. Research fields and specialties:

Chemistry, Electrochemistry

4. Host institution: Shinshu University, Ueda (Nagano)

5. Host researcher: Prof. Wataru SUGIMOTO

6. Description of your current research

The two most fundamental reaction types in general chemistry are redox- and acid/base reactions. The redox potential of any species depends on its activity and is influenced by the medium. This holds of course for the used reference systems in different media itself. Thus to date the existing lists of redox potentials and pH scales in aqueous and non-aqueous solvents aren't comparable.

We recently introduced the concept of the Protoelectric Potential Map (PPM) which presents a new combined pH- and redox scale in an absolute sense.[1] The PPM is thermodynamically well described and allows one to compare and predict stabilities and reaction behavior of any species in any medium. The choosen reference states are solvent independent which allows the introduction of comparable values.

For this purpose we define the reference state of maximum acidity/reducity as the standard chemical potential of the proton ($\mu_{abs}°(H^+, g)$)/ of the electron ($\mu_{abs}°(e^-, g)$) in the gas phase (ideal H^+/e^- gas at 1 bar and 298.15 K) which are arbitrarily set to 0 kJ mol^{-1}. These states are totally notional but well to calculate. The acidity/reducity and hence the chemical potential of the gaseous proton H^+/e^- is lowered by the interaction with any type of medium and results in absolute acidities pH_{abs}/reducities pe_{abs} or E_{abs}.

For the experimental approach reference systems in an absolute manner need to be established in different media. In addition we want to introduce particular examples in the PPM to show its use and encourage people to join this new but promising concept. The goal is to establish a database containing easy comparable redox potentials and pH values. We opened the corresponding website (www.ppm.uni-freiburg.de) with the current present values and working on its extention.

[1] V. Radtke, D. Himmel, K. Pütz, S. Goll, I. Krossing, *Chem. Eur. J.***2014**, 20, 9194.

7. Research implementation and results under the program

Title of your research plan:

Electrochemical Characterization of Pt/C Anodes Modified with RuO_2 Nanosheets for an Enhanced CO Tolerance in Polymer Electrolyte Fuel Cells.

Description of the research activities:

In polymer electrolyte fuel cells (PEFCs) presently PtRu binary nanoparticles supported on carbon (PtRu/C) are used as anode catalyst. PtRu/C shows compared to Pt/C a higher tolerance to CO which adsorbs on Pt blocking the active sites for the conversion of H_2. Still CO concentration of reformate fuel must be cut down to 10 ppm which leads to high system costs. Metal oxides can act as co-catalyst to decrease CO adsorption but in many cases covers part of Pt the hydrogen oxidation reaction (HOR) sites. The goal is to find an additive that does not block the HOR site but reduces CO adsorption and/or enhances CO oxidation.

It could be shown that the additive $RuO_{2.1}$ nanosheets to PtRu/C ($RuO_{2.1}$ns-PtRu/C) doesn't obstruct HOR and in addition shows higher CO tolerance compared to PtRu/C.[2] A different composition of the additive RuO_2 was investigated in this project. First starting for a better understanding of the role of RuO_2 with RuO_2ns-Pt/C with no metallic Ru. For a comparison different catalyst types (Pt/C, RuO_2ns-Pt/C and RuPt/C) were prepared and deposited on a mirror-polished glassy carbon rod (Ø: 6mm). The electrochemical characterization included the determination of the surface area and the activity of the materials for the conversion of H_2. The activity was characterized via chronoamperometry at 0,02 V vs. RHE in $HClO_4$ (0,1 M) saturated with H_2 as well as with 300ppm CO/H_2 at 25 °C and 60 °C. First results show similar characteristics of RuO_2ns-Pt/C compared to $RuO_{2.1}$-Pt/C but for a better comparison more research needs to be done. In addition the oxidation potential of CO on RuPt/C and RuO_2ns-Pt/C was characterized by CO stripping in $HClO_4$ (0,1M, 25 °C).

[2] D. Takimoto, T. Ohnishi, W.Sugimoto, *ECS Electrochemistry Letters*,**2015**, 4 (5) F35-F37.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

9. Advisor's remarks:

Katharina has experienced much during her short stay, in terms of both research as well as cultural-wise. In addition to spending time in the laboratory, she took time to visit another research group in Yokohama National University to discuss her work, and also attended a well-known international conference in Korea. Of course, our students have also enjoyed the experience of having an international graduate student. 7 weeks in the lab was a little too short to conduct experimental electrochemistry with high impact. I hope that we can collaborate in the future and continue research.

RESEARCH REPORT

1. Name: Marco SEKULLA （ID No.: SP15311）

2. Current affiliation: Universität Siegen

3. Research fields and specialties:

Mathematical and Physical Sciences (Theoretical Particle Physics)

4. Host institution: KEK, High Energy Accelerator Research Organization

5. Host researcher: Prof. Dr. Mihoko Nojiri

6. Description of your current research

After a Higgs has been discovered, there are many open physical questions concerning the Higgs sector and the associated electroweak symmetry breaking. Weak vector boson scattering (VBS) is very sensitive to any new physics associated with electroweak symmetry breaking.

As part of my research I model deviations from the Standard Model of particle physics with effective field theory (EFT) operators and generic resonances. Here I also take care of unitarity issues, and the implementation into WHIZARD for complete Monte-Carlo simulations.

Anomalous couplings describe new-physics effects in weak VBS using an EFT approach. It is necessary to consider a complete and non-redundant basis of higher dimensional operators O_i with corresponding Wilson coefficients C_i at a new-physics scale Λ to construct a bottom-up EFT. However only the ratio C_i/Λ can be tested by experimental data, and the validity of the EFT is a priori unknown. A conventional EFT analysis will fail at high energies, especially in the presence of the light 125 GeV Higgs boson.
The T-matrix unitarization scheme extends the K-matrix unitarization prescription to provide an asymptotically consistent reference model that has been matched to the low-energy effective theory of arbitrary non-perturbative and perturbative (to all orders) models.

My further studies concern resonance models for electroweak multi-boson interactions at highest energies and the explicit matching of such a model parametrization on the generic EFT.

7. Research implementation and results under the program

Title of your research plan:

Vector Boson Scattering at the International Linear Collider

Description of the research activities:

The International Linear Collider (ILC), which is planned to be built in Japan, should be more sensitive to VBS processes. The experimental samples are cleaner for electroweak physics processes and in addition one can benefit of polarized beams.
We are conducting a phenomenological analysis of VBS with anomalous quartic gauge couplings an additional resonances at the ILC within above mentioned calculation scheme.

During my studies, I gave a talk about my research at the 14th Meeting of the Higgs working group in Toyama. Besides an overview of Higgs research in Japan, the workshop and my research at KEK gave me the opportunity to establish contact with several researchers in Japan.

The research with Mihoko Nojiri will be continued after the JSPS summer program 2015.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The homestay during the introductory week of the summer program was a unique experience to get insights in the everyday life of Japanese families. I was overwhelmed by the hospitality of the mother of my guest family and other members of the hippo family club.

Additionally, I would like to thank Mihoko Nojiri and Shinya Kanemura, who gave me the great opportunity to attend to the workshop in Toyama.

9. Advisor’s remarks (if any): He have got used to the other students and PD showing high ability to research in abroad.

RESEARCH REPORT

1. Name: Robert WESTPHAL （ID No.: SP15312）

2. Current affiliation: Department of Neuroimaging, The Institute of Psychiatry, Psychology & Neuroscience (IoPPN), King's College London, UK

3. Research fields and specialties: Biological Sciences

4. Host institution: Department of Functional Brain Imaging, Institute of Development, Aging and Cancer, Tohoku University, Sendai, Japan

5. Host researcher: Akira Sumiyoshi

6. Description of your current research

My current research is centered on the characterization of a commonly used rat model of Parkinson's disease (PD), the 6-OHDA rat, with focus on structural and functional brain changes using magnetic resonance imaging (MRI), immunohistology and behavioural tests. PD is a debilitating disease affecting primarily elderly people, who struggle to initiate and execute simple motor movements. Classic motor symptoms include tremor, slowness of movement and gait disturbance but non-motor symptoms such as depression, loss of smell and cognitive deficits s are common as well. Pathologically, dopaminergic neurons in the substantia nigra degenerate resulting in striatal dopamine depletion and dysfunction in basal ganglia transmission and ultimately in motor deficits. Neuroimaging studies using MRI have also consistently reported changes in cortical brain regions, particularly in frontal motor and prefrontal motor cortex, on a functional and structural level using tools such as voxel-based morphometry (VBM) and resting state MRI connectivity analysis. However, the biological correlate of changes in MRI measurements remains unclear. In the 6-OHDA rats, we were now able to attribute some of these MR changes to dopaminergic denervation in the cortex and subsequent remodeling of the surrounding tissue (Westphal, unpublished). This information thus may help to better interpret MR images in clinical studies and highlights the utility of animal models in PD research. Indeed, the loss of dopaminergic neurons and the associated striatal dysfunction has been modelled in several animal systems to study and better understand the mechanisms underlying the disease pathophysiology. Unfortunately, despite its undisputable contribution of our understanding of the pathophysiology and pathogenesis of PD, the 6-OHDA rat does not recapitulate all features seen in the human conditions. In particular, the 6-OHDA rat does not show the accumulation of alpha synuclein filled Lewy bodies, a major hallmark of PD, and its disease state is a static one reflecting end-stage PD. This fact hampers the development of imaging-based translational biomarker(s) of

progressive brain changes, which would allow an early and non-invasive diagnosis of the disease. Critically, without imaging biomarkers, the efficacy of new drug candidates cannot reliably be verified non-invasively.

To extend previous effort in determining a rodent MRI phenotype for the verification and validation of imaging biomarker candidates, we propose to investigate the patterns of gray matter loss in a more relevant rat model of PD, the rotenone rat, by using the clinically-relevant VBM tool for the analysis of structural MRI data in conjunction with corroborative behavioral testing and immunohistology.

7. Research implementation and results under the program

Title of your research plan: Characterization of gray matter atrophy following daily rotenone injection in rats

Description of the research activities:

50 rats were randomly assigned to either of two groups: rotenone n=35 and sham (control) n=15. Animals in the rotenone group received a daily injection of rotenone for seven days to induce parkinsonism. Equally, rats in the control group received a daily injection of saline. After injection week, rats were left for another week before MRI. All rats were monitored on a daily basis for signs of motor deficits using appropriate behavioral tests. At the final time point at day 15, all rats were subjected to an in vivo structural MRI experiment, wherein high resolution T2-weighted images of the brains were acquired. Upon completion of each MRI scan, rats were transcardially perfused, decapitated and their brains removed for further histological examination of the degree of dopaminergic neurodegeneration.

The principal finding of this experiment was that the rotenone rats demonstrated a significant loss of gray matter volume in the motor and sensorimotor cortex, which is consistent with the development of motor deficits as evidenced by the behavioral tests. The motor cortex is critical for motor execution and gray matter loss in this part of the brain may underlie the behavioral complications observed in the rotenone group. Furthermore, we observed mild dopaminergic cell loss in the substantia nigra, a key region in the pathology of PD and dopaminergic denervation in the cortex, which may partly explain the gray matter loss as observed using MRI. Overall, this data suggests that cortical gray matter loss can be detected non-invasively in the rotenone rat using MRI in ways detectable in human PD, further highlighting the utility of preclinical MRI studies in rodents for translational research and the identification and validation of cross-species imaging biomarkers.

RESEARCH REPORT

1. Name: Jana WILMERS （ID No.: SP15313）

2. Current affiliation: Helmholtz-Zentrum Geesthacht
Simulation of Solids and Structures

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Nagoya University

5. Host researcher: Prof. Nobutada OHNO

6. Description of your current research

My current research at the Helmholtz-Zentrum Geesthacht deals with the modelling of polymeric materials. In particular, this research deals with the development and implementation of thermodynamically and physically consistent models to describe and predict the highly non-linear coupled behavior observed in multiphysics phenomena such as solvent-induced swelling and ion conductivity in polymers.

Numerical simulations of material behavior enable us not only to predict a new material's properties without resorting to time and cost intensive experimental studies but, especially in the case of coupled phenomena, allow to study the interactions of different influencing factors that cannot be separated in experiments. Thus, simulations help in elucidating the mechanisms that result in characteristic material properties. This understanding, in turn, is essential in developing high-class engineering and functional materials.

7. Research implementation and results under the program

Title of your research plan:

Homogenisation analysis of Carbon-Fibre Reinforced Polymer Laminates

Description of the research activities:

Engineering and natural materials are heterogeneous on different scales. This heterogeneous microstructure has a strong influence on the observed macroscopic behaviour. Understanding the relations between microstructure and macroscopic behaviour, thus, does not only allow for the prediction of existing materials but is also the key to developing new, highly specialized materials. Using the homogenization method, macroscopic properties can be obtained from calculations on a detailed model of the microstructure. This is only possible if the boundary conditions are chosen carefully so that they accurately transform the macroscopic state to the microstructure. Further, care must be taken to choose these boundary conditions in a physically meaningful way. One of the requirements ensuring this is Hill's macrohomogeneity condition.

In the work here at Nagoya university, we have mathematically shown that so called periodic boundary conditions and their implementation in a Finite Element Software in fact guarantee the fulfillment of Hill's condition. This proof was then utilized in simulations of Angle-Ply Carbon Fibre Laminates, an important material which has a high specific strength and a complex microstructure of long fibres that are oriented in different angles to each other. Due to this microstructure, the material shows a pronounced anisotropy in its macroscopic behaviour, and, for certain angles exhibits anomalous characteristics such as auxeticy, i.e., an extension perpendicular to the strain during tension. The simulations carried out here are verified with recent experimental studies on the material and allow for an important insight into the mechanisms causing the characteristic behaviour.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Nancy Berg （ID No.: SP15401）

2. Current affiliation: Queen's University

3. Research fields and specialties:

Engineering Sciences

4. Host institution: National Agriculture and Food Research Organization

5. Host researcher: Toshikazu HORI

6. Description of your current research

My current research at Queen's University focuses on measuring slope displacement, primarily through the use of photogrammetry and installed in-ground sensors. Landslides occur all over the world and destroy vital infrastructure and can also be life threatening. For this reason, it is important to have a means to monitor the movement of slopes that are prone to landslides and to determine visual warning signs that are present prior to a landslide occurring. Traditionally, slope movement has been monitored using slope inclinometers. However, this method is expensive and does not give any information about visual changes in the slope. My research project is testing an emerging slope monitoring technology that uses images captured either from the ground or from an unmanned aerial vehicle. These images are then used to produce digital terrain models through the principles of photogrammetry. Photogrammetry is the science of making measurements from photographs. It works by determining the unique 3D location of an object or ground feature, through the use of two overlapping images taken at two different camera locations. Through the use of this method a site can be modeled in 3D allowing visual changes in the slope as well as the displacement of a slope to be monitored over time.

I am also conducting the first North American trial of an acoustic emissions (AE) sensor called Slope ALARMS which works by measuring and analyzing AE produced by soil due to inter-particle friction. Inter particle friction causes shear stress resulting in a rearrangement of soil particles along developing shear surfaces and causes slope deformation. For this reason AE can be used to determine the movement rate of a slope, which is proportional to the frequency of the AE.

7. Research implementation and results under the program

Title of your research plan:

Modeling of Earth Dam Failure Induced by Heavy Rainfall

Description of the research activities:

My research activity in Japan included performing full-scale tests on an earth dam similar to those used for agriculture. In Japan there are about 210,000 small earth dams that are used for irrigation purposes. Many of these dams are old and were constructed without the use of compaction equipment and are composed of sandy soils with low dry densities. For these reasons they are prone to seepage induced failure caused by heavy rainfalls. Heavy rainfall is a concern to dam stability since it results in greater saturation and increased pore water pressures which can lead to a decrease in soil strength within the embankment. As rainfall infiltrates the slope unsaturated soil becomes saturated, resulting in a reduction of soil suctions. This reduction in soil suction can cause shear displacements or compressions to occur resulting in saturated collapse of the earth embankment. In order to better understand seepage induced dam failure, full-scale tests need to be conducted. During the completed full-scale tests overlapping images were collected using six stationary cameras in order to produce a point cloud of the x,y,z coordinates of the downstream face of the earth dam. By comparing the change in the produced point clouds for images collected at different intervals throughout the rainfall tests the displacement of the slope can be determined. In order to confirm the accuracy of the calculated displacement from the produced digital terrain models the slope displacement was also measured using 25 displacement gauges that were evenly distributed throughout the downstream face of the dam

The pore water pressure was also measured at 15 locations throughout the slope in order to determine the importance of water infiltration and excess pore water pressures on the failure mechanism of the slope. By measuring the pore water pressure instances of piping where pore water pressure is released, which can lead to slope erosion, can be monitored. Through the use of the data collected during the completed full-scale tests warning signs, which can be used to safeguard communities near earth dams, can be determined.

RESEARCH REPORT

1. Name: Melissa B. BREDOW （ID No.: SP15402）

2. Current affiliation: Queen's University

3. Research fields and specialties:

Biological Sciences

4. Host institution: Iwate University

5. Host researcher: Prof. Matsuo UEMURA

6. Description of your current research

Unable to regulate their internal temperature, overwintering plants are highly susceptible to freezing-induced injury during winter months. Some freezing tolerant plants secrete antifreeze proteins (AFPs), which allow survival at temperatures below −10 °C. AFPs protect plants by lowering the freezing point of extracellular fluids and preventing ice-crystal growth. There is also evidence that AFPs may associate with the plasma membrane providing stabilization during freeze-thaw cycles however, a direct interaction has never been shown. My research is focused on understanding the mechanisms involved in AFP-induced freezing tolerance in plants. Using genetic and biochemical approaches I have identified and characterized seven novel AFPs in the model grass *Brachypodium distachyon.* The generation of transgenic lines with attenuated AFP expression has allowed us to verify that AFPs are required for membrane protection and freezing survival in this species. The use of AFPs for the development of more cold-hardy crops is an attractive prospect. We have demonstrated that expression of AFPs from the perennial rye grass, *Lolium perenne*, are capable of enhancing freezing-tolerance in *Arabidopsis thaliana*. Additionally, we found that the localization of these proteins and the number of isoforms expressed are critical factors in determining the degree of freezing protection.

7. Research implementation and results under the program

Title of your research plan:

Elucidating the mechanisms underlying antifreeze protein-induced freezing tolerance in cereal grasses

Description of the research activities:

My research at the Cryobiofrontier Research Center focused on determining if AFPs from *Brachypodium* associate with the plasma membrane following exposure to low temperatures. Dr. Uemura's research group at Iwate University has established a highly optimized protocol for the extraction of plasma membrane proteins from *Arabidopsis*. The plasma membranes of non-acclimated and cold-acclimated plants were extracted using a dextran-polyethylene glycol two-polymer system. The peptides associated with the plasma membrane were treated by in-gel tryptic digestion and purified prior to nano-LC MS/MS analysis. More than 1,400 peptides were identified using four replicates of non-acclimated and cold-acclimated plasma membrane extracts. Enzyme activity assays were conducted to verify the composition of purified membrane fractions. Unfortunately, low levels of microsomal components, such as mitochondria, appear to have been retained in the plasma membrane extracts so further optimization of the plasma membrane isolation protocol for *Brachypodium* will need to be done before reliable proteomics can be established. Proteomic analysis suggests that AFPs were not associated with the plasma membrane in this species. However, it is also possible that the concentration of AFPs was too low to be detected by mass spectrometry or that AFPs, which are readily degraded, did not maintain stability during the procedures. Plasma membrane extracts will be tested for AFP activity using methods that require very low levels of AFP expression following my return to Queen's University.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Dana DANIELSON (ID No.: SP15403)

2. Current affiliation:

University of Ottawa

3. Research fields and specialties:

Biological Sciences

4. Host institution: University of Tokyo

5. Host researcher: Prof. Yukihide TOMARI

6. Description of your current research

RNA silencing is a highly conserved pathway that allows sequence specific inhibition of gene expression and functions as an anti-viral immune defense in plants. In response, many viruses have evolved mechanisms to suppress the RNA silencing pathway. Tombusviruses, RNA viruses which infect plants, employ the p19 protein to suppress RNA silencing. p19's activity has largely been attributed to its ability to bind short interfering RNA (siRNA) molecules with high affinity, although details of its mechanism remain unclear. At the University of Ottawa, I have been working to develop p19 as a tool for studying small RNA molecules and for suppressing RNA silencing in heterologous systems.

7. Research implementation and results under the program

Title of your research plan:

Biochemical investigation of the p19 protein

Description of the research activities:

At the University of Tokyo, I have investigated the kinetic parameters of p19:siRNA interactions. From the experiments performed here, I have been able to determine important details of how p19 is able to bind its small RNAs. We observe that p19 is able to bind its small RNAs very tightly, forming a protein:RNA complex than is more stable than previously thought. These findings lend mechanistic insights into tombusvirus biology, and are also relevant to the development of p19 as a biotechnology tool.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

My stay in Japan has been a very rewarding experience, both scientifically and personally. Performing experiments in Prof. Tomari's laboratory at the University of Tokyo has been very fruitful, and has helped my development as a scientist. Furthermore, learning more about the research program in this laboratory has been very interesting for me. I have had many cultural experiences facilitated by Prof. Tomari and the members of this lab, all of which have been very welcoming, and have made special efforts to make my stay in Japan more enjoyable. We have visited sites in Tokyo and have shared many meals together, as well as cooking traditional Japanese food together.

9. Advisor’s remarks (if any):

During her stay in our lab, Dana devoted herself to experiments every day and gained important insights into the enzymology of p19, an anti-RNA silencing protein of tombusviruses. Her enthusiasm and positive attitude have had a very positive impact on the members of our lab and I really appreciate that. I just wish that she could stay longer—two months was just too short—but I’m confident in her continued success back in Canada.

RESEARCH REPORT

1. Name: Ryan EVELEIGH (ID No.: SP15404)

2. Current affiliation: Queen's University

3. Research fields and specialties:

Biomedical Engineering

4. Host institution: Tokyo Women's Medical University

5. Host researcher: Prof. Ken MASAMUNE

6. Description of your current research

The human hip joint is commonly modelled mechanically as a ball and socket joint. This model is widely held by physicians and biomechanics researchers to be a suitable representation of hip joint motion. The characterization of the hip joint as a ball and socket implies that the head of the femur (thigh bone) and the acetabulum (indentation where the head of the femur interfaces with the pelvis) are spherical in shape. This also implies that the head of the femur rotates inside the acetabulum, and does not undergo linear motion relative to the pelvis.

The Medical Computing Laboratory at Queen's University has found evidence that suggests that the ball and socket model is false. Studies of CT scans of human patients have found that the shape of the head of the femur as well as the acetabulum are better described by an ellipsoid than by a perfectly round sphere [1]. In addition, studies of human cadaver hip joint motion using optical tracking equipment and CT scans have been able to demonstrate measurable relative translation between the head of the femur and the acetabulum on the order of about 4 mm during passive motion [2].

The next steps in continuing this research include studying hip joint motion in live human subjects which requiring less invasive methodology than the previous cadaver study. Low tesla, open MRI scanners are suitable for this, as they are non-invasive and allow for large hip motions.

[1] B. J. Rasquinha, J. F. Rudan, G. C. A. Wood, and R. E. Ellis, "Ellipsoid Fitting of Dysplastic and Early Arthritic Articular Hip Surfaces," *Orthop. Res. Soc.*, 2011.

[2] S. Zakani, E. J. Smith, M. Kunz, G. C. A. Wood, J. Rudan, and R. E. Ellis, "Tracking Translations in the Human Hip," *ASME 2012 ...*, 2012.

7. Research implementation and results under the program

Title of your research plan:

Magnetic Resonance Imaging for In-Vivo Assessment of Three-Dimensional Hip Joint Translation

Description of the research activities:

My research activities focused on development of a method to measure hip joint translation using open gantry low tesla MRI to track bone position and conventional high tesla MRI (which can generate higher resolution images) to measure anatomical information.

First, a high tesla (3T) MRI scan of a single subject's right hip joint was taken in a conventional, clinical grade MRI scanner. Next, MRI scan parameters were found that allowed for good quality images to be taken of the same hip joint using a low tesla (0.3 T) scanner available at Tokyo Women's Medical University. Both the high tesla and the many low tesla images were processed in order to extract 3D models of the subject's pelvis and femur. In addition, various implementations of the Intermittent Closest Point (ICP) algorithm were tested to determine suitability for correlating the low tesla images with the high tesla images. The correlation process is known as registration. Low tesla MRI scan parameters were adjusted in order to minimize root mean squared error (RMSE) between the low tesla images and the high tesla images after registration via ICP.

It was found that low tesla images taken of the subject's hip joint in a neutral pose could be registered to the high tesla images with under 1.5 mm RMSE. This error was deemed acceptably low for this method to be used in further biomechanical research, including investigation of hip joint translation. It is likely that this project will be continued through future collaboration between Tokyo Women's Medical University and Queen's University. Additional scans of the subject's right hip were taken with the hip joint positioned in a variety of poses that were thought to show translation. These scans will be analyzed further at Queen's University.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): I quite enjoyed my time in Japan. Tokyo was a very fast-paced city! I was fortunate to be able to visit many nature sites in and around I also was able to climb Mount Fuji – a highlight of my trip, and I definitely recommend it to anyone else who comes. Finally, I was able to see Kyoto and experience one of the most beautiful cities in the world. Everyone I interacted with was hardworking, kind, and helpful, especially my host family and the people I worked with in my lab. Japan was amazing!

9. Advisor's remarks (if any): I was pleased to have Ryan come and visit our lab. Ryan worked very hard during his time here. Many times he would encounter a problem and would figure out a way to solve it so that the research could continue. His hard work has paid off and he has obtained good results for his preliminary study. I look forward to collaborating in the future with Ryan and to his next visit in Japan.

RESEARCH REPORT

1. Name: Dany LACHANCE-QUIRION （ID No.: SP15405）

2. Current affiliation: Université de Sherbrooke

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: University of Tokyo

5. Host researcher: Prof. Yasunobu Nakamura

6. Description of your current research

My research project aims to combine two different candidates of quantum bits (qubits) used to encode and process quantum information. In such an hybrid architecture, the advantages of each types of qubit could be used to circumvent the disadvantages of the other. More specifically, I'm aiming to make qubits encoded in the spin of a single electron compatible with those based on superconductivity, thus combining two of the most promising candidates for qubits in solid state systems.

7. Research implementation and results under the program

Title of your research plan:

Toward encoding quantum information in a magnetostatic mode

Description of the research activities:

The research group of Pr. Yasunobu Nakamura at the University of Tokyo is studying an hybrid architecture where a macroscopic magnetostatic mode in a ferromagnet is used as a spin system, as opposed to the single electron spin used in my main PhD project. The interaction between this ferromagnet and a qubit based on superconductivity enables in principle the encoding of quantum states of the qubit in the ferromagnet. The macroscopic quantum states in the ferromagnet could then be used to transfer quantum information from superconducting qubits, operated in the microwave domain, to photons in an optical fiber. This quantum transducing protocol would potentially enable quantum processors to be distributed over large distances.

During my internship in the group of Prof. Nakamura, I first investigated the interaction between the magnetostatic mode and the superconducting qubit in the so-called dispersive regime. Using microwave spectroscopy, I was able to resolve single quanta of excitation in the magnetostatic mode (called magnons) using the superconducting qubit as a quantum probe.

Resolving magnon-number states in the qubit spectrum is a necessary ingredient for encoding quantum information of the qubit to the magnetostatic mode. Using time-domain microwave control of both the superconducting qubit and the magnetostatic mode, I started to investigate the implementation of a encoding protocol already demonstrated between a microwave cavity and a superconducing qubit. Preliminary results suggest the aforementioned protocol can indeed be implemented in our system and that successful encoding of quantum information in the magnetostatic mode therefore seems possible.

RESEARCH REPORT

1. Name: Kristjana LOPTSON （ID No.: SP15406 ）

2. Current affiliation: University of Alberta

3. Research fields and specialties:

Social Sciences

4. Host institution: Kobe University

5. Host researcher: Dr. Yosuke HIRAYAMA

6. Description of your current research

My research is a comparative political economy study of housing insecurity in Japan and Canada. I compare the ways in which the two housing systems have been shaped by distinct political interests and institutions, and the impact of housing provision on social welfare in each country.

7. Research implementation and results under the program

Title of your research plan:

A comparative study of the political economy of housing insecurity in Japan and Canada

Description of the research activities:

My research involved a literature review of publications on housing bubbles and Japanese housing policy, with particular emphasis on the political environment leading up to the Japanese housing bubble in the late 1980s. I conducted a search of various Japanese government documents and statistical reports. I also relied heavily on the published research of my host researcher, Dr. Hirayama. It was a unique opportunity for me to meet with Dr. Hirayama and discuss various questions I had about Japanese housing.

My research was enabled by the incredible support I received from my colleagues in the department. Part of my research involved walking tours to observe the layout of housing. My colleagues took me to a neighbourhood with social housing and homeless facilities. This gave me a better understanding of how housing insecurity manifests differently in Canada and Japan. I was also taken to a museum with models of housing developments from the Edo period of Japanese history until the present day, which showed how housing developments corresponded to urbanization and changing economic circumstances over different periods of Japanese history.

In the instances where I could not find English language information, I was able to hire two students with JSPS research funds to help me locate Japanese documents and have them translated for me into English. The students also translated an overview of my research into Japanese.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

The JSPS fellowship program provided me with many rich experiences of Japanese culture. I was warmly welcomed by my host department at Kobe University and was included in the weekly research seminars, which was a special experience. After each of the weekly seminars the other students, Dr. Hirayama and I would share a meal together. Dr. Hirayama and the students went out of their way to organize a number of activities, including a tour of Kobe and museum visits. I was also invited to a tea ceremony, and various social activities including a department welcome party and also a farewell party. Through building up relationships with a number of people in the department I learned a lot about life in Japan and made many friendships.

9. Advisor’s remarks (if any):

Ms. Loptson’s comparative research on housing in Canada and Japan has developed substantially during her stay in Kobe University. She has positively joined my and students’ group with friendly attitudes notwithstanding language barriers and she provided a stimulating and inspiring presentation regarding her research. I and my students have been very happy with accepting her.

RESEARCH REPORT

1. Name: Katelyn SEABORN （ID No.: SP15407）

2. Current affiliation: University of Toronto

3. Research fields and specialties:

Engineering Sciences

4. Host institution: National Institute of Advanced Industrial Science and Technology

5. Host researcher: Dr. Yutaka SATOH

6. Description of your current research

Powered chairs, including electric wheelchairs and mobility scooters, are increasingly being adopted by older adults facing reduced mobility in and outside of the home. Human factors research has investigated training, functional, and environmental factors related to the design of such devices for older people, but little research has considered other relevant factors, such as the social, entertainment, and non-assistive technology needs of this group. Findings from my first doctoral study suggest that older powered chair users desire advanced training, such as obstacle courses and challenging driving tasks, as well as greater understanding of their circumstances in the non-powered chair users around them. Further, they are willing, if not actively interested in, trying platforms that harness new technologies and interaction paradigms to achieve this.

The goal of my doctoral research is to explore whether and how psychological well-being as performance mastery and empathy training for older powered chair users and their friends and family can be facilitated by a mixed reality platform. Mixed reality occurs when physical and virtual space are seamlessly integrated. As such, it may be an appropriate platform for making conscious use of a powered chair while benefitting from the advantages of virtual interaction and digital displays. Mixed reality has been facilitated through head-mounted displays (goggles worn over the eyes), projectors, laptops carried on the body, and/or mobile phones. However, these devices have known limitations during use, including being too heavy, awkward, and causing dizziness. Further, little research has explored the efficacy of these devices during powered chair use, e.g. operation and navigation tasks. Consequently, there is some concern that these devices are not ideal for concurrent use with powered chairs.

Since operating a powered chair bears some similarity to operating other motor vehicles, a potentially suitable alternative is a heads-up display (HUD) inspired by those used in aircraft and, more recently, road motor vehicles, such as cars and trucks. A HUD could

allow the powered chair user to scan his or her environment and complete driving and navigation tasks while taking in additional relevant information (such as directional information) provided as a dynamic visual overlay. However, it is unknown what impact such a display could have during driving and navigation tasks, especially for inexperienced or older powered chair users. Therefore, an important first step in designing the mixed reality platform is to ensure that such a display is usable during powered chair operation and determine what configuration is most suitable.

7. Research implementation and results under the program

Title of your research plan:

Usability of a Head-up Display for Powered Chair Navigation: A Pilot Study

Description of the research activities:

A HUD prototype was developed and a pilot study with eight adults was conducted to evaluate its usability and determine the optimal design for use during powered chair operation and navigation. Three styles of transparency—transparent, semi-transparent, and opaque—plus three styles of information presentation—icon, text, and icon+text—were assessed. Usability (System Usability Scale, errors, task time, satisfaction) and workload (NASA-TLX and subjective distraction) data were collected and analyzed using descriptive and inferential statistics. Workload scores were even and low (about 5/15) across display styles; however, subjective distraction indicated that the opaque style was perceived to be significantly more distracting than the transparent style. Usability (SUS) scores were even and high (about 76/100) across display styles. There was no significant effect on error, except in terms of the amount of errors during the “go forward” task, which was unexpected and may be due to primed expectations for task difficulty. Task time was affected by presentation mode and technophobia category. Findings suggest that individual differences levelled the playing field for transparency style and presentation mode in terms of usability, workload and error, but the most stable style across presentation mode and technophobia in terms of task time was the transparent style.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): Staying at a Buddhist temple in the heart of beautiful Koya Mountain, walking the lantern-lit pilgrimage trails at dusk, and partaking in shojin ryori (Buddhist vegetarian cuisine) were especially memorable for me.

9. Advisor’s remarks (if any): N/A

RESEARCH REPORT

1. Name: Alexandru Sonoc（ID No.: SP15408）

2. Current affiliation: Queen's University, Department of Mechanical Engineering.

3. Research fields and specialties: **Engineering Sciences**

4. Host institution: Kansai University

5. Host researcher: N. Murayama & J Shibata

6. Description of your current research

My current research consists of developing a novel process of recycling lithium ion batteries. The aim of the novel process is to achieve a high recovery rate of lithium and to produce a high purity lithium carbonate product. The main application area envisioned is automotive lithium ion batteries.

Automotive batteries are predicted to become the main user of lithium in the world in the near future. The demand from them is also predicted to outstrip the world lithium supply by the early 2020's if large scale recycling is not implemented. Current recycling processes have a very low recovery rate of lithium. This is the reason why the novel process is being developed.

The novel process consists of discharging batteries to 0.0V, which renders them safe to open. Shredding the batteries. Sorting the shredded batteries and isolating fines and cathodes. Leaching fines and cathodes in formic acid, which has the advantage that it selectively leaches only the active cathodic material (the part that is of interest). Following leaching the leachate is separated into various products by use of cation exchange membranes and Donnan dialysis.

Briefly the separation process consists of four steps. 1) Recovery of lithium ions from the leachate and partial regeneration of the formic acid by passing by a monovalent cation exchange membrane with concentrated sulphuric acid on the other side. 2) Neutralization of the sulphuric acid. 3) Recovery of lithium ions from the sulphuric acid by passing by a monovalent cation exchange membrane with concentrated potassium bicarbonate in a CO_2 atmosphere on the other side. 4) Precipitation of lithium carbonate by releasing the CO_2. 5) Recovery of cobalt, nickel, and manganese ions from the leachate and complete regeneration of the formic acid by passing the lithium poor leachate by a polyvalent cation exchange membrane with concentrated sulphuric acid on the other side.

7. Research implementation and results under the program

Title of your research plan: Determination of overall mass transfer coefficients in Donnan dialysis of Li, Mn, Co, Ni solutions with sulphuric acid and potassium bicarbonate at various dissolved salt concentrations and pH values through monovalent and polyvalent cation exchange membranes.

Description of the research activities: Steady state diffusion experiments were conducted with dissolved Li, Mn, Co, and Ni on one side of a monovalent cation exchange membrane and sulphuric acid on the other. The salt concentration and pH of acid were varied between 0.03M to 0.57M and 0.045 and 2 respectively. The experiments were repeated with a Mn, Co, Ni solutions and a polyvalent cation exchange membrane. Salt concentrations were between 0.015 and 0.285M. The pH values were the same. Lastly experiments were also conducted with dissolved Li on one side and dissolved $KHCO_3$ on the other side. What was observed in all experiments was a small flux of cation across the membranes. Ions moved in both directions (e.g. Li^+ trading places with H^+). Samples were taken and analysed by ICP over the duration of each experiment.

The experiments were successful: steady state diffusion was indeed achieved, as shown by a linear increase in of cation concentration observed (e.g. Li in the acid side). The increase was statistically significant and well in the detection range of the ICP.

From the rate of increase observed, the dissolved salt concentration, volumes of solutions, and membrane area cation specific overall mass transfer coefficients were calculated at each of the conditions investigated. These overall mass transfer coefficient will be used to model the leachate separation process. The model will be used to design the separation process such that lithium recovery and purity are optimized while maintaining a low required membrane area.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): My experience in Japan was excellent both on the technical side as well as the socio/cultural side. Not only were my experiments successful and gave me excellent data but I also went on two plant tours which were very enlightening and I learned a lot more about analytical techniques. Furthermore I became friends with my lab mates and we toured Osaka, Kyoto, and Kobe together as well as participating in many recreational activities. I also went to dinner on quite a few occasions with my host professors and not only did we have a very agreeable time but I got to experience excellent Japanese cuisine and learned a lot about Japanese culture and the university system in Japan.

I also travelled extensively on my own: Nara, Kobe, Kyoto, Fuji, and Koyasan. I stayed in Koyasan at a Buddhist temple for two nights and immersed myself in the temple experience. Overall my stay in Japan has been a superb, life changing experience.

9. Advisor's remarks (if any): My advisors agree that my experience in Japan has been "splendid" (in their words). They thanked me for coming and told me that my presence was very beneficial for them and for their students. They invited me to ask them any questions, collaborate with them on a scientific paper on my results, and asked that I recommend them to other students in Canada to come study with them like I did. I will most certainly highly recommend both the JSPS and my advisors to students at my university.

RESEARCH REPORT

1. Name: Lucy Yin （ID No.: SP15409 ）

2. Current affiliation: California Institute of Technology

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Disaster Prevention Research Institute, Kyoto University

5. Host researcher: Prof Jim Mori

6. Description of your current research

My research work involves implementing Earthquake Early Warning (EEW) algorithms that improve from the existing technology. Most of the EEW algorithms in the current technology take two steps to evaluate earthquake severeness They first use waveform records to predict the earthquake parameters such as magnitude and location of the source, and then use attenuation relationships to convert the earthquake parameters to shaking intensity at users' sites. There are two challenges with these algorithms. First, the period of data collected need to be sufficient in order to achieve accuracy in the parameter estimation, which causes delay the warning time to the public. Second, a significant error can be accumulated through various steps of earthquake parameter and intensity estimations. My current research aim to tackle these two major issues in the current EEW technology. As a graduate student at California Institute of Technology, my research involves implementing algorithms that interprets real-time incoming data by comparing with prior observed seismicity to quickly identify earthquake events, which allows to increase warning times. This work is the first in the world to use earthquake catalogue, and it is the fastest EEW algorithm in history to provide reliable earthquake location estimation. It is now developing under the California ShakeAlert project to provide EEW message for the west coast of America. At Kyoto University, I created a model that classifies shaking intensity directly from the recorded waveforms to reduce uncertainties in the conventional EEW methods. I used the first three to five seconds of the earthquake waveform data to predict if the shaking is destructive or harmless for the people.

7. Research implementation and results under the program

Title of your research plan:

Prediction of Ground Shaking Intensity for Earthquake Early Warning System

Description of the research activities:

The goal of the project is to use the first few second of earthquake data to predict destructive events that require issuing public alerts. First, We collected waveform from the strong motion sensors recorded from 11 large earthquakes above M 6.0 (8 for training and 3 for test), including 3032 waveforms. For each waveform, we filter the information from the first few seconds of data after p-wave arrival: extract its amplitude and zero-crossing distribution as feature representations. Then, classified these samples into two predefined groups based on its shaking intensity (defined by the Japanese Metrological Agency standards): above Level 4.5, and below Level 4.5. Later, we applied machine-learning methods and evaluate its performance under linear, logarithmic regression, linear discriminate analysis models. The success rates of the training data and test data have reached 91.4% and 88.2%, respectively. This result achieved a significant improvement from the previous studies.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Japan has a rich culture. I visited many modern and traditional places during my stay in Japan, from the crowded Shibuya in Tokyo to the world heritages Ginkaku in Kyoto. I tried many type of delicious Japanese food including sushi, ramen, and miso. I also met many lovely, generous, and hard working Japanese people. It is my first time visiting Japan, and I enjoyed my stay in Japan very much, every memory here has left a valuable footstep in my heart. I appreciate this opportunity provided by JSPS summer program to brighten my vision in the Asian culture.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Jie Yu （ID No.: SP15410 ）

2. Current affiliation: PhD Candidate, Queen's University, Canada.

3. Research fields and specialties: Social Sciences

4. Host institution: Kyoto University

5. Host researcher: Prof. Ishikawa

6. Description of your current research:

Generally speaking, I want to understand elder care in Japan and the geographic implications of population aging under the current Long-term care insurance.

On a national scale, domestic migration is highly related with age. A combination of "I-turn" and "U-turn" are observed in Japan. Different prefectures experience different depopulation and return migration processes. (Ishikawa, 2015) This has great implication for care resource allocation among the areas.

On the municipality scales, Kyoto city has social welfare association (京都福祉サービス協会) that guides nursing homes, day care centers, home care services, care manager office etc. Under the city government, there are four Silver Human Resources Centers to introduce jobs for older people's later life fulfillment.

On a home and community level, a new form of community care center is started. It is mixed with different services with people with various levels of care needs. It is highly community-focused. (地域密着型) Private companies are anticipating in elder care on a community level. Services include day care center, nursery care etc. Since the reform of Long-term care insurance, the promotion of community welfare services and preventive measures to reduce high-cost welfare facilities are taken place.

Overall, Japan is doing well in catering for the diverse needs of its older population. The care needs assessment system ensures people in needs to receive proper care. It reduces inequality in the system by introducing the social insurance model with the government covering 90% of the care cost. It actively encourages the private sector to engage in the industry. The high-level professional trainings of care workers are key to the favorable caring environment. There are also problems in the current system such as long waiting list for certain facilities, elderly poverty especially older women, care worker's workload and well-being and the potential influence of market liberation in the welfare sector.

7. Research implementation and results under the program

Similarities and differences are found between the Canadian and Japanese system. The most important implication for Canada is the Canadian provinces could learn from Japan is running a long-term care insurance system on a social-insurance model. Since long-term care is not part of Canada Health Act, how to test a sustainable model for a better access to long-term care is a crucial issue.

Title of your research plan: Comparing Long-term Care System in Japan and Canada

Description of the research activities:

I have undertaken several research activities during my stay in Japan.

First, I have weekly meeting with Ishikawa-sensei to discuss research and get advices. Ishikawa-sensei presents his current work to me, which talks about retirement migration in Japan. The findings have great implication for aging in Japan. Ishikawa-sensei also gave me some key papers and books for understanding aging and elder care in Japan.

Second, I participated APRU Multi-Hazards Program 2015 Summer School. Since a large number of older people are affected during the Tsunami and they play a huge role in re-build the community, it sheds light on elder care in the post-disaster areas. We visited a newly built public housing for older people whose housings were destroyed in the Tsunami. I also participated in the 8th Next-Generation Global Workshop. It discusses various issues concerning aging. During the fieldtrip, we visited four sites. The first is “Pinocchio Nursery” where older women babysitting for younger parents. The second is Silver Human Resource Center Hokubu Office. It is an agency to introduce part time jobs for people 60 years old and over. The third is a community nursing home called “Murasakino”. It is a new form of community-focused service for older people under the recent changes in the Long-term care insurance. The last site is “Kita-oji” nursing home, which is under Social Welfare Service of Kyoto City. It has more residents from low-income group.

Besides the above activities, I went to visit a day care center in Kyoto with Asato-sensei. I spent a whole day with the older people there and also interviewed the owner and the care workers. I also did an informal interview with a colleague whose friends are working as care workers in the nursing homes.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I gave two presentations at Kobe University and Kyoto University. I also visited Iya Valley during my stay. I am amazed at how the youngest villager there is 66 years old. Community and mutual support play a huge role in elder care.

I climbed world heritage Mt.Fuji, which is an unforgettable experience for me. I enjoyed various summer festivals, Japanese art and food greatly during my stay.

9. Advisor’s remarks (if any):

Although the length of Jie Yu’s stay in Japan was only two months, she learned a lot in both of academic and other terms. The advisor (Yoshitaka Ishikawa) was greatly impressed by her aggressive attitude.

RESEARCH REPORT

1. Name: Laurie M. Charrieau （ID No.: SP15 501 ）

2. Current affiliation: Department of Geology/CEC, Lund University, Sweden

3. Research fields and specialties: Interdisciplinary and Frontier Sciences

4. Host institution: Research Institute for Global Change, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

5. Host researcher: Dr Takashi Toyufuku

6. Description of your current research

Large variations in the distribution of living benthic foraminifera in the Skagerrak-Baltic Sea region (Sweden) were revealed by a research cruise in November. In the Skagerrak region where the conditions are fully marine, the species richness is high (51 species) and the foraminifera's shell is well preserved. Conversely in the Baltic Sea proper, which has more brackish waters, only 2 different species were found, and the shell of the foraminifera were partially to totally dissolved ("zombie" foraminifera).

7. Research implementation and results under the program

Title of your research plan:

Culture experiments to better understand biomineralization under varying geochemical conditions
--Zombie factory in Japan: the first tests on Scandinavian foraminifera--

Description of the research activities:

The aim of this research stay was to culture living foraminifera under different geochemical conditions such as variable pH and salinity, to investigate how those zombie foraminifera will react in diverse living conditions. Foraminifera had been collected in the Baltic Sea region in the beginning of June and brought to JAMSTEC in Japan. This time, no zombie foraminifera were found directly, but all the specimens showed clear signs of dissolution.

Two experiments were carried out. The aim of the first experiment was to compare foraminifera's survival rates in two kinds of water: Baltic Sea water and Pacific water. After one month, we found that the large majority of foraminifera were unable to maintain their shell and their life in the Baltic Sea conditions (low salinity, low alkalinity and low levels of oxygen). However the few specimens found were all alive, enveloped in large amounts of sediment. This suggests that these foraminifera

are used to such an environment and can resist for a short time, probably protected in their sediment cyst. This dissolution in the foraminifera's shell was not observed in the Pacific water conditions. The salinity and alkalinity of Pacific waters are high enough to allow foraminifera to survive.

In the second experiment, it was possible to control the pH thanks to a C3S (Chemostat Continuous Cultivation System). The idea was to recreate zombie foraminifera by putting them in Baltic Sea water in the same conditions as it was last November. We lowered the pH gradually during one month by bubbling CO_2 though the water. Surprisingly, zombie foraminifera were not as easy to create as we thought. Indeed, the specimens showed resistance to the low pH, with increasing signs of dissolution but still a shell. It was impossible to create zombies from the 1st batch before the foraminifera died. After the shell had been slightly dissolved, the inner membranes were gradually destroyed instead of preserved as in zombie foraminifera. The 2nd and 3rd batches, which were introduced into the system when the pH was already low, gave different results: some zombies suddenly appeared. However, we suspected that most of them were dead.

The absence of sediment in the system and thus the absence of abrasion could explain why most of the foraminifera still had a shell before dying. Moreover, we saw in the first experiment that sediment gives them some kind of protection against hostile environment. The amount of food and the rapid pH changes in the tanks also have to be taken into consideration. The 2nd and 3rd batches passed very rapidly from high to low pH, and it is interesting that foraminifera could survive that long. However the changes in the pH of the Baltic Sea are probably much slower, which could explain why they could not resist dissolution, and why most of them suddenly died, probably after reaching a tolerance threshold.

These two experiments show that the Baltic Sea is not the most favorable place to live as a foraminifera. However, they seem to be used to these conditions, and they have developed some resistance mechanisms against dissolution. Next step would be to investigate more precisely to what extent.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): It was an excellent research stay. I could learn a lot about Japanese cultures from many different angles. I will definitely recommend the JSPS summer program.

9. Advisor's remarks (if any): It is really nice work with Laurie. The relax time with her is also indescribable valuable. I deeply appreciate the summer program of JSPS at all.

RESEARCH REPORT

1. Name: Alexander Edström （ID No.: SP15502 ）

2. Current affiliation: Uppsala University

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Nagoya University

5. Host researcher: Shunsuke Muto

6. Description of your current research

The topic of my research is theoretical studies of magnetism and magnetic materials. Throughout my PhD studies, the main topic of my research has been to use electronic structure theory to understand and find new materials with large magnetocrystalline anisotropy. Recently, I have been studying the scattering of electrons in magnetic matter which might lead to new ways of studying magnetic properties of materials in electron microscopes. In particular, I have developed a model to describe the elastic scattering of, so called, electron vortex beams through magnetic matter and performed simulations indicating the possibility to use such beams for investigating magnetic material properties.

7. Research implementation and results under the program

Title of your research plan:

Elastic Scattering of Electron Vortex Beams in Magnetic Matter

Description of the research activities:

In Nagoya I have visited the research group of Prof. Shunsuke Muto who works on experimental and theoretical research on advanced characterization techniques utilizing electron microscopes. I have given a seminar about my research about the elastic scattering of electron vortex beams and had discussions with Prof. Muto as well as prof. Saitoh, who has expertise on electron vortex beams, regarding possibilities for an experimental realization of the theoretical research I have performed. In addition to this, with Prof. Muto I have had some discussions regarding modeling of structural and magnetic properties in ferrite materials using electronic structure theory. Prof. Muto has also brought me to the electron microscopy laboratories and shown me some of the experimental work .

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

With the research allowance from JSPS I was able to attend a conference about advanced characterization techniques by the national institute for material science (NIMS) in Tsukuba as well as a meeting for young researchers at Hokkaido.

9. Advisor’s remarks (if any):

RESEARCH REPORT

1. Name: Daniel Kastinen （ID No.: SP15503）

2. Current affiliation:

Luleå Technical University

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: National Institute of Polar Research

5. Host researcher: Takuji Nakamura

6. Description of your current research

Proper methods of finding meteor showers in databases are still an open area of research and the theoretical work surrounding statistics and mathematics are far from complete. The purpose of this research is to develop proper statistical methods of pattern recognition and machine learning in combination with advanced simulations of orbital evolution including perturbation from all major solar system bodies and electromagnetic effects to test and validate several permutations of methods thereby finding the optimal solution within the frames of this research. The question of construction of and later effect on results due to similarity functions and metrics for orbits is also under consideration and will be tested. To execute this research software is being written to perform: simulations of dust material ejection from comets being propagated, generation of solar system initial condition from ephemerides, generation of parent bodies from debisaed population data, propagation of test particles and close encounter determination using Mercury6 software, orbital clone generation from observational errors using OrbFit software, several similarity functions such as D-criterions, grouping methods such as kernel density estimation and hierarchical cluster analysis, association threshold determination methods such as k-fold cross validation and association profile analysis, and analysis of large scale meteor databases. Main focus in data analysis is on analyzing the Shigaraki Middle and Upper atmosphere Radar Meteor Head Echo Database. Other used databases are JPL's Planetary Ephemerides database and included software, IAU meteor shower database, and Pan-STARRS Synthetic Solar System Model.

7. Research implementation and results under the program

Title of your research plan:

Meteor association and Celestial Dynamics

Description of the research activities:

During this summer almost all software described above in section 6 has been developed with the help of National Institute of Polar Research (NIPR), Nihon University, Institute of Statistical Mathematics (ISM), and National Astronomical Observatory of Japan (NAOJ). Without the help and cooporation of several researchers the software would never have been completed to the stage that it is in today. Invaluable conversations and discussion about the execution and methods used have led to the correct formulations of work and development of useable software in more research questions outside the scope of the current work. The intent is to release the software for public use and the interest and support within the Japanese research community for this project has helped immensely. Also presentation on this work and surrounding questions has been given at NIPR, NAOJ, and Nihon University, sparking many discussions and further improvements to the work. Three research trips have been executed during the summer. First one to visit Nihon University for discussion and presentations, second to Shigaraki Radar facility for tour and explanation of the system used to collect data to be analyzed. And lastly to Norikura Observatory for meteor stream observation campaign using optical measurements. All trips added fantastic perspective to the work and created many contacts within the Japanese research community that will be invaluable in the future.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I have had almost too many good experiences to list. Besides the many fantastic social gatherings I have attended the more prominent currently in my memory is climbing Mt Fuji and Mt Norikura, visiting several onsen, participating in two festivals, and spending countless hours exploring Tokyo! I have also had a wonderful food experience and will dearly miss the Japanese cuisine. During my time here I have met so many fantastic people and they have made my stay very enjoyable. One of the more prominent and reoccurring experiences outside of the research community are my time at Shihan Sugiharas dojo where I had the wonderful opportunity to continue my Kyokushin Karate training under his guidance.

9. Advisor's remarks (if any):

RESEARCH REPORT

1. Name: Elena Pagnin （ID No.: SP15504）

2. Current affiliation:

Chalmers Institute of Technology, Göteborg, Sweden

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: Tokyo Institute of Technology, Tokyo, Japan

5. Host researcher: Prof Keisuke TANAKA

6. Description of your current research

My current research area is secure and efficient server-aided computations. The main motivation for investigating server-aided computations comes from the increasing demand to perform sophisticated computation using resource constrained devices (such as smart watches and smart cards). There are two main limitations when using resource constrained devices: storage space, computational power. The first issue is usually bypassed by outsourcing the data to an external data base (e.g. the *cloud*); and in case users want to maintain privacy, the data is stored in an encrypted way. The second limitation is more delicate to handle: if users want to compute a *heavy* function that requires more computational power than what the device can provide, we need to outsource, partially or fully, the computation to an external *server*. The main problem when delegating the computation to a third party is that we cannot *trust* that the server does the computation we require it to do. Therefore there is a need for (a) mathematical tools that somehow force the server to behave honestly, and (b) ways/structures to securely outsource the computation, possibly without undermine users' privacy. My current research focuses on points (a) and (b), with the additional challenge to make it efficient for the device to perform both the verification of (a) and the computations left to the device from (b).

7. Research implementation and results under the program

Title of your research plan: **Outsourcing computation for resource constrained devices (server-aided computations)**

Description of the research activities:

During JSPS summer program I have worked with Prof Keisuke Tanaka on building a framework to describe all Digital Signature Systems (DSS) that rely, fully or partially, on a server to carry out the verification step. Intuitively, a DSS has all the properties as the handwritten signature: one person (the signer) has a personal way (the secret key) to sign messages. Everybody can verify (using a public key) that the signature appended to the message is valid, and was made by the claimed signer.

This verification step, however, can be very *heavy* to perform, especially if the signature has some additional properties (e.g. homomorphic or structure preserving signature). Thus if a resource constrained device wants to verify such a signature, it needs to rely on a server, and outsource the *heavy* computation.

During this visit at Tokyo Institute of Technology, I investigated how to formalize the 'outsourcing to the server' part, as well as possible attacks scenarios.

The outcome of my research is going to be a paper in which we *(a)* fix the security issues present in previous work on server-aided signature verification, *(b)* introduce new attack scenario, and *(c)* propose schemes that are secure in our model.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

I really enjoyed all JSPS has offered me: the program and the introductive week, the opportunity to live in Japan and make your every-day life here, the chance to collaborate for a 'longer than usual' term with Japanese professors and students, and to travel a give talks in other institutions.

9. Advisor’s remarks (if any):

During her stay in our institute, I have always had fruitful discussions with her on the models and the schemes for cryptographic protocols in the presence of the powerful servers. I was impressed by her passion and strong mind for reearch as well as her high ability. For example, she has always read many papers and made long drafts between once-a-week regular discussions. Also, she has found an important technique by herself, which is traditional and well-known. I am convinced that she can be a very good researcher, and I hope that I can work again with her in the near future.

RESEARCH REPORT

1. Name: Szabolcs Fodor （ID No.: SP15505 ）

2. Current affiliation: Umeå University, Sweden

3. Research fields and specialties:

Engineering Sciences

4. Host institution: Nagaoka University of Technology

5. Host researcher: Michael Ruderman

6. Description of your current research

Nowadays, automation and robotics is gaining more terrain in several industrial fields where production lines are optimized via automation and human workforce is replaced by robots. In Scandinavian countries the logging industry is following the same trend by using heavy duty machines in timber harvesting processes. Basically, operators use these machines to harvest and load the trees for further processing. A forestry machine consists from a mobile platform and a manipulator. The mobile platform usually is a tractor, while the manipulator is a hydraulically actuated robotic arm built from several joints interconnected by links. Like in the human arm, the motion of the robotic arm is done by systematic actuation of the joints. To safely and reliably control such a machine is not an easy task, therefore operators are trained several years.

My research is focused on partial automation and control architecture development taking into account nonlinearities such as friction. Friction is a complicated nonlinear effect which deteriorates the performance of the actuators especially in a complex mechanical system such as the mentioned robotic manipulator. This is why it needs to be studied carefully and included into the control design architecture by a form of feed forward compensation. Basically, this means that the effect of friction is canceled in a particular actuator. Since it is a changing phenomenon, I'm investigating different methods which can estimate friction in an adaptive way and use them to design compensation schemes to improve the performance of the actuators in robotic manipulators.

7. Research implementation and results under the program

Title of your research plan: **Adaptive compensation of friction**

Description of the research activities:

The aim of the research was to test and implement an adaptive friction estimation method and use it for compensation in a feedback velocity controller. The starting point of the work was based on Friedland and Park (1992) method where the authors designed an adaptive friction estimation algorithm to estimate the Coulomb friction parameter. They verified it using simulations. Our goal was to extend this method keeping in mind that friction models are more complicated than a simple Coulomb friction model. The first month was dedicated to modeling and testing the adaptive algorithm. We identified the model of the experimental setup (ball-screw drive) what we planned to use for verification of our hypothesis. Having a model gave us the freedom to test different experimental scenarios and carefully monitor the behavior of the adaptive algorithm. As we expected the estimator was not suitable in presence of an extended friction model containing the Coulomb and viscous part. We overcame this problem simply by using offline identification of the static friction model and used the coefficients to subtract the unwanted effects from the estimator input. After, a velocity feedback controller was designed and the adaptive estimator was used as a feed forward term to cancel the effect of friction in the model.
The second part of my stay was dedicated to verify our hypothesis on a ball-screw drive experimental setup. The experiments were carefully designed and tested on the experimental setup. After analyzing the recorded data from the experiments we concluded that the results of the adaptive estimator and the feedback velocity control is similar of what we obtained in our simulations. Basically we extended the proposed Coulomb friction estimation algorithm and verified it using simulations and experimental data.

8. Please add your comments, including any cultural experience during your stay in Japan (if any):

Climbing Mt. Fuji was an unbelievable experience which I will never forget.

9. Advisor’s remarks (if any):

Mr. Fodor has been attending my laboratory “Smart Control Systems” at the Nagaoka University of Technology during the JSPS Summer Program 2015. He has done a good work on analysis, implementation, evaluation, and experiments of adaptive friction compensation aimed for the controlled motion systems. He showed a good extent of the control engineering skills and worked thoroughly on the research topic, corresponding to the PhD candidate level. It was a pleasure to host Mr. Fodor, to have scientific discussions with him, and supervising his progress on the object of investigation.