



FY 2016 Follow-up of WPI Program

By Program Committee

February 2017

(This document reports on progress made under the WPI Program in FY 2015.)

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In 2007, the Japanese government launched an ambitious initiative to create globally visible and internationally opened research centers. This program, World Premier International Research Center Initiative (abbreviated WPI) has successfully finished its first 10 years of implementation. The program's 2016 follow-up report includes important information, e.g. final project evaluations (Session D), interim project evaluation (Session F), and future WPI Program plans (Session G).

A. Outline of WPI program

In 2007, MEXT (Ministry of Education, Culture, Sports, Science and Technology) launched WPI Program aiming to establish "World Premium Institute" by

- Achieving top-notch science
- Crossing borders of countries and disciplines and barrier of traditional cultures
- Serving as a hub of global brain circulations.

The following four missions are crucial requisites for a WPI center.

- Advancing top-quality of science
- Making breakthroughs by fusion studies
- Achieving internationalization
- Reforming research and administration systems

MEXT supports these WPI centers under the following conditions:

- About 1.3~1.4 billion Yens a year per center
(About ~700 million Yens a year per center for WPI Focus)
- Research money is not included.
- Support for 10 years with possible 5-year extension

Many countries are now operating Research Excellence Initiatives (REI) under the following background and WPI program is regarded as a role model of REI.

- There is increasing worldwide competition in creating new research outcomes and recruiting talented scientists.
- Strong needs are felt of more efficient forms of funding to advance fundamental and innovative sciences, which are essential for a knowledge based society.
- REIs are designed to encourage outstanding research by providing large-scale and long-term funding to selected research areas and/or units.

B. WPI Centers

Currently, the following 9 WPI centers are on-going:

The first 5 WPI centers from 2007

- **AIMR** on materials science, Tohoku University.

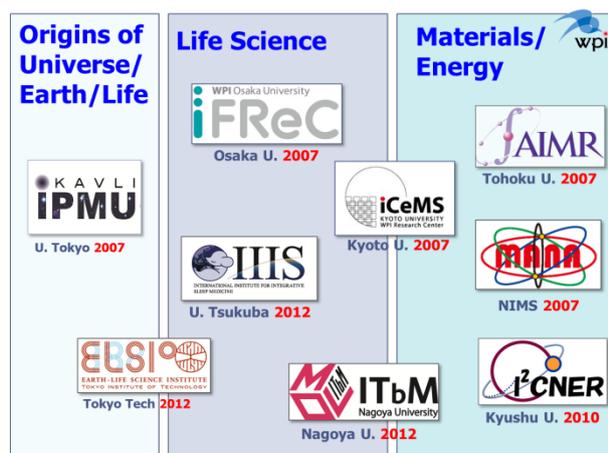
- **Kavli IPMU** on universe, The University of Tokyo.
- **iCeMS** on cell biology, Kyoto University
- **IFReC** on immunology, Osaka University
- **MANA** on nanotechnology, National Institute for Materials Science

The sixth WPI center under the program of green innovation from 2010

- **I²CNER** on energy, Kyushu University

The three WPI centers under the program of “WPI Focus” on focused research areas from 2012

- **IIIS** on sleep, University of Tsukuba
- **ELSI** on Earth-Life, Tokyo Institute of Technology
- **ITbM** on Bio-Molecules, Nagoya University



9WPI Centers

As shown in this figure, the 9 WPI centers can be categorized into 3 groups: Origins of Universe, Earth, and Life; Life Sciences; and Materials/Energy Sciences.

C. Follow up

The WPI program carries out a robust follow up system which is comprised of the International Program Committee, Program directors (PDs), Program officers (POs) and Working groups (WG).

Program Committee

Program committee meeting of FY2016 was held on October 26-27, 2016 in Tokyo. Of 19 members, 16 members participated and evaluated on achievements of 9 WPI centers based on presentations of president of host institutions and center directors as well as site visit report and progress report of the centers.

