JSPS Summer Program 2022
Research Report

1. Name: Demi L. FANG （ID No. SP22001 ）
2. Current affiliation: Massachusetts Institute of Technology
3. Research fields and specialties: Interdisciplinary and Frontier Sciences
4. Host institution: University of Tokyo
5. Host researcher: Prof. Ken'ichi KAWAGUCHI
6. Description of your current research Buildings contribute to over a third of global carbon emissions. Of those emissions, a significant portion is from the emissions associated with structural systems, also known as the *embodied carbon* of structures. As global demand for buildings continue with population growth, building designers and engineers thus have considerable responsibility in implementing effective design strategies for mitigating the embodied carbon of structural systems. My PhD research focuses on identifying those strategies and improving the decision-making process in early-stage design for mitigating the carbon impact of buildings' structural systems.

7. Research implementation and results under the program

Title of your research plan:

Strategies for sustainability in historic and modern Japanese structural design

Description of the research activities:

The research was concerned with strategies for sustainability in 1) historic and 2) modern Japanese structural design.

Several destinations were selected for deepening understanding around part 1), including governmentally recognized Important Cultural Properties and Important Preservation Districts, ranging from shrines and temples (Kyoto, Ise) to preserved houses and teahouses (Gifu, Nagano, Aichi). In total, over 46 structures were visited during the research trip. Build and rebuild dates were recorded to understand the tradition of rebuilding and preservation in Japanese historic construction.

Most notably for part 1), the design and construction of a chair museum at Lake Kawaguchi was selected for case study documentation. The owner/designer and head carpenter were interviewed to document the highly unique project.

For understanding part 2), surveys (Japanese and English) were distributed to architects and engineers in Japan. Participants were additionally prompted for a follow-up interview (English). A total of 15 survey responses were collected and 8 interviews scheduled.

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

The host laboratory environment was stellar given the pandemic circumstances. My host professor was incredibly welcoming and supportive. I was also able to visit several other research labs in Tokyo and across Japan during my fellowship, making new and deepening existing academic connections.

I unexpectedly found a warm sense of community in Japan in this short period of time through friends and colleagues. Every meeting was a meaningful cultural exchange. Some Japanese specialties that I enjoyed were *onsen*, nostalgic media from childhood, and delicious Japanese cuisine (both from restaurants and from the local *konbini*).

JSPS-organized Japanese lessons and homestay only enhanced all of the above experiences.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Layla HAZEMI （ID No. SP22002　）

2. Current affiliation: University of California, Berkeley

3. Research fields and specialties:
Humanities

4. Host institution: Waseda University

5. Host researcher: Prof. Koji TOBA

6. Description of your current research

I am currently beginning my dissertation, taking the Takarazuka Revue as my object of focus, and examining the revue from the perspective of literary and dramatic studies (seeing the individual plays as *texts* and specific performances worth individual, careful close reading, an intervention I hope to make against Takarazuka studies thus far, which tends to analyze or use examples from individual plays only insofar as they are supposed to prove a generalized point about the company's patterns of production), as well as fan and performance studies (looking at the ways performances of celebrity, fandom, and affective circulation occur beyond the bounds of the theater itself).

My research entails, then, first and foremost a familiarization with the Takarazuka repertoire, as well as assembling a tentative map of what one might deem a Takarazuka "canon" of aesthetically or historically significant works. It additionally entails a familiarization with the financial, social, and affective economies that more through (and are built by) fans, patrons, actresses, and theatergoers, the latter of which will form the "texts" I close read as performance. I want to examine the ways cityscapes—the area around the Tokyo Takarazuka theater, the entire layout of Takarazuka City—script behavior, and are in turn shaped and dictated by patterns of movement to and from the theater.

7. Research implementation and results under the program

Title of your research plan and description of research activities:

History in Gaps, Slips, and Kitsch: Time, Nostalgia, and the Takarazuka Revue

My main research activity was attending performances of the Takarazuka Revue in both Tokyo and Takarazuka City, as well as understudy performances. I additionally found and attended live theatrical performances in Tokyo that starred former Takarazuka actresses who are now integrated into the theater scene (*M. Butterfly* and *The Pride*), performances by Takarazuka's analog company OSK in Kyoto and Osaka, and small, independent theatrical productions that drew on Takarazuka-style performances (*Sepia-iro no Otometachi*). Furthermore, I had the opportunity to attend Prof. Toba's graduate seminars at Waseda University, which allowed me learn deeply and gain important connections with current graduate students.

Furthermore, I studied the radical transformations in Takaruazuka fandom over the past 3 years and through the pandemic: it is a completely different "text" than it was when I first began drafting my dissertation prospectus. I spoke to a number of patrons, backers, and former Takarazuka actresses whom I have been lucky enough to meet over my time researching the company. Through informal interviews, sharing anecdotes and strengthening personal connections, I have gained a fuller picture of what life engaged in the affective (and literal) economies of Takarazuka entails. I also made some new connections with the family of a current, active Takarazuka performer.

Finally, I was able to explore vintage and used bookstores to gather discontinued and old Takarazuka materials: company magazines from the 1930s, 40s, and 50s, informational books about the company over multiple decades, personal actress goods never sold in general retail. I have already started reading and taking notes on these texts as a beginning to my archival work.

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

I was enormously grateful for the opportunity to be in Japan this summer. Virtually none of the research I did—attending live shows, familiarizing myself with the entirely reworked flows of fan movement and fan practices in the pandemic era, and connecting with performers and patrons who could tell me anecdotes about their experiences or walk me through their days, would have been possible from abroad. It was an invaluable experience.

JSPS Summer Program 2022
Research Report

1. Name: Gerald Nelson Jr. （ID No. SP22003）

2. Current affiliation: Pennsylvania State University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Nanzan Institute for Religion and Culture 南山宗教文化研究所

5. Host researcher: Moriya Tomoe 守屋友江

6. Description of your current research

My current research concerns the study of historical consciousness in Japanese Buddhism before the influence of Western modernism on Japanese Buddhist thought. Scholars such as Paul Tillich, Arnold Toynbee, and Mircea Eliade have denied the existence historical consciousness in Buddhist thought. Kyoto School philosopher Keiji Nishitani responds to this criticism with his own creative reinterpretation of Buddhism's view of time and history. However, in this project I attempt to demonstrate through the study of Kamakura era Japanese Buddhist thought and the work of later Buddhist activists of the Meiji and Showa eras that historical consciousness was exhibited in Japanese Buddhism without reference to Western modernism.

7. Research implementation and results under the program

Title of your research plan:

Historical Consciousness in Japanese Buddhism

Description of the research activities:

Under Prof. Moriya's direction, I read primary source texts by Buddhist activists Takagi Kenmyo, Uchiyama Gudo, and Seno'o Giro. I also took further references from Matthew McMullen on primary and secondary sources on theories of time and history in Kamakura era Buddhism. I also contacted and spoke with Prof. Mark Shields of Bucknell University about Buddhist Activism of the Meiji and Showa Eras and scheduled to meet with him in Kyoto when he returns in November.

Through this research and further correspondence with experts in the field of Japanese Buddhism, I drafted a paper to hopefully publish later in a journal such as the Japanese Journal of Religious Studies. I was advised by Professor Moriya to add more references from contemporary Japanese scholars in Buddhist studies since my current draft makes little use of references to their work. Hopefully, with this advice I can make improve my paper and prepare it for publication in the future.

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

I visited Inuyama Castle, Tokugawa Garden, Nagoya Castle, and Atsuta Shinto Shrine for sightseeing. I also did a homestay through JSPS's program with a local family in Nagoya. If I return to Nagoya, I plan to contact them again. All these experiences were wonderful.

9. Adviser's remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Taylor E. PAPSTEIN-NOVAK (ID No. SP22004)
2. Current affiliation: Auburn University
3. Research fields and specialties: Biological Sciences
4. Host institution: Japan Monkey Centre
5. Host researcher: Prof. Misato HAYASHI
6. Description of your current research For my dissertation I am focusing on how stressors affect an organism and their impact on evolutionary history such as speciation. However, I have a broad range of interests across taxa. My current projects are 1) using computational tools to look at the possible genetic culprits for the uniqueness of *M. arctoides* as a macaque species, 2) looking at how nutritional variation affects stress physiology across the organism in the fruit fly, *D. pseudoobscura*, and 3) investigating out nutritional stress affects recombination rate in *D. melanogaster*.

7. Research implementation and results under the program

Title of your research plan: Can Primates Count?

Description of the research activities:

This summer we used the relative numbers task, one of the two quantities tasks, from the PCTB to look at cognition across a wide range of primate species. This was the first study to look at all four major primate groups using a component of the PCTB and was the first to use New World Monkeys (NWM). We assayed chimpanzees, gibbons, mandrills, Japanese macaques, common marmosets, and ring-tailed lemurs. Two plates were set with varying amounts of same size food while hidden from participants. Then participants viewed the plates for 5 seconds before being allowed to make a selection. A participant choosing the plate with the larger quantity was scored as correct. Participants were tested with 16 treatments and 4 controls to account for any selection bias. Currently, we only have data analyzed for 5 of the 7 tested species (we are still working on the ape data). We found no significant difference between species ($p=0.14$) which matches with previous studies. The percentage of correct answers also lines up with previous studies species averages ranging from 60-80%.

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

This was a really great experience! In addition to doing my research, I was able to explore several locations in Aichi and Gifu prefectures and learn about Japanese history, art, and modern culture. Even when I did not leave Inuyama, I was able to experience new foods almost on a daily basis and was surrounded by history!

9. Adviser's remarks (if any):

She was the first international student visited us after the COVID-19 outbreak. She was very collaborative and adapted well to the circumstances in JMC. She was patient for the negotiations with the keepers from different sections and for testing primates from all four primate groups with huge species/individual variations in their responses. Although the statistical result was not significant, the individual data and the testing protocol that she acquired during her stay in Japan should be valuable for the promotion of science in the future.

JSPS Summer Program 2022
Research Report

1. Name: Clarissa Mae de Leon （ID No. SP22005 ）

2. Current affiliation:

University of Texas Rio Grande Valley

3. Research fields and specialties:

Biological Sciences, Agricultural Sciences

4. Host institution: Kyushu University

5. Host researcher: Dr. Oumi NISHI

6. Description of your current research

Metarhizium species have been found to be effective in lowering pest populations in a variety of crops using various inoculation methods. Some pest populations in wheat and bean were reduced via seed inoculation with conidia solution under greenhouse and laboratory settings. Similarly, Metarhizium ssp. was discovered to be effective on maize when spore concentration solutions (i.e., foliar spray) (ranging from in a greenhouse setting against cetin pests) were used (Oo, Mekkamol, Srithi, & Saengyot, 2017). The application of Mycopesticides (entomopathogenic strains of B. bassiana and Metarhizium ssp.) on cabbage plants twice a week (through spray) decreased aphids by 73% in a field scenario (Prince & Chandler, 2020). Furthermore, in a lab environment with conidial suspension (conidia/mL), entomopathogens were found to be productive against Macrosiphum euphorbiae on tomatoes (Sinno, 2004). Furthermore, in Sorghum, (Calvin, Beuzelin, Liburd, Branham, & Simon, 2021) evaluated the efficacy of entomopathogens in lowering Melanaphis sacchari in the laboratory and under greenhouse settings by foliar spray. Similarly, Enrique Arcocha-Gomez and colleagues examined entomopathogens in similar studies where these entomopathogens had the capacity to help reduce pest rates. However, there has been limited investigation into whether entomopathogenic fungi has tri-trophic interactions that might induce plant responses against pests like M. sacchari in seed coating modality Chemical seed coating has been shown to be effective in avoiding disease (Leukel, 1953), and the application of EPF as a seed coating may have a similar impact in minimizing insect invasion.

Objectives

The aim of this study was to measure the effects of 2 Metarhizium species in wheat via seed coating inoculation by analyzing physical qualities such as germination success, height, number of leaves, presence of fungi in root systems and direction of mycelium during choice assays. We hypothesized that seeds inoculated with Metarhizium spores would have increased physical qualities like height and number of leaves. in addition, we will evaluate the direction of the fungi when given a choice assay between soil with roots present and without. our findings will be a preliminary framework for future studies of native and commercial Japanese Metarhizium stains of entomopathogenic fungi.

7. Research implementation and results under the program

Title of your research plan:

Assessment of 2 Japanese Metarhizium species with varying qualities to identify potential tri-trophic interactions in varieties of wheat.

Description of the research activities:

Plants and seed preparation

This study was carried out in a laboratory setting between September 9th to October 20, 2022. Wheat seeds were used for this investigation. A total of 72 wheat seeds were sterilized with a 10% bleach solution and rinsed with reversed osmosis water to prevent contamination and maintain sterile growth conditions.

Seed inoculation

A commercial strain of Metarhizium (SMZ2000) as well as a native strain (3G5-2-7), plated spores were used to generate a suspended spore solution. These fungi were chosen according to specification of growth and viability. To inoculate the crop, 36 lightly dampened seeds were coated with the spore solution by placing the seeds inside an Eppendorf tube with the solution and hand-shaken vigorously for 1 minute, to ensure proper coating. For controls, the other 12 seeds were not coated with the fungi.

Growth conditions

Once seeds were inoculated and controls were prepared, a sum of 18 pots, each with 4 seeds, were established. Cling wrap was placed on top of each pot to enhance humidity and promote germination. The pots were then placed in a growth chamber under a 12L:12D cycle at 27.1°C with maximum relative humidity. After 7 days, germination rates were calculated and were repotted to individual pots as well as monitored continuously. Through the monitoring process, the plants physical qualities such as height and number of leaves were measured on a weekly basis.

Fungal Identification after inoculation

Florescent light Microscopy using Alexa Fluor® 488 - Alexa Fluor 488 conjugates was used to identify the fungi within the root systems. after confirmation of the mycelium in the roots, we then continued by measuring length of fungi away or toward the plant roots in the choice assays

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

My experience this time in Japan was very welcoming and I owe that to my host family as well as my host researcher. My host mom went above and beyond what she was obligated to. She took me shopping and got me settled in, we even went sightseeing on multiple occasions. The family as very kind and welcomed me with open arms. In addition, my host researcher allowed me to learn much more than what my project has encompassed. He taught me about genetics as well as other very important skills a good mycologist should have. I am extremely grateful to JSPS for allowing me to do research with on of my personal scientific heroes. It’s been so much fun and am saddened that it has come to

an end so quickly.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Alexandra Richardson (ID No. SP22101)

2. Current affiliation: King's College London

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: National Institute of Environmental Sciences (NIES)

5. Host researcher: Nakajima, Daisuke

6. Description of your current research

Chemical pollution in the environment is a growing concern as upwards of 630 compounds have now been identified in multiple environmental compartments on almost every continent. Of these, pharmaceuticals, pesticides, industrial chemicals and personal care products have been identified as contaminants of emerging concern (CECs) and are monitored for by government bodies throughout the world. These CECs, if occurring at biologically relevant concentrations, have the potential to cause physiological and behavioral changes in organisms and can impact human health. Current methods for measuring contaminant concentrations in animals involves a lengthy collection and extraction procedure. Therefore, the use of a surrogate to model CEC accumulation in organisms is favorable for removing the need for testing model organisms entirely or prioritise CECs for laboratory testing. Passive samplers have been proposed as a potential surrogate for aquatic invertebrates in bioconcentration studies, however there are some challenges with directly predicting from a passive sampler to an animal. Machine learning is a useful tool for finding patterns and relationships in complex data and has successfully been used to predict the bioconcentration factor in fish for a variety of CECs. Thus, the aim of my PhD project is to combine passive samplers and *in silico* machine learning to act as surrogates for invertebrates during *in situ* micropollutant bioconcentration studies.

As a part of this work, I have utilised a benchtop stereolithography (SLA) 3D printer to design, develop and prototype a miniaturised 3D printed passive sampler (3D-PSD) for the monitoring of CECs in river water. The 3D-PSD hold five 9 mm sorbent disks separately from one another, allowing the device to be multiplexed, while all parts are connected through an interference fit, thus increasing the simplicity of the device. The sampler was assessed for compound sorption and three sorbent chemistries (HLB, cation and anion) were assessed for compound uptake at 50 and 100 ng/L in an artificial freshwater matrix. The 3D-PSD has been deployed in a south London; freshwater chalk river (the River Wandle) downstream of a pollution source for seven consecutive days per month for the past six months. At the same time, river water and invertebrate samples were taken four times a month, three of which timepoints overlap with the 3D-PSD deployment. The purpose of this experiment is to collect aligned data for the three sorbent chemistries, the river water samples and the invertebrate samples from which a predictive machine learning model can be trained. A variety of models will be assessed and validated.

7. Research implementation and results under the program

Title of your research plan:

Investigation of chemical pollution in the Kinugawa River using 3D printed miniaturised passive sampler devices (3D-PSDs) and traditional water sampling

Description of the research activities:

Three sites were chosen along the Kinugawa River (S1: 36°09'40.7"N 139°56'49.0"E, S2: 36°10'06.9"N 139°56'40.0"E, S3: 36°09'12.3"N 139°56'51.1"E) in the Ibaraki prefecture, with a fourth site located on the Higashinire River (S4: 36°00'10.6"N 139°55'45.9"E). Site 1 (S1) was the direct outfall from a local wastewater treatment plant, with S2 and S3 upstream and downstream of the outfall, respectively. The 3D-PSD (with a hydrophilic-liphophilic balanced (HLB) sorbent disk and polyether-sulfone (PES) membrane) were deployed for seven days in early July and water samples were collected when the 3D-PSD were deployed and retrieved from the river. Water samples underwent a SPE pre-concentration step before analysis using GC-MS and LC-MS for chemical pollutants. Bioassays for human thyroid hormone (hTR), constitutive androstane receptor (CAR) and human estrogen receptor (hER) were also conducted on the concentrated water samples. 3D-PSD were extracted using methanol and prepared for analysis with methanol and acetone for LC-MS and GC-MS analysis, respectively.

Unsurprisingly, the highest levels of hTR and hER were present at the WWTP outfall site while it was not detected or at very low concentrations at the other sampling sites. CAR, which is an indicator of xenobiotic metabolism was present at all sites with particularly high concentrations at S1 and S4. From the GC-MS results of both the water and 3D-PSD across all sites, 91 unique chemical pollutants were detected encompassing a range of compound classes including manufacturing products, flame retardants, pesticides and pharmaceuticals. Of these, 29 were common to both the 3D-PSD and the water samples, with 52 unique to the water and 10 unique to the passive sampler. Concentrations in the water samples ranged from 0.02 (dimethyl phthalate, a compound used in solid rocket propellants, plastics, and insect repellents) to 54 ug/L (bis(2-ethylhexyl)phthalate, a plastic additive, median = 0.18). Mass of contaminant on the passive samplers ranged from 2.2 (DEET, an insect repellent) to 107 ng ((Bensulide, a pesticide from crop control, median=9.7 ng). At the time of writing, the semi-quantification and non-target LC-MS data is still being collected and processed. I will continue to analyse the data in the UK after my visit.

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

During my time in Japan, I travelled extensively visiting so wonderful places with Nikko, Mt. Fuji-yama, Kyoto and Enoshima being most memorable. The cultural diversity across Japan was wonderful to experience along with the different cuisines and local specialities. Who knew there could be such contention between the Hiroshima or Osaka style of okonomiyaki, and which one is better. The diversity of temples and shrines everywhere I went was beautiful and spiritually very grounding in an otherwise very busy schedule.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022

Research Report

1. Name: Edith-Clare Hall （ID No. SP22102 ）
2. Current affiliation: University of Bristol
3. Research fields and specialties: **Engineering Sciences**
4. Host institution: Tokyo Institute of Technology
5. Host researcher: Suzumori-Sensei
6. Description of your current research Development and application of thin pneumatic thin artificial muscles (Suzumori-Lab, Japan) to a pincer grip assist and resist orthosis conceived using a co-design process (UK) specifically for people living with ‘split hand’ symptoms of motor neuron disease/ ALS to better meet user needs and improve device uptake compared to existing products on the market. The research is based on an iterative design sprint model which includes stakeholder requirements analysis, rapid prototyping, testing, and development.

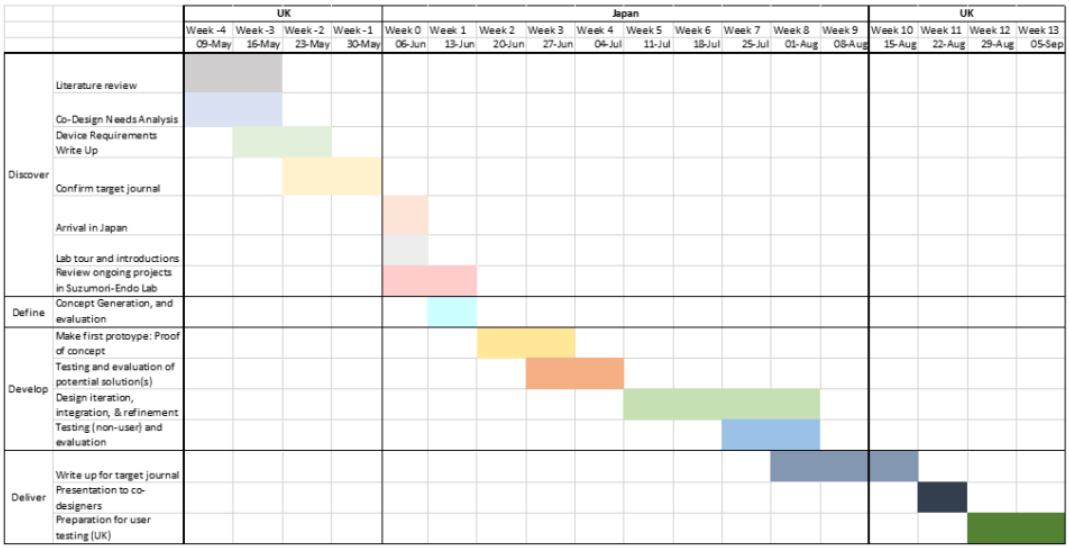
7. Research implementation and results under the program	
	Title of your research plan: Soft robotic biomimetic assist and resist pincer grip orthosis for people living with motor neuron disease

Description of the research activities:

The research activities followed the Gantt chart shown below. However, the final weeks of Journal writing up will not be shared due to ongoing discussions regarding the potential for commercialisation following further development. JSPS will be informed of any journal/ commercialisation outputs in the future.

The highlights are-

- Creating multiple functional device prototypes and exploring some initial testing
- Development of novel biomimetic actuation pattern
- Preparation for user feedback



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

I have had a fantastic and enriching experience in Japan.

I was able to visit 4 other Universities and meet with professors working within the field of soft robotics incuding - Kyoto University, Rikken University, Sendai University, and Ritsumeikan University.

I have also significantly improved my Japanese language skills and have enjoyed actively immersing myself in the culture. I have attended a sumo tournament, many temples and shrines, climbed mountains, visited quirky Japanese cafes and so much more! I have also seen how Japanese society is pioneering the integration of robotics in everyday life.

9. Adviser's remarks (if any):

She has worked very well and achieved a nice prototype of orthosis through our discussions. The results will be submitted to an academic journal. I believe this summer program was very valuable for her to work with us, visit several professors in Japan, and experience Japanese culture.

JSPS Summer Program 2022

SP22103 Research Report

1. Name: Eugene Malthouse （ID No. SP22103）

2. Current affiliation: University of Warwick

3. Research fields and specialties:
Economics and Psychology

4. Host institution: Institute of Social and Economic Research, Osaka University

5. Host researcher: Prof. Nobuyuki Hanaki

6. Description of your current research

The current focus of my research is on collective action problems: situations where the interests of individuals seem to come into conflict with the interests of the community. I use experimental methods to explore the factors that influence people's willingness to put community interests before their own. These factors include inequalities, the cause of inequalities (e.g., merit vs. luck), beliefs about fairness, levels of trust in others, levels of reliance on others, and emotional states.

7. Research implementation and results under the program

Title of your research plan: Collective Action Problems in Japan and the UK

Description of the research activities:

Prof. Nobuyuki Hanaki and I have conducted two experiments with students at Osaka University during my time on the JSPS Summer Programme.

In the first experiment, we assigned participants to groups of six and asked them to play a game with each other known as the *prisoner's dilemma*. This game has been used by researchers for many decades to investigate individuals' willingness to cooperate with and trust others in social interactions. We adapted this game to explore how groups may become increasingly cooperative or competitive over time, and how individuals within these groups respond to these changes.

Our second experiment was designed to investigate how people decide whether to solve problems as a group or as individuals. We face many choices like this in society: for example, we can educate our children privately or in public schools. Equally, we can keep ourselves safe by living in gated communities or by funding a public police force. In general, solving such problems as a group tends to be both more economically efficient and more supportive of community cohesion. Specifically, our study explored whether wealth inequalities determined either by merit or luck influenced people's inclination to solve problems as a group rather than individually.

Having collected data in Japan, we plan to conduct the same experiments with university students in the UK and compare results between these two populations. It is worth mentioning, however, that a technical error prevented us from collecting our full sample in Japan for the second experiment, which we plan to resolve as

soon as possible. Overall, we hope that our results will highlight interesting cultural differences that may inform further research and public policy in both countries.

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

One of my most enjoyable cultural experiences was my homestay with a family in Osaka. However, there have been many other highlights, including completing the Kumano Kodo pilgrimage in Wakayama; cycling across Shikoku and visiting the island of Naoshima; staying in Kyoto for the Gion-Matsuri festival; watching the sumo in Nagoya and football and baseball in Osaka; and visiting Tokyo – all of which were very enriching in many different ways.

9. Advisor's remarks:

It was very nice to have Eugene around for a month. He participated actively to our seminar and also interacted with our graduate students.

Note:
Your research report will be complied with those of the other participants into a PDF file, which will be posted on JSPS's website. We need the research reports to be prepared in MS-Word and PDF format.
Keep the length of your report within 2 pages. Your report should be submitted **before the completion of your fellowship tenure.**
First e-mail your report to: **jsps2020-ecc5@or.knt.co.jp**

JSPS Summer Program 2022
Research Report

1. Name: Jack D. HOPKINS （ID No. SP22104 ）

2. Current affiliation: University College London

3. Research fields and specialties:

Biological Sciences

4. Host institution: The University of Tokyo

5. Host researcher: Professor Kouhei Tsumoto

6. Description of your current research

My research focuses on the role of extracellular matrix proteins in the initiation and development of the intraocular pediatric cancer, retinoblastoma. Originally, I used conditioned media containing PRELP, a small secreted protein. However, to improve my experimental design, I switched to purified recombinant PRELP protein which has fewer variables. This protein is synthesized by Prof. Tsumoto's group at the University of Tokyo.

I perform *in vitro* functional analysis to measure the effect of PRELP on viability, proliferation, apoptosis and adhesion. In addition, I study the expression and localization of cancer biomarkers when treated with retinoblastoma. Recently, I have performed single cell RNA-sequencing on PRELP-treated retinoblastoma cell lines to elicit the transcriptional events that govern the results observed in the functional analysis. PRELP has a strong role in inhibiting progression of retinoblastoma, by preventing colony formation in soft agar and enhancing adhesion.

I have also begun to study the effect of recombinant PRELP protein on primary retinoblastoma tissues. Unlike immortalised retinoblastoma cell lines which are grown in flasks, tissue samples are collected during surgical removal of the retinoblastoma tumors and immediately treated with PRELP. This gives a better representation of how the diseased cells respond to PRELP treatment which is valuable information if PRELP can be developed for clinical trials.

7. Research implementation and results under the program

Title of your research plan: Purification of recombinant PRELP protein by baculovirus infection.

Description of the research activities: The main aim of my research has been to produce purified recombinant PRELP protein that I can then utilise in my laboratory in the UK to treat primary retinoblastoma tissues. In order to purify PRELP, I infected Sf9 insect cells with a baculovirus containing the PRELP gene. Infected cells produce PRELP protein at a high concentration rather than viral components. Furthermore, the PRELP gene was modified to include a secretory signal to translocate to the media. Thus, protein could be collected easily by centrifuging the solution and collecting the supernatant (media) whilst discarding the pellet (cells).

Various purification techniques were then employed to obtain purified PRELP protein. Affinity columns, in which only PRELP proteins would bind to affinity beads, were used to remove the main bulk of non-PRELP proteins. Size-exclusion chromatography was also used to separate proteins by mass. The presence of PRELP in these samples was then determined by western blotting.

Once purified, PRELP was concentrated to make a stock solution and then the activity and function was checked. This was completed using various biophysical techniques (circular dichroism, differential scanning fluorimetry, etc) to confirm that PRELP had the correct structure, which would imply function is also correct. Function can be confirmed later in my laboratory with retinoblastoma cells.

PRELP is difficult to purify. The structure is unstable at high temperatures and prone to aggregating which would lower the activity. Thus, experiments were completed at 4 ºC and the samples only concentrated in the final steps. Despite this, several attempts were needed before PRELP was purified successfully.

As a secondary aim, a mutated PRELP protein was also constructed and purification attempted. In my research, I have found that proteases secreted by cancer cells can degrade PRELP, reducing activity. Thus, I attempted to synthesis and purify a protease-resistant PRELP protein which would have improved stability and efficacy for treatments. Unfortunately, the mutation proved to be detrimental to stability and mutated PRELP was unable to be secreted, indicating perturbed folding of the protein.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): My host institution was the University of Tokyo, Hongo Campus. I managed to explore most of Tokyo, such as Shinjuku, Shibuya, the Imperial Palace and Tsukiji. In addition, I was able to visit Kyoto in the west to experience much of the Japanese culture. I also had the opportunity to complete a weekend homestay with a Japanese family where I enjoyed the cultural experiences of homelife in Japan.

During my stay, I was also able to visit other groups that my laboratory is in collaboration with in Japan. This included the National Cancer Center and other scientists at the University of Tokyo.

Through JSPS, I was able to experience much of Japanese culture, boost collaborative and networking links in Japan and also purify protein samples for my experiments in the UK.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Janine Dovey （ID No. SP22105）

2. Current affiliation: University of Reading

3. Research fields and specialties:
Biological Sciences

4. Host institution: University of Tsukuba

5. Host researcher: Professor Sonoko Ogawa, Dr. Mariko Nakata

6. Description of your current research

My present research is focused on understanding both the local production of hormones in the brain and their relevance to function, using female mice as a model system. We know that hormones such as oestrogen and testosterone are important in driving social behaviours but the cellular and molecular mechanisms that underlie this is often poorly understood. In rodents, oestrogen acting via oestrogen receptors in the brain's soc is critical for the display of sexually dimorphic social behaviours such as sexual behaviours, parental behaviours and aggression as well as behaviours that denote learning and memory and anxiety. Oestrogens act by binding estrogen receptors in a set of interconnected brain nuclei, called the social behaviour network (SBN). The SBN is functionally and anatomically conserved amongst vertebrates and is thought to be critical for the production of these sexually dimorphic yet conserved behaviours. For example, oestrogen binding to oestrogen receptors in one of the areas of the SBN i.e., the ventromedial hypothalamus (VMH) is necessary for female rodents to exhibit lordosis or female sex behaviour in response to male stimuli.

The overarching objective in our lab is to understand how oestrogen production is regulated to drive social behaviours in mice. So far, I have investigated the production of steroid hormones in two nuclei of the SBN: the VMH and medial preoptic area of the hypothalamus (mPOA), both of which are important in lordosis as well as anxiety. At the University of Reading, I have optimized a novel technique of acute hypothalamic slice maintenance; a similar technique has been used by others to show that females synthesize neuroestrogen from the hippocampus. Our data, using ELISA and solid phase extraction, shows that there is an increase in neuroestrogen and neurotestosterone secretion from slices containing the VMH and mPOA. Having shown that SBN nuclei can produce neuroestrogens, we sought to understand how this is regulated. To do this, we used enzyme inhibitors in the hopes of showing a decrease in oestrogen. In doing this, we discovered a novel, androgen-mediated mechanism of regulation that exists in the mPOA.

7. Research implementation and results under the program

Title of your research plan:

Understanding the behavioural relevance of a novel androgen-mediated mechanism of neuroestrogen production, and how oestrogens within the mPOA contribute to social behaviours in mice.

Description of the research activities:

To understand the behavioural effects of the novel pathway that I discovered at the University of Reading, I injected mice with two inhibitors that are necessary to block this pathway: letrozole, an aromatase inhibitor, and dutasteride, an inhibitor of 5alpha-reductase. The mice were used in behavioural paradigms to assess anxious behaviours. Mice treated with letrozole alone showed less anxious behaviour than mice treated with letrozole and dutasteride; we believe this is dutasteride blocks the downstream production of 3beta-diol, to 3beta-diol, the steroid necessary for this novel pathway. This allowed us to conclude that, firstly, lack of oestrogen is anxiogenic in female mice, and secondly, that the novel androgen-mediated mechanism of regulation I discovered at the University of Reading is behaviourally relevant in an *in vivo* model.

Alongside this, I used aromatase-flox mice available in Prof. Ogawa's lab to knockdown aromatase expression specifically within the mPOA. In typical aromatase knockout models, it is hard to distinguish the relative importance of gonadally-produced oestrogens *vs* neuroestrogens in behaviour. This masks the region-specific importance of neuroestrogens in the brain. Using stereotaxic injections, I was able to show that aromatase in the mPOA is important for driving sexual behaviours and aggressive behaviours in male mice.

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

I thoroughly enjoyed this experience. Being able to work in another lab whilst getting some time to travel Japan has been life changing. I have visited Kyoto, Osaka, Nara, Enoshima, and Tokyo, and experienced food, life, and culture in a way I would never have got to experience it had I came to Japan as a tourist.

9. Adviser's remarks (if any):

【SP22106　】

JSPS Summer Program 2022
Research Report

1. Name: Joseph Weeks （ID No. SP22106 ）

2. Current affiliation: The University of Sheffield

3. Research fields and specialties:
Engineering Science

4. Host institution: The University of Tokyo

5. Host researcher: Professor Yoko Mitarai

6. Description of your current research

Niobium Silicide-based alloys are a potential candidate material to replace Nickel-based superalloys for use in jet engines. The higher the operating core temperature, the more efficient the engine. Current Designs and materials are perhaps at their limit with regards to operating temperature. However, Niobium silicide-based alloys have a higher melting temperature than Nickel-based superalloys and exhibit good creep resistance.

The main issue preventing further development and application of this new type of aerospace alloy is poor oxidation performance. Certain alloying addition to the Niobium and Silicon system have been tested in the past with varying result. Boron and Germanium are the primary focus of this current research as they both independently improve oxidation resistance and notably are both glass formers. If a glassy layer could be formed upon oxidation utilizing Silicon, Boron and Germanium with the adsorbed oxygen then this would dramatically improve oxidation resistance. This layer would act as a barrier to further oxidation transportation into the alloy and could viscously flow into cracks, self-healing over time.

Several alloy compositions with varying amount of Germanium and Boron are investigated to assess the effects these additions have on oxidation and to characterize the microstructure and phase information.

7. Research implementation and results under the program

Title of your research plan:

High temperature characterization of Niobium silicide based-alloys with boron and germanium additions.

Description of the research activities:

Four premade alloys (JW0 – Nb-18Si-24Ti-5Cr-5Al, JW1 – [JW0]-5B-5Ge, JW2 – [JW0]-10B-5Ge, JW3 – [JW0]-5B-10Ge) were sectioned and prepared for High temperature X-ray diffraction (HT-XRD), Differential thermal analysis (DTA), Scanning electron microscopy (SEM), furnace oxidation tests and vacuum heat treatments.

SEM confirmed that this batch of alloys had the same microstructures as previous batches consisting of: Niobium silicide phases, known as T2 and $D8_8$, Nb_{ss}, NbB and a Cr_2Nb laves phase. After 100 hours of heat treatment at 1300°C in a vacuum furnace the microstructure consisted of similar phase but the microstructures had coarsened and the eutectic structures had been lost.

DTA was carried out on each alloy up to 1600°C. Previously undetected exothermic peaks thought to be some form of recrystallization appeared in the boron and germanium containing alloys between 1000°C and 1300°C.

HT-XRD was performed at temperatures 600, 800, 1000, 1100 1150, 1200 and 1250°C over a range of 10° to 100°. Certain unidentified peaks formed consistently across the alloys as temperature was increased, which require further work to identify. One possible option is TiO_2 formation from a contaminated environment, implying this is the first/most abundant oxide to form.

Isothermal oxidation tests were performed over a period of 100 hours at 1200°C on thin specimens of each alloy. This revealed that out of the four alloys, JW2 (the highest boron content alloy) oxidised the least, and that at 1200°C germanium is less effective than boron at reducing oxidation.

The same experimental regime of high temperature XRD was performed on the oxidised samples in order to analyse the formed oxides and if any phase changes occur within the oxide layers as temperature increases. The structure of the bulk oxides was shown to be stable up to 1200°C, and a desirable SiO_2 oxide was present along with Ti based oxidise. Growth of an Alumina phase is reported.

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

The JSPS programme has been a great experience and I've been able to see lots of Japan during my stay here including cities; Osaka, Kyoto, Tokyo, Sendia, Himeji, Takamatsu, as well as scenic tourist attractions like Matsushima, Amanohashidate and of course Mt fuji.

The host research group has supported me with my experiments and organised events to help me experience Japan fully.

9. Adviser's remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Lauren Constance （ID No. SP22108）

2. Current affiliation: Cardiff University

3. Research fields and specialties:
Humanities

4. Host institution: Tokyo University of Foreign Studies

5. Host researcher: Professor Philip. A. Seaton

6. Description of your current research

The purpose of this research project is to understand how digitalisation can be used to display eyewitness testimony in Japanese memorial museums. Direct eyewitnesses to historical events play an important part in memorialisation and education at memorial museums, as seen in research on Holocaust museums (Hartman 1995; de Jong 2018). However, there comes a time when direct eyewitnesses can no longer share their stories, and numbers of eyewitnesses to certain historical events in the past (such as those who witnessed the atomic bombing of Hiroshima) are dwindling. Although eyewitness video testimony is said to be a common feature of memorial museums (de Jong 2018), this may not be the case in Japan. Previous research on the Hiroshima Peace Memorial Museum and museums memorialising the 3/11 Fukushima triple disaster have highlighted the flaws in current approaches and that improvements to eyewitness testimony may be required (Chen 2012; Maly and Yamazaki 2021). Therefore, this research aims to analyse practices at Japanese memorial museums to establish how digitised personal stories of eyewitnesses can be immortalised and disseminated through museum exhibits so they are both accessible to museum visitors, who may wish to gain a deeper understanding of the event while remaining respectful to the eyewitnesses, in the context of the ongoing impact of restrictions during the COVID-19 pandemic.

7. Research implementation and results under the program

Title of your research plan: Visualizations of eyewitness testimony in Japanese memorial museums

Description of the research activities:

Through the JSPS Summer Program 2022, I was able to make site visits to 46 museums across Japan, where I made observations on the museums' overall narrative, exhibition practices, display of eyewitness testimony and the impact of the COVID-19 pandemic on exhibitions. The museums memorialize a range of historical events, including a number of sites exhibiting various aspects of the Asia-Pacific War, environmental pollution, and disasters such as the 3/11 Great East Japan Earthquake, Tsunami and Nuclear Incident. During the site visits, I also made contacts with curators, museum staff, volunteers and (in some cases) eyewitnesses and either conducted interviews on site, or was then able to send a written questionnaire, in order to gain a deeper level of understanding of the processes and decision-making behind the display of eyewitness testimony in Japanese memorial museums. I also collected materials, pamphlets, and documents which I would not have had access to if I had not been able to come to Japan.

Additionally, being in Japan allowed me to develop my research network. I am particularly grateful to my host supervisor, as I could contact him to discuss initial observations from my site visits and talk through any difficulties or issues. I also used my time in Japan to reach out to Professors in my field who kindly gave their time to talk to me about their research and gave me invaluable advice and support.

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

The Japanese language lessons were particularly useful, as I had not spoken Japanese for a long time before starting the program, so it was great to have the opportunity to refresh my language skills and covered relevant grammar points which I ended up using many times during my conversations with curators.

9. Adviser's remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Sean Stansill （ID No. SP22109 ）

2. Current affiliation: University of Leeds, UK

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: Institute of Chemical Research, Kyoto University, Japan

5. Host researcher: Teruo Ono

6. Description of your current research

My research focuses on the thermodynamics of magnetic materials. I use and create computer programs to quantitatively model these materials. My research group is the only group in the world whose atomistic simulations can be directly compared with experiments as we use a specialist method for adding heat into the system. This allows me to understand from a very fundamental perspective how these materials work. These simulations do not require the assumptions that analytic theory require which makes it a very general tool to understand a wide variety of problems.

Antiferromagnets are a class of magnetic materials which are very hard to study experimentally as they produce no magnetic field for experiments to measure and manipulate. This means effects in these materials are often inferred and cannot be measured directly. My simulations fill this gap in our ability to understand these materials. I can gain information both at the microscopic and macroscopic scale to gain insights into experimental measurements. We have a very comprehensive model of NiO – an antiferromagnetic insulator which is often thought to be simple but is quite complex. This is parameterized from ab initio calculations and using this multiscale model, our simulations give a critical temperature that is within 5% of the experimental value. Other atomistic spin dynamics calculations give a critical temperature that is roughly half of the experimental value.

7. Research implementation and results under the program

Title of your research plan:

Finite temperature damping in NiO

Description of the research activities:

During my tenure I reproduced the experimental results from one of my host group's peer-reviewed papers and identified that dipole-dipole coupling was not the leading order source of finite temperature damping, instead it is coupling to transverse optical phonons which are excited at around 400K. This is something that has long been suspected but has never been verified because magnon and phonon sources of damping cannot be separated in experiments. But I can do this using simulations.

There are magnon modes which exist in this material but have not been observed in the groups' previous experiments. Simulations identified that this magnon mode couples weakly to the polarisation of incident light using in the previous work. We have therefore agreed to try new experiments using a different polarisation to investigate a higher frequency magnon mode which is more sensitive to the dipole-dipole interaction and is relevant for high frequency information technologies.

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

While in Japan, I was lucky to go to a conference in Okinawa where I met many international researchers and made many friends at other institutions in Japan. Living in Uji allowed me to experience Japan in a very different way to many tourists and JSPS fellows that live in large cities. Experiencing the Japanese countryside while still being able to easily visit large cities like Kyoto, Osaka and Tokyo is an experience I am very grateful for and meant I got to experience authentic Japanese culture.

9. Adviser's remarks (if any):

He is a theorist but has a good understanding of experimentation and often discussed with members of my lab. His original computational methods are very useful for understanding experimental results. I would like to continue our joint research and hope to achieve great results in the future.

JSPS Summer Program 2022
Research Report

1. Name: Veronika LACHINA (ID No. SP22110)

2. Current affiliation: University of College London

3. Research fields and specialties:
Biological Sciences

4. Host institution: Kyoto University

5. Host researcher: Prof. Tasuku Honjo

6. Description of your current research

I am in the process of investigating the role of tumour draining lymph node on the anti-cancer immune response. I have three batches of mice, under different conditions, from which I regularly collect blood and analyse their immune response. I will also sacrifice the mice in a few days and analyse how the PD-1 immunotherapy changes stromal populations in the tumour draining lymph node, particularly looking at the expression of some key molecular markers that define the stromal cells phenotype.

In the first batch of mice, I have injected the tumour, then surgically removed the tumour draining lymph node and administered PD-1 immunotherapy. I am now analysing the blood for immune cell populations from these mice weekly.

In the second batch of mice, I have grown the tumours and then surgically removed the tumour and the tumour-draining lymph nodes to see how systemic immune response changes if you no longer have a tumour draining lymph node. This is very similar to the most common practice in the hospital when treating cancer patients. I am also looking at the dependency of formation of memory cell populations on the tumour draining lymph node.

Thirdly, I removed the tumour draining lymph node before injecting the cancer cells and I am yet to analyse the mouse blood.

7. Research implementation and results under the program

Title of your research plan:

The role of the tumour draining lymph node in cancer.

Description of the research activities:

I have learnt how to handle live mice, how to grow and prepare cancer cell lines, how to inject them sub-dermally and how to collect and analyse mouse blood via FACS. I have taught myself how to surgically remove tumour draining lymph nodes and tumours from live mice and use surgical stitches to close the wound. I have tried a new digestion protocol that helps stromal cells from the lymph nodes survive and be analysed via FACS. Overall, I have determined that tumour draining lymph node is essential for a specific anti-tumour response and it is essential for an immunotherapy to work, which has implications on the common practice of excising the tumour draining lymph node from cancer patients for the purpose of diagnosis.

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

Homestay with a local family was a very enriching experience, the host mother let me wear her yukata to the Kyoto star festival.

9. Adviser's remarks:

JSPS Summer Program 2022
Research Report

1. Name: Chris Gregson (ID No. SP22118)

2. Current affiliation: National Nuclear Laboratory and University of Bristol

3. Research fields and specialties:
Mathematical and Physical Sciences
Chemistry

4. Host institution: Institute of Planetary Materials, Okayama University

5. Host researcher: Prof. Masami Kanzaki

6. Description of your current research

Water can be incorporated as hydrogen lattice defects in nominally anhydrous minerals that constitute the composition of the Earth's deep mantle interior. Even in trace amounts, water can significantly influence the physical (melting temperature, phase relations, thermal conductivities, diffusivity and rheology) and chemical properties of mantle minerals. In turn, water can influence plate tectonics and drives volcanic eruptions. The distribution of water in the mantle is heterogeneous and is controlled by the water capacity of different mantle minerals at variable temperature/pressure conditions. Perovskite minerals are a major constitute of the lower mantle, which represents almost half of Earth's volume. The capability of water incorporation perovskites may influence the physical and chemical nature of the lower mantle but remains unknown and requires new information. This research is also cross disciplinary as perovskite structured phases are widely studied in materials sciences for their electrical and optical properties, including superconductivity, for advancement of technology. The incorporation of hydrogen defects is also a major focus in perovskites as it can enhance or lessen these properties.

7. Research implementation and results under the program

Title of your research plan: **Hydrogen incorporation in perovskites**

Description of the research activities:

The project found hydrogen incorporation can vary across perovskites with different chemical compositions and crystal structures. To determine this we made synthetic hydrous perovskite samples using high temperature/pressure experiment to determine water solubilities and their likely hydrogen incorporation mechanisms. Phase determination and crystal structure was made using micro-X-ray diffraction and Raman measurements - including novel in-situ high-temperature measurements. Hydrogen defects were measured using ^{1}H MAS nuclear magnetic resonance (NMR) and Fourier transform infrared (FTIR) spectroscopy. Ab initio calculations were used to model various hydrogen incorporation mechanisms in perovskites and to calculate their corresponding theoretical NMR shifts and FTIR frequencies which helped interpret our experimental results. We also discovered perovskite crystal show a range of colours when grown under different oxidation conditions and we intend to determine the origin of this colouration. Overall, the results from the project were very extensive forming a body of work that will make a major new contribution to understanding hydrogen defects in perovskites. We hope to publish this research in the near future and acknowledge the generous contribution made by JSPS to make this contribution possible.

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

Living in the hot spring town Misasa was an incredible experience. The countryside town is full of welcoming people, amazing food and historic culture! I was lucky enough to bring my bike with me to explore the local volcano, mountains, and beaches across Tottori prefecture. During my rides I met local cyclists who encouraged me up tough hill climbs and I also encountered wild boars, snakes, and even a mountain deer! Japan has made a strong impression on me, and I cannot wait to return in the near future.

9. Adviser’s remarks (if any):

N/A

【SP22201】

JSPS Summer Program 2022
Research Report

1. Name: GARNIER-BRUN Jérôme, Mathieu, Samuel （ID No. SP22201）

2. Current affiliation: Ecole polytechnique

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: Kyoto University

5. Host researcher: Prof. Shin-ichi Sasa

6. Description of your current research

As part of my PhD, I study the statistical physics of disordered systems loosely inspired by socio-economic systems, to understand how different ingredients (imitation, reciprocity, decisiveness, learning…) affect the emergence of collective behavior (for example economic crises, fashions and trends, opinion formation…). Whereas in traditional thermodynamics the system spontaneously evolves as to minimize the free energy, such collective systems don't have an analogous energy-like quantity to optimize in general. As such, they are perpetually out-of-equilibrium, and their theoretical understanding requires an out-of-equilibrium description, for which there is still no robust and general framework.

A large part of my work is therefore dedicated to studying the impact of out-of-equilibrium perturbations on equilibrium systems that are known to display aggregation or coordination. In its most simplified description, this amounts to assessing how the energy minimization that occurs in equilibrium statistical mechanics, represented by an overdamped Langevin equation, is altered by the presence of generic out-of-equilibrium driving. Doing so then requires a combination of theoretical work, using recent development from stochastic thermodynamics and spin-glass theory, and numerical simulations.

7. Research implementation and results under the program

Title of your research plan: Theoretical and numerical study of the impact of out-of-equilibrium currents on the relaxation of overdamped Langevin dynamics.

Description of the research activities: While at the *Nonlinear Dynamics* group of Prof. Sasa, my work first consisted in getting familiar with the theoretical techniques developed by the group in recent years. Having gained exposure to these tools, we decided to focus on a specific class of out-of-equilibrium currents that preserve the equilibrium system's steady state distribution. On a day-to-day basis, I performed numerical simulations and theoretical calculations in collaboration with Dr. Andreas Dechant, involving many discussions aiming at building some intuition for the novel out-of-equilibrium relaxation mechanism we were studying. I also had the opportunity of meeting with colleagues from RIKEN Kobe's *Nonequilibrium Physics of Living Matter* group to discuss preliminary findings and their possible implications on the study of some biological systems.

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

I had the incredible luck of arriving in Kyoto just in time for the first post-covid *Gion Matsuri* festival, giving me a unique experience of traditional Japanese culture. Beyond this initial exposure and the incredible landmarks offered by Kyoto, the homestay program was also a fantastic cultural experience.

9. Adviser's remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Adrien CARRERE （ID No. SP22202）

2. Current affiliation: ILM, Institute for Light and Matter, University Claude-Bernard Lyon 1, France

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: Graduate school of Arts and Sciences

5. Host researcher: Prof. Satoshi SAWAI

6. Description of your current research

Aggregation dynamics in cell population :

My PHD thesis focuses on the aggregation of *Dictyostelium Discoideum,* a social amoeba. This cell is known to be able to evolves from a single cell life-form (call vegetative cycle) to a multicellular structure (call development cycle). Usually this appends when the cell lack food. However, an aggregation process has been observed in nutritive medium suggesting that the social life of *Dictyostelium Discoideum* may be triggered by another signal. This observation was made under a millimetric medium film after cell reach very high density. Contrary to is development cycle this aggregation process doesn't form spore that will help the amoeba to colonize new and hopefully more suitable places for its development. At the beginning of my thesis our knowledge of this aggregation stops there. However, early experiment and simulation show a relationship between oxygen availability in the bottom of the dish and the aggregation process. Moreover, oxygen availability will even dictate the size of the aggregate. Now, our study focuses on the dynamics of aggregate how they move and interact with each other, how they form? But new projects have started to explain what the biology behind this aggregation process are and how cell adapt to the lack of oxygen.

7. Research implementation and results under the program

Title of your research plan:

3D imaging of *Dictyostelim Discoideum* aggregate under hypoxia

Description of the research activities:

During my stay in laboratory of Professor Sawai my main focus was the obtention of 3D images of the aggregation phenomena I study in France. Thanks to the library of fluorescent cell lines and the diSPIM microscopy of Sawai laboratory and the help of Sawai-sensei and Kuwana-san, the 3D structure of the aggregate have been observed. Images obtained show a structure similar to a blastula (a hollow spherical layer of cells) and may help to understand the apparition of such structure in mammalian embryogenesis (development of embryo). Moreover, image of cell polarization (that not have yet been analyzed) will help to better understand how cell organize themselves insides the aggregate and move. Finally, some image will be acquired (after my leaving) to understand how cell adhere together to form this complex structure. All the result will help to better understand this aggregation process.

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

During my stay in Tokyo, I have the chance to enjoy local food and culture. I visited several important cultural places and some museum during my stay as well as some local festival like the Mirama matsuri and Chiyoda City floating lantern festival. Moreover, I have the chance to go to Sendai during the Tanabata Matsuri and visit a little bit. Finally with my host family I have participate in a pottery workshop and learn to do some Japanese sweets.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022

Research Report

1. Name: Guillaume Grob ID No. SP22203
2. Current affiliation : University of Strasbourg, France
3. Research fields and specialties: Biological Sciences
4. Host institution: University of Tokyo
5. Host researcher: Professor Osamu Nureki, Dr. Yuzuru Itoh
6. Description of your current research

My current research focus on a protein called Mig-14, a protein from the family of Aminoacyl-tRNA transferases (ATT) which uses aminoacyl-tRNA (aa-tRNA) as a source of amino acid to transfer amino acids on various other macro-molecules in bacteria and fungi. ATT are of great interest since numerous types of ATT are found only in bacteria and fungi infecting humans. In addition, the inactivation of ATT in bacteria can lead to a greater sensitivity against human immune system or against antibiotics used to fight these bacterial infections.

Mig-14 is a ATT found in the human opportunistic pathogen *Pseudomonas aeruginosa*. This bacterial species is widely causing lung infections in patients with pre-existing lung condition such as cystic fibrosis, severe seasonal flu or severe Covid-19 infection requiring ICU admission. In addition of infecting human, P. aeruginosa is highly resistant to a wide range of antibiotics used to treat bacterial infections. It is therefore of great important to identify new targets to develop new antibiotics to fight such infections.

A Mig-14 protein is encoded in the genome of *P. aeruginosa*. It has been shown in other bacteria that Mig-14 protein is involved in virulence and resistance against antibiotics and the host immune system. Furthermore, Mig-14 has been suggested to be an essential in P. aeruginosa, meaning that its inactivation leads to the death of bacteria.

To investigate the potential inhibition of Mig-14, its enzymatic activity as well as its structure should be determined. This is achieved mainly through biochemical and molecular biology approaches to decipher all these different aspects.

7. Research implementation and results under the program

Title of your research plan:

Determination of the structure of the complex between Mig-14, alanyl-tRNA synthetase and alanyl-tRNA from *Pseudomonas aeruginosa*.

Description of the research activities:

Since Mig-14 use aminoacyl-tRNA as a substrate, it needs to be in interaction with the enzyme responsible for the synthesis of this substrate. The research activity I conducted in Japan aimed to produce and purify Mig-14, alanyl-tRNA synthetase and tRNA. The complex formation between the 3 partners was then assessed by gel filtration chromatography and the complex structure is yet to be determined using cryo-electron microscopy.

Mig-14 and alanyl-tRNA synthetase are proteins, therefore they can be expressed recombinantly in bacteria using an expression plasmid, encoding both proteins with tags, so

the proteins are so-called fusion proteins and can be purified more easily subsequently. The bacteria expressing the proteins were then lysed, and the proteins were purified by affinity chromatography, thanks to the tag that was encoded in the expression plasmid. Further purification steps (size-exclusion chromatography for Mig-14 and alanyl-tRNA synthetase and ion-exchange for alanyl-tRNA synthetase) enabled to achieve a greater purity (of almost 95 % for alanyl-tRNA synthetase).

The third partner of the complex, the alanyl-tRNA was produced in a different way. RNA can be synthetized chemically, purified directly from an organism, or synthetized in vitro using an enzyme called T7 RNA polymerase. This last technique was used. A DNA fragment, obtained by PCR was used as a template to synthetize the RNA of interest. This method enables the production of highly pure and large amount of RNA.

After the 3 partners were obtained in sufficient quantity and with a good purity, they were mixed with other cofactors to assist the formation of a complex. This sample was then applied on a grid suitable for cryo-electron microscopy. Such grids are made of copper-rhodium alloy of gold. In both case, metal is covered with a thin layer of carbon in which there are holes. Particles of proteins and RNA are sticking in these holes thanks to the surface tension of water, which forms a thin layer in the hole. The grid is then flash-frozen to -196 °C, the freezing speed prevent formation of water crystals, so water remains transluscent and protein-RNA particles can be observed, and their structure determined.

Please add your comments, including any cultural experience during your stay in Japan (if any): This experience enabled me to discover a new working environment, in a lab focused and experienced in structural biology. It also enabled me to discover a new country, a new culture, and the opportunity to confront myself to unprecedented challenge. I would like to thank my host lab for their kindness and help during my stay.

Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Clara GOBE　（ID No. SP22204）

2. Current affiliation:

Université Paris Cité, INSERM, CNRS, Institut Cochin, F-75014 Paris, France

3. Research fields and specialties:

Biological Sciences

4. Host institution: Institute of Quantitative Biosciences, The University of Tokyo, Tokyo, Japan.

5. Host researcher: Dr. Yuki OKADA

6. Description of your current research

My research projects aim at studying gene regulation and chromatin remodeling during spermatid differentiation into spermatozoa (i.e. spermiogenesis). This process results in the reorganization and compaction of the paternal genome, which is of great importance to ensure the paternal genome protection and its correct transmission. In the nucleus, the DNA is wrapped around octamers of proteins named histones. The sperm genome compaction needs two important steps: histones hyper acetylation to open the chromatin, and histones replacement by smaller proteins called protamines to allow the extreme compaction. However, even if a vast majority of histones are replaced by protamines during spermiogenesis, some of them remain in the genome (1-5% in mouse and 10-15% in human) and could carry specific histone post-translational modifications such as acetylation or methylation. It has been recently published that the trimethylation of the histone 3 lysine 4 (H3K4me3), an epigenetic mark specific of active genes promoters, is retained at the promoter of developmental genes in sperm and may contribute to embryonic development (Jung *et al.,* 2017 ; Yamaguchi *et al.,* 2018 ; Lismer *et al.,* 2020). During the past years, many teams have struggled to study histones marks in sperm due to the extreme compaction of the genome and the few quantity of histones remaining. Those technical difficulties led to the elaboration of very different protocols trying to bypass them and created a debate concerning the position and the function of retained histones (Hammoud *et al.,* 2009 ; Erkek *et al.,* 2013 ; Carone *et al.,* 2014 ; Yoshida *et al.,* 2018 ; Yamaguchi *et al.,* 2018). The laboratory has recently characterized two mouse models with a germ cell specific knock-out (KO) of (i) *Spin1*, an H3K4me3 reader, or (ii) *Dot1l*, the only histone 3 lysine 79 (H3K79) methyltransferase known to date. In both models, KO mice present abnormal sperm differentiation, including chromatin compaction defects and KO spermatozoa for *Dot1l* used for *in vitro* fertilization were unable to give preimplantation embryos. This gene has also been under investigation in Dr. Yuki Okada's lab for its potential role in spermatogonial stem cells, proliferation, differentiation and fertilization. Considering the challenge to study sperm chromatin marks in mouse and human, we both decided to collaborate to determine whether or not H3K79me is retained in sperm and participate to embryonic development.

7. Research implementation and results under the program

Title of your research plan: **How does sperm chromatin contributes to the embryonic genome?**

Description of the research activities:

Dr Julie Cocquet's group and Dr. Yuki Okada's team are both interested in gene regulation and chromatin remodeling during spermatid differentiation into spermatozoa (i.e. spermiogenesis). During this process, a vast majority of histones are replaced by protamines to allow sperm DNA compaction. However, it is known that some of them remains in the sperm genome and could contribute to the embryonic development. To study the localization and the epigenetic modifications carried by those histones, our both labs decided to study sperm chromatin marks in mouse and human, using a recently developed technology called Chromatin cleavage Under target (CUT&Tag). During my stay in Dr. Okada's laboratory I managed to set up the CUT&Tag protocol on mouse and human sperm. In the first place I had to try different methods to decondense the sperm DNA and access to sperm chromatin. Since human sperm is more sensitive than mouse sperm to chromatin decompaction, I had to used two different treatments: dithiothreitol and/or nucleoplasmin to decondense human and/or mouse sperm respectively. In a second time I established a protocol that combine efficient sperm DNA decompaction and successful DNA cleavage without losing the genomic material. These protocols have been applied successfully on sperm samples for the epigenetics marks H3K4me3 and H3K79me2, and the samples have been sent to sequencing.

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

Thanks to the JSPS summer program 2022 I was able to set up a common protocol between our both labs, which will help to solve a scientific question still under debate in our field. This knowledge transfer helps creating new collaborations and helps improving the quality of our research. During my stay I also had the opportunity to visit many places to discover more about the Japanese history, culture and traditions. I also had the time to learn some Japanese and to enjoy the Japanese life style with my homestay family. All of this is important if we consider coming back to Japan for a short or long time stay.

9. Adviser's remarks (if any):

In the last two months, Dr. Gobe has been very hard to develop a unique experimental method for sperm chromatin analyses. She was able to manage the several technical issues, and she is currently awaiting the final results. We will continue to collaborate and brush up on the method she has developed.

Other than the experiment, Dr. Gobe is very friendly and she quickly got used to living in Japan. Her visit was exciting in many ways for the lab members.

JSPS Summer Program 2022
Research Report

1. Name: Cuong PHAM （ID No. SP22205 ）

2. Current affiliation:

Sorbonne Univertisty

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: National Institute of Advanced Industrial Science and Technology

5. Host researcher: Tomokazu Tsurugizawa

6. Description of your current research

Glymphatic system, is featured with the dynamic water exchange between cerebrospinal fluid (CSF) and interstitial fluid (ISF), has emerged as a brain-wide clearance pathway for potentially toxic substances. Glymphatic pathway is driven by the convective flow of the peri-arteriole CSF, through the parenchyma ISF, to the recirculation of CSF along the draining veins. A functional link between the glymphatic system and the meningeal lymphatic vessels has been proposed for brain molecular clearance.

Glymphatic clearance has been suggested to rely on the water channel aquaporin 4 (AQP4), the most abundant water channel in the mammalian brain and predominantly expressed in astrocytes. Despite the need for further validations, recent data in rodent models show that genetic or pharmacological inactivation of AQP4 impairs the glymphatic clearance of Abeta and tau in Alzheimer's disease. Manipulating astrocyte AQP4, therefore, might regulate the efficacy of glymphatic clearance so to maintain brain homeostasis. **However, it remains elusive how AQP4 regulates glymphatic water diffusion, which has hindered the therapeutic targeting of AQP4 in brain phyiopathology.**

My PhD study aims at understanding the mechanism by which AQP4 regulates brain glymphatic fluid. I have used mouse as the animal model and a multidisciplinary approach comprising ex vivo and in vivo real-time imaging, mouse genetics and acute pharmacology targeting. **My results thus far lead to the new finding that AQP4 mediates a tonic inhibition of astrocyte swelling in brain parenchyma. This suggests that AQP4 regulates astrocyte volume dynamics thereby sculpturing the extracellular route for glymphatic flow.**

7. Research implementation and results under the program

Title of your research plan:

Targeting astrocyte water channel to image glymphatic system with difusion MRI

Description of the research activities:

During my stay at Dr. Tomokazu Tsurugizawa's lab i have investigated brain's glymphatic system by using diffusion magnetic resonance imaging (DW-MRI), a well-established MRI technique used for the diagnosis of diseases such as stroke and edema. It uses the diffusion of water molecules to generate a contrast and therefore an image. By using this technique I was able to investigate water diffusion in human brain in the context of awake and sleeping state which is said to impact glymphatic system water diffusion in the brain. Our results show that water diffusion was increased in awake state as compared to sleeping state. Investigation of the role of aquaporin-4 (AQP-4) one of the main water transporter in the central nervous, and an essential component in the glymphatic system was also done using DW-MRI in a rodent model. The results shows that water diffusion is greatly impacted upon blocking of the AQP-4. Indeed inhibition of the AQP-4 have shown that there is an increase of water diffusion in the brain. Those results although very preliminary can lead to clues for diagnosis and treatment for neurodegeneratives pathologies such as Alzheimer's disease.

As a side project I also have set up experimental design and analysis for functional ultrasound imaging. This study will be used as a pilot study in order to mesure neurovacular coupling in rodents. This study might be applied in the future for application in glymphatic system investigations, or other brain pathologies.

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

My stay in Japan was short, but it was an amazing experience. It was first an enriching experience professionally for me as I arrived here eager to learn many thing from my host lab, and I was not disappointed. It was also an exceptional experience personally for me. Japanese culture have so much to offer that it was impossible for me to see everything. From the food (I really fell in love with all the kinds of ramen Japan have to offer), to cultural events;

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Julien CICERO ID No. SP22206 ）

2. Current affiliation: CANTHER & LBHE laboratories, University of Lille

3. Research fields and specialties:
Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: The University of Tokyo, Institute of Industrial Science

5. Host researcher: Professor Yoshiho Ikeuchi

6. Description of your current research

With nearly 2.3 million cases diagnosed worldwide each year and an estimated 685,000 deaths by 2020, breast cancer is the leading cause of cancer-related death in women. Brain metastases cause severe cognitive complications that severely impair quality of life.

In Triple negatives breast cancer, the prognosis for brain metastases is particularly poor with a median survival of no more than 6 months. It is therefore crucial to know the molecular actors that promote the metastatic dissemination of TN breast cancer to the brain but also to prevent the proliferation of brain micrometastases that can cause fatal recurrences.

To do so, we summarize the last steps of brain metastasis of breast cancer cells through different study models:

- Human blood-brain barrier (BBB) in vitro: cancer cells that metastasize to the brain must cross the BBB to reach the brain parenchyma. study of adhesion and transmigration of cancer cells across the BBB.
- 3D organotypic matrix in vitro: study of the persistence and development of cancer cells within the brain parenchyma.
- Ex vivo organotypic culture: This model reproduces in particular the interactions between cancer cells and glial cells at the interface of the brain parenchyma and the metastatic tissue. Using this model, we assess the ability of breast cancer cells to colonize a brain environment.

7. Research implementation and results under the program

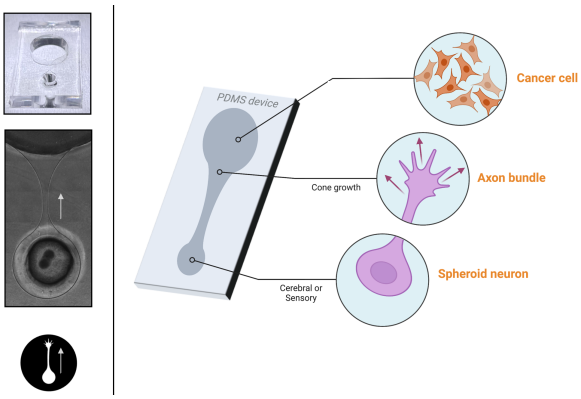
Title of your research plan:

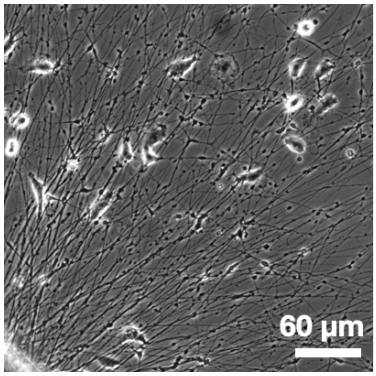
Neurons & breast cancer cell interaction in brain metastasis progression

Description of the research activities:

In order to study the interaction between neurons and cancer cells, we generated cerebral and sensory neurons from human induced pluripotent stem cell (hiPSC). After differentiation, spheroid neurons were seeded inside a 2 compartments PDMS device that allow the culture of neurons (with axon growth) with breast cancer cells.

Through this collaboration, we were able to show the communication between both neurons and cancer cells in the metastatic progression context. On the neuronal side, the integrity of the cell bodies as well as the growth of the axonal network was measured. On the cancer cell side, proliferative, migratory and chemotactic processes were quantified.





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

New techniques learned, great encounters, total immersion in a wonderful society. This mobility within the framework of our research project on brain metastasis of breast cancer was a unique experience. From now on, we will be able to continue our work in our lab in France on neuron/cancer cell interactions.

9. Adviser's remarks (if any):

I would like to thank JSPS for giving us a chance to collaborate with Mr. Julien Cicero in the summer of 2022. He was enthusiastic, professional, and energetic throughout the time in Japan. He established many important experiments using our system to co-culture neurons with his cancer cells during his relatively short stay. We will certainly continue our collaboration after the program, and hope that we will meet again soon.

JSPS Summer Program 2022
Research Report

1. Name: Valérian Christian Francis GUILLAUME （ID No. SP22207）

2. Current affiliation: École Normale Supérieure (ED540) — Paris (Ulm) and Conservatoire national supérieur d'art dramatique (CNSAD)

3. Research fields and specialties:

Humanities

4. Host institution: Gakushuin University, 学習院大学, Gakushūin daigaku

5. Host researcher: Prof. Thierry Maré

6. Description of your current research : Reading and writing on the stage (research-creation through practice) Dramaturgical, aesthetic and performative issues of writing on contemporary stages Fields: Creative Writing, Theatre Studies, Literature Out of the Book, Visual Arts, Comic Books — Presentation of the main lines of research-creation: The subject of my research-creation PhD will be devoted to the study of the forms taken by the graphies on stage and their dramaturgical, aesthetic and performative stakes. My doctorate is interested in graphies that are performed by a person on the theater stage live and on sight. The writing is considered here as a movement or even as a graphic and choreographic development. Theoretically, I rely on the concept of "graphiation" that the comic strip theorist Philippe Marion forged in his thesis[1] in order to question graphic enunciation. My research-creation's issues are these. In what way do the graphics participate in the production of meaning, and more broadly, do they orient the reception of the show? What hermeneutic and sensitive relationships do they allow to establish with the spectators? To what extent can they constitute a performative material? Of what theatricality can they be the vectors? 1) Contemporary theater shows us two types of fixed graphie: a fixed graphie as scenography, most often illustrative, and a fixed graphie which calls more for the experience of reading over time and duration. Regarding the graphie as scenographic vocation, we no longer count the theatrical proposals punctuated by the use of projections on canvas or the display on screen of the text or paratext (most often in the form of a chapter intended to the spectator). More generally, we see that the graphic material, far from being limited to the words of the performers on stage, is just as well painted, drawn, sculpted, suspended, and sometimes even worn by the actors themselves (T-shirts, tattoos , ...). In their formaland material diversity, fixed graphy on the stages then put the spectators in the position of decipherers, invited to produce meaning. 2) The rising diffusion of theatrical proposals in foreign languages with subtitles places the spectator in the position of reader. If the use of subtitling took some time before being admitted to the stages, theaters today resort to increasingly powerful software, such as Kalieute or Babel, whose technical possibilities are reinventing dramaturgy and the aesthetics of the projected text. The reception of a text through reading changes the relationship between the scene and the audience and creates a relationship of complicity between the written text and the imagination of the spectator who deciphers it. What are the reasons that motivate an artist to place the spectator in the position of reader? What does graphie express that the voice cannot? If the pleasure of the text manifests itself here in a fixed graphie could we not therefore imagine an equal pleasure with a show that presents writing in the making ?

7. Research implementation and results under the program

Title of your research plan: Shodō performance in Japan. As a writer, actor-performer and director, I question how writing exposed in theatrical and non- theatrical spaces, performed live and on sight, can allow the emergence of the spectacular. My practice of writing, acting and directing is inseparable from digital creation and the hybridization of practices and languages. The shows I stage provoke a double cohabitation: 1) performers with writing, 2) theater with other mediums: live electronic music composition, choreographic score design, animation of living armatures for puppeteer objects and integration of drawing in the rehearsal process and video-projection of live traces made live. When I write, influenced in particular by the Oulipo and George Perec and Goldsmith's Uncreative Writing, I apprehend the text, not as an end, but as a living material. By applying the notion of "graphiation" to live performance, my research-creation has often led me to the Japanese culture and particularly that of calligraphy. At first, I immersed myself in the history of GUTAÏ, whose artists gave performances through which drawing and trace are approached by the gesture and movement of the trace. And then, more broadly, I became fascinated by Shodō which seems to echo my artistic concerns on stage. Historically, the art of calligraphy was very early present in the education of Japanese children. During the Edo era, children went to the *terakoya* to learn to read and write, but also to indulge in the writing of harmonious kanji, sitting on the floor. Even today, there are many calligraphy classes. These classes are compulsory from elementary school to high school, so every Japanese person practices shodō at least once in his life. If few people continue to practice calligraphy afterwards, there are new mediatizations of calligraphy, both on television and in magazines (the celebrity Kanazawa Shôko is an example). And there are manga, series and movies about shodō. We can say that there is a consequent phenomenon. There are also - and this is what interests us particularly - Shodō shows. In high schools, there are Shodō clubs. And every summer there is the national Shodō championship of high schools, which gathers thousands of spectators. It is held in the framework of the festival organized in Shikoku-Chuo in Ehime prefecture. The rules of the competition are as follows. Each team (composed of ten high school students) realize their calligraphy on giant sheets (4 meters by 6). The teams dance to the rhythm of the music played in the gymnasium. The jury appreciates both the calligraphy (the trace produced) and the spectacle of it (the movement). These dancers-calligraphers are not perceived as artists or performers but as athletes. The athletic dimension of this practice interests me and makes me think of the theatrical concept of affective athleticism according to Antonin Artaud.

Description of the research activities:

My research project in Japan was a way for me to experience Shodō exhibitions, Shodō clubs, and Shodō performances firsthand. I observed the national Shodō competition in Ehime and tried to compare this practice with my own experience of French theater. I visited many museums and met Japanese people to talk with them about calligraphy and theater. I wrote an excerpt of my thesis which is devoted to the performance of Shodō and the Gutai group in relation to my personal artistic performances that I am developing in France within the framework of my theater company (compagnie théâtrale désirades). I plan to continue writing this part in a dedicated article.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): It was for me a fantastic experience, really inspiring and a way to reconsidered my own art (writting and theater). I met a lot os fascinating people and discovered beautiful places (Kyoto, Osaka, Hiroshima, Mastuyama). All my gratitude to the Gakushuin University, 学習院大学, Gakushūin daigaku, Prof. Thierry Maré, MS. TOMOKO MORIYASU, Pr. Patrick de Vos for their warm welcome and their precious help. It was a strong and intense experience that will considerably modify my relationship with art and writing. I am now considering taking Japanese classes in France.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Achille Hippolyte JACQUEMOND （ID No. SP22209 ）

2. Current affiliation: École Centrale de Lyon

3. Research fields and specialties:
Engineering Sciences

4. Host institution: Tohoku University

5. Host researcher: Associate Prof. Koji SHIMOYAMA

6. Description of your current research

My research focuses on the robust shape optimization of a disc brake system under dynamical criterion. The first step is to construct a simplified simulation model of a disc brake system which can reproduce so-called “friction-induced instabilities” which are the origin of undesirable squeal noise in these types of systems. This model can then be used to predict the propensity of squeal noise in disc brake systems with different geometries, through a well-defined stability criterion based on dynamical analysis of the model. The recently proposed Isogeometric Analysis method is used to construct the disc brake model, as it provides better performance than classical methods and more importantly because it enables generation of complex and original disc brake shapes. This model is then used as the basis of an optimization problem where the main objective is to minimize squeal noise (maximize stability), and the input parameters are parameters which allow to control the shape of the disc brake system. Maximization of disc/pad contact surface area is also added as a second optimization objective in order to guarantee good braking capacity.

Because the estimation of the stability criterion is computationally expensive and we have no access to its gradient, we opted for a bayesian optimization approach to solve this problem, because many stability function evaluations are needed in the optimization process. This approach is based on a so-called “surrogate model”, which is an approximation of the stability criterion function, and which is computationally cheaper to evaluate. We chose the Kriging method for the construction of our surrogate model as it has shown good applicability to functions with complex behavior.

One main challenge of my research is to take into account uncertainties in the optimization process in order to compute robust optimal solutions. This means we wish to find disc-brake shapes which provide good stability and where the stability is not degraded when the shape is modified very slightly around its optimal configuration.

Before the JSPS Summer program, the construction of the isogeometric disc-brake model, the derivation of the stability criterion, and initial work on the generation of the Kriging model of the stability function, were carried in my home university.

7. Research implementation and results under the program

Title of your research plan: Robust shape optimization of a disc brake system under dynamical criterion

Description of the research activities:

The main goal of the 2-month stay at Tohoku University was to take advantage of the expertise in optimization, surrogate modeling, and uncertainty quantification of Prof. Shimoyama and his lab members, in order to advance these aspects of my research project. Main activities:

- The Kriging model of the complex stability criterion was successfully constructed and adjusted. Before arrival in Japan, the Kriging model was still in early stages and did not show good performance. With the help and advice of Shimoyama lab members, the Kriging model now shows good approximation of the stability criterion.
- The robustness aspect of my research, not studied before arrival in Japan, now has promising perspectives. Two methods for taking into account uncertainties are being evaluated, under the guidance of Prof. Shimoyama. Both methods are based on the Kriging surrogate modeling approach and use the minimization of the variance of the stability function as the main idea to guarantee robust solutions. The first method is to construct a “noisy” Kriging model which directly contains information about the variance of the stability criterion inside each prediction. The main challenge of this approach is to separate the variance of the Kriging model and that of the stability function. A way to accomplish this was proposed with the advice of Prof. Shimoyama, and the method is now being tested. The second method for robustness is to directly construct a Kriging model of the stability function variance. Fitting a Kriging model to the variance initially showed poor efficiency, however we believe it can be accomplished by increasing the stability function variance values which are very low for now. Both approaches are being tested in parallel. Thanks to Prof. Shimoyama and his lab members, the robustness aspect of my research shows high prospects.
- The time at Shimoyama lab was also used to prepare my participation in the WCCM 2022 conference (took place online from July 31st to August 5th) on computational mechanics. Prof. Shimoyama’s input and advice during my preparation was very fruitful and helped accomplish a successful presentation with many questions and feedback. It was a great opportunity to present my research results and perspectives.
- I also participated in weekly meetings with all the lab members, where I could share my research progress, and appreciate the diverse range of optimization-related research projects carried out by the different students of Shimoyama lab. Daily interactions with the lab members were also very productive and helpful.
- I extended my stay in Japan for (until the beginning of September) in order to continue to take advantage of the research environment of Prof. Shimoyama’s lab. The research aspects described above will continue during this period.

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

From a cultural point of view, the experience was exceptionally enriching. Day-to-day communication with lab members, and Japanese people in general was extremely interesting and helped me improve my Japanese language skills. The Homestay program organized by JSPS was also one of the best cultural experiences of my life.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Pierre Tadeusz HOUEDRY （ID No. SP22210 ）

2. Current affiliation: Université de Caen

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: the University of Tokyo

5. Host researcher: Atsushi SHIHO

6. Description of your current research

Through my first year of PhD I have been working on a generalization of the sequence of articles written by Bernard Le Stum, Adolfo Quiros and Michel Gros. I obtained a theoretical set up where it is possible to not only deal with twisted differential equations in one variable but also in several variables. The main idea is that at the moment we have been dealing with q-difference operators. I have been working on a generalization of the theory in the case of one variable and q-differences by considering the several variables case and taking any endomorphisms of a ring. Under certain hypothesis we obtain an equivalence of categories between twisted differential modules (modules over our ring where the derivation acts) with certain convergence condition and untwisted (where we take the endomorphisms to be the identity) differential modules on p-adic annulus. In some sense the results I have obtained so far are similar in the spirit to the theorem 6.3(ii) of Pulita in the article « p-adic confluence of q-difference equations » and to the main result of the article « q-differences and p-adic local monodromy » written by André-Di Vizio. Those results show, under some conditions, that it is similar, under the arithmetic-geometrical point of view, to study differential equations or the associated twisted differential equations. The idea of this construction is to be able to compute p-adic cohomologies developed by Bhatt, Morrow and Scholze for example. I'm currently looking forward to apply the techniques to make this generalisation to make the theory of several variables twisted differential operators fit in the framework of prismatic crystals.

7. Research implementation and results under the program

Title of your research plan:

Study of twisted differential modules in several variables

Description of the research activities:

We had seminars every week with Atsushi Shiho and his PhD students Kimihiko Li and Peiduo Wang to discuss about the theory of twisted differential operators in several variables. The first part of seminars consisted of the presentation of the results that I have obtained so far during my two first years of PhD. Then we discussed several topics related to them. We came up with a few examples of topologically étale morphisms which plays an important role in the constructions of the theory. Also, through our discussions we have been able to weaken some hypothesis required to make one of my theorems to hold. We found that a certain new convergence condition seems to fit more naturally into my results.

Our weekly seminars were also the opportunity to have new questions on twisted differential modules which are related to the known properties on untwisted differential modules: We asked if we can check a convergence property of a finite twisted differential module on its generators. Also, we asked for a condition that every finite twisted differential module is locally free. We also asked if a finite twisted differential module with convergence condition comes from a finite twisted differential module on a smaller ring called a ring of definition.

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

I had the opportunity to take in the Home Stay program. It was a great experience. I was also able to meet a lot of the fellows of the summer program during my stay and we did travel on the weekends to discover Japan.

9. Adviser’s remarks (if any):

Pierre has contributed a lot to the seminar with me and my students. I believe that it was also a good opportunity for my students to have seminars with him.

JSPS Summer Program 2022
Research Report

1. Name: VIGUIER Florian （ID No. SP22212）

2. Current affiliation: ATER – University of Strasbourg

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: Kavli IPMU – University of Tokyo

5. Host researcher: Pr. ABE Tomoyuki

6. Description of your current research

My field of research is algebraic geometry, in a p-adic context. I study more precisely arithmetical Fourier-Mukai transforms for p-adic abelian varieties (formal abelian schemes or rigid analytic abelian varieties). Abelian varieties are geometric objects endowed with a structure of commutative group. Elliptic curves are famous examples of such varieties. The p-adic base we are working on refers to the field of rational p-adic number. Concretely we work with varieties on fields that are finite extension of the field of p-adic rational numbers.

The Fourier-Mukai transform was first introduced by Shigeru Mukai in 1981 for the study of complex abelian varieties. It can be thought of as an algebra-geometric analog of the Fourier transform, linking sheaves of O-modules (or, roughly speaking, functions) over an abelian variety A with the ones over its dual abelian variety $\hat{A}$, that parametrizes isomorphism classes of rigidified line bundles over A satisfying the theorem of the square. Since its original introduction, the Fourier-Mukai transform turned out to be a useful tool for studying various problems such as moduli problems or mirror symmetry conjecture, which says that for any Calabi-Yau manifold M (with good properties), there is another Calabi-Yau manifold X – the mirror one – such that the complex geometry of M is equivalent to the symplectic geometry of X, and vice versa. This has useful applications in string theory as it gives an equivalence between A-type D-branes and B-type D-branes (D-branes occur in string theory as dynamical objects on which strings can end).

In my research I aim to adapt the construction of the classical Fourier-Mukai transform for abelian varieties over rings V that are finite extensions of the ring of the p-adic integers. I also aim to extend its definition so that this transform acts not only on functions over A, but also on p-adic linear differential equations, i.e. on arithmetic D-modules over A. The motivation is to obtain a new tool to study the category of (quasi)-coherent sheaves over rigid or formal abelian varieties in arithmetic geometry, as well as p-adic linear differential equations on abelian varieties.

The main challenge with these constructions is to preserve fundamental properties of the classical Fourier-Mukai transform as, for instance, its involutivity. This property allows to prove some interesting equivalence of categories results.

7. Research implementation and results under the program

Title of your research plan:

Fourier-Mukai transform for arithmetic D-modules

Description of the research activities:

During the two months of the program and thanks to the numerous discussions I had with Pr. Abe, I understood more deeply the problems behind the arithmetic Fourier-Mukai transform.

More precisely and put in simple words, there are numerous notions of arithmetic D-modules, each indexed by an integer m and denoted $D^{(m)}$, and a 'limit' structure, denoted $D^{\dagger}$.

At the beginning I planned to construct a Fourier-Mukai transform for $D^{(0)}$-modules, as they are the closest to the one used to define to Fourier-Mukai transform in the non-arithmetic case. But thanks to Pr. Abe, I understood that this functor is probably not the good one to consider, as it might not be involutive.

I then considered $D^{(m)}$-modules, aiming to define the functor on the $D^{\dagger}$-modules. A lot of constructions are harder in the case $m \neq 0$, but I have done most of them and I'm hopeful to prove the results I need for $D^{(m)}$-modules and use them to define a Fourier-Mukai transform for $D^{\dagger}$-modules.

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

9. Adviser's remarks(if any):

【SP22　　】

JSPS Summer Program 2022
Research Report

1. Name: Raphaël MIGNOT （ID No. SP22213）

2. Current affiliation: Université de Lorraine

3. Research fields and specialties:
Mathematical and Physical Sciences

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

5. Host researcher: Dr. Nozomi SUGIURA

6. Description of your current research

As a second year PhD student in Statistics and Machine Learning, I am studying multidimensional time series analysis, which is data indexed by time. Time series analysis appears in almost all engineering fields and has been of much interest in the recent years in the mathematical community. This complex problem finds many practical applications in various fields such as environmental sciences, health and finance.

In this context, I am studying a tool called the signature method. The signature method, coupled with ubiquitous statistical methods, has shown to be useful for many issues such as handwritten ideograms recognition, bipolar condition detection and oceanography. The signature method extract intrinsic information about the time series and more precisely the dependencies in variations along the space dimensions. This so-called signature appears naturally in rough paths theory, a subfield of stochastic integrals theory.

The goal of my research is on the one hand to analyze theoretical statistical aspects of the signature. On the other hand is to make use of it on classical problems that appear in the multivariate time series analysis context.

【SP22　　】

7. Research implementation and results under the program

Title of your research plan:

Ocean data analysis using the signature method

Description of the research activities:

During this JSPS summer program, I have been hosted at the Research Institute on Global Change of the Japanese Agency for Marine-Earth Science and Technology (JAMSTEC). Data used in the monitoring of oceans has been recovered for 20 years from floats equipped with temperature, pressure and salinity sensors and scattered around the globe. Acquiring insights from those time series could lead to a better understanding of climate phenomena. Such as the possible shifting of main currents, which would have a large impact, for instance, on the climate of continents.

The aim of this two months stay has been to collaborate with climatologists and oceanographers on the mathematical models they use to analyze their data and how those might be improved using the signature method. I have been working with Dr. Nozomi Sugiura, who is well aware of the many mathematical characteristics of this method. Together, we have developed several ways to take advantage of the signature method in this context.

Another important aspect of this stay has been to introduce the signature method in plain English to oceanographers through several oral presentations, making this method, I hope, more accessible. This might lead to future uses of it and potential collaborations.

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

This stay has been a wonderful experience regarding both scientific and cultural aspects. I had the opportunity to travel a bit during the weekends and the few summer holidays. I particularly enjoyed the Kyoto area and also the beaches near the Tokyo area: from Kamakura all the way down to Shimoda.

9. Adviser's remarks (if any):

He made good presentations to our colleagues on the signature method, including the one combined with the kernel method. Also, discussions with him were fruitful, which include possible application of the signature method to data assimilation or the detection of ocean anomalous mixing. He has been quite friendly and made every effort to familiarize himself with Japanese culture and our field of study.

JSPS Summer Program 2022
Research Report

1. Name: Kenza RAHLI （ID No. SP22214 ）

2. Current affiliation:
Université Paris Cité – Institut de physique du globe de Paris

3. Research fields and specialties:
Social Sciences

4. Host institution:
Kyoto University – Disaster Prevention Research Institute (DPRI)

5. Host researcher:
Dr. Masumi YAMADA

6. Description of your current research

Newly graduated with a master's degree in Natural Hazards from Université Paris Cité – Institut de physique du globe de Paris, I got interested in Earthquake Early Warning Systems after getting introduced to it during my M1 internship in citizen seismology and science communication. Now, my interests lie in the social aspects of Earthquake Early Warning Systems, Disaster Risk Reduction and Risk Communication with a specific focus on international people living in Japan and the impact of the language barrier.

In Japan, since October 2007, earthquake early warnings are issued by the Japan Meteorological Agency (JMA). According to the JMA website, earthquake early warnings are issued right after an earthquake strikes, based on the prompt analysis of waveform data of one seismograph from which the focus, magnitude and intensity of the earthquake are estimated. When a region is, according to the estimations, going to be affected by a shaking intensity of 4 or above in the JMA Intensity Scale, an earthquake early warning is issued and received on smartphones, TV or radio.

Earthquake early warnings are a means for disaster risk reduction as they allow damage mitigation by warning people and giving them seconds to a very few tens of seconds to take measures to protect themselves and control or stop hazardous tasks. Combined to this, work in disaster preparedness is being done at the Disaster Prevention Research Institute. A concrete example is disaster preparedness for the Nankai Trough Earthquake and the induced tsunami that will hit the southern coasts of Japan, from the Kanto to the Kyushu regions. In view of this event, a disaster education program is being held in Matsuyama City, Ehime Prefecture organized by the Non Profit Organization Matsuyama Sakanoue Japanese Language School, in collaboration with the crisis management division of the local government and Professor Genta Nakano from the Disaster Prevention Research Institute, Kyoto University. This disaster education program is held in 5 workshops and welcomes Japanese and International people from all ages and backgrounds to think about the foreigner-friendly evacuation management in addition to disaster prevention learning.

7. Research implementation and results under the program

Title of your research plan:

Disaster Risk Reduction for the Nankai Trough Earthquake: a survey to understand and consider means of helping international people during a disaster in Japan.

Description of the research activities:

Having the opportunity to attend the 3rd and 4th sessions of the disaster education program in Matsuyama City, a survey has been prepared for both Japanese and International people (in Japanese, English and Indonesian) that aims to get their experiences of disasters and to better understand how the language barrier affects international people during an earthquake in Japan. This will help to think of what is needed to reduce their vulnerability hence reducing the disaster risk. It needs to be thought from the risk communication, disaster prevention and disaster education points of view and in a multicultural context. In total, 25 answers to the survey were collected: 17 from Japanese people and 8 from international people.

The results to the survey show that 22 out of 25 have experienced an earthquake and 7 out of 8 international people have experienced an earthquake in Japan. For half of the international people, the language barrier affected them when receiving an earthquake early warning on their mobile phone: they couldn't understand the Japanese words, nor the areas that were affected and how strong the earthquake was. It is important to mention that earthquake early warnings announced and displayed on TV are in Japanese hence the necessity to improve the communication for earthquake early warnings. Moreover, to the question 'Going to disaster prevention and disaster education programs, what information do you want to learn, including practical and theoretical knowledge?', the answers were: practical drills and basic actions to do when an earthquake strikes as well as first aid and what to have in emergency kits. They also want to learn how to read hazards map and earthquake alerts. The results to the survey handed to the Japanese people show that they have a great interest in participating to disaster education and disaster prevention programs that aim to improve international people's experiences of disasters in Japan. They want to learn about different cultures and how to help international people with respect to their culture and religion in order to ease everyone's life in shelters, considering that shelters management is also done by volunteers. For this purpose, Japanese people have expressed their desire to learn English which is a step forward to reducing the vulnerability a community has to face in the aftermath of a disaster.

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

This fellowship in Japan has been full of great experiences and interactions: from the kindness and the immense help of my host researcher, to the support of my lab's colleagues and the opportunities Prof. Yamori and Prof. Nakano have given me to explore more of my field's interests, this adventure was very fulfilling. I also got to discover some aspects of Japan's culture, history, nature, tradition, and modernity through trips and sightseeing in Kyoto, Kobe, Nara, Nagoya, and Tokyo. Finally, the hospitality and gentleness of the Japanese people I have met through this trip is the memory I will hold the dearest.

9. Adviser's remarks (if any):

Kenza RAHLI is a highly motivated student and it was very enjoyable to work with her during this internship. She tried to take action by herself and self-navigated her research. She seemed to like Japan so much and I hope she can continue her study in Japan in the future. Thank you for giving us this opportunity.

JSPS Summer Program 2022
Research Report

1. Name: Robin HAVAS （ID No. SP22215 ）

2. Current affiliation: Laboratoire Biogéosciences, Université de Bourgogne-Franche-Comté

3. Research fields and specialties:

Interdisciplinary and Frontier Sciences (Bio-geo-chemistry)

4. Host institution: Tokyo Institute of Technology

5. Host researcher: Pr. Yuichiro Ueno

6. Description of your current research

My current research focuses on characterizing the geochemical signatures of lakes from Mexico that present analogous characteristics to the primitive Earth environments (they present anoxic conditions, primitive Earth-like microbial deposits, …). By understanding these lakes current functioning (what type of organisms, what they eat, how are they influenced by oxygen levels, etc.) and checking how it is recorded in the lakes geological archives (sediments, microbialites), we hope to help for the reconstruction of environments that are based on ancient sediments chemical interpretations. More specifically, I focus on the geochemical (and isotopic) signatures of C, N, S and O, which are key elements for the evolution of life and surface conditions on Earth. The isotopic signatures of components produced by microorganisms (e.g. organic C and N, pyrite minerals, etc.) can be used to trace their metabolic diversity (e.g. oxygenic vs anoxygenic photosynthesis) and the type and concentration of inorganic sources they use (e.g. CO_2, NO_3, SO_4, etc.). In parallel, by constraining the actual metabolic diversity and physico-chemical characteristics of these lakes, we can estimate if our isotopic proxies are actually good tracers and if some of them can give clear-cut answers of what we see is going on in these environments.

Moreover, my work on the Mexican lakes pushed me to investigate limnological topics centered around the C cycle (constraining the fluxes of C sources, sinks, how dissolved organic matter is produced and consumed etc.) and the hydrology of such stratified endorheic lakes.

7. Research implementation and results under the program

Title of your research plan:

Characterization of S quadruple isotopes in pyrites grains from modern and Archean microbialites

Description of the research activities:

The research plan aimed at measuring the S isotopic composition of dissolved sulfates (S source) and pyrites grains (S products of biological activity) found in microbialites of stratified lakes. The goal was to identify the metabolic diversity of these objects and what isotopic signatures they leave behind in the geological record. To do so, I used a technique developed a few years ago in Tokyo-Tech (and still unique around the world) allowing to rapidly and safely reach precise quadruple S isotope compositions.

The procedure was successful and I could obtain a lot of results. The data indicate clear sulfato-reduction reactions producing the pyrite, allowing us to properly characterize the isotopic signatures of this reaction in natural environments while it was so far mostly described from pure culture lab experiments.

Beyond these results, this experience made me learn many different analytical techniques practiced in the lab.

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

This summer program was a great experience to discuss and exchange about my field of research with many new people. More generally, it allowed me to discover how research is practiced in Japan and potentially opened ways for future collaborations.

Besides, it was obviously great to learn about Japan itself. 2 months is a great time to wonder around the city and the country, to experience the way Japanese people live, like no tv documentary can make you experience.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: **Charles Bosson** （ID No. SP22216）

2. Current affiliation: **Paris-Saclay University**

3. Research fields and specialties:
Physical Sciences & Biological Sciences

4. Host institution: **National Institutes for Quantum Science and Technology**

5. Host researcher: **Dr. Ryoichi Hirayama**

6. Description of your current research

My current work is part of medical physics field for the improvement of oncological treatments. Today, many cancer treatments exist such as chemotherapy, immunotherapy, radiation treatment, etc. Radiotherapy is one of the main treatments in cancer (around 50%), and it can be improved using heavy atoms, as radiation enhancers. Developments in nanotechnology brought new perspectives. These small objects can be injected and storage thanks to the tumor vascularization. Combined with metallic nanoparticles (NPs), the effect of radiations is focused on cancer cells to reduce the dose delivered to healthy tissue. A second objective is to enhance the radiation effect on radio-resistant tumors, difficult to treat in radiotherapy due to poor angiogenesis. The poor oxygen concentration within the tumor decreases the desired effects of the radiation therapy.

My study focused on the combination of metallic NPs with photons (gamma or X-rays) or heavy ion therapy under different oxygen conditions to improve the current radiation treatments.

7. Research implementation and results under the program

Title of your research plan:

Study of the metallic nanoparticles – radiations combined effect under hypoxia on cancer cell lines.

Description of the research activities:

My research activity in the QST lab was focused on the effect of two different kind of radiation beams combined with metallic nanoparticles (NPs). I used the X-rays of low energy (200 kV) and the carbon ion beam (290 MeV) in HIMAC to observe the enhancement effect due to the presence of metallic NPs in HeLa cells, a human cervical cancer cell line.

I prepared the cell cultures for irradiations and realized the clonogenic experiments corresponding to each irradiation. Before each irradiation, I put the half of the samples under hypoxic by adding CO_2 and N_2 gases. The oxygen modulation modifies the cell medium which deeply influenced the effect of radiations, as in a center of a hypoxic tumor. By counting the fixed and colored cell colonies two weeks after the irradiations, I fit the survival curves to compare the effect of each condition.

I extracted the dose enhancement factor (DEF) thanks to the curves which indicates the effectiveness of NPs in cells compared to the controls. I already obtained good results for the Bismuth-Platinum NPs developed by my French team under X-Rays.

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

This experience was benefic in a researcher point of view because I learned a lot about the Japanese methods in my host lab thanks to Dr. Hirayama. Moreover, he gave me many advice about Japanese culture and even made me participate in an Aikido class, which I particularly appreciated. I visited a lot of shrines during the weekends and the Japanese food is awesome. During my stay in Japan, I had the time to visit lot of different places: Tokyo, Kyoto, Hiroshima, Nikko, Kamakura, Yamanaka, Okinawa… Japan has many regions, and each of them is different in their customs and culinary culture. I also participated in a homestay program and the Japanese family who host me was very kind. We went to a local matsuri, to a karaoke and discuss about culture during hours. I'm very happy that JSPS selected me for this program!

9. Adviser's remarks (if any):

Charles Bosson participated in many experiments. Most of the experiments are radiation biology. He studied biology from a medical physics perspective. Understanding these two fields is very important as a researcher involved in radiation therapy. Many of the things he experienced in Japan will make his life even better.

HIRAYAMA Ryoichi, Ph.D.
Principal Researcher

JSPS Summer Program 2022
Research Report

1. Name: Quentin BOUSSAU （ID No. SP22 218 ）

2. Current affiliation: Center of Structural Biology (CBS) – Montpellier University

3. Research fields and specialties:
Engineering Sciences / Biological Sciences

4. Host institution: The University of Tokyo – Bioengineering Department – Cabral Lab

5. Host researcher: Prof. Horacio CABRAL

6. Description of your current research

My research aims to develop anticancer treatments based on live cells. In the first place, I am interested in the use of bacteria as smart agent to deliver anticancer molecules at the tumor site. Since some bacteria have been shown to invade solid tumors and present innate anti-tumor properties, they are seen as a promising vector for cancer therapeutics. Working in the field of synthetic biology, I genetically engineer the bacterial genome to give them new specific features with anticancer properties, such as the secretion of small tumoricidal molecules or the ability to colonize a specific tumor microenvironment. Secondly, I am working on the use of mammalian cells for cancer immunotherapy, especially with human T and NK cells in order to trigger an important immune response toward the tumor.

However, the use of living cells as cancer therapeutic has some limitations. Administration of bacteria or exogenous mammalian cells inside the body can be immunogenic, leading to undesirable side effects from localized inflammation to sepsis.

To counter this current limitation in the development of anti-cancer treatment based on live cells, I develop a single-cell encapsulation strategy that would hide the therapeutic vectors from the recognition of the immune system in the blood circulation while setting them free at the tumor site. This encapsulation is made with poly(ethylene glycol) (PEG)-based block copolymers combined with poly(lysine) and a maleic anhydride group that can bind to proteins at the surface of the bacteria or mammalian cells. PEG-based block copolymers have a long term record of use in therapy for the delivery of small molecules, proteins and nucleic acids inside micelles, with demonstrated safety in both preclinical and clinical settings. Moreover, the maleic anhydride group of the PEG-based block copolymer is able to switch conformation depending on pH. In this way, the polymer binds the cells vectors at physiological pH but unbinds them when pH goes under 6.5, as often found in the tumor microenvironment. Consequently, as Trojan Horses, the bacteria or mammalian cells are encapsulated and protected from the recognition of the immune system after injection in the blood flow, but will be liberated at the tumor site to activate their therapeutical effect. This system would then allow an effective anticancer treatment based on live cells with decreased immunogenicity and off-target effect.

7. Research implementation and results under the program

Title of your research plan:

Development of polyethylene glycol-based block copolymers for live cell encapsulation.

Description of the research activities:

During my stay at Cabral Lab, I have been taught how to synthesize the polymer I use to encapsulate cells in France, from the assembly of the poly(lysine) to the PEG by NCA polymerization to complexation of the obtained block copolymer with maleic anhydride group and fluorescent dyes. Cabral's team familiarized me with the different lever to play with during the synthesis to change the polymer size, solubility or competence to sense pH or not.

Then, I used the PEG-based polymer to try to encapsulate Jurkat cells, an immortal line of human T lymphocytes, which are a useful model of immune cells for future immunotherapies. After trying different encapsulation protocols, cell and polymer concentration, pH, etc. I did not manage to obtain convincing results as the polymer seems to be able to enter the cells instead of binding the membrane. In any case, this work allowed me to be trained to use a super-resolution confocal laser scanning microscope, and to better understand which part of the encapsulation protocol is crucial for its efficacy. Also, this project can be continued in France or by other members of the Cabral Lab in Japan.

As I will continue to use this polymer in France to work on bacterial and mammalian cells encapsulation I ran some stability experiments to found out the best conditions to send the polymer to France without altering its quality.

Lastly, I took part of the different week meetings of the Cabral lab and could see the different projects run by the members of the lab, their use of polymers for bio-therapeutical applications and have interesting conversations about this research field.

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

My stay at Cabral Lab and in Japan was a great experience. I had the opportunity to discover a different way of working, firstly because I was not trained as a chemist and secondly because of the country related differences. This allowed me to learn a lot on how research in conducted in different fields and countries and will surely be helpful for my future work as a PhD student. Meeting the member of the Cabral lab with who I will collaborate during my PhD was also of great value for building an efficient and long term collaboration for the future. About cultural experiences, a two month stay permitted me to visit the major parts of Tokyo, to travel within the countryside on the weekends and to have a deep overview of the Japanese culture in all its forms. Great memories for sure!

9. Adviser's remarks (if any):

Mr. Boussau showed strong dedication and motivation to do research. He rapidly learned the methods in the lab and apply them to his topic. He showed to be a proactive student, who loves research, trying to solve the problems by himself and coming with smart alternative solutions. In the meantime, he started writing a review article on encapsulation strategies on live cells, which we hope to publish soon. Quentin is also friendly, with high communication skills, helping to create a good environment at the office.

JSPS Summer Program 2022
Research Report

1. Name: Gabriel Niebel （ID No. SP22219）
2. Current affiliation: Université de Bourgogne
3. Research fields and specialties: Mathematical and Physical Sciences
4. Host institution: Yukawa Institute of Theoretical Physics, Kyoto University
5. Host researcher: Sinya Aoki
6. Description of your current research My last M2 project was about the study of the Mathematical background lying behind Chern-Simons Theory such as Bundles, Connections, Holonomy Chern forms, and also Knot Theory since Witten showed (1989) that Chern-Simons theory is nicely linked to Jones polynomial. From there, we dive into Physics by the studying the basics principle of Topological Quantum Computation (TQC is an approach of Quantum Computation which is theoretically less sensitive to errors, due to its topological characteristics remaining the same under small perturbation). Finally, the goal is to study, using a certain model from TQC called the Fibonacci model, a quasiparticle named anyon which has exotic properties and statistics.

7. Research implementation and results under the program

The research was about Fracton Phases of Matter, also alongside Professor Honda Masazumi. Fracton is a relatively new quasi-particle that arises in many theoretical models, although it hasn't yet been observed experimentally. The goal was to understand from which models and how Fractonic behavior appears. For instance, it is known that Fractons can be found in a Gauge Theory approach using so called "Tensor gauge theory". It also appears in discrete descriptions of several spin models, such as in Haah's Code and the X-cube model (two solvable spin models). Fractons have many interesting relations that we can for instance classify using Foliations and have relation with Quantum error correction or even Gravity.

Description of the research activities:

Understanding and studying the review article "Fracton Phases of Matter" (Arxiv:2001.01722) by Michael Pretko, Xie Chen, Yizhi You. Every week/2weeks, a reading club was organized presented by either me or another M2 student Taiichi Nakanishi.

8. Please add your comments, including any cultural experience during your stay in Japan (if any): The internship was nice, internship facilities were really good, and the Homestay program was really nice too.

9. Adviser's remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Jonas DECHENT （ID No. SP22301）

2. Current affiliation: Ludwig-Maximilians-Universität München

3. Research fields and specialties: Chemistry

4. Host institution: Earth-Life Science Institute (ELSI), Tokyo Institute of Technology

5. Host researcher: Shawn E. MCGLYNN

6. Description of your current research

My research at ELSI was embedded in my wider studies of the origins of Life, albeit separate from my previous master studies research at LMU Munich and my future PhD project at ISIS / University of Strasbourg.

In my master's studies I worked in the group of Prof. Oliver Trapp and completed a total synthesis as well as prebiotic formation of 2-deoxyapionucleosides. These are considered potential early contenders to DNA in molecular evolution, but disfavored due to their less stereoselective formation, giving four instead of one favoured isomer.

My doctoral research with Prof. Joseph Moran will focus on abiotic metabolic pathways at the origins of Life, i.e. finding ways energy and matter is converted before the advent of complex biochemical machinery like enzymes. The primary axis of this work is to find transitions from stoichiometric, kinetically driven reactions to catalytic reactions under thermodynamic control, remodeling the evolution of ion, cofactor and peptide catalysts.

In between these topics, my research stay at ELSI focused on the abiotic interconversion of acetyl phosphate and thioesters as two important energy currencies at the origins of life.

7. Research implementation and results under the program

Title of your research plan: **Inter-conversion between thioesters and acyl phosphates: A missing link in prebiotic metabolic networks**

Description of the research activities:

First of all, model systems were chosen: acetyl phosphate (AcP) as the simplest acyl phosphate on one hand, and thioesters methyl thioacetate (MTA) as the simplest thioester as well as S,N-diacetylcysteamine (SANAC) as a primitive analogue of acetyl-coenzyme A. Different procedures employing aqueous solutions of stoichiometric orthophosphate and catalytic divalent cations (Mg, Ca) were tested for reproduction. When employing procedure by Whicher *et al.* using the even simpler precursor thioacetic acid instead of thioesters, no acetyl phosphate could be found.

The imidazole-catalyzed formation of AcP, postulated by Weber but never monitored, was repeated. From both MTA and SANAC, AcP formation could be confirmed by 31P-NMR. With excess imidazole after one day, yields were about 3-4% for SANAC and 0.5-1% for MTA, whereas catalytic imidazole yielded 0.5-1% for SANAC and below 0.5% for MTA, thus showing a higher activity for the acetyl-CoA analogue even though MTA releases gaseous methane thiol upon reaction. The reaction of SANAC to AcP was monitored in continuous NMR analysis over 12 hours.

Thiolysis of thioesters (thiol-thiol exchange) was previously described and characterized by Bracher *et al*. Changing the excess substrate from alternative thiols to sodium hydrogen

sulfide, almost quantitative thiolysis of MTA to thioacetic acid could be monitored, showing another conversion step in the prebiotic reaction network of thiolated compounds.

In an alternative investigation line, dry-down experiments at 65 °C were conducted from similar solutions as mentioned before. For many of them, no AcP but pyrophosphate (PPi) was observed after 1-3 days dry down. As AcP is known to phosphorylate orthophosphate, the PPi may stem from intermediarily formed AcP. However, controls without thioester showed substantial formation of PPi under the same conditions. Therefore, only further quantitative analyses can show the extent of additional PPi formed with thioesters *via* AcP. Further dry-down experiments were performed with solid minerals as catalysts, particularly first-row transition metal sulfides and metal oxides, with analyses pending.

For analysis, standard 1H and 31P NMR (400 MHz) was used, with 90% aqueous sample and 10% D_2O as solvent. D_2O contained different standards. The pH-independent DSS overlapped with product or starting material signals. The standard TMSP-d_4 gave only one signal at ~0 ppm, but is subject to pH differences (pKa ~ 5) and most reliable at very high or low pH. Therefore, DSS-d_6 was identified as a suitable standard to be used in the future.

UPLC analysis has the advantage of tolerating paramagnetic transition metal, while excluding solids by filtration in the sample preparation. For analysis *via* UPLC, first attempts were made by using the methods by Sanden *et al.* using 5mM NBu_4HSO_4 as ion pairing agent for charged compounds and methanol as organic co-eluent. However, separation of thioacetic acid, AcP and PPi proved difficult under isocratic and gradient conditions, and requires further screening and optimization.

Literature screening for this project was a challenging. There is some seminal work from the 1980s and early 90s, and more recent experimental work elucidating the hypotheses postulated back then. However, no systematic review has been published in the meantime. Therefore, following up on this project, a review may be drafted summarizing the prebiotic chemistry of sulfur compounds and their relation to extant biochemistry.

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

The preparatory meetings and language classes provided me with a basic understanding on how to get along in Japan. The homestay programme as part of the JSPS summer programme was a particular highlight to get to know Japanese home life outside my international and/or academic bubble. Outside academia, I had the chance to engage with Japanese youth civil society in the run-up to the Japanese G7 presidency, and hope we can leverage common ground of democratic youth representation to push for youth inclusion.

The research environment of ELSI as a whole broadened my understanding of how graduate students can be organized to study and research. From self-organized study groups to full inclusion in department seminars, always with an interdisciplinary approach and in English, students play a much more active role in the academic life than at my home university. Furthermore, the flat hierarchies and open spaces contribute to debate and exchange, liberating synergies that are always present in origins of life research.

Furthermore, the stay in ELSI and the McGlynn lab has broadened my view on the origins of life, understanding primordial life from a geochemical and biological perspective, more than my own organic chemistry view.

JSPS Summer Program 2022
Research Report

1. Name: Calvin Dunker （ID No. SP22302 ）

2. Current affiliation: University of Münster

3. Research fields and specialties:
Medical, Dental and Pharmaceutical Sciences

4. Host institution: Kanazawa University

5. Host researcher: Assoc. Prof. Dr. MURAKAMI Kazuhiro

6. Description of your current research

The overall goal of my PhD project, which I started two months ago, is to design and synthesize novel subtype-selective hyperpolarization-activated cyclic nucleotide-gated (HCN) channel ligands. HCN channels have a key role in the control of heart rate and have been shown to be valuable targets for the therapy of angina pectoris. Additionally, HCN channels have been addressed in the therapy of epilepsy, neuropathic pain, and Parkinson's disease. As pharmacological tools, HCN subtype-selective inhibitors are highly desired; however, the scarcity of selective ligands and limited knowledge of structure-activity relationships (SARs) hinders further development of selective inhibitors and the potential of HCN channels as drug targets.

Selectivity determinations of potential subtype-selective HCN channel antagonists can be performed via electrophysiological measurements using HEK293 cell lines overexpressing the HCN channel of interest.

7. Research implementation and results under the program

Title of your research plan:

Establishment of HEK293 cell lines which constitutively express human or murine HCN4 receptors

Description of the research activities:

During the research stay, we generated human and murine HCN4 overexpressing HEK293 cell lines. (HCN1, HCN2 and HCN3 overexpressing HEK293 cell lines are already available in our group) First, commercially available human and murine HCN4 genes were cloned into the PiggyBac vector, which has the CAG constitutive active promotor. Correct integration and sequences were confirmed by restriction enzyme cut and plasmid sequencing, respectively. Then, the cloned HCN plasmids together with the PiggyBac transposase (pBase) plasmid were introduced into the HEK293 cell line using lipofectamine. In the cells, the HCN expression cassettes are excised from the plasmids and inserted into the genome by the pBase. Subsequent expression of the corresponding functional HCN channel resulted in human and murine HCN4 overexpressing HEK293 cell lines, which was confirmed by quantitative PCR. On the last day, freezing stocks of polyclonal cells were send to the University of Münster in Germany.

After the research stay, the polyclonal cell lines will be further selected into the stable monoclonal cell lines and then subsequently used in pharmacological screenings of subtype-selective HCN antagonists.

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

I would like to express my gratitude to Prof. Murakami, who has been an excellent mentor and supervisor and has helped me with all organizational matters outside of the lab. I thank him for his trust in me and all the materials necessary for the completion of this project. Ms. Deguchi and Mr. Kita created a very friendly and supportive work environment. In my free time, I was able to explore several other cities in Japan besides the beautiful city of Kanazawa, experiencing a very welcoming atmosphere and valuable cultural experiences such as the integrative coexistence of the many historical artifacts and modernity. Highlights also included Kanazawa University's International Events, such as the 'Tanabata Fes'.

9. Adviser's remarks (if any):

Calvin is a very talented student. He did very well despite cultural and language barriers in JAPAN. Although his expertise is chemistry, his attitude towards molecular biological experiments was excellent. I wish him success on his research and future career.

JSPS Summer Program 2022
Research Report

1. Name: Saskia Christine FRANK （ID No. SP22303）

2. Current affiliation: Westfälische Wilhelms-Universität Münster, Germany

3. Research fields and specialties:
Chemistry

4. Host institution: Nagoya Institute of Technology, Japan

5. Host researcher: Prof. Shinya TSUKIJI

6. Description of your current research

The aim of my research in the lab of Prof. Wegner in Germany is to develop a multistimuli responsive soft material. For this, I use hydrogels because -i- they have an easy readout (gel-sol transition) and -ii- their crosslinks can sense various input signals, process them following a chemically defined logic and respond accordingly with an output signal. The crosslinks are mediated by photoswitchable proteins that react towards light of different wavelengths and metal coordination complexes which undergo chemical changes when altering the pH, redox potential or in the presence of small soluble molecules. Depending on how a signal is processed or integrated into the matrix, a memory can be created.
The hydrogel system we will develop will provide a basis for molecular level information processing in chemical and biological applications.

The synthetic protein-recruiting/-releasing condensates (SPREC) system of Prof. Tsukiji's lab is based on proteins that form phase separated condensates with a gel like structure upon self-assembly, making it to a soft material.
For the future, other protein domains can be used to build new SPREC systems that respond to a stimulus of choice. In this way, the physical and dynamic properties of the protein condensates can be tuned to have a greater control over protein recruitment and/or release. Especially light of different wavelengths is a promising candidate because of its spatio-temporal precise application. Also, embedding other stimuli sensing units into the SPREC system can create multiresponsiveness, making this system to a promising tool in, e.g., cell biology.

7. Research implementation and results under the program

Title of your research plan:

Constructing Responsive Membraneless Organelles in Synthetic Cells for Controlled Protein Recruitment and Release

Description of the research activities:

The group of Prof. Tsukiji has already developed a synthetic protein condensate system called SPREC (synthetic protein-recruiting/-releasing condensates) successfully in mammalian cells. My aim during my research in Japan was to incorporate the SPREC system into synthetic cells, thus creating a cell-like molecular system. This incorporation of artificial organelles into synthetic cells will simplify the future study of spatially regulated biological processes *in vitro*. Moreover, our approach will lead to future applications in biotechnology and biomedical science since protein activity can also be controlled by the SPREC system.

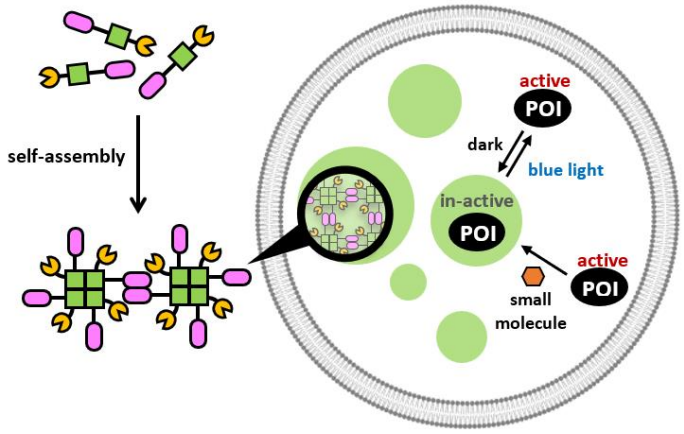


Figure 1: Concept and design of SPREC system inside synthetic cells. Protein condensates will be created upon self-assembly after expression *in vitro*. Protein activity of a Protein of Interest (POI) can be controlled by adding a small molecule which will trap the POI inside the coacervates when using the SPREC-IN system or the protein activity can be switched on or off, respectively, by using blue light for the OptoSPREC system.

Because the protein condensates already form after expression, I used the cell free *in vitro* protein synthesis system PURE to express all components inside the synthetic cells. For this, protein sequences needed to be amplified prior by PCR. The synthetic cells were prepared by using the inverted-emulsion centrifugation technique. For visualisation of the fluorescent protein condensates inside the synthetic cells confocal microscopy was used.

In the beginning I used the red fluorescent protein mCherry to establish the basic system because it has an easy read out. For the SPREC-IN system, the protein of interest (POI), in my case mCherry, will be recruited into the condensates when rapamycin is added. The recruitment is based on the heterodimerisation of two protein domains FRB and FKBP, one of each fused to the protein coacervates and POI, respectively.
During my time in Tsukiji's lab, I was able to show a successful protein recruitment of mCherry into the coacervates after addition of rapamycin.

For the control of enzymatic activity inside the synthetic cells, we fused the enzyme BS2 esterase to mCherry, thus creating our new POI. The BS2 esterase is successfully expressed inside the synthetic cells by PURE system and does also convert its substrate. When rapamycin is added, mCherry-BS2 is recruited to the protein coacervates. But to make further statements, if this does either enhance enzyme activity locally or reduce the overall activity, more experiments need to be performed.

The same applies to the OptoSPREC system. Even though it could be shown that all protein components are successfully expressed inside the synthetic cells, the releasement of the POI by light and recruitment in the dark need further investigations.

Nevertheless, through this JSPS summer program, I was able to construct small-molecule- and light-responsive artificial (protein condensate-based) organelles inside synthetic cells,

which have the potential to be applied to construct various intelligent synthetic cells whose function can be programmed or modulated in a stimuli-responsive manner.

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

I am very thankful that I had the opportunity to do part of my research in Japan and to get in touch with this amazing culture and beautiful country. Even though I was afraid at first because of the language barriers, my lab mates and every Japanese I've talked to showed me that there was no reason for such questioning. They were all so kind and welcomed me so warmly that I will really miss them all.

During the weekends I had the chance to explore some closer cities like Kyoto, Osaka, Kanazawa and Tokyo. I was surprised that everything works so well here, especially the public transportation system. Everyone is kind and respecting others. I fell in love with the architecture and Japanese food.

I hope that my goodbye is not forever, and I will be able to visit Japan and my new friends very soon.

9. Adviser's remarks (if any):

I was very fortunate to have been able to host Saskia in my lab. During the JSPS summer program, she made tremendous contributions to our research. First, she has successfully established the method to express and construct synthetic protein condensates inside synthetic cells using the PURE system. She has also produced promising results demonstrating that the protein condensates work as artificial organelles that can recruit and/or release model proteins in synthetic cells in response to a small molecule or light. I believe that her achievements will open an exciting new direction in the bottom-up construction of functional synthetic cells, and we will continue the project as an international collaboration even after she returns to Germany.

In addition to the research side, Saskia's joining my lab provided an excellent opportunity for all lab members to experience and improve international communications in English. Thanks to her kind, cheerful, and friendly personality, the language barrier was not an issue at all, and we were able to build a good relationship readily. Lab members organized various activities (for example, the Star festival, Somen party, and a one-day lab short trip) to enjoy with her. Through these activities, we also could learn about many differences between the Japanese and German cultures and research systems. Every event we shared with her was big fun and fruitful, and our relationship will continue for sure.

Finally, I would like to thank the JSPS for giving us this precious opportunity.

JSPS Summer Program 2022
Research Report

1. Name: Ali Heidari (ID No. SP22304)

2. Current affiliation:
University of Muenster, Germany

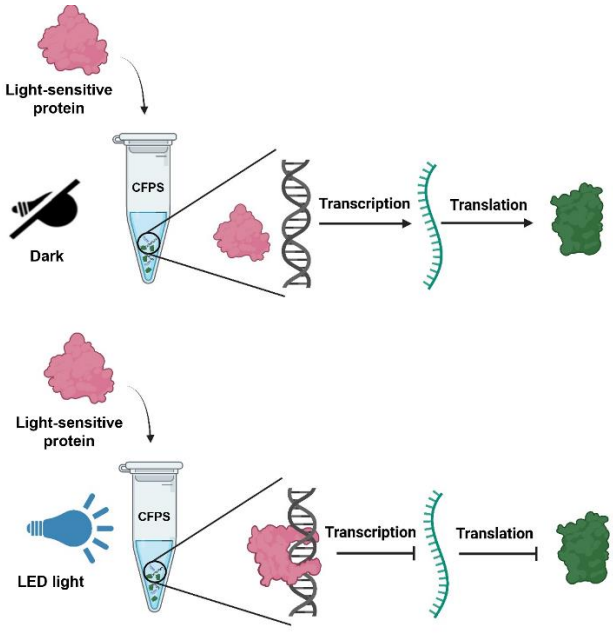
3. Research fields and specialties:
Biological Sciences, Chemistry

4. Host institution: Tokyo Institute of Technology

5. Host researcher: Prof. Tomoaki Matsuura

6. Description of your current research

Cell free protein synthesis (CFPS) is a technical core of synthetic biology which can stimulate “central dogma” without a complete living cell. Due to its advanced engineering features in flexibility and controllability, it has been used a wide area of basic and applied research field.[1] In nature, biological processes are regulated with precise spatial and temporal resolution at the molecular, cellular, and organismal levels. Optical control of protein function in live systems has primarily been achieved through two approaches: genetic encoding of light-responsive amino acids or optogenetic methods using natural photo-responsive protein domains.[2] However, the design of an optical protein switch that can control the function of CFPS remains a challenge. Light as the pinnacle of movement in the universe as an external trigger could provide spatial and temporal control with minimal adverse effects. In this study we aimed to develop a light sensitive protein that can inhibit the activity of CFPS upon light illumination.



References:

[1] Y. Cui, X. Chen, Z. Wang, Y. Lu, *BioDesign Res.* **2022**, *2022*, 9847014.

[2] T. Courtney, A. Deiters, *Curr. Opin. Chem. Biol.* **2018**, *46*, 99.

7. Research implementation and results under the program

Title of your research plan:
Design of a light-sensitive protein switch for cell-free protein synthesis

Description of the research activities:

After PCR purification and amplification of a reporter (GFP or mCherry) gene for CFPS, we tested the activity of our light sensitive protein as an inhibitor for the synthesis of GFP or mCherry protein in CFPS. First, we introduced the purified protein into the system in different concentrations in order to find the optimal concentration of light sensitive protein needed for system to work. Second, we tested the inhibitory effect under different illumination time, and we found that with the increase of light illumination time, the inhibitory effect increases. Then, we encapsulated the system inside lipid vesicles and observed the same effect upon light illumination vs. dark as a control. Finally, we analyzed the amount of mCherry protein expressed inside the vesicles using a fast and reliable FCM (Flow Cytometry Machine).

Together, we developed a system that uses a naturally accruing light-sensitive protein as a switch for controlling the protein synthesis inside a cell-free protein expression system.

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

Japan is one of the cleanest and most beautiful countries with a rich culture and respectful people.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Simon Gottschalk （ID No. SP22306）

2. Current affiliation: L3S Research Center, Leibniz Universität Hannover

3. Research fields and specialties:
Computer Science

4. Host institution: National Institute of Informatics

5. Host researcher: Prof. Hideaki Takeda

6. Description of your current research

My major research focus is on the creation, enrichment and application of knowledge graphs. Knowledge graphs (KGs) are used to represent the real world, where nodes represent real-world *entities* such as Japan or Tokyo, and edges represent relations between them. For example, consider an edge labeled “capital of” between the nodes representing Japan and Tokyo. Entities in KGs are typically typed using a set of classes: for example, Tokyo is assigned to the class “City”. By modeling the real world through KGs, we target to enable a *semantic* understanding of concepts and entities, which goes beyond traditional representations of data as plain texts or numbers.

Knowledge graphs serve as an underlying resource of knowledge in many applications, including question answering (“What is the capital of Japan?”), data structuring and enrichment, as well as many downstream machine learning tasks (e.g., product recommendation in an online shop).

I have published in major KG-related conferences (e.g., International Semantic Web Conference and Conference on Information and Knowledge Management) and Journals (Semantic Web Journal and ACM Transactions on the Web). My research topics in these publications include using KGs for modeling events such as the Brexit and considering spatial data, i.e., entities with a spatial extent such as cities and car trajectories.

Within my research projects, I have investigated how semantic data modeling can simplify the configuration of machine learning tasks for inexperienced users. Currently, I am investigating how to fight money laundering by applying artificial intelligence to trade and company data. In both these projects, the understanding of data and its preparation for downstream machine learning tasks play an essential role. Therefore, my research focus during the JSPS summer program 2022 was on the specific task of semantic table understanding, i.e., the understanding of tabular data with the means of semantic modeling.

7. Research implementation and results under the program

Title of your research plan: Bringing together Machine Learning on Tables and Knowledge Graphs via Semantic Table Interpretation

Description of the research activities:

Given a table (e.g., a football league table or a table of Tokyo subway stations), semantic table interpretation (STI) aims at identifying its concepts and entities. Typically, this is done by establishing connections between the table and a knowledge graph. For example, the first column in a football league table might refer to the KG class “Football Team”, with its cells representing KG entities such as “FC Tokyo”.

Together with Prof. Hideaki Takeda and his group member Dr. Phuc Nguyen, I pursued the topic of STI from three perspectives during the JSPS summer program:

1. Semantic table interpretation using graph neural networks: Graph neural networks are deep learning models used for graph-related machine learning tasks (for example, to identify missing edges between nodes in a graph). After converting tables into graphs (where the nodes represent rows, columns, and cells), we applied graph neural networks, which we trained to solve three STI tasks: link columns to KG classes, identify relations between columns, and link cells to their respective entities in a KG.

2. Join text and table understanding: The task of document understanding typically aims at text understanding, e.g., by identifying KG entities in text. However, documents such as news articles and Wikipedia articles are typically multi-modal, often including tables that provide rich context to the text. By combining approaches towards text and table understanding and jointly training on these two objectives, we aim at a more complete and multi-modal understanding of documents.

3. Question answering over interpreted tables: Question Answering (QA) empowered by artificial intelligence is an important task for many real-world applications such as virtual assistants. When giving a table, a specific case of QA is to answer a question about its content. For example, consider a football league table and ask which team has achieved eight wins. We conducted first analyses to which extent the correctness of QA methods can be improved when applied to tables that have been interpreted before via STI.

Based on these research activities initiated in my two months at the National Institute of Informatics, we plan to continue our collaboration, aiming to publish our results in joint publications.

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

During the weekends, I took the opportunity to visit many great places in Tokyo itself and its surroundings (Himeji Castle, Hiroshima, Kobe, Kyoto, Mount Nokogiri, Mount Fuji, Nagano, Nara, Nikkō, Osaka, Yokohama). Albeit being exhausting to rarely have breaks between work and travels, I am very thankful that I got the opportunity to explore Japan, its culture, food, landscape, cities, and mountains in all these places. Furthermore, I had the chance to meet many other JSPS researchers from different research fields and countries and to exchange our impressions about Japan.

9. Adviser’s remarks (if any):

Dr. Simon Gottschalk quickly initiated the discussion with one of my research group (Dr. Phuc Nguyen) and fixed and started to investigate the topic during the program soon. I think that he spent good research time by exchanging and discussing research ideas and knowledge during the period.

JSPS Summer Program 2022
Research Report

1. Name: Merle LAU （ID No. SP22307　）

2. Current affiliation: German Aerospace Center (DLR), Braunschweig, Germany

3. Research fields and specialties:
Engineering Sciences

4. Host institution: Keio University

5. Host researcher: Prof. Dr. Tatsuro DAIMON

6. Description of your current research

My research focuses on the external communication between automated vehicles and vulnerable road users, i.e., pedestrians. In the near future traffic, automated vehicles and pedestrians will interact together in a mixed traffic. Due to the absence of a human driver, pedestrians will no longer be able to communicate as they are used to. Therefore, automated vehicles need to be equipped with communication tools to communicate with pedestrians, e.g., to inform them about the vehicle's intention or next maneuver intentions (cf. Habibovic et al., 2019; Schieben et al., 2019).

Current research suggests that mainly two communication tools will enable automated vehicles to communicate implicitly and explicitly. On the one hand, dynamic human-machine interfaces (dHMIs) transmit implicit information via vehicle dynamics, e.g., braking behavior (Bengler et al., 2020). On the other hand, external human-machine interfaces (eHMIs) located on the vehicle's outside are able to inform pedestrians on vehicle's future maneuver intentions (Schieben et al., 2019). To this point, it is not sufficiently manifested how the exact interplay of dHMI and eHMI should be considered for different sized AVs and its interaction with pedestrians. Therefore, both communication tools (eHMIs and dHMIs) are under investigation in current studies to examine how the interplay needs to be designed to achieve a well working interaction between automated vehicles and pedestrians.

References

Bengler, K., Rettenmaier, M., Fritz, N., & Feierle, A. (2020). From HMI to HMIs: Towards an HMI Framework for Automated Driving. Information, *11*(2), 61. https://doi.org/10.3390/info11020061

Habibovic, A., Lundgren, V. M., Andersson, J., Klingegård, M., Lagström, T., Sirkka, A., . . . Larsson, P. (2018). Communicating Intent of Automated Vehicles to Pedestrians. *Frontiers in Psychology, 9,* 1336. doi:10.3389/fpsyg.2018.01336

Schieben, A., Wilbrink, M., Kettwich, C., Madigan, R., Louw, T., & Merat, N. (2018). Designing the interaction of automated vehicles with other traffic participants: design considerations based on human needs and expectations. *Cognition, Technology & Work, 21*(1), 69–85. https://doi.org/10.1007/s10111-018-0521-z

7. Research implementation and results under the program

Title of your research plan:

Investigating the interaction between pedestrians and automated vehicles in road traffic focusing on external human-machine interfaces (eHMIs) as communication tool

Description of the research activities:

My host institution, the Keio University, and the German Aerospace Center (DLR) are cooperation partners in a Japanese-German research cooperation on the research topic "Connected and Automated Driving". During the JSPS Summer Program, I was able to strengthen the cross-cultural research exchange and to continue existing research on Japanese and German side by gathering the expertise that could already be collected in previous research.

Firstly, I was able to support the conduction of field operational experiments in which the application of an automated shuttle was tested in rural areas in Japan. The field tests took place in two cities, Akagikougen (Shimane prefecture) and Miyama (Kyushu prefecture). The automated shuttle was equipped with an external human-machine interface (eHMIs) to communicate with the surrounding traffic environment. Secondly, we were able to conduct a joint online-based experiment focusing on the interplay of vehicle kinematics and eHMIs for differently sized automated vehicles and their interaction with pedestrians. Moreover, the study investigated possible negative effects of eHMIs and addressed possible cross-cultural differences between Japan and Germany. The joint experiment is still on-going and will continue after the end of the JSPS Summer Program. This experiment takes place at the Yagami campus at Keio University.

Furthermore, I was able to visit the University of Tsukuba and the National Institute of Advanced Industrial Science and Technology (AIST) in Tsukuba to give a lecture on the investigation of eHMIs for an external communication between automated vehicles and pedestrians. Additionally, we discussed cross-cultural differences between Japan and Germany during my visit. Moreover, I was able to visit the University of Occupational and Environmental Health in Kitakyushu to discuss a possible methodological approach to measure pedestrians' stress and mental workload in the field of transportation research.

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

The JSPS Summer Program was an extraordinary opportunity to get deeper insights into the research and the culture in Japan. My work with my colleagues at Keio University was a great experience and I enjoyed exchanging research ideas in a very collaborative environment. The JSPS Summer Program has strengthened the collaborative research between my host and my home affiliation and we are looking forward to building upon this.

JSPS Summer Program 2022
SP22309 Research Report

1. Name: Philipp Thomas Kagerer （ID No. SP22309）

2. Current affiliation:

Experimental Physics VII – Julius-Maximilians Universität Würzburg

3. Research fields and specialties:

Physical Sciences

4. Host institution: Hiroshima Synchrotron Radiation Center (HiSOR), Hiroshima University

5. Host researcher: Prof. Kenya Shimada

6. Description of your current research

The topic of my PhD, as well as the research goal of my JSPS stay in Japan is concerning the search for materials suited to become the new generation of semiconductor-electronics, in my case the class of magnetic topological insulators. These materials are semiconductors with a band structure fundamentally different from the materials typically used in semiconducting devices, which results in a property often simply described as a "cookiebox". While they are normally insulating materials (corresponding to the cookiebox as being hollow), they have conducting states at the surface (depicted by the metallic walls of the box), which can transport electric current and spin without dissipation or heat production. As heat is one of the major problems, when trying to further boost the performance of classic semiconductors, especially these properties make these materials highly interesting for applications.

My research consists of the growth, as well as the spectroscopic investigation of suitable materials combining topology and magnetism. In our lab in Würzburg I grow nanometer thin films of the topological insulator Bi_2Te_3 and its magnetic counterpart $MnBi_2Te_4$ by molecular beam epitaxy (MBE), a method to grow single crystalline films by evaporating the individual elements on suitable substrates in vacuum chambers. Afterwards I characterize these materials with various methods like x-ray diffraction (XRD) or scanning transmission electron microscopy (S-TEM), to confirm that they actually match my expectations.

Next to the growth of these compounds, I try to understand their electronic properties and investigate in how far the magnetism can influence or change the band structures. My main method here is photoemission spectroscopy, a method, where electrons are emitted from the sample surface by the irradiation of ultraviolet or soft x-ray light. As the energy and momentum of the electrons are partially conserved during photoemission process, it allows me, to learn a lot about the behavior of the electrons inside of the material, by simply measuring the energy and direction of the outgoing electrons. Doing this, I can directly image the conducting states arising at the surface of my sample and see, whether any changes in these states occur at certain sample temperatures.

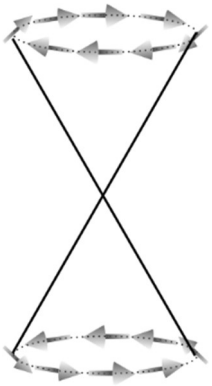
7. Research implementation and results under the program

Title of my research plan:

The Ferromagnetic Extension – Interfacing a 3D TI with a 2D Ferromagnet.

Description of the research activities:

The Hiroshima Synchrotron Radiation Center (HiSOR) is a synchrotron facility specialized among others on high-resolution, spin-resolved and very low photon energy research on novel electronic materials. My research goal was to investigate one of the specialties of topological materials, namely their spin structure. The metallic surface states typically show a linear crossing of two electronic bands (also referred to as massless electrons), while the spin of the electrons is only allowed to have certain directions with respect to the momentum direction and exhibits helical spin texture as depicted on the right. In my experiments, I aimed towards a direct visualization of this surface state by photoemission spectroscopy and to imaging its spin-polarization. Especially the latter is a highly complicated, but also very intriguing measurement, as it involves first soring the outgoing electrons by angle and energy and afterwards reflecting them of a specially prepared and magnetized target to select them by their spin-direction. This method is still only available at a few facilities worldwide and can be conducted here in two very specialized setups.



In my experiments here, I directly measured the helical spin structure, present in samples as thin as 10 nanometers and was able to image a large influence on the magnetism on the electronic properties of these samples.

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

For me, my stay in Japan has been an experimentally very fruitful time, giving me the chance to complete the research still missing for my PhD theses. Nevertheless, my experience here was not only limited to labwork. Rather I was also able to take part in the daily life at the institute, including the weekly meetings of my hosts group and was able to get in touch with many PhD students, as well as professors at the university for scientific discussions. After all, I have felt very welcome here at HiSOR. I am also very thankful for the chance to travel to other parts of Japan, to both meet other researchers and professors in my field, as well as to meet up with fellow JSPS scholars and experience Japanese culture and festivals together. I was able to travel once through Japan using the famous Shinkansen train visiting Osaka, Kyoto and finally Tokyo.

9. Adviser's remarks (if any):

It was our great honor to accept a Ph.D. student through the prestigious JSPS summer program. For more than 15 years, we have collaborated with the research group, Experimental Physics VII, in the Julius-Maximilians Universität Würzburg where Mr. Kagerer is from. Mr. Kagerer ran several ARPES experiments using synchrotron radiation and ultraviolet laser. He presented his research work in the seminar. All of our students enjoyed fruitful discussions with him.

JSPS Summer Program 2022
Research Report

1. Name: Leonie Karr （ID No. SP22 310 ）

2. Current affiliation: LMU Munich

3. Research fields and specialties:
Mathematical and Physical Sciences
Biological Sciences

4. Host institution: Earth Life Science Institute Tokyo

5. Host researcher: Prof. Yasuhito Sekine, Prof. Dr. Tomoaki Matsuura

6. Description of your current research

The lab of Prof. Dieter Braun at LMU conducts research on the origin of life. This is usually done in specifically built setups that mimic miniature water cycles and represent a plausible environment on the early Earth. In this context I was working on RNA replication with a ribozyme, trying to achieve an autocatalytic replication network. Matsuura-sensei's lab at ELSI researches primordial cell like structures. To this extend properties of phospholipids that assemble into vesicles are probed. They are a realistic candidate to be the precursor of today's cell as they are able to separate certain molecules or chemical reactions from their environment. However, not much is known about the influence different membrane compositions have on the behavior of vesicles during freeze thaw cycles. The probed temperature cycles are thought to be a plausible setting on the early Earth and other planetary bodies like Europa, also helping the accumulation and aggregation of the vesicles.
Joining the research on phospholipid vesicles with the non-equilibrium setting from the Braun lab might be able to see how the accumulation of phospholipids can come about in a one-pot setting.

7. Research implementation and results under the program

Title of your research plan:

Impact of membrane composition on growth during freeze thaw cycles

Description of the research activities:

Research on the mechanism of phospholipid fusion and fission is important to assess their plausibility as proto-cells on Earth and other Solar System objects. Vesicle growth is important as it is a required aspect for self-replication. Additionally, accumulation and fission of vesicles is necessary to concentrate biomolecules inside a membrane. Using freeze-thaw cycles investigations into the behavior of phospholipid vesicles and the influence of their membrane composition on aggregation and growth was conducted.

At the Earth-Life-Science Institute (ELSI) I was preparing vesicles with different lipid compositions. As I have not yet worked with the techniques necessary for large unilamellar vesicles (LUV) production and the corresponding experiments and analysis I was taught by two students. During the course of this internship I prepared LUVs with 8 different membrane compositions and researched their growth during cycles of flash-freezing and thawing. As analysis method I used dynamic light scattering and lipid assay. The experiment samples will also be analyzed in a LC-MS. I was able to find some tendencies that impact vesicle growth. It was observed that mixtures of POPC (1-palmitoyl-2-oleoyl-glycero-3-phosphocholine) with either PLPC (1-palmitoyl-2-linoleoyl-sn-glycero-3-phosphocholine) or DOPC (1,2-dioleoyl-sn-glycero-3-phosphocholine) undergo bigger vesicle growth and a higher percentage of the overall lipids is affected by this growth compared to pure POPC vesicles. Therefore, it is hypothesized that unsaturated bonds in the fatty acid chains play an important role in the mechanics of growth and aggregation during flash-freezing and thawing. According the results, it seems advantageous for vesicle growth to have a higher amount of double bonds in the lipid chains.
In the future, these results will inform experiments where LUVs with certain membrane compositions will undergo slow freezing. This setting is more realistic for the early Earth compared to flash-freezing experiments, but require longer timescales for each experiment (around 1 week). Therefore, to make the most of the 9 weeks of research and conduct parameter screening, experiments were performed with a flash-freeze thaw protocol. Whether flash-freeze thaw and slow freezing experiments show similar behavior of LUVs will be a question answered in the future. Additionally, in further experiments the encapsulation efficiency of lipid vesicles will be tested, to see phospholipid LUVs capability to concentrate biomolecules. A visit to Munich of Matsuura-sensei's Postdoc is scheduled for early 2023 to continue the collaborative work.

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

Visit to the research group of Prof. Shoichi Toyabe at the Tohoku University and presentation of research topic

Visit to the Okinawa Institute of Technology and discussions with group members of Prof. Greg Stephens group, with Prof. Jonathan Miller and group members, with Prof. Amy Shen, with Prof. Samuel Reiter, with Prof. Simone Pigolotti (+seminar talk) and with Prof. Mahesh Bandi

9. Adviser's remarks (if any):

Research Report

JSPS Summer Program 2022
Research Report

1. Name: Ines Ayu KLUGE （ID No. SP22311 ）

2. Current affiliation: RWTH Aachen University

3. Research fields and specialties:
   Mathematical and Physical Sciences
   Engineering Sciences

4. Host institution: University of Tokyo

5. Host researcher: Prof. Mitsuru TAKENAKA

6. Description of your current research

My research project as a master's student was focused on the development of an integrated external cavity laser (ECL) in the visible spectral range at wavelengths around 640 nm. These lasers are very compact, small and mostly tunable and are integrated into a silicon or silicon nitride chip. The whole laser consists of mainly two components, the photonic integrated circuit (PIC) based on silicon nitride and the III-V gain medium, consisting of a prefabricated semiconductor optical amplifier (SOA), that amplifies the light and reflects it back into the chip.

A main challenge of this work was the integration of the SOA onto the chip by flip-chip bonding. This integration method is very useful for mass-production but on the downside lacks active alignment possibilities, which would be important to achieve high placement accuracies needed to prevent high insertion losses.

To accommodate for that, the edge coupler of the silicon-nitride PIC was replaced with a multi-mode edge coupler interface, which relaxes the requirements on the placement accuracy.

7. Research implementation and results under the program

Title of your research plan:

III-V Si-MOS Hybrid Phase Shifter with Phase Change Materials (PCM)

Description of the research activities:

The research group led by Prof. Takenaka intensively deals optical modulators, which are essential for many optical communication systems. During my research stay in Japan I focused on III-V Si-MOS Hybrid Phase Shifters with the addition of Phase Change Materials to enhance the phase shifting properties.

Since this is a novel concept, the feasibility of this approach had to be evaluated first.

For this purpose, I performed MODE and FDTD simulations on Lumerical, to estimate the performance of these devices based on their phase shifting properties, absorption and insertion losses and the quality factor.

Since the simulations showed promising result, we proceeded with the fabrication of test devices. An existing SOI chip with prefabricated micro ring resonators was used and its passive device characteristics were measured and evaluated at the near-infrared region without any additional layers on top.

To fabricate the device, a III-V and a PCM-layer had to be bonded/deposited and patterned. I gained experience in the wafer bonding process which is needed to attach the III-V layer. Electron beam lithography (EBL) was used in the subsequent steps to pattern the films.

Unfortunately, unresolved errors occurred repeatedly on the EBL machine and prevented progress. Due to the time constraints we were not able to finish the fabrication of the test devices.

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

This research stay was a wonderful experience for me. I am really grateful for the support and help from the students in my lab.

Through the JSPS network I also met a lot of students from different countries with very diverse and interesting research topics. Especially staying in Tokyo was great, since many JSPS students were located here and there was always someone proposing a new activity or place to go, which I would not have known about otherwise.

Culturally, I was able to travel quite a bit on the weekends. My highlights were the Gion Matsuri in Kyoto and the beautiful landscape and nature in Kyushu.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Christoph HESS (ID No. SP22312)

2. Current affiliation: University of Cambridge

3. Research fields and specialties:
Humanities Social Sciences

4. Host institution: Keio University

5. Host researcher: KAJIMA Jun

6. Description of your current research

My project, *Family, Kinship, and the Limits of Choice in Pre-Industrial China*, examines the economic impact of family and kinship structure in pre-industrial China, with a micro-study of the historical prefecture of Huizhou at its centre.

While historical micro-demography has assembled a rich and data-driven understanding of demographic dynamics within Chinese families and wider kinship networks, hardly any of these studies have systematically linked in economic data. We therefore know little about if and how the bond of the family to a particular plot of land, held to have been the hallmark of pre-industrial European 'peasant societies', might have structured Chinese rural society.

I approach this question by asking what limits the family and kin set to the scope of individual choice in pre-industrial China. This sets a clearer and more fruitful research agenda than the dichotomy between individualistic and familiaristic societies that has enriched many of the key studies on the land-family bond, notions that come with a heavy ideological baggage. Huizhou is an interesting example for examining this question because it was characterised by strong kinship ties and itself a mainly agricultural region, all the while an important share of its population left their native place to work as sojourning merchants elsewhere. The region thus combined structural elements of an agricultural and family-centred 'peasant society' with high geographic mobility, arguably distinctive only of 'individualistic' societies in which kin groups had little power to dictate their members' decisions.

The quantitatively larger group are commonly referred to as 'popular documents' (*minjian wenshu* 民間文書), an umbrella term that encompasses a vast range of contracts that families have held on to, often over centuries, due to the documents' legal relevance. Among this variety of documents, it is for one thing loan contracts, and for another household division records (*fenjia shu* 分家書) that I am interested in. I have spent the four months from January to April 2022 digitising ca. 4,000 loan contracts, which I have relied on to complete the third chapter of my dissertation. My work on the household division record database is yet to start, but I have collected about 700 of these documents and set up the digital infrastructure for the database (see Appendix B).

Second are lineage genealogies (*zupu* 族譜), which I have culled this summer from archival collections in Japan. The genealogy database will mainly be used to analyse geographical mobility and to a lesser extent family size. I have set up a Javascript-based data entry form (see Appendix A) that allows me and currently one research assistant to

digitise the biographical records of around 10,000 individuals from the genealogies I have collected and digitised.

7. Research implementation and results under the program

Title of your research plan:

"The Economic Effects of Family and Kinship in Chinese History"

Description of the research activities:

My research in Tokyo and Japan at large has been focused on locating suitable genealogies for a study of migration in pre-industrial China. My aim was to find genealogies with suitably detailed information on places of burial that I could consistently compare the places of burial of fathers with their sons' to obtain information on geographic movements between generations.

I have found these genealogies by searching through three major library collections: Toyo Bunko, which hosts the largest collection of Chinese genealogies in Japan; the National Diet Library, the second largest; and the Toa Bunka Kenkyujo at the University of Tokyo, the third largest. I found good materials at all three institutions, but chose to focus on genealogies I had found among the collections of the Toa Bunka Kenkyujo and the Toyo Bunko. With generous funding from JSPS and the support of Prof Kajima, I then managed to hire two research assistants, who helped me to transcribe a first 1,000 individual records from the genealogies, as a first step towards my desired sample size of 10,000 individuals.

I also further collected a second, more diverse, set of sources. The largest chunk of these materials consists of copied from the Niida collection, which I was lucky to find at the University of Tokyo. This collection was of great value because Niida was interested in much similar topics such as the legal function of the family and kinship or the structure of the Chinese family as I am. The collection will therefore allow me to embed my findings from Huizhou in a wider geographical context from the Chinese-speaking world. With the same purpose, I have collected a wide range of statistical materials, mostly generated by the South Manchuria Railway Cooperation, from the institutions mentioned above, as well as Kyoto University Library.

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

I greatly enjoyed the homestay with the Morimoto family, but wish it would have been a bit longer, perhaps at least a week. The language course was useful, but it would have been more effective if delivered in person, over a longer period of time, and in shorter lessons (two hours without a break are intense).

9. Adviser's remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Elias Koenig （ID No. SP22313）

2. Current affiliation: Institute for Advanced Sustainability Studies (IASS)

3. Research fields and specialties:

X Humanities　Social Sciences　Mathematical and Physical Sciences
Chemistry　Engineering Sciences　Biological Sciences
Agricultural Sciences　Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Prof. Kohei SAITO

6. Description of your current research

The aim of my current research project is to theorize the climate strike as a key action form of the global climate justice movement and to contribute to the strategic debate concerning its evolution as a form of action, a debate I believe to be both pressing in praxis and underappreciated in theory. The project builds on my previous work on climate justice in the context of my B.A. thesis (on climate justice and epistemic justice), and my M.A. thesis (on climate justice and Chinese philosophy), which culminated in the publication of my first book, *Klimagerechtigkeit* (Unrast, 2021). Contrary to those previous publications, this new project poses more concretely praxis-related questions such as: “What does it mean for a climate strike to become a climate justice strike?”, “How can the climate strike movement address and overcome the perceived dichotomy between social and environmental justice?”, and “How could the climate strike as a form of action be compatible with the strategic trajectories of other progressive justice-focused movements?”

7. Research implementation and results under the program

Title of your research plan: **Theorizing the Climate Strike**

Description of the research activities:

While in Japan, I primarily worked on two papers:

- One long paper (10 000 words) titled “Towards a Theory of the Climate Strike” (forthcoming in *Socialism and Democracy*)
- One shorter paper (3000-4000 words) titled “Striking for Another World Order? The Global Climate Strike as a Worldmaking Project” (to be presented at two conferences in Athens and Manchester)

The first paper is primarily concerned with interrogating various aspects of the first wave of the climate strike movement in 2019 and examining the concept of the climate strike in the context of other strike-based movement. Abstract:

The climate strike has become a central strategy of the climate justice movement. This article examines both its success and its limitations as a form of action. The first part assesses the recent history of the climate school strike movement and analyzes its development in the context of a broader conflict between 'green' and 'gray' capital fractions amidst an escalating climate and ecological crisis. I argue that the present ineffectiveness of the movement is related to its absorption into political projects of ecological modernization that fail to address the structural roots of the climate crisis. The future effectiveness of the climate strike movement will therefore be determined by its ability to effectively challenge fossil capital in its totality. In view of this dilemma, the second part of the article proposes a 'long history of the climate strike', placing the climate strike into the longer genealogy other forms of strike action that are opposed to fossil capital, such as labor, feminist, anti-racist strikes. Grounded in this longer history, it explores the potential of the climate strike to overcome its present strategic impasse through new alliances and a widening of the climate justice frame.

The second paper, in turn, focuses on what some organizers have dubbed a kind of “second wave”: the movement-internal conversation that followed the ebbing of the first wave of the climate strike movement (in no small part due to the restrictions associated with the COVID-19 pandemic). In particular, I examine what I call the movement’s *reparative turn* towards a more distinctly justice-centered politics with a particular emphasis on the demand for climate reparations. Below is a preliminary abstract:

In the past four years, the Global Climate Strikes organized by Fridays for Future and allied organizations have emerged as the arguably most popular form of action in the history of the broader climate justice movement. At the peak of the movement’s first mobilization cycle in September 2019, more than six million people participated in climate strike actions across the globe. While this first mobilization cycle was still heavily dominated by groups in the Global North, the movement’s leadership and outreach have considerably diversified since. Most notably, Fridays for Future groups from the Global South took over the movement’s official global communication channels in 2021. This has resulted in a stronger focus on issues of global justice and climate reparations. Inspired by this reparative turn, this paper theorizes the climate strike as a worldmaking project. Drawing on the work of philosopher Olúfemi O. Táíwò and political theorist Adom Getachew, I situate the present climate strike mobilizations in the longer genealogy of anti-colonial and anti-imperialist strike movements. According to Getachew, many influential anti-colonial activists and thinkers of the 1960s

and 1970s understood that European imperialism had been "world-constituting" and concluded it would have to be met by worldmaking resistance on the same scale. They envisioned national and international legal structures protecting people's right to self-determination and thus give nations broad powers to control investment and political interference by foreign powers, culminating in the proposal for a New International Economic Order (NIEO). Similarly, I argue, groups like Fridays for Future increasingly articulate a vision of climate justice that fundamentally challenges the tenets of the given extractivist and colonial world order, a vision shaped by new practices of inter- and transnational solidarity. I conclude with some speculations on how the history of post-colonial self-determination could inform current strategic debates regarding the future of the climate strike movement.

Parallel to writing these two papers, I have been interviewing climate justice activists from different countries/communities, as well as academics working on the climate justice movement. So far, I have interviewed seven activists and academics from seven different countries, with the goal being to interview a total of twenty activists/academics. In this context, I also had the chance to meet and interview several activists active in the Japanese climate movements. I also attended a *Fridays for Future* protest in Shinkjuku ahead of the municipal elections.

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

I feel that interacting with and learning from my supervisor, Professor Saito, as well as with other Japanese climate activists and comrades was probably the most remarkable part of my experience in Japan. Through them, I learned not only much about the contemporary debates concerning climate activism in Japan, but also about a wide range of topics including the history of social movements in Japan, the peace and anti-nuclear movement, organic farming, the history of Japanese imperialism, labor movements, Japanese philosophy, Marxism in Japan, and many other topics.

I was also fortunate to have the chance to travel to other cities in the country, including Hiroshima, Naha, Osaka, Kyoto, Kanazawa, and Sendai. Through these travels, I got to connect with other JSPS scholars, make new friends, learn more about history, architecture, and culture of Japan, and visit a variety of museums. I feel immensely privileged and grateful to JSPS for giving me the chance to make these experiences.

9. Adviser's remarks (if any):

As an adviser as well as the host family, I confirm that Elias Koenig made his best effort in order to successfully conducted his research. It was a great experience for me too.

JSPS Summer Program 2022
Research Report

1. Name: Louise LOUW　（ID No. SP22314）

2. Current affiliation: Justus-Liebig University Giessen
Graduate Centre for the Study of Culture

3. Research fields and specialties:
Humanities

4. Host institution: Waseda University

5. Host researcher: Prof. Hideto TSUBOI

6. Description of your current research

In my PhD-project, "Representation of Trauma in Japanese American and Canadian Internment Narratives," I research the ways in which Japanese American and Canadian texts of different genres and publishing times approach and narrate Japanese American identity after the WWII internment. Through my research I seek to prove that Japanese American and Canadian communities were able to use literature and art to assert, define, and reclaim agency over their history and cultural identities after the war. In order to do so, I conduct a close reading and comparative literary analysis of Japanese American and Canadian internment narratives. Using a diachronic and comparative approach, I compare and contrast the ways in which both fiction and non-fiction texts on internment published between 1946-2020 approach and narrate identity and trauma in the context of post-internment, redress-time, and contemporary North America. Here, I consider how these texts may have been influenced by their various publishing times and how the texts have, within themselves, come to influence our contemporary understanding of what it means to be ethnically Japanese in North America. Throughout my research I look at how these texts were received by the public and what their reception means for US and Canadian post-war discourse. By considering these texts in relation to both historical and contemporary perspectives on internment, I aim to evaluate how literary narratives have formed our understanding of North American cultures and value systems today, and how these value systems inform our current understanding internment as a whole. I hope to understand which historical, political, and social factors inform the position of internment texts as part of the Japanese American and Canadian literary canon. My study aims to find where fiction and non-fiction texts intersect in their portrayal of experience and to compare and contrast their unique literary responses to history.

7. Research implementation and results under the program

Title of your research plan:

Researching the Representation of Trauma in Japanese American and Canadian Internment Narratives

Description of the research activities:

My activities can be divided into two main research foci: Literary and historical.
For the first research focus, I primarily conducted on-campus research into aspects of Japanese culture, customs, language, and folktales present in my primary corpus of texts. My research into culture, customs, and language included looking at traditional Japanese forms of address, family structures, religion, and funeral rites, as well as specific Japanese words and phrases that commonly recur in the texts. I then conducted research into the traditional folkloric texts referenced in my primary corpus. This allowed me to better evaluate their presence and significance in Japanese American internment narratives. Here, my research aided me in understanding not only the origin and purpose of traditional folktales, but also how they function as intertexts in Japanese American internment narratives.
My second research topic, concerning the remembrance and aftermath of WWII in Japan, formed the primary focus of my research stay. In addition to further on-campus research into Japanese American internment narratives, I conducted museum-based research into Japanese migration to the Americas, Japanese American art and activism, post-war repatriation of Japanese nationals, and the bombings of Hiroshima and Nagasaki. This research has allowed me to begin to compare the remembrance and understanding of the war in Japan and America, as well as to gain some insight into how the remembrance of the war might have influenced the subsequent relations between these countries on a political and social front.

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

My research stay in Japan was particularly valuable in allowing me to experience Japanese culture and everyday life first hand. In addition to contributing greatly to my own research, this stay has allowed me to practice Japanese, interact and network with Japanese researchers in my own field, and to come into contact with fellow PhD researchers from a diverse variety of fields.

JSPS Summer Program 2022
Research Report

1. Name: Fabiola Mallach （ID No. SP22315）

2. Current affiliation:

Sciences Po Paris

3. Research fields and specialties:

Social Sciences

4. Host institution:

Waseda University

5. Host researcher:

Professor Yuji Uesugi

6. Description of your current research

Development Cooperation is increasingly implemented in fragile and post-conflict contexts. In 2020, Japan was the fourth largest Official Development Assistance (ODA) donor country, while Germany was the second largest ODA contributor among the Organisation for Economic Co-operation and Development (OECD) member states. Both countries are regarded as close partners and important actors internationally, also in the realm of fostering international peace and supporting peace-building efforts. Importantly, Japan has been the forerunner of integrating the concept of human security into its foreign policy and development cooperation. The concept of human security refers to prioritizing human needs over state security interests, in order to better respond to human vulnerabilities and demands. Nowadays, the concept of human security is also increasingly incorporated into Germany's foreign policy. Still, no universal agreed-upon definition of the concept exists. Due to the broadness of the concept of human security, it has received considerable amounts of criticism. Nevertheless, others argue that the broadness of the concept facilitated partnerships between different actors and opened the way for more integrated cooperation between humanitarian, development and peace actors.

To better address and respond to the high levels of fragility and complexity in post-conflict settings, more comprehensive approaches are attempted to be developed and implemented. One example for this is the Humanitarian-Development-Peace Nexus (HDP-Nexus). The HDP-Nexus describes efforts to better link and coordinate between humanitarian assistance, development and peace efforts, in order to better address challenges and vulnerabilities - especially in fragile contexts.

7. Research implementation and results under the program

Title of your research plan:

The Humanitarian-Development-Peace Nexus in Japanese Development Cooperation

Description of the research activities:

The focus of my research during the program was the Humanitarian-Development-Peace Nexus in Japanese Development Cooperation. Here, I focused on how the cooperation and coordination between Japanese humanitarian, development and peace actors is perceived by practitioners from the three different fields in Japan, what challenges to a more integrated approach exist and what influence the concept of human security had on the development of the HDP-Nexus. For this, Japanese support for South Sudan and Northern Uganda served as case studies.

Firstly, I was conducting literature reviews on Japanese Official Development Assistance, the evolvement of the concept of human security, peace-building and the HDP-Nexus. Here, I also looked closer into the relation between Official Development Assistance and peace-building in the Japanese context. Through attending a conference on *Asian Peace-building* and a workshop on *Japan in the Global Governance of Peace-building*, I had the chance to hear from and exchange views with academics and practitioners alike on the topic. The main focus of my research under the program was conducting interviews with practitioners who worked in the field of peace-building and Official Development Assistance in the context of South Sudan and Uganda. These interviews enabled me to build a better understanding of how the cooperation between humanitarian, development and peace actors is coordinated on the ground and highlighted that the HDP-Nexus as an integrated approach is highly context-dependent.

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

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report SP 223116

1. Name: Nicole Marion Mueller ID No. SP22316

2. Current affiliation: Martin-Luther University Halle-Wittenberg (Germany)

3. Research fields and specialties:
Humanities

4. Host institution: Keiô University Tôkyô

5. Host researcher: Prof. Minori MURATA (PhD)

6. Description of your current research

I am currently in the final stages of writing my PhD thesis, titled *One century of Japanese Thomas Mann Reception in Digital Topic Modeling - Comparative Translation Analysis and Historical Contextualisation*. This interdisciplinary PhD project focuses on the cultural, literary and academic historical significance of German-Japanese translation in the 20th and 21st century. After more than two hundred years of isolation from the West, post-Meiji Japan negotiated the relationship between national literary tradition and foreign influences by translating the Western literary canon incarnated for example by German Nobel Laureate Thomas Mann. Consequently, his prose has been translated into Japanese repeatedly, so that the respective characteristics of several translations based on the same source text can be traced back to processes of literary assimilation and emancipation during the 20th century. Since these translations still have not been analyzed comprehensively, I have developed an innovative tool for a comparative translation analysis which is digitally augmented by Topic Modeling. This tool not only facilitates a quantitative expansion of scope (encompassing 15 whole translation texts of Mann's early novel *Tonio Kröger*), but also allows for the quantification of both thematic and stylistic similarity between source and translation as well as similarity between different translations derived from the same source. While this comparative analysis is initially based on quantitative criteria, it is then expanded through qualitative interpretation and a dense description of historical and cultural framework conditions such as the Japanese academic movement for an idealized Western *Bildung* (*kyōyōshugi*). This not only contextualises Japanese attitudes during the 20th century towards Thomas Mann in particular and Western literature in general, but furthermore elucidates on the connection between the intrinsic literary design of translation strategy and external historical factors of literary reception and (re)production.

7. Research implementation and results under the program

Title of your research plan:

Finishing the PhD thesis (title: *One century of Japanese Thomas Mann Reception in Digital Topic Modeling - Comparative Translation Analysis and Historical Contextualisation*) especially by obtaining and reading Japanese-language academic literature relevant to the subject.

Description of the research activities:

During the first few weeks after arriving in Japan, I focused on including the final missing translations (which I previously couldn't obtain due to travel restrictions) into my analysis and on summarizing the results. I also discussed the results with my host researcher on multiple occasions and got valuable feedback essential to the finalization of my project.

Additionally, I also spent much time at Keiô University's library and collected extensive information on the translators such as their biographies, academic background and especially their stance on literature and translation in itself. To that end, I conducted research on their other translations and read the fore- or afterwords (in included). This kind of context information is necessary for my interpretation of various translation strategies.The same goes for information on Japan's publishing landscape which I also acquired at Keiô University's library. This information will prove useful for further contextualization of the results of my analysis.I also registered at the National Diet Library in Tôkyô and used the ressources which are available there to gather further background information on various translators.

While researching those context informations, I also wrote the analysis chapter for my PhD thesis, thus summarizing the results of my digital analysis. This chapter has been the only chapter which I had not yet written prior to my stay in Japan, while I have written at least drafts for all other chapters of my PhD thesis. Since I expect to finish the analysis chapter (which currently contains a little more than 100 pages) in the first week after returning to Germany, I will finalize the drafts of the other chapters in the weeks after and submit my PhD thesis by the end of 2022.

In addition to those research activities, I also introduced myself at the German Institute for Japanese Studies (Deutsches Institut für Japanstudien) and had the chance to talk to the director, Prof. Franz Waldenberger, about my PhD research as well as possible opportunities to continue my post-doc studies as research fellow at the German Institute for Japanese Studies.

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

I was graciously invited by one of my former teachers at Keiô, Hitomi KUDEIRA-Sensei, who teached a special class on Japanese culture (*bunka kamoku*), to attend a tea ceremony at her home in Tôkyô. Since I personally do not own any of the (very expensive) equipment needed for tea ceremony, this has been my first *o-temae* in more than 4 years. I was very happy about this opportunity and hope that I will be able to continue studying *sadô* when I next return to Japan.

9. Adviser's remarks (if any):

JSPS Summer Program 2022

Research Report

1. Name: Elia Joël WEBER （ID No. SP22317）

2. Current affiliation: Freie Universität Berlin

3. Research fields and specialties:
Humanities

4. Host institution: Kyoto University

5. Host researchers: Prof. Dr. Miho ISHII, Prof. Dr. Kyoko AMANO

6. Description of your current research

Avestan and Middle Persian, as well as a few non-Indo-Iranian sources clearly state the existence of animal sacrifices in pre-islamicate Zoroastrianism. My PhD project aims to deliver a comprehensive study of this ritual practice based on the available written and archaeological sources. The slaughtering, consecration, offering and consumption of an animal and its parts are to be described and analyzed within the larger Zoroastrian liturgical setting. The comparison with the corresponding Vedic rituals will also allow insights into how this ancient Zoroastrian practice may have looked like.
I have been focusing on this last aspect recently, as I am currently working on a systematic comparison of animal sacrifices in the Old Iranian and Old Indic traditions, which are usually assumed to have derived from a common “Indo-Iranian” ancestor religion. The comparison with the richer Vedic textual material is of utmost importance for the interpretation of the difficult and sometimes inconclusive Old Iranian texts in which animal sacrifices are mentioned. Rather than the reconstruction the “Indo-Iranian” ancestor religion, however, the differences and similarities between Old Iranian and Old Indic texts will be of interest for the specific study of the Zoroastrian rituals involving animal sacrifices.

7. Research implementation and results under the program

Title of your research plan: The Vedic practice of animal sacrifice

Description of the research activities:

While in Japan, I was able to complete a translation and commentary of the most detailed description of animal sacrifices in the oldest extant Vedic prose text, the *Maitrayāṇī Saṃhitā* (III 9,2–10,5), while making references and translations of parallel passages in two other important texts from the same "Black Yajurveda" tradition, the *Taittirīya Saṃhitā* and the *Kāṭhaka Saṃhitā*. The twice-weekly reading sessions with Kyoko Amano revealed other important passages to be studied in the future. I could already begin working on these new findings in Japan, and plan to come back in the future to continue this work.

In parallel, I started to systematically compare the chapters on animal sacrifice of the *Maitrayāṇī Saṃhitā* with passages previously known to me from the Avestan and Middle Persian *Nērangestān*, a meta-ritual text written for Zoroastrian priests, in addition to references in the *Avesta*, the most famous Avestan liturgical text.

I also attended Kyoko Amano's seminar on the *Maitrayāṇī Saṃhitā*, which was very useful to get more familiar with the text and Vedic prose in general. My interactions with the other students in the seminar and department in general were very helpful to introduce new ideas into my work.

On two occasions, a monthly colloquium of Japanese Indologists and the Indology department research seminar, I was invited to present my research and obtained most valuable feedback. In the first presentation I presented my research plan for my PhD in Germany, the second presentation was intended to give an overview of the work done so far at Kyoto University.

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

Everyone at the Institute for Research in the Humanities, as well as the department of Indological Studies at Kyoto University, has been most welcoming and supportive of my research. I am most grateful for the many hours Kyoko Amano has invested into our reading sessions, as well as the opportunities to present my PhD project and the valuable feedback I obtained.

During my stay, I was able to visit other Japanese cities such as Osaka, Nara, Hiroshima and Tokyo. I remain in awe at the gorgeous landscapes and rich cultural history and certainly plan to come back in the future for this reason as well. I am also very grateful for the experience of the home stay; it was a very interesting one and I spent a great weekend with my Japanese host family.

9. Adviser's remarks (if any):

JSPS Summer Program 2021
Research Report

1. Name: Luisa Emilia Aviles Podgurski （ID No. SP22318 ）

2. Current affiliation: Potsdam Institute of Climate Impact Research and Technical University Berlin

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: Japan Agency for Marine Earth Science and Technology

5. Host researcher: Dr. Masami NONAKA and Dr. Ingo RICHTER

6. Description of your current research

In our current project we aim to identify and quantify causal relationships at short lead-times (three to twelve days) between remote and local climate patterns and the Indian summer monsoon (ISM) rainfall during boreal summer. Specifically, we focus on the Western and Eastern Himalayan foothills, two regions that experience extreme precipitation events during the ISM season while also being densely populated. For this we apply causal discovery tools, a method that is based on concepts of information theory and statistical mechanics, and allows to identify strongly interdependent climate patterns associated with the ISM and to distinguish between spurious and truly causal links.

Our analysis reveals that WHF rainfall variability is influenced by mid-latitude teleconnections such as the circumglobal teleconnection in addition to local drivers like the sea surface temperature or the outgoing longwave radiation. By contrast, the EHF rainfall is driven by a different set of atmospheric processes. Specifically, we find a causal driver in the eastern equatorial Pacific, potentially indicating that intraseasonal tropical variability patterns associated with the Madden-Julian oscillation and/or the Walker circulation might exert a significant influence on EHF rainfall.

7. Research implementation and results under the program

Title of your research plan:

Causal relationship between the Indian and the East Asian summer monsoon

Description of the research activities:

During these two months, I analysed the causal relationship between the Indian and the East Asian summer monsoon (EASM) in order to identify and understand the underlying physical processes and mechanisms driving these interconnected systems. Both are components of the whole Asian summer monsoon system and related to large precipitation amounts with strong intraseasonal variability that have large socioeconomic implications. The difficulty lies in finding an index that describes the total intraseasonal variability of the EASM as it is governed by complex rainfall and circulation structures. For this analysis I applied causal discovery tools to a shear vorticity index, that was shown to reflect the total variance of the precipitation circulation over east Asia. In addition, I studied two different rainfall indices. This analysis revealed that the EASM circulation system is driven by tropical drivers over the western Pacific and the rainfall over Northern China and Southern Japan is causally influenced by the midlatitudes, more specifically by the circumglobal teleconnection. This implies that the Indian and the East Asian summer monsoons share common causal drivers.

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

I enjoyed my stay in Japan to the fullest. Even though the pandemic had a big impact on the work environment, which resulted in a somewhat deserted office from time to time, I still had the opportunity to meet some colleagues and get to know my supervisors quite well. The weekends and multiple national holidays during my stay allowed me to get to travel a bit and I explored Shimoda, Hakone, the Fuji national park, the Izu Islands and many more beautiful spots. Sadly, JSPS cancelled the introductory week at Sokendai, which usually allows all fellows to meet and spend time together. I hope that this will be reintroduced in the next years.

9. Adviser’s remarks (if any):

【SP22319】

JSPS Summer Program 2022
Research Report

1. Name: GUT Florian Raphael （ ID No. SP22319 ）

2. Current affiliation: University of Hamburg, Hamburg, Germany

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: National Institute of Informatics (NII), Tokyo, Japan

5. Host researcher: Ken-ichi Kawarabayashi

6. Description of your current research

Most recently, the following topic has been in the focus of my attention: In undirected graphs, the so-called graph minor theorem, which states that in any collection of infinitely many finite graphs, there is one that is the minor of another, is one of the deepest results in graph theory. This can be deduced from the size of the project alone: It was proved in many papers by Neil Robertson and Paul Seymour, which span more than 500 pages combined. As is true for almost all results about (undirected) graphs, moving the graph minor theorem to directed graphs turns out to be even tougher than solving the original problem. Thus, a good place to start is translating the individual results that lead up to the graph minor theorem to directed graphs independently. Two such related topics that surely are a step in the right direction are *directed treewidth* and *cycle width*, which are, roughly speaking, measures of how complex a considered directed graph is. The simpler a digraph is, the smaller its width parameters tend to be. I organise a regular meeting within my local department where a number of colleagues and I familiarised ourselves with this complex topic. A first result was soon obtained which proves a direct relationship of cycle porosity, a foundational concept for cycle width, and the existence of small hitting sets, a set of vertices which touches all relevant cycles of a graph.

7. Research implementation and results under the program

Title of your research plan:

Directed graphs: immersion minors and 1-separations.

Description of the research activities:

In the first half of the stay at the NII we focused on the area of graph minor theory, as this is the field of research of both, the host and I. Intuitively this means that for every sequence of graphs there is a pair of two graphs in that sequence such that one is "contained" in the other. Since the landmark result by Robertson and Seymour was completely published in 2004 many graph theorists have worked in this field and worked on transferring the findings to other forms of minors (read as “how can one graph be contained in another”) or even minors in directed graphs. We worked in the latter, looked at the so-called immersion minor and could successfully prove one important element of the project for directed graphs: the so-called "two paths theorem". It is a tool to tell apart directed graphs that have two paths that cross each other, no matter how they are drawn in the plane, from those that don't.

In the second half of the stay we still worked with directed graphs. Rather than understanding the relationship of different directed graphs with each other as with minors, we wanted to understand the structure of a directed graph by itself. One way to do so is to look for "weak points" which in the language of graph theory are areas of low connectivity and in our case we focused on the so-called 1-separations. There already exists a result that essentially states that there is just “one” way of taking apart a (finite) directed graph along these weak points, but it does not apply to infinite directed graphs. Moving results about finite (directed) graphs to infinite ones often bears pitfalls, a popular example illustrating the necessary effort can be found in the history of Menger’s theorem for infinite graphs. We nevertheless were successful in obtaining a good result that states that if two ways to take apart an infinite directed graph along its “weak points”, then we can describe the cause for this well. We expect that this result will be published in a scientific journal.

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

I want to thank the Japanese people wholeheartedly for their warm welcome, the fantastic food and the opportunity for research collaboration.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Stephan Schmidt （ID No. SP22320）

2. Current affiliation: Junker Lab, EIMI, WWU

3. Research fields and specialties:

Chemistry Biological Sciences, Medical, Dental and Pharmaceutical Sciences

4. Host institution: Itami Laboratory, Nagoya University

5. Host researcher: Prof. Kenichiro Itami

6. Description of your current research

My research focuses on the development of P2X7 receptor ligands, which can be used for imaging applications and for the treatment of various diseases. The P2X receptors (P2X7R) are trimeric, non-selective cation channels activated by extracellular adenosine triphosphate (ATP). The homotrimeric P2X7 receptor (P2X7R) subtype is a promising target for therapy and diagnosis due of its involvement in the pathologies of various diseases. Those include autoimmune diseases such as *rheumatoid arthritis* (RA), neurodegenerative diseases, neuropathic pain and cancer.

7. Research implementation and results under the program

Title of your research plan:

Photoswitchable P2X7 Receptor Ligands for Dynamic SAR Studies

Description of the research activities:

Bioactive compounds whose potency can be regulated by light are promising drug candidates for the treatment of diseases that require high local concentrations. Furthermore, they can be useful in SAR studies, to scan through the binging pocket of an enzyme. It was the goal of the project to synthesis photoswitchable *N*-acylhydrazones, based on a benzothiazole scaffold as P2X7 receptor antagonists. Adamantly acetic acid was linked to the molecule, as it is crucial for ligand binding.

It was possible to establish the synthetic route to obtain *N*-acylhydrazones, linked to various aromatic aldehydes, that can be further functionalized.

In future works these compounds will be evaluated towards their photochemical properties, as well as in in biological assays.

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

“Japan is the country between the combinis and the vending machines.”

Japanese PhD Students’ description of Japan

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Alessandro Ferreri （ID No. SP22321 ）

2. Current affiliation: Forschungszentrum Jülich

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: RIKEN

5. Host researcher: Prof. Franco Nori

6. Description of your current research

My current research concerns the investigation of both dynamics and thermodynamics of systems consisting of confined fields in a cavity. Such systems have been offering the exploration of fascinating physical effects since, in an article by C.K. Law in 1995, one of the cavity wall was hypothesized as a quantum object, i.e. a rigid object whose position cannot be determined deterministically but rather thought as a quantum fluctuating quantity.

The presence of such quantum degree of freedom contextualizes the wall-field interaction in the frame of a pure exchange between particles. Two types of particles are typically involved: the excitations of the electromagnetic field, called photons, and the ‘quanta of motion’ of the wall, generally called phonons.

Among the phenomena that such cavity systems reveal, two of them cover a specific important role in my current work: the radiation pressure and the excitation exchange. In the framework of a quantum description of the fluctuating wall, the former reveals the shift of the position of the wall merely due to the presence of photons within the cavity, whereas the latter consists of the conversion of phonons into photon pairs and the backwards effect. Interestingly, in a recent publication I have studied the interplay between these two effects, in particular I showed how the increasing number of photons (due to the phonon-photon conversion) enhances the radiation pressure within the cavity, and affects the force between the cavity wall, formally including the static and dynamical Casimir effect in one formula.

On the other hand, a cavity confining a system is elegantly similar to a piston contain an ideal gas, with which humans have formulated thermodynamic cycles since the born of thermodynamics. Supported by this analogy, my current research is focused on the determination of quantum thermodynamic features of a cavity confining a quantum field, wherein one of the cavity walls is supposed to behave as a quantum harmonic oscillator. Interestingly, the possibility to theoretically control internal parameters, such as the frequency of the harmonic oscillator (the wall) and the length of the cavity, enables the activation of internal resonances of the system, which can be exploited in order to include and combine effects such as squeezing and particle exchange throughout the thermodynamic transformations of the cycle.

I believe that this topic, which is also reflected in my JSPS summer school project, will be part of my research also in my next future.

7. Research implementation and results under the program

Title of your research plan:

Quantum thermodynamics of optomechanical system in the nonlinear regime

Description of the research activities:

One of the key factors of the project is the extraordinary number of new ideas, concepts and possible research paths that can explored. Therefore, a discrete amount of time was initially required in order to discuss both the focal points of the current investigation and the optimal approaches.

Finally, we have been leading the study of quantum thermodynamic cycles following two parallel investigations. We started from a full Hamiltonian of the optomechanical system; this describes both the confined quantum field and the fluctuating cavity wall, as well as their mutual interaction. As first approach, we assumed a classical motion of the fluctuating wall, leading to an effective linearized Hamiltonian describing effects such as the squeezing and particle exchanges between field modes. This strategy allows us to describe the system exactly (analytically) and already achieve interesting results about the efficiency of a thermodynamic cycle based on the above-mentioned effects. As a second approach, we have been holding the full Hamiltonian with a quantum wall, and the system is currently described both perturbatively and numerically.

It is interesting to notice that specific thermodynamic transformations suggested us to explore combinations of squeezing and particle transfer during the same cycle.

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

I have desired visiting Japan for many years. This was the best opportunity for me to come to this country, and at the same time make an amazing work experience.

I had the opportunity to meet new colleagues and work beside them. Together we had very deep discussions about quantum physics, sometime overlapping philosophical and pretty scientific aspects. Communication between me and my colleagues in Japan has been an essential part of our collaboration, and it helped me a lot to comprehend some topics from different but fascinating points of view.

Beyond the work, Japan is a magical place to visit. It is scientifically impossible to not fall in love with it.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Bjarne Silkenath　　ID No. SP22322
2. Current affiliation: University of Konstanz
3. Research fields and specialties: Chemistry
4. Host institution: Sophia University
5. Host researcher: Prof. Dr. Noriyuki Suzuki
6. Description of your current research In my PhD I am interested in creating new chemical compound and testing them for their ability to inhibit bacterial growth. The process of synthesizing these chemicals requires a lot of toxic or harmful substances such as solvents. For successful commercialization a synthetic route requiring less of these chemicals is desirable rendering the synthesis more environmentally benign.

7. Research implementation and results under the program

Title of your research plan:

Synthesis of novel polymers bearing ligands enabling chemical synthesis in water

Description of the research activities:

I synthesized a thermosresponsive polymer designed in the group of Prof. Suzuki and tested its application in in metal catalyzed reactions. The properties of this polymer allows to perform reaction in aqueous media with substances that are normally insoluble in this medium. Therefor the reaction solvent can be changed from harmful organic solvents to environmentally benign water. This is a process inspired by nature where complex organic reactions take place in water with the help of different compartments inside cellular organisms.

The thermoresponsivness of the polymer allows for creation of micelles at elevated temperatures and dissolvement of these micelles at ambient temperatures. This leads to an easy and clean separation of the reaction product from the reaction mixture. Sometimes however when a catalyst is applied during this reaction it can be located in the organic phase of the reaction. The loss of this precious metal catalyst is undesired because ideally a second batch of product can be synthesized with same reaction medium. When the catalyst is lost during work up, new catalyst has to be added each reaction cycle. This lead to the desire to synthesize a polymer where the catalyst is bound to polymer itself via a ligand. Therefore, minimizing the loss of catalyst and improving the reusability of the reaction medium. In this summer program a N,N-ligand was successfully incorporated into a thermoresponsive polymer and the scope of reactions that can be conducted with a thermoresponsive polymer using water as the reaction medium was investigated.

In a second part of the research stay a novel polymer was designed which is bearing a norbornene moiety. These kind of strained alkenes exhibit extraordinary reactivity in a reaction called the Diels-Alder reaction with invers electron demand. The reaction partner in this reaction is a tetrazine. When a ligand is attached to the tetrazine the norbornene modified polymer can be decorated with the ligand at the last stage of the synthesis opposed to before where the ligand introduction was the first step. This allows for the introduction of ligands to the polymer that are incompatible with the reaction conditions needed for the synthesis. This new approach greatly expands the scope of ligands that can be introduced to the system. It potentially also speeds up the discovery process by allowing a quick introduction of a ligand to a norbornene modified polymer that can be synthesized in larger quantities and kept in stock.

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

The JSPS summer program provided a great opportunity to get to know the research life in Japan and to be part of life in Japan in general. I am grateful for the experience because now I feel like I am able to make a decision on a potential application for a post doc position in Japan on a more “educated” basis.

9. Adviser’s remarks (if any):

I found that Mr. Bjarne Silkenath is a talented chemist, and very enthusiastic for chemistry experiments. He carried out a number of experiments, and also proposed new idea for our project. He indeed almost finished the proposed method and left good results in our laboratory. Despite for short period, his stay in the lab highly stimulated the students. They found how hard and efficiently a real PhD student works. Besides, they tried to talk to him in English and to made a good relationship. I sincerely thank JSPS Sommer Program for providing this opportunity to him and our lab.

JSPS Summer Program 2022
Research Report

1. Name: Vincent Gousy-Leblanc (ID No. SP22401)

2. Current affiliation: University of Victoria/TRIUMF

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: University of Tokyo

5. Host researcher: Prof Yasuhiro Nakajima

6. Description of your current research

The end goal of this work is to reduce the systematic uncertainty related to the mismodelling of the individual detector of light, a photomultiplier tube (PMT), response in the Super-K detector. This can be done by first making very precise measurements over the surface of a PMT using a set of robotic arms and a laser. With this set up it is possible to study the effect on the PMT response of different environmental effects such as the magnetic field, the energy of the photon, the polarization of the light and the effect of the incident angle on the surface of the PMT.

Once all these measurements are done on the PMT, the second step is to integrate the results into the Super-K simulation to estimate the impact on those calibration sources (cosmic muons and Michel electrons). We can integrate the measurements into the simulation by deriving a semi-empirical model that consists of taking the ratio between the measurements and simulations, which will give the corrections needed for the Super-K simulation. Implementing this for all the PMTs, we can then study the “physics” impact of the PTF measurements on the control sample source and hopefully reduce the systematic uncertainty of the Super-K detector.

7. Research implementation and results under the program

Title of your research plan: Precise calibration of the Super-Kamiokande photosensor.

The goal was to gain the experience and communicate with experts on how to implement the measurements previously done in Vancouver into the simulations to estimate their effect and reduce the systematic uncertainty for the high energy events. Moreover, a similar facility needed to be developed in Tokyo so I could help conceptualize and help planning a measurement campaign on the Hyper-K PMT.

Description of the research activities:

I participated in a gadolinium loading shift at the Super-Kamiokande detector. I was helping monitor and control the quantity of gadolinium being loaded into the water system. During my shift, I meet a few Super-K experts and I had the chance to learn about the parts of the experiments (water system, monitoring, hardware used, calibration etc). Related to Super-K, I also did a monitoring shift to make sure to be able to solve any of the issues that arise during normal operations. It was an opportunity to extend my knowledge of how the experiment is monitored and how the problems are being fixed.

Moreover, with the guidance of my host professor, I started a study to establish the pre-calibration requirements for the Hyper-K PMT, by comparing different parameters measured during the pre-calibration campaign and comparing them with the specifications of the manufacturer. This allowed me to expand my knowledge on this detector of light, PMT. I also help start a similar setup as the one in Vancouver with my host professor and another graduate student for the characterization of the Hyper-Kamiokande photomultiplier tube. This new facility is the second step to establishing the pre-calibration requirements discussed previously. It was a direct exchange of expertise between the 2 groups.

Furthermore, I visited the local expert in the large-scale simulation (SKG4) to discuss the plan to integrate more PTF measurements into the simulation, along with the feasibility of doing so. This meeting was fruitful and hopefully a starting point for more collaboration between the TRIUMF and the Okayama University research group.

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

Visiting Japan was an exceptional experience. Being able to see how other group works, the actual experiment (Super-K) that I have been working on for some time, and meeting people I had only seen on zoom was truly amazing. I had the chance to try a lot of different foods, bike in Tokyo and a live a few different “Japanese experiences” (homestay, baseball, arcade games, Kobe beef, okonomiyaki) I was able to hike to the summit of Mt Fuji and attend the Gion festival, which was also a breath-taking experience. I am very thankful for the opportunity and funding I received from JSPS.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Angela Sheng-Min LIN （ID No. SP22402）

2. Current affiliation: University of Toronto (UofT)

3. Research fields and specialties:
Chemistry

4. Host institution: Okinawa Institute of Science and Technology (OIST)

5. Host researcher: Professor Christine K. Luscombe

6. Description of your current research

My research focus at UofT is on developing materials that are soft so that they are mechanically compliant with biological systems and yet conducting so that no further processing is needed to improve electrical performance, which would simplify the manufacturing of bioelectronics. To this end, I have been exploring different synthetic pathways and techniques to access a class of high-performing intrinsically stretchable polymers with a bottlebrush architecture.

Bottlebrush polymers have a highly branched architecture consisting of polymeric side chains attached to a polymer backbone, which leads to reduced entanglements in comparison to linear analogues that enables “super-soft” materials. In my work, polymer architecture will be leveraged to adjust for softness while variations in polymer composition will be used to optimize electronic performance. In particular, conjugated polymers with an alternating electron-rich (i.e. donor) and electron-deficient (i.e. acceptor) composition, referred to as donor-acceptor (D-A) polymers, will be investigated as their electronic properties can be finetuned by varying the structure of the units used. We hypothesize that the unique architecture of bottlebrush polymers, in comparison to traditional linear polymers, will allow bottlebrush polymers to be synthetically tuned to match the softness of biological tissue while the D-A composition will allow access to electrically conducting materials viable for electronics without further modifications needed.

7. Research implementation and results under the program

Title of your research plan: An intrinsically stretchable and soft indacenodithienothiophene-co-thienopyrroledione polymer via direct arylation polymerization

Description of the research activities:

Professor Christine Luscombe is an established professor working in the field of semiconducting polymers whose research aligns with the direction of my graduate studies in terms of the group's work with D-A conjugated polymers. Specifically, the Luscombe group has investigated the influence of side chain interdigitation on the mechanical properties and charge mobility for indacenodithiophene (IDT)-based copolymers. Building upon this previous work, my JSPS internship in the Luscombe group investigated similar D-A polymer systems, with a focus on the impact of extending the conjugation of the donor unit on charge mobility. Through this JSPS internship, I have gained valuable insight into the intricacies of synthesizing IDT-based copolymers via direct arylation polymerization (DArP) to target desired mechanical properties (e.g., softness, ductility).

The Luscombe group has made significant contributions to developing new synthetic methodologies for conjugated polymers, specifically with DArP. DArP is a method of interest as it enables conjugated polymers to be accessed with reduced synthetic complexity and cost in comparison to alternative coupling reactions such as Stille and Suzuki-Miyaura reactions. By working in the Luscombe group, this internship provided me with the valuable opportunity to concurrently work on tailoring the mechanical properties of IDT-based copolymers while also learning new technical skills in polymer synthesis.

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

Being able to explore Okinawa during the weekends helped to enrich my internship experience and the OIST campus is a walking distance to a lovely beach. Travelling to Tokyo with lab mates for a weekend trip to see more of Japan was also an amazing experience. Through the online homestay program, I enjoyed talking to the host family about Japanese culture and learned how to make okonomiyaki and yakisoba!

9. Adviser's remarks (if any):

Angela made rapid progress on her project and her visit has allowed us to establish a new collaboration with researchers in Canada. Angela became quickly embedded within our research group and became an integral part of our community. We will miss her when she leaves and I wish her every success in future endeavors.

JSPS Summer Program 2022
Research Report

1. Name: Joseph T. ENGLISH （ID No. SP22403 ）

2. Current affiliation: University of British Columbia

3. Research fields and specialties: Engineering Sciences

4. Host institution: University of Tokyo

5. Host researcher: Kazuhiro TAKANABE

6. Description of your current research

Electrolytic ammonia production will be critical for the decarbonization of the marine transport, power generation, and industrial chemical sectors. However, current technologies are poorly suited for integration with distributed and decentralized sources of green and sustainable energy whereas next generation technologies have yet to demonstrate reasonable rates and efficiencies. Electrochemical reduction of nitrate in wastewater as a means for green ammonia production may fill this niche.

Traditionally, the problem of nitrate in wastewater media has been approached as an environmental issue to be solved by denitrification. The nitrate reduction reaction (NO3RR) forming ammonia repositions this problem as an opportunity exploitable only by effective electrocatalysts. Considerable progress in the development of effective NO3RR electrocatalysts has been made for concentrated nitrate in alkaline media. While such conditions may be relevant to low-level nuclear wastewater, efforts utilizing dilute nitrate in circumneutral media relevant to industrial wastewater and some environmental media have been relatively less effective.

My research has focused on the development of effective electrocatalysts for the NO3RR forming ammonia in conditions relevant to industrial wastewater. I am investigating the effectiveness of platinum group metal (PGM) single atom alloys (SAAs) on oxide-derived copper (OD-Cu) meshes. PGMs are very effective electrocatalysts for the NO3RR, but are prohibitively expensive due to their low abundance. Incorporating PGMs as SAAs maximizes their material use efficiency and is easily accomplished by the galvanic replacement method on copper. Furthermore, the SAA motif eliminate multi-atom sites, which catalyze undesirable and parasitic reactions such as water splitting. In turn, using OD-Cu as an electrocatalyst support increases the PGM SAA surface, yielding cost-effective electrocatalysts with desirable characteristics and performance.

7. Research implementation and results under the program

Title of your research plan:

Coupled green ammonia electrosynthesis and industrial wastewater treatment

Description of the research activities:

The development of assays for the quantification of reagents and products of the nitrate reduction reaction.

The development of protocols for the preparation of oxide-derived copper.

The development of protocols for the galvanic replacement of copper with platinum group metals.

The development of protocols for the electrochemical characterization of electrocatalysts for the nitrate reduction reaction forming ammonia.

The physical characterization of electrocatalysts to understand their composition and morphology influencing their electrochemical behaviour.

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

Outside of my time at my host institute, I was fortunate to accompany my group to a 2-day symposium at the University of Hokkaido on the topic of catalysis. There I met other researchers in the Japanese community. While in Hokkaido, I enjoyed many cultural experiences including eating *jingisukan*, miso ramen, and other fresh seafood; going to a traditional *onsen*; and visiting Otaru to see the canals and make a music box. I consider this to be one of the cultural highlights of my time in Japan.

9. Adviser's remarks (if any):

Mr. English has been devoted to the research activities in our laboratory. He has developed his own setup in a short time for his experiments, and generated interesting results. He is also interested in various topics conducting in our research group, and discussion with other students are effective to stimulate discussion, impacting the atmosphere in a research group. It has been an excellent experience for us to accommodate Mr. English and I wish to continue good relationship with him and his home research group in Canada.

JSPS Summer Program 2022
Research Report

1. Name: Colin Angus James Colterjohn （ID No. SP22404）

2. Current affiliation:

McMaster University PhD Candidate, Eng. Physics (Nuclear Eng., Power Mix Modelling)

3. Research fields and specialties:

Humanities Social Sciences **Mathematical and Physical Sciences**
Chemistry **Engineering Sciences** Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Prof. Yasumasa Fujii

6. Description of your current research

The aim of this research position was to achieve 3 main tasks during the fellowship:

1. The improvement and completion of the semi-dynamic linear optimization model for simulating the optimal future power mix for Ontario and projecting the implementation of small modular reactors (SMRs).
2. The completion of a final paper draft reporting the results of this semi-dynamic model.
3. The initiation of a new, fully dynamic linear optimization model for analyzing both the future optimal power mix and quantitatively assessing the impacts on the nuclear fuel cycle. The fuel cycle analysis will be revised from a previous model version created for modelling a Japan-based scenario and will aim to increase the complexity and be applicable to both Ontario- and Japan-based scenarios.

The model begins by considering the current energy mix and accounting for Ontario's approximately 40.5 GW of installed capacity. The existing capacity for each of the 7 real resources is inputted as a constant, having no initial construction costs included other than those associated with power production, thus ensuring that the starting point for the program reflects reality. In the case of the 8th resource, SMRs, the minimum installed value is left at 0 MW as there are no operational commercial SMRs yet installed in Ontario. There are 3 primary decision variables in the model: kn_j, representing the optimal amount of new capacity for the model to install, per plant type; k_j, representing the optimal total amount of installed capacity (pre-existing capacity plus new capacity, $k_{new,j}$) for each power plant type, j; and x_{ji}, representing the power output for each resource, j, at each time step, i. There are 8 power plant types and the timesteps are hourly. The objective function for the model is a summation of the respective costs for the initial construction and ongoing usage of each powerplant type throughout the forecast period of a single model instance. These values are represented by the fixed and variable costs for each powerplant type. Final updates to the model included, but were not limited to, the inclusion of time-varying inputs such as load demand growth and Canada's federal carbon tax; CANDU refurbishment/decommissioning scheduling; and learning curve cost reduction considerations.

7. Research implementation and results under the program

Title of your research plan:

OPTIMIZING THE IMPLEMENTATION OF SMALL MODULAR REACTORS INTO ONTARIO'S ENERGY MIX

Description of the research activities:

The fellowship has successfully achieved all three of the aforementioned goals. The semi-dynamic model was completed following the start of the fellowship with the aid of the host professor's oversight (Prof. Fujii) and the resources available within University of Tokyo's Fujii Labs. The final paper draft has been completed and is pending submission to a journal following final internal revisions. The abstract of this paper is as follows:

This paper performs a detailed analysis of the optimized Ontario power mix under impending load and emissions constraints with the consideration of small modular reactor (SMR) deployment. The target of minimizing the total cost of the 2055 power mix while retaining real world energy requirements was achieved using a semi-dynamic, Flow Control-based linear optimization model with hourly time-resolution for the accurate consideration of wind and PV variable renewable energy. Utilizing recursive optimization, dynamic factors such as forecasted demand growth, increasing capacity installations, learning curve applications, and reactor refurbishment and decommissioning schedules were applied to the modelling scenarios. Optimized scenarios have demonstrated that SMR-based capacity should play a vital role in the provincial energy mix in order to minimize cost while meeting emissions reduction goals and responding to increasing demand. Simulations show ideal cost reductions when approximately one third of generated energy is produced by SMRs and that the absence of SMRs may lead to up to 29% higher spending. Additional cases have considered the benefits of early SMR investment and direct SMR-CANDU cost comparisons.

Lastly, the creation of the dynamic model was initiated in weeks 6-9 of the fellowship and work on this version will continue following the return to Canada. The initial model layout for considering time-varying simulations of the optimal energy mix has been scripted and the fuel cycle analysis is now underway. Plans for this model include detailed simulations of the optimal power mix and expected impact on the nuclear fuel cycle (both front- and back-end) which will ultimately contribute to a future paper for publication.

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

In addition to achieving the planned objectives, the fellowship provided the opportunity to review the Japanese nuclear industry first-hand and draw comparisons between Canadian and Japanese industries following opportunities to visit both the JAEA's high level waste management research facility in Horonobe and JNFL's reprocessing facility in Aomori prefecture. This involved traveling to remote, beautiful and geographically significant places such as Wakkanai (Japan's northernmost point) and touring much of Japan/Hokkaido's beautiful northern countryside in trains.

9. Adviser's remarks (if any):

N/A

JSPS Summer Program 2022
Research Report

1. Name: Eric LACEY （ID No. SP22406 ）

2. Current affiliation: Carleton University

3. Research fields and specialties:
Engineering Sciences Biological Sciences

4. Host institution: Nara Institute of Science and Technology

5. Host researcher: Dr. Kiyoshi KIYOKAWA

6. Description of your current research

Using a shape changing haptic device with a mobile platform to create a system to emulate the haptics of various differently shaped objects in a Virtual Reality Environment, at any position around the user

Currently consideration is to use a drone to combine existing drone haptic research alongside shape changing haptic display research from Carleton University.

7. Research implementation and results under the program

Title of your research plan:
Drone based haptic display

Description of the research activities:

This project began with evaluating goals for the project, realizing two months being too short to build the full system and run a user study on a complete drone-mounted final system. Instead, focus was changed to developing prototypes that could be continually developed post-fellowship. During the two months, two prototypes were developed but require additional work.

The first prototype, a shape changing haptic display meant to emulate the shape changing Adaptic system, was developed in CAD and the mechanical systems were finished and built using 3D printers. The second, new design, is a device which allows for producing spherical haptic feedback of various sizes using an iris mechanism and a pneumatic chamber with an elastic bladder which inflates through the hole of the iris for the user to touch.

A third device was considered but not pursued due to time constraints, in which a belt could swap between different textured plates and provide textural feedback to a user in VR. This may be a future joint project starting following the fellowship period.

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

I love everything this program has done, and the JSPS side of the program has been incredible. You have been super helpful and as a first-time traveler, helped me a lot in the procedures of the program. I could not have asked for a better lab to be part of than Care Lab @ NAIST

I attended the Gion festival, and had outings across Kansai spending time at Nara Park, Namba, Kobe, Kyoto, visiting the Kyoto Imperial Palace, Universal Studios Japan, several temples, and had many social events with my lab mates. On my final day I ran a professional design thinking workshop for the lab.

9. Adviser's remarks (if any):

Mr. Eric Lacey has made significant contributions to a challenging project in a short period of time. The project aims to develop a novel haptic device that provides a variety of tactile sensations by using a deformable device mounted on a drone.

However, designing a small, lightweight deformable device that can be mounted on a drone with a small payload is extremely challenging. Using his extensive experience in 3D design, he has devised a few lightweight deformable devices using novel and unprecedented methods through repeated CAD design and prototyping using a 3D printer. Some of these devices were actually produced using a 3D printer. Although it is not yet ready to be mounted on a drone, it is a good achievement considering the time commitment.

He was also very jovial and cooperative, contributing ideas to the research projects around him. He has been a great asset to our laboratory.

JSPS Summer Program 2022

Research Report

1. Name: Rhea Gaur （ID No. SP22407）

2. Current affiliation: TRIUMF and University of British Columbia

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: Kavli Institute of the Physics and Mathematics of the Universe, University of Tokyo

5. Host researcher: Dr. Mark Vagins, Dr. Patrick de Perio

6. Description of your current research:

Super-Kamiokande (Super-K) is a Japan-based, Nobel Prize winning underground neutrino detector aimed at measuring differences in the behaviours of tiny fundamental particles called neutrinos and their antiparticle counterparts, antineutrinos. These measurements would provide part of the answer as to why our universe is dominated by matter and why so much antimatter is missing. The detector is a 50-kiloton water tank surrounded by 11000 single photon sensors (PMTs). My project focuses on the research and development of a cross-disciplinary approach between particle physics and remote sensing called photogrammetry. Using underwater images and videos of the Super-K detector, I can extract information about the detector geometry and its feature positions to unprecedented precision. This is to reduce uncertainties arising from structural distortions and allow us to better understand complicated neutrino interactions that occur within.

My time in Japan has been extremely useful for building this photogrammetry analysis framework. I have been able to consult with the experts who were involved with the original mechanical design of the detector as well as those who have written the software for its analysis.

My photogrammetry approach can be described by the following pipeline framework: 1. Optics calibration; 2. Detector photos; 3. Feature detection; 4. Stereoscopic (3D) reconstruction; 5. Physics simulations. The first step focuses on camera calibration and building camera models that describe the optics. This accounts for distortion effects, the focal length, misalignments in the sensor and lens, and more parameters that describe the camera function for each image. The second step is to capture images of the detector. In the case of Super-Kamiokande, the pictures were taken using an underwater remote operated vehicle – an underwater drone. Imaging the entire detector and almost 11 000 PMTs meant a very large dataset of ~13 000 photographs. The third step in the pipeline involves detecting features like the PMTs and the bolts that surround them from the images. In this step, the features must also be labeled using a system developed by my colleagues at TRIUMF. Since the detector appears symmetric, this step is very important in correctly identifying each PMT across multiple images. The fourth step makes use of the first three to perform a 3D reconstruction of the detector using the correctly identified positions of the features. This build should represent the most realistic model of the detector's present geometry. The final step in the pipeline is to input this reconstruction into the Super-K simulation software called SKG4 and perform physics studies comparing the effects of changing the geometry on final physics quantities.

7. Research implementation and results under the program

Title of your research plan: Novel Underwater Survey of Super-Kamiokande

Description of the research activities:

My host supervisors Profs. Mark Vagins and Patrick de Perio were integral to making this an enriching experience. We developed ideas and projects, both immediate and over-arching, that supplement and guide the essence of my Master's thesis. Additionally, their connections to Super-K collaborators in Japan enabled visits and dialogue that has ultimately influenced the course of my research.

One of the aforementioned visits was to Okayama University. There I met the group of experts on the Super-K simulation software. By working with them, I was able to understand how the detector is currently built in our simulations of particle interactions and the challenges that lie in modifying this method. I have since begun working on new ways to integrate the photogrammetry 3D reconstructed detector model, or any new model of the detector, into the simulations. This visit established a communication channel for me to be able to consult with the experts in Okayama and we have continued to work together since.

A very novel experience on this trip taking shifts monitoring the detector from the Mozumi mine in Kamioka, where Super-K is located. During this time, I witnessed and partook in the routine checks that must be performed for the upkeep of the detector, saw how calibration sources are deployed into the detector and how that data is analyzed. In Kamioka I met experts and long-time Super-K members who shared insight about the mechanical design of the detector. I used their opinions about what changes they expect in detector geometry over time, to create and inform the analysis plan for my thesis, particularly the kinds of particle events and energies I will explore to evaluate the impact of the photogrammetry measurements.

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

My stay in Japan has been an incredible experience both academically as well as personally. I have been able to progress in my work due to the openness of my Japanese and foreign collaborators based in Japan. They have done their best to ensure I could experience as much of the experimental environment (visits to the JPARC facility, Kamioka Observatory, and other sites planned for future experiments).

I have also taken this opportunity to travel to the different regions of Japan. From Hokkaido, to Hiroshima, with Kyoto, Osaka, Okayama, Tokai and Toyama in between, I have loved learned about Japanese history, food, architecture, and social and cultural norms. Climbing Mount Fuji-san was another unforgettable experience.

9. Adviser’s remarks (if any):

Rhea is a talented researcher with excellent communication skills. She was especially able to communicate well with other Japanese students, where English was not their first language but still managed to collaborate and share information effectively. At Super-K, she familiarized quickly with the lab and the scientists there to make the most of this visit, for which we are grateful to be supported by JSPS.

JSPS Summer Program 2022

Research Report

1. Name: Sebastian Persson （ID No. SP22501 ）

2. Current affiliation: University of Gothenburg

3. Research fields and specialties:

Mathematical and Physical Sciences

4. Host institution: The System Biology Institute Tokyo

5. Host researcher: Prof. Hiroaki Kitano

6. Description of your current research

Several chronic and age-related diseases, such as diabetes, are caused by faults in the interplay between cellular nutrient signalling and metabolism. Understanding this interplay, hence its role in diseases via experimental methods has proven hard, as both the metabolism and nutrient signalling are strongly interconnected and inconstant. Mathematical modelling is a powerful tool to complement experiments with, to unravel the complexity of biological processes. My current research focuses on building an integrated dynamic model of nutrient signalling and metabolism to better understand the role of nutrient signalling in ageing, and subsequently age-related diseases.

7. Research implementation and results under the program

Investigating the impact on NMN on RNA expression in humans

People are aging rapidly, and the UN has set a goal of sustainable aging to ensure people can age gracefully. Nicotinamide mononucleotide (NMN) has been proposed as nutrient supplement that can partially reverse the aging process in humans and alleviate symptoms of infections like Covid. However, there is much we do not understand about NMN and how it affects different organs, such as the lungs and heart.

In my project, we investigated NMN's impact by analyzing RNA levels in both healthy and infected human cells through mathematical statistical methods. This allowed us to gain insights into how NMN affects various cellular processes – and in extension how it affects human health. Our findings suggest that a high NMN dosage can be detrimental, pushing cells toward an infected state, while lower doses seem to be harmless. It's crucial to emphasize that our conclusions are constrained by the high variability, and few samples in our dataset. Because, as a part of this project we showed that high variability and small sample size greatly limit how much we can learn from our data.

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

Apart from my research, I had the chance to experience Japanese culture. The highlights of my experience included visiting Nara and Kyoto, where in the latter I had the opportunity to participate in a traditional tea ceremony.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Xiaolong Li （ID No. SP22502）

2. Current affiliation:

PhD student at IMS/MM at Chalmers university of technology.

3. Research fields and specialties:

Engineering Sciences

4. Host institution: National Institute for Materials Science | NIMS

5. Host researcher: Prof. MURAKAMI Hideyuki.

6. Description of your current research

My PhD project is about designing ultrahigh-temperature refractory high-entropy alloys aiming for the potential replacement of the state-of-the-art Ni-based superalloys, which are commonly used in the combustion chamber in the turbine engine. As is well-known, the tradeoff between ductility and strength exists in almost all current alloy systems, and for the alloys used at high temperatures the tradeoff effect is even more remarkable and complicated. Although Ni-based superalloys are working fine at 1050 ºC, their upper working temperature is set by their melting points at around 1400 ºC. Their working temperature can be pushed up to 1300 ºC, but only with the help of cooling so at the cost of thermal efficiency. Not surprisingly, advanced materials that can work at ultrahigh temperatures without turning to help from cooling are in great demand. As for alloys working at high temperatures, there are at least three equally important requirements: high temperature strength, room temperature ductility and oxidation resistance along the whole range of temperatures. Unfortunately, these material requirements are rarely simultaneously satisfied in one alloy system. The request for ultrahigh-temperature alloys with acceptable comprehensive mechanical properties is now even higher than before, with the acceleration of climate change and global energy crisis. The new alloying concept of high-entropy alloys opens a new door to tackle the materials challenge targeting ultrahigh-temperature applications.

High entropy alloys, typically containing 4 or 5 elements mixed in close-to-equal proportions, exhibit several advantageous merits compared to conventional alloys, such as simpler phase constitution, severe lattice distortion that could lead to strengthening, and sluggish diffusion which contributes to thermal stability. When the concept of HEAs is combined with refractory metals, the resultant refractory high-entropy alloys (RHEAs), first launched in 2010 by Senkov et al., have gained substantial attention among the high-temperature alloys community, due to their superior high-temperature performance.

In my PhD project, we choose to design tensile ductile single-phase body centered cubic (BCC) structured RHEAs as the starting materials, then to optimize them to achieve a good combination of room temperature ductility and high-temperature strength. At this stage we put the oxidation resistance aside, to focus only on the mechanical properties. The consideration is that the addition of oxidation resistant elements such as Al, Cr, and Si would easily cause the formation of topologically close packed (TCP) phases, which tend to deteriorate the tensile ductility. Specifically, we now set Nb(Ta) as the base element(s), then explore the addition of some ductile Ti group (Zr, Hf) elements and some brittle Mo(W) elements, to see whether a good balance of room temperature ductility and high temperature strength can be achieved.

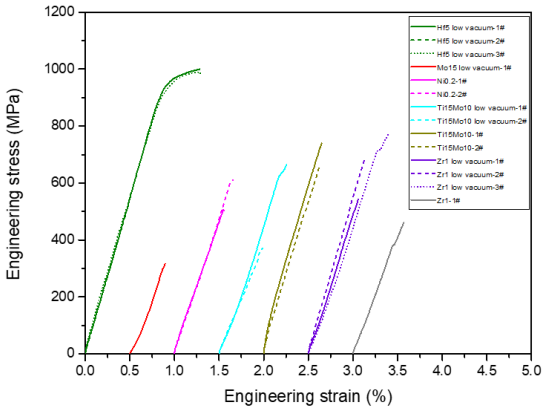
7. Research implementation and results under the program

Title of your research plan:

1. Room temperature tensile tests of sub-sized specimens.
2. High-temperature compression tests.

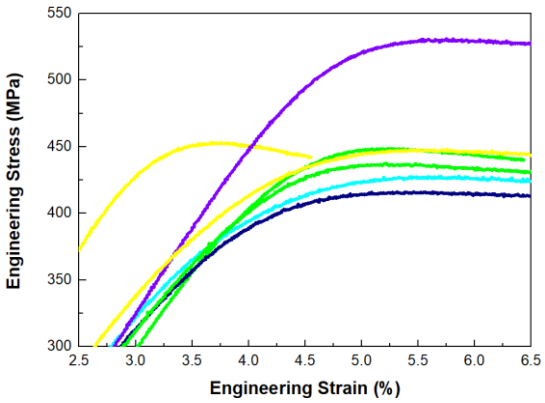
Description of the research activities:

1. Room temperature tensile tests of sub-sized specimens with a gauge length of 5 mm. (with help from Kyoto university)



As shown above, unfortunately all the tested alloy compositions are brittle. We are now trying to figure out reasons for the unexpected brittleness.

2. Compression tests at 1000°C under vacuum with a strain rate of 10^{-3}/s, for specimens with a diameter of 3 mm and 5 mm in height. (with help from Tokyo university)



As we can see, the yield strength of tested alloys ranges from 340 to 470 MPa at 1000°C. Unfortunately, the test of each composition was done just for once and without repetition. To make sure the results are reproducible, these results will be reconfirmed in the near furfure.

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

The three-month stay in Japan really gives me a wonderful experience about the local culture, which is totally new to me from many perspectives. I enjoyed going to the drug stores, shopping malls, temples and playing games. It is for sure a good memory for me, and I think I will come back again.

9. Adviser's remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Filip Olsson　　(ID No. SP22504　　)

2. Current affiliation: Stockholm University

3. Research fields and specialties:
Social Sciences

4. Host institution: Waseda University

5. Host researcher: Shunsuke Tanabe

6. Description of your current research

My research focuses on the topic of unconscious or implicit nationalism. I look at sentiments, beliefs, and associations that we might harbor towards our nation beyond our conscious control. In my research, I specifically focus on the disconnect between conscious and unconscious nationalist beliefs. While e.g., Swedes often report a more inclusive (civic) understanding of Swedishness and Swedish national identity, they implicitly tend to harbor more nativist/ethnic views.

My research also tries to explain the relationship between these different nationalist sentiments. While civic or liberal nationalism is often portrayed as inclusive and tolerant, I show how this type of nationalism is not necessarily more banal or benign than ethnic nationalism. A certain liberal discourse (e.g. Sweden being a tolerant and multicultural society) might then activate the same patterns of exclusion and prejudice as a more nativist nationalist discourse.

7. Research implementation and results under the program

Title of your research plan:

Everyday reproductions of unconscious nationalism: a cross-cultural perspective.

Description of the research activities:

In collaboration with my Japanese supervisor, I have worked on a study that will be launched in both Japan and Sweden. In the study, participants are exposed to either civic, ethnic, or liberal nationalist framings. They might, for example, read a text framing either Japan or Sweden as a tolerant and inclusive society. They are subsequently primed to believe that a majority of their peers also support this framing. The purpose of the study is to explore whether exposure to these framings can affect unconscious and conscious nationalist beliefs.

Throughout my stay, we have developed and launched a number of pilot studies in different countries. We have found that participants from more liberal/civic countries tend to consciously reject ethnic nationalist framings while being more susceptible to civic and liberal framings. We have, however, also found the reverse trend for unconscious attitudes; participants become more unconsciously nationalistic when exposed to frames of ethnic nationalism regardless of background and conscious beliefs.

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

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Magnus Neikter （ID No. SP22505　）

2. Current affiliation:

University West

3. Research fields and specialties:

Humanities　Social Sciences　Mathematical and Physical Sciences
Chemistry　X Engineering Sciences　Biological Sciences
Agricultural Sciences　Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Osaka University

5. Host researcher: Kota Kadoi

6. Description of your current research

The research concerns an austenitic stainless steel called JBK-75. This alloy has been manufactured using laser powder bed fusion (LPBF), which is an additive manufacturing (AM) processes where laser is combined with powder bed. In order to know which process parameters can be used to obtain good material (with low porosity content) a design of experiment (DOE) has been performed. By analyzing the material it is then been possible to determine which process parameters that render the optimal material quality. With that information it has then been possible to continue the study by doing an additional build, using the optimized process parameters. With this additional build the tensile properties of LPBF manufactured JBK-75 have been analyzed, which then can be compared to conventional wrought material. With AM there are two potential drawbacks, porosity/defects (that are minimized during the DOE stage) and potential anisotropic behavior. In order to minimize the porosity/defects even further, hot isostatic pressing (HIP) has been performed and the resulting material has been analyzed in detail. The anisotropic behavior stems from several factors, one is texture and grain morphology, and another one is defects and their orientation. These aspects have been studied in this work as well.

7. Research implementation and results under the program

Title of your research plan: LASER POWDER BED FUSION BUILT JBK-75 STAINLESS STEEL

Description of the research activities: First a detailed literature study must be done, to compile all related published research on the topic. Secondly, to conduct this work porosity measurements, microstructure characterization, tensile testing, and fractography is needed to be performed. The instruments needed to carry out these experiments are a scanning electron microscope (SEM) coupled with electron backscattered diffraction (EBSD), an optical microscope, a hardness machine, and potentially an electron probe microanalyzer (EPMA). These types of equipment are all available within the research consortium. With these experiments it is then possible to obtain the porosity content of the material, grain size and their morphology, and the tensile strength/ductility of the material. With these findings the results will then be explained and compared with already published information about the stainless steel JBK-75.

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

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

JSPS Summer Program 2022
Research Report

1. Name: Lea Charlotte Manke （ID No. SP22506）

2. Current affiliation: Karolinska Institutet

3. Research fields and specialties:
Biological Sciences

4. Host institution: Osaka University

5. Host researcher: Prof Michiya MATSUSAKI

6. Description of your current research

In Sweden, I was working on deciphering the impact of aerosolization on *Mycobacterium Tuberculosis (Mtb)* survival and fitness. Mtb is the bacterium that causes Tuberculosis in humans and infects around 13 million people every year through aerosol expulsion by an infected patient. Since transmission via aerosol is the main route of infection, I study the biological changes that occur in the bacteria during aerosolization. Which environmental factors influence bacterial survival within the aerosol such as air humidity, temperature, UV light etc. Are certain strains of Mtb more robust and survive better than other strains and if so which genes or genetic aberrations are responsible for the difference in fitness? The overarching goal is to identify these environmental factors as well as genetic changes to enable us to better prevent Tb transmission and develop strategies to kill Mtb whilst contained in aerosols.

For that aim, I aerosolized different Mtb strains in an air-tight box within the BSL-3 facility at the Karolinska Institutet. Following aerosolization, the aerosol which contains the bacteria is aged for different time intervals (10min, 30min, and 1 hour) to study changes in bacterial regrowth on selective agar plates which are indicative of bacterial fitness and survivability. My preliminary results indicate that longer aerosol incubation drastically reduced bacterial regrowth in broth and agar suggesting that bacteria are dying within the aerosol over time. Nevertheless, even after 1 hour in the air, sufficient Mtb bacteria remain viable to recolonize and regrow, highlighting the genetic adaptation of the microbes to the stressful environment of the aerosol. In future studies, it would be of interest to identify the stress genes that are activated in the bacteria in response to aerosolization. This could allow for the development of treatments that directly deactivate those stress genes, thereby rendering the bacteria incapable to survive in aerosols.

7. Research implementation and results under the program

Title of your research plan: *Generation of prevascularized injectable adipose tissue for soft tissue reconstruction*

Despite my background in infection biology, I decided to gain knowledge in the field of tissue engineering and reconstructive medicine during the JSPS summer program.
In recent years, the possibility to grow and culture 3D tissues in laboratories became more advanced and the potential use of these *ex vivo* grown tissues for reconstructive medicine was quickly identified. One of the tissues with the highest demand is adipose and breast tissue. Breast cancer is the most common cancer in female patients and the number of mastectomies is increasing every year. Thus. the aim of my research project was to culture prevascularized injectable adipose tissue, abbreviated iPATs, for reconstructive purposes.

Adipose tissue is composed of mature adipocytes and adipose-derived stem cells (ADSC) which are embedded in an extracellular matrix (ECM) with collagen as the main component. In order to grow adipose tissue in the laboratory, the different cell types must first be isolated from donated fat tissue. Subsequently, the two cell types are seeded in a mash of collagen microfibers. Collagen microfibers have previously been shown to prevent adipocyte de-differentiation in culture and stimulate vessel formation. Following the seeding of mature adipocytes and ADSC into the mash of collagen microfibers, the ball of cells (iPAT) is shrinking into a compact sphere and blood vessels are formed over the course of several days. In order to enhance shrinkage of the 3D tissue, fibrinogen is added at time of cell seeding.

Over a period of 2 months, I seeded several hundred iPATs and made some unexpected observations. My results show that the shrinkage of iPATs is dependent on several factors. We found that some fibrinogen stocks are not effective in promoting ball shrinkage indicating that there is variability between different fibrinogen stocks. In addition, the fitness and quality of the cells added, especially the ADSC, affects the shrinkage of the iPATs. ADSC with a higher passage number, meaning older cells, were less effective in stimulating vessel formation and ball shrinkage. Histology of the seeded balls also revealed a non-uniform distribution of CMF within the iPATs. This means, that in the future more focus should be laid on how the cells can be seeded uniformly in the CMF. Furthermore, the results highlight the importance of standardization for 3D tissue cultures. In order to provide breast tissue reconstructs in the future, a standard protocol must be developed that ensures the quality of the cells and prevents variability in fibrinogen.

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

During the JSPS summer program, I had the opportunity of visiting many beautiful places all over Japan. The highlight of my travels was the overnight hike to the top of Mount Fuji, the highest peak in Japan. I will never forget the sunrise from Mt. Fuji, a memory I have shared with many fellow Japanese hikers who conquered the summit. Another memorable part of my JSPS program was the homestay with a Japanese family. It was such a unique experience to spend time with such a kind and loving family.

Moreover, my colleagues at Osaka University made sure that I had a great time in Osaka, and they introduced me to a lot of delicious local dishes. The Gion Matsuri festival in Kyoto might constitute the ultimate cultural experience in my 2 months in Japan. I truly enjoyed every moment here.

JSPS Summer Program 2022
Research Report

1. Name: CHIRTES Daria Mara （ID No. SP22507）

2. Current affiliation: Linkoping Institute of Technology

3. Research fields and specialties:
Engineering Sciences

4. Host institution: Institute for Life and Medical Sciences, Kyoto University

5. Host researcher: VANDENBON Alexis Robert Paula

6. Description of your current research

Gene expression and metabolic pathways, of the liver samples obtained from mice, were studied under different conditions with the help of bioinformatic algorithm. By combining single cell with spatially resolved transcriptomics, the different cell types present in the livers and their positions could be identified. Additionally, metabolome data was analyzed in order to see if there are changes in the metabolic pathways inside the livers of the cancer bearing mice and to see in case cancer affects the metabolism.

7. Research implementation and results under the program

Title of your research plan:

Gene expression profiles of liver cancer.

Description of the research activities:

Firstly, the single cell and spatial transcriptomics datasets were analyzed in R studio for the healthy versus cancer bearing mice. Thereafter, the same procedure was conducted in Python in order to see if similar results could be obtained. Although not the exact same results could be obtained, they were still similar in some ways.

Single cell and transcriptomics datasets showed that there is a distinguished difference between healthy compared to cancer bearing liver tissue. The gene expression for the healthy bearing mice looked the same for the two samples whereas the cancer bearing mice had a different gene expression where they were similar between samples. Finally, the metabolome data indicated that there may be some differences between healthy and cancer bearing mice.

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

It was a really fun experience that I am grateful for. I truly enjoyed the cultural experience that I had in Kyoto with the beautiful nature, temples, shrines, old buildings, onsens, language, food, festivals, and tea. I really liked how the traditions and culture were kept there.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022

Research Report

1. Name: Anton Stoiber (ID No. SP22509)

2. Current affiliation: Linköping University

3. Research fields and specialties:
Engineering Sciences
Biological Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Kyoto University

5. Host researcher: Prof. Taiji Adachi

6. Description of your current research

Cells are known to sense and adapt to mechanical environment to maintain tissue homeostasis. Mechanical sensation by cells is mediated by various kinds of "sensors", such as ion channels in cytoplasmic membrane and characteristic proteins at cell-cell (Maki et al., Sci. Rep., 2018; Maki et al., Sci. Rep., 2016) and cell-ECM adhesions. Recently, chromatin is also known to serve as a mechano-sensor in a nucleus, where histone modification profile in cells is dramatically altered by hydrostatic pressure (Maki et a., J. Cell Sci., 2021). Although the critical roles of mechanical stimuli in chromatin have been increasingly reported (Nava et al., Cell, 2020), the upstream mechanism is still unclear. In this study, we focus on conformational changes in genomic DNA itself, especially a transition between double-stranded (ds) DNA and single-stranded (ss) DNA under mechanical stimuli.

In order to understand the effects of mechanical stimuli on dsDNA-ssDNA transition in cells, Biomechanics Lab in Kyoto (Prof. Taiji Adachi and Assist. Prof. Koichiro Maki) has established a novel fluorescent technique for ssDNA in cells. This technique appears to be the world's first technique to visualize ssDNA in cells to our knowledge.

My research activities in Kyoto focused on literature research, actual experiments, and scientific discussion - in the context of nucleolar structure and assembly, ssDNA synthesis and mechanical properties. This was distilled down to find my own research question, namely deciphering the cell cycle dependency of nucleolar assembly – in order to gain a baseline for further characterization of nucleolar associated findings. Moreover, additional research questions emerged via discussion of my literature research: quantifying nucleic acids (ssDNA, dsDNA), creating FISH-probes against Nucleolar Organizer Regions (NOR), amongst others.

In addition, I would partly assist and observe in research activities of colleagues and thus gain insights into the mechanisms of underwound DNA, different high-power microscopy techniques (AFM, super resolution microscopy), and computational mechanics of bone tissue, next to the principles of computer-based prognosis of drug screening.

7. Research implementation and results under the program

Title of your research plan:

Assisting in deciphering ssDNA mechanisms associated with the nucleolus

Description of the research activities:

Whole cell nucleic acid was analyzed via Qubit. We found that ssDNA is 4.6-fold more abundant than dsDNA. This trend was also observed via computer-based analysis of fluorescence intensity measurement. Furthermore, this computer-based approach highlighted proximal association of ssDNA and dsDNA, suggesting the presence of ssDNA rich architecture in the cell nucleolus.

Regarding the mechanical properties of ssDNA, we treated cells with Myosin inhibitors in order to disrupt the link between mechanical sensing to chromosomal DNA. We observed differences in cytoplasmic organization of myosin 6 - ring forming structures compared to homogenously distributed fibers.

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

The two months I spent in Kyoto were rich in cultural experiences. While characteristics of modern life span beyond countries and thus enable a common ground for exchange, Japan, and it seemed especially Kyoto, maintained parts of its traditional culture, compared to central Europe. Never ending patience and politeness wrapped in formal etiquette and a strong sense for hierarchy always accompanied my everyday life, especially due to the COVID situation.

I would like to highlight that the people I met had a strong sense of philosophy, an integer way of thinking. I am glad to have gained a glimpse of deeper inter-social thinking, despite language barrier. It would be amazing to talk on an eye-to-eye level, in regard to language, and thus explore and express the borders of our mind in a better way.

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: Lame Maatla Kenalemang-Palm （ID No. SP22510）

2. Current affiliation: Örebro university

3. Research fields and specialties:
Humanities, Media and Communication Studies

4. Host institution: Tokyo Womans Christian University

5. Host researcher: Professor Akie Arima

6. Description of your current research

My research interests are on critically examining representations of older women in advertisements, to identify what discourses about gender and ageing are communicated through these representations and how these representations relate to successful ageing. The current research I am working on, uses a triangulation of methods (quantitative and qualitative), to examine the differences between representations of older women in Japanese and Swedish advertisements. I am interested in showing how inequalities such as of age, race, gender, and class intersect to produce certain expectations about how older women should or should not age, privileging successful ageing.

7. Research implementation and results under the program

Title of your research plan:

Representations of older women in Swedish and Japanese advertisements

Description of the research activities:

Professor Arima (and three of her dedicated students) and I, have met once a week to work on and collect data for the research. One of the methods we employ is quantitative content analysis, which requires large amounts of data, a great amount of time has gone into collecting the data and working with it (coding, inserting it into SPSS). It was a challenge for me to collect the data from the Swedish database as I had to watch several hours of tv to look for the advertisements, which took a lot of time to do. In addition, I also read several texts which I used to write the introduction as well as the literature review. All-in-all, the research has been very time consuming, and I wish that I had more time in Japan to be able to do more work. Professor Arima and I, have, however agreed that we will continue to work on the research even upon my arrival in Sweden and schedule some meetings online. She has expressed interest in visiting my home institution in Sweden where we will continue to work on the research and work towards publishing our co-authored article.

Through Professor Arima's professional network, I had the opportunity to have an online meeting with the vice president of L'Oréal in Japan. During our discussion we talked about L'Oréal's beauty practices and choice of models and how their marketing practices can be related to ideas of successful ageing. Furthermore, as we are interested in comparing cultural differences in our study, it was a great opportunity to learn about L'Oréal's marketing practices and relate them to intersectionality. This is relevant to our research considering that L'Oréal now seeks to diversify and democratize beauty, which has seen them include models of different ages and racial backgrounds, sexual orientation, body size, etc. in their campaigns. I have also held a mini public lecture on my research at TWCU and had the opportunity to interact with students of Professor Arima, which I am grateful for.

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

I have had a wonderful experience in Japan and had the privilege of experiencing the beauty and richness of Japanese culture. I was overwhelmed with the level of kindness and hospitality “omotenashi” that I received from Japanese people, especially from my host Professor Arima and her colleagues at Tokyo Woman’s Christian University (TWCU). Professor Arima has gone above and beyond to make me feel welcome and ensure that I have a great experience at TWCU and in Japan. It was a great honour to get to know, work with her and learn from her. Her students have also shown me around Tokyo, shared meals with me, helped me with things that I needed help with, and even accompanied me to the airport!

9. Adviser’s remarks (if any):

JSPS Summer Program 2022
Research Report

1. Name: COOD SOLLGARD Joar Erik Christopher （ID No. SP22511　）

2. Current affiliation: Lund University, Sweden

3. Research fields and specialties:

Humanities　Social Sciences　(Mathematical and Physical Sciences)
Chemistry　Engineering Sciences　Biological Sciences
Agricultural Sciences　Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

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

5. Host researcher: Yosuke Aoki

6. Description of your current research

As a Master's student I have been working on ground deformation at geothermal power plants not only from ground-based instruments such as Global Navigation Satellite System and leveling survey but also from remote sensing techniques such as Synthetic Aperture Radar. The observed deformation is understood through physical modeling. My study is starting to figure out that ground deformation data constrains the physical properties of rocks at geothermal power plants, although it is still ongoing.

7. Research implementation and results under the program

Title of your research plan:

Ground deformation associated with the 2018 eruption of Ambrym volcano, Vanuatu, as observed with Synthetic Aperture Radar

Description of the research activities:

Ambryn volcano is one of the most active volcanoes of the word with the most recent eruption in 2018. This project investigates the ground deformation associated with the eruption from Synthetic Aperture Radar (SAR) images because few ground-based instruments are available. Interferometric and pixel offset analysis of SAR images revealed that the volcano deformed up to 2 meters during the eruption. The observed displacement field is characterized by subsidence around the summit and north-south extension at the eastern flank. Deformation modeling indicates that the observed deformation is well explained by horizontal propagation of magma-filled cracks (dike) from beneath the summit. Because of the loss of magma beneath the summit, the summit caldera has been subsiding, consistent with the deformation modeling.

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

9. Adviser’s remarks (if any):

Joar has worked hard during the visit in my research group. I hope he had a good experience not only at the University but also off the Unviersity.

JSPS Summer Program 2022
Research Report

1. Name: Daniel BERGMAN (ID No. SP22512)
2. Current affiliation: Karolinska University Hospital
3. Research fields and specialties: Medical, Dental and Pharmaceutical Sciences
4. Host institution: Obihiro University of Agriculture and Veterinary Medicine
5. Host researcher: Prof. Naoaki YOKOYAMA
6. Description of your current research Currently, I'm working as a laboratory animal veterinarian, which means that I am responsible for the welfare of the research animals at the preclinical laboratory. I oversee the health of the animals and provide veterinary care as needed. Moreover, I help the researchers to plan and carry out their research projects in accordance with the 3R principle (Replace, Reduce, Refine).

7. Research implementation and results under the program

Title of your research plan:

***In vitro* assessment of plant-derived medicines for the treatment of piroplasm infections**

Description of the research activities:

In this project, the growth-inhibiting effects of plant extracts on protozoan parasites were investigated. *Babesia bovis* and *Theileria equi* were cultured in the laboratory and incubated together with different concentrations of plant-derived chemicals. Based on the results, the half-maximal inhibitory concentrations (IC_{50}) of the chemicals were calculated.

Two of the investigated chemicals were potent inhibitors of *B. bovis* growth and are promising drug candidates. The next step is to unravel the toxicological safety profiles of the chemicals. Another goal is to study the effects on other *Babesia* parasites, including *B. divergens*, the predominant pathogen in Europe.

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

I only have positive things to say about my experiences in Japan. The research facilities and supervision at the host university in Obihiro were excellent. The environment was very inclusive and I immediately felt like a part of the group despite only spending two months there. Outside of the project, I participated in the homestay program and had a memorable weekend with many fun activities together with the host family. I also went out dining at local restaurants with some members of the lab and enjoyed the delicious food in Japan.

9. Adviser's remarks (if any):

During his time in our lab, Dr. Daniel Bergman worked on the development of novel therapeutics for babesiosis, a clinically important disease with veterinary and public health implications. Despite the short duration of the program, he worked very hard and obtained promising results, which will serve as a foundation further research. I will stay in touch with Dr. Daniel and, if possible, pursue a collaborative research project. I wish him every success in his future endeavors.

JSPS Summer Program 2022
Research Report

1. Name: Marko DIMITROV （ID No. SP22513）

2. Current affiliation: Malardalen University, Sweden

3. Research fields and specialties:
Mathematical and Physical Sciences

4. Host institution: The University of Electro-Communications

5. Host researcher: prof. Lu JIN

6. Description of your current research

An American call (put) option is a financial contract that gives its holder the right but not obligation to buy (sell) a so-called underlying asset for a predetermined strike price K on or before a maturity time T. American option can be exercised any time before or at the maturity, which makes the pricing problem of an American option difficult. Knowing some analytical properties of the American option price and the structural properties of the optimal exercising strategies is very useful for the pricing problem.

In our research, we consider the valuation of American option when the asset price dynamics follow an extended Geometric Brownian motion driven by a varying economic situation. We assume that the economic situation is partially observable, where the option will be evaluated at each epoch of economic situation transition. The decision-maker can decide whether to early exercise or hold the option based on the asset price, economic situation and holding time. The decision-making problem is formulated using a Partially Observable Semi-Markov Decision Process (POSMDP). Based on simulation results, some properties on the optimal exercise regions and the monotonicity of option prices are discussed. In addition, the conditions of the transition probability matrix for maintaining the monotonicity of the option price are examined.

Option prices mainly fluctuate depending on asset prices, and volatilities of asset prices differ depending on the economic situation. Extending our previous work, economic situations can be considered when pricing using the Partially Observable Semi-Markov Decision Process. Continuous market changes are accounted for when pricing by capturing changes in economic situations using POSMDP. An extended Geometric Brownian motion with stochastic volatility driven by a POSMDP is used to model changes in asset prices.

We plan to do numerical experimental studies on the structural properties of early exercising strategies for American options in our work. The interest is to see how the structural properties are affected under some violation of sufficient conditions presented in previous work.

7. Research implementation and results under the program

Title of your research plan:

American options under a Partially Observable Semi-Markov modulated Black-Scholes model

Description of the research activities:

During part of the program, we worked on finishing our previous work *Properties of American options under a semi-Markov modulated Black-Scholes model* that will be published at The Stochastic Modeling Techniques and Data Analysis International Conference (SMTDA) Conference Proceedings organized in Athens, Greece, on June 7-10, 2022.

Next, we extend our research using the Partially Observable Semi-Markov Decision Process to model changes in the economic situation. This assumption helps us continuously capture real-world market changes to get American option prices. The underlying economy is partially observable in the form of a signal stochastically related to the actual state of the economy. The American option pricing problem is then formulated using a Partially Observable Semi-Markov Decision Process (POSMDP). We have been working on numerical studies to discuss optimal exercise regions and the monotonicity of option prices.

In addition, we have been working on proving theoretical properties under such a model and discussing other types of models and future collaborations.

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

The impact this experience had on me is enormous. This opportunity did not only help me develop myself in my academic career but also personally. Understanding Japanese culture, how amazing people are, the food, nature, politeness, and willingness to help have influenced me in ways I cannot simply explain. I am grateful for this fantastic experience!

9. Adviser's remarks (if any):

It is my pleasure to host Mr. Dimitrov as a short-visiting researcher of our research lab. Our scientific goal is to extend our previous research using the Partially Observable Semi-Markov Decision Process to model changes in the economic situation. We discussed this topic and completed the formulation during his stay. This is a good experience for both my students and me. I am looking forward to the results of our further collaboration.