The Committee was shuffled in FY2016: committee consisting of 19



Program committee on 26-27 October, 2016 in Tokyo

members is chaired by Dr. Ryoji Noyori, after retiring of Dr. Hiroo Imura who served as a chairperson since launching WPI centers in 2007. New members are:

Victor Joseph Dzau

Michinari Hamaguchi

Maki Kawai

Hiroshi Matsumoto

Norihiko Suzuki

Klaus von Klitzing

Harriet Wallberg

Jean Zinn-Justin

All members and their affiliations are listed in the following URL:

http://www.jps.go.jp/english/e-toplevel/data/07_committee.html

PDs, POs and WGs

PD: Toshio Kuroki, JSPS and Akira Ukawa, RIKEN Advanced Institute for computational Science (Deputy PD).

PO: Experts of the research area of the center. POs chair site visit and prepare site visit report by compiling comments of site visit team members.

WG: organized for each WPI center, principally consist of 3 domestic and 3 international experts in the areas covering the center's activities.

PDs, POs and WG members and their affiliations are listed in the following URL:

http://www.jps.go.jp/english/e-toplevel/08_followup.html

Site Visit

Site visits to the 9 WPI centers were conducted over 2 days during June-September period in 2016. Site visit members consist of PD, PO, WG, MEXT officials and Japan Society for the Promotion of Science (JSPS) secretariats. Program committee members also participated in some site visits following their interests.

The schedule includes a briefing by the president of host institutions, center director and presentations of selected PIs,



Site visit at ITbM in 2016

and poster presentations by young researchers allowing free discussions with site visit team members.

Report of the site visits were submitted to the Program committee and disclosed to the corresponding centers.

D. Final Evaluation and 10th Year Evaluation of 5 centers launched in 2007

5-year Extension

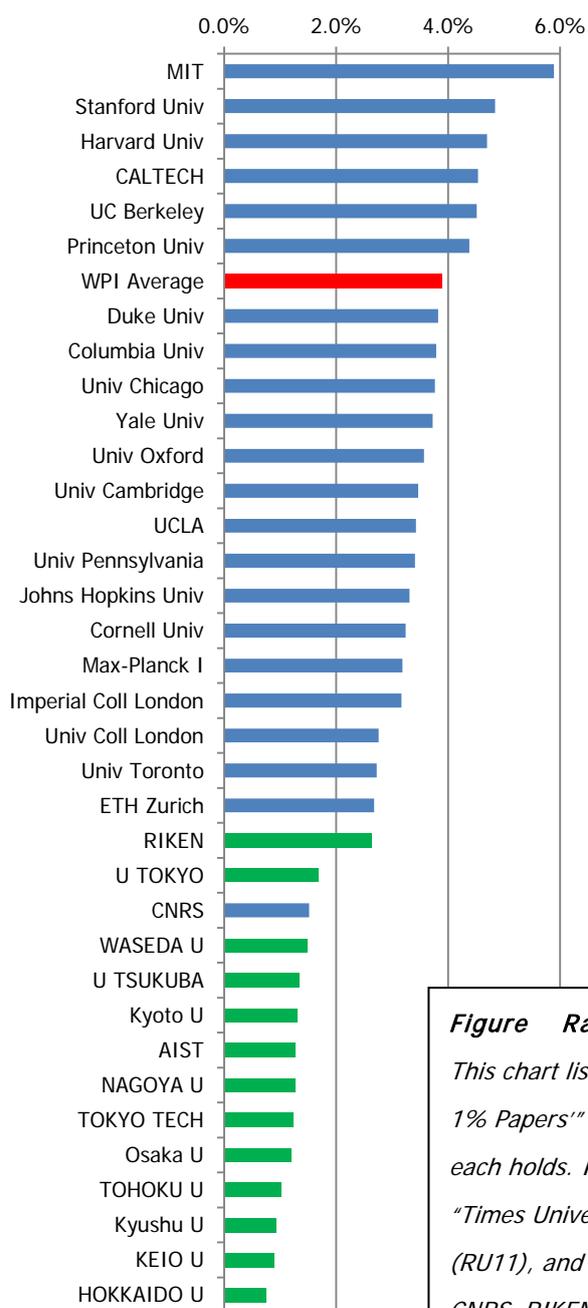
The support period for the WPI centers is 10 years. A possible extension for another 5 years is possible if in the process of extension application screening centers are nominated for ones by program committee. In 2014, All five WPI centers launched in 2007, i.e. AIMR, Kavli IPMU, iCeMS, IFRcC and MANA, applied for a 5-year extension after FY 2017. In 2014, the WPI program committee carefully examined their achievements and concluded that each of these WPI centers has achieved a "world premier status," fully meeting the goal of the WPI program.

After an extensive discussion, the Program committee reached a decision to grant a 5-year extension to only Kavli IPMU, which had achieved truly outstanding performance beyond the very high WPI standard.

When MEXT support ends after periods of either 10 or 15 years, the centers are to be sustained under the auspices of their host institutions, as promised by their presidents.

Final and 10th year evaluations

The 2016 Program Committee has conducted its final evaluation of AIMR, iCeMS, IFRcC and MANA, for which the WPI funding will end in FY2016, and 10th year evaluation of Kavli IPMU, which shall have 5 more years of funding. The Committee members were all impressed with the high levels of science being conducted at these centers.



As shown in a figure, their production of “top 1% papers” since their launching (2007-2015 period) is remarkably high, reaching an averaged percentage of 3.9%, placing them in 7th place among world-leading universities. Other WPI missions, i.e. fusion studies, internationalization and system reforms, have also been carried out at levels beyond those set as the program goal. The Committee fully confirmed its previous evaluation result in 2014 that these centers have achieved “world premier status” satisfying the goal of the WPI program.

Figure Ratio of Top 1% Papers of WPI centers

This chart lists the universities and research institutions with “Top 1% Papers” and ranks them by the percentage of Top 1% Papers each holds. Included in the list are the top 20 universities in the “Times University Ranking,” Japan’s top 11 research universities (RU11), and other leading institutions (e.g. Max-Planck Society, CNRS, RIKEN). The averaged percentage of Top 1% Papers among the 2007-launched 5 WPI centers during the 2007-2015 period was 3.9 % (shown in red). Japanese institutions are shown in green on the chart. (Data provided by Clarivate Analytics, former Thomson-Reuters.)

Comments by the Program committee and site-visit teams are summarized below.

D-1 AIMR Final Evaluation

Center director: Motoko Kotani

Program officer: Yoshihito OSADA, RIKEN

1. Scientific achievements

AIMR has fully achieved the very high standards of the WPI Program and become a world-leading institute of high prominence. With its activities recognized around the world, AIMR has become a leading research center in material sciences.

2. Implementation as WPI center

Interdisciplinary research: Marriage between mathematics and material science is an innovative idea that opens up a new scientific discipline. This unique “math-mate” merger is credited to the effort of Dr. Kotani, the current center director.

Publication of a series of monographs “Springer-Briefs in the Mathematics of Materials” also enhances AIMR’s reputation as the first institute to advance Math-Mate collaboration in the world.

Internationalization: AIMR has built an impressive international network with key organizations, increasing its global visibility and benefitting greatly from these links.

The circulation of talented young scientists is working well. A number of them have gone on to obtain higher positions abroad. AIMR has become a well-recognized global career step in the field of materials science.

System reforms: AIMR has instituted a number of reforms in Tohoku University. These include the “Organization for Advanced Studies (OAS),” “International Administrative Office”, “Graduate School in Spintronics,” “joint appointments,” and “overseas training program,” etc.

3. Efforts toward sustainability

President Satomi confirmed that the host institution is committed to providing AIMR with resources sufficient to maintaining many aspects of its operation including the number of scientists (10 tenured positions) and a budget for sustaining joint laboratories within a world-leading hub.



AIMR's young researchers and Dr. Kotani, the center director

4. Progress plan after WPI grant ends

AIMR has proposed mid- to long-term objectives for establishing a world-class materials research center. Director Kotani is to be commended for her vigorous leadership in pushing/pulling AIMR along the new direction with a whole list of agenda items.

Strengthening collaboration with industries will be of critical importance in making AIMR sustainable. We should keep watching how AIMR is being sustained after the WPI grant has ended.

D-2 iCeMS Final Evaluation

Center director: Susumu KITAGAWA

Program officer: Toru NAKANO, Osaka University.

1. Scientific achievements

iCeMS has fully achieved WPI's stringent program goals with regard to quality of science, new paradigms of research through innovative interdisciplinary collaboration, internationalization, and the empowerment of young researchers.

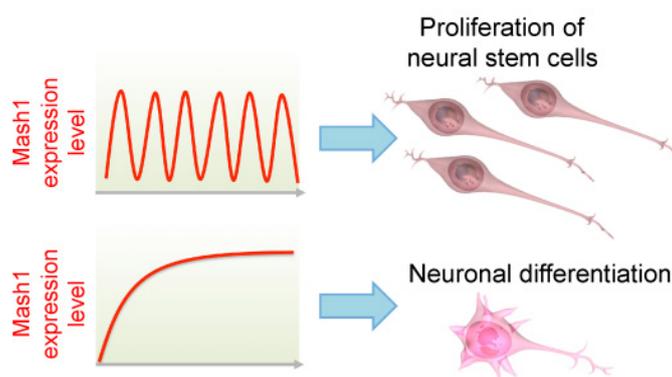
Stem-cell utilization and cell-inspired materials are very good directions for the future, even if their conversion is questioned.

iCeMS's big successes in science notwithstanding, a minor concern is the apparent fluctuation in the institute's goal, which dictates its research focus. iCeMS appears to still be seeking a focus for its identity.

2. Implementation as WPI center

Interdisciplinary research:

As for its research fusion, it is still in a state of progress. Some of the chemicals it has synthesized are being utilized in medical research. This is one example of its fusion; however, it does not constitute exceptional collaboration in that it could be accomplished without iCeMS's existence. We must be patient in waiting to see the future success of the institute's fusion.



Mash1 expression can be switched on and off by blue light illumination and dark conditions, respectively, with use of the light-responsive protein GAVPO. This light technology allows to induce oscillatory and steady expression of Mash1, which leads to proliferation of neural stem cells and neuronal differentiation, respectively.

Internationalization: The percentage of oversea researchers in iCeMS has reached 30%, the target level set for a WPI center, which is highly evaluated. Support for foreign researchers is well prepared including an environment well-suited for their scientific and daily life. Mainly conducted in English, this support is excellent. Collaborations with many overseas institutes and the launching of a new journal will contribute to iCeMS's globalization after the WPI program ends.

System reform: President Yamagiwa initiated the WINDOW concept and new institutional system KUIAS, under which iCeMS will be sustained after MEXT funding ends. iCeMS will become a core and hub institute under the WINDOW plan and KUIAS system, and will play more important roles in the organizational reform of Kyoto University.

3. Efforts toward sustainability

The president of Kyoto University has expressed a strong will to continue iCeMS's activities, incorporating it within the new WINDOW system. Young investigators introduced by the director will hopefully drive the direction of the center in the future.

4. Progress plan after WPI grant ends

For iCeMS to continue to be successful as an institute within KUIAS, it will be important for KUIAS to continue the process of transforming the landscape for advanced research in Kyoto University. Attention must be paid to creating strong relationships between KUIAS members and the rest of the university. Otherwise, there is a danger that iCeMS will be placed on a pedestal, isolated from the rest of the university.

D-3 IFRc Final evaluation

Center director: Shizuo AKIRA

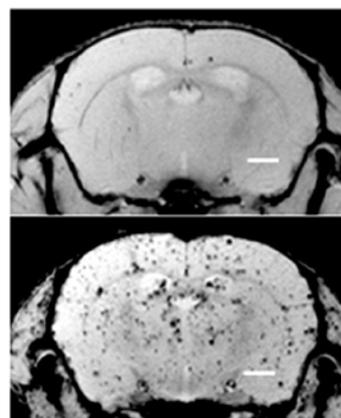
Program officer: Takehiko SASAZUKI, Kyushu University

1. Scientific achievements

IFReC is clearly doing world-class research; its achievements in immunology are particularly impressive. It is good to see the international prominence that the center has achieved.

Assessments using scientific criteria, including quality of research, numbers of papers, impact factor and citation index of publications, receipt of prestigious national and international prizes, and continuous success in obtaining major grants/contracts, testify to IFRc's truly exceptional achievements and outstanding success as a WPI center.

2. Implementation as WPI center



Macrophages in brain after administration of LPS in mice. (at 24hr after injection of upper; saline, lower; LPS)

Interdisciplinary research: IFRcC strengthened its research in the field of immunology by introducing imaging and information technologies, which has been further advanced by collaboration with CiNeT and QBiC (RIKEN) and vice versa.

Internationalization: IFRcC is receiving many applications from overseas postdocs and graduate students, and it has been able to recruit ambitious and talented young PIs from abroad. The “Winter School on Advanced Immunology,” jointly organized with Singapore Immunology Network, is an example of a highly successful, broadly recognized international scientific event.

System reform: It is evident that Osaka University regards IFRcC as a role model for research organization in terms of internationalization and system reform. Ripple effects stemming from the WPI program can be clearly seen across the entire university.

3. Efforts toward sustainability

Osaka University has committed to making IFRcC a permanent institute. IFRcC's sustainability is financially secured by the university's contract with Chugai Pharmaceutical Co. However, this should not hinder the Center's academic freedom or weaken its excellent basic scientific activities.

4. Progress plan after WPI grant ends

IFRcC plans to continue not only with its basic research, but to also include more clinical/medical immunology. However, as much of IFRcC's success so far has been based on fundamental science, its move into translational research should be done with care and not at the expense of basic research.

D-4 MANA Final evaluation

Center director: Masakazu AONO

Program officer: Gunji SAITO, Meijo University

1. Scientific achievements

MANA opened a new research field, Nanoarchitectonics, under the strong leadership of its Director Masakazu Aono. MANA's scientific achievements are evidenced by their publications and citations. A number of remarkable results have been achieved, greatly aided by MANA's excellent infrastructure with topnotch research facilities.

2. Implementation as WPI center

Interdisciplinary research: MANA has taken both strategic and bottom-up approaches in successfully carrying out various fusion research initiatives toward creating new materials sciences. In the Nano-Life field, however, its perspective is primarily from the nano-technology side: Results that can really be termed interdisciplinary are yet to come.

Internationalization: MANA is an outstanding basic-research center. It has a very good foreign-friendly environment and is a model for the internationalization of research centers. Both the scientific activities and daily life of scientists from abroad are well supported by excellent administrative and technical staffs.

System reforms: MANA has implemented continued system reforms by modifying its research groups and management system. System reforms being made at MANA are now spreading back to NIMS in terms of globalization, management, and scientist training.



MANA building in NIMS, Tsukuba

3. Efforts toward sustainability

MANA is incorporated within NIMS as one of seven research centers. Further, NIMS has promised to sustain MANA by providing it with staff positions and a budget. However, MANA will need to make more effort to secure new funding sources so as to continue as many of its projects as possible, including the financing of postdocs after WPI support ends.

4. Progress plan after WPI grant ends

MANA's director will be switched to Dr. T. Sasaki, who is now its deputy director. He should carefully prepare a new vision for MANA. The role of Nano-theory in providing design-based physical, chemical and biological concepts is very important for spawning original and innovative ideas on connecting different fields. Additional work is still needed to establish a solid program in the Nano-Life area. The current Nano-Life researches seem to be oversimplify biological phenomena. Critical review by bio-medical scientists is highly recommended.

D-5 Kavli IPMU 10th year evaluation

Center director: Hitoshi MURAYAMA

Program officer: Ichiro SANDA, Nagoya University

1. Scientific achievements

Kavli IPMU has demonstrated impressive progress since its launching in 2007. The quality of its science is excellent. The center is now recognized as a world premier institute in its research field of astrophysics and mathematics. It's seen to be exerting a major influence worldwide on this discipline while delivering benefits through cross-disciplinary cooperation.

2. Implementation as WPI center

Interdisciplinary research: Mutual intellectual stimulation between physicists, cosmologists, and mathematicians is working exceedingly well, which may be a unique feature, realized at no other laboratory in the world.

Internationalization: With an unusually open atmosphere, Kavli IPMU is attracting many outstanding young and established scientists from all over the world. Kavli IPMU has become a global brand and is a sought-after international destination for researchers in related fields.



Kavli IPMU's Researchers at 9th anniversary

System reforms: Kavli IPMU has initiated a number of system reforms: nempo system and merit-based salary system, split appointments, top-down management, Kavli endowment, and non-traditional tenure positions. These reforms have become widespread in other WPI centers, and even adopted by MEXT in its National University Reform Plan.

3. Efforts toward sustainability

The University of Tokyo (UT) has created the University of Tokyo Institutes of Advanced Studies (UTIAS). The tenured positions that UT provided through UTIAS are extremely important for the future of Kavli IPMU.

4. Progress plan after WPI grant ends

During the extension period, along with on-going projects, Kavli-IPMU plans the following expansions: Next generation XMASS1.5, T2K-II, NuPRISM, KL2-Zen. Test of leptogenesis by HyperKamiokande; study of inflation by LiteBird. These goals are appropriately profound and flexible. WINGS (World-leading Innovative Graduate Study) is a new graduate program at UT, which must be expanded. Some mechanism for sending UT students to Kavli IPMU must be included in President Gonokami's UT reform plans.

E. Evaluation of I²CNER launched in 2010

Center Director: Petros Sofronis

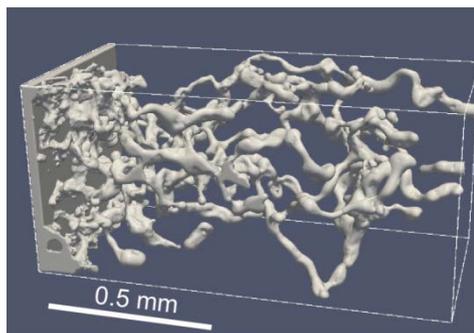
Program officer: Kazunari DOMEN, The University of Tokyo

1. Scientific achievements

The science advanced at I²CNER is of high quality with significant practical implications. The center is also carrying out studies reaching across multiple divisions and multiple research fields. An important issue regarding energy is the need to integrate its flow from the upstream zone (that is, primary energy) to the final usage. The center's Energy Analysis Division should clearly identify bottlenecks in the flow and locate the tasks to be carried out by each division on a road map.

2. Feeding research outcomes back into society

There have been a number of technology transfers from I²CNER to various companies. The number of patent applications and patent awards is also significant. However, it seems that the center does not have a firm plan or strategy for feeding back its results to society in a more concerted way, so there is room for improvement.



3D natural sandstone under various conditions using two-phase lattice Boltzmann (LB) simulations

Implementation as WPI center

Interdisciplinary research: A conscious effort has been made to more fully integrate the discipline of mathematics into I²CNER research. Interdisciplinary research between the Electrochemical Energy Conversion and the Molecular Photo-conversion Devices Divisions is bringing theory and experiment together. The research activities of the Energy Analysis Division will require further collaboration, especially with economists, social scientists, government agencies and other stakeholders.

Internationalization: There is a significant percentage of non-Japanese researchers at every position level, totaling 52%. Kyushu University and the University of Illinois are moving into a closer relationship involving undergraduate student exchanges. This is a good example of a research collaboration that triggers a larger alliance between universities.

System reforms: Kyushu University will support I²CNER and continue to use the institute as a driver for system reform throughout the university. I²CNER's merit-based salary system has been extended to the entire university.

3. Efforts toward sustainability

President Kubo is supportive of I²CNER future and is planning to carry it as a permanent activity within Kyushu University. However, more comprehensive planning is required, including the provision of administrative support, research infrastructure, and other

financing.

4. Advice/Recommendations

Carbon-neutral research covers quite a wide area. It will be important to clearly identify which of the achievements of I²CNER can be considered truly significant and thereby determine which avenues of research should continue to be allocated the center's considerable resources. The Internal Program Review Committee (IPRC) and Energy Analysis Division should continually monitor the overall direction of the Institute and the roadmap of each division.

To increase the number of female researchers, it is recommended that external advice be sought from women in senior positions of relevant fields.

F. Interim evaluation of 3 centers launched in 2012.

At the 2016 Program Committee, an interim evaluation was conducted on the 3 WPI centers, i.e. IIIS, ELSI and ITbM, launched in 2012. The materials used in the evaluation were briefings by the presidents of their host institutions and center directors, site visit reports, and self evaluation reports. Overall scores were given on each center's implementation of the four WPI missions, based on the following criteria:

- S. Progress being made in establishing the center exceeds its initial goals. Even greater progress in developing itself as a "top world-level research center" is anticipated.
- A. It should be possible for the center to achieve its initial goals by continuing its current efforts. A half score can be applied to A, e.g. A+ of A-.
- B. More effort will be needed to achieve the center's goals, including consideration given to the Committee's advice.
- C. Under the current state, it is deemed difficult for the center to achieve its initial goals. It will, therefore, need to effectively amend its plan, taking into consideration the Committee's advice.
- D. Given the state of progress to date, it is deemed difficult for the center to achieve its initial goals even if further effort is made to do so. Therefore, the center project should be terminated.

The interim evaluations of these 3 WPI centers are as follows:

F-1. IIIS Interim evaluation

Center director: Masashi YANAGISAWA

Program officer: Kozo KAIBUCHI, Nagoya University

1. Scientific achievements

IIIS's mission is to solve major social problems related to sleep. Overall, the quality of its science is excellent. Three major scientific breakthroughs have been achieved.

- 1) Drs. Yanagisawa and Funato performed forward genetics to isolate sleep in mutant mice, and successfully obtained two mutant lines (Sleepy and Dreamless). They identified the corresponding genes as SIK3 kinase and NALCN non-selective cation channel, respectively.
- 2) Dr. Nagase and his colleagues have developed new orexin agonists for hypersomnia including narcolepsy.
- 3) Dr. Hayashi has made a breakthrough in the field of REM/NREM sleep. He identified neurons in the SLD area, which are involved in the switch of REM/NREM sleep.



Mice in measurement

2. Implementation as a WPI center

Interdisciplinary research: Although the research at IIIS continues to be conducted using medical, pharmaceutical and biological approaches, the center's work is highly interdisciplinary. It provides a strong core for genetics, physiology, and basic sleep analysis using EEG, neurogenetics, pathway tracing and other methods.

Internationalization: The organizational structure of IIIS falls in line with the more integrated framework of a US departmental type grouping of PIs and their research teams. Of the 53 core researchers at IIIS, the percentage of foreign researchers is 38%. In addition, 14 of the 58 students (24%) are foreign nationals. Its administrative staff of 12 people lists 7 bilingual speakers.

System reforms: Under a financially difficult situation, the University of Tsukuba has greatly supported the building of a new facility for IIIS by providing its own budget in addition to support from the government.

Drawing upon his lengthy experience in the U.S., the Director appears to have successfully implemented a U.S.-style institute, which is well supported by a very capable internal administrative staff and by U. Tsukuba.

3. Actions required and recommendations

The center's translational potentials are significant, and IIIS is expected to make major

discoveries in the human condition over time. There is a need to develop more expertise in human sleep research and to develop strategies for elucidating the genetic basis of human sleep regulation and disorders. To advance the identification of human genes in sleep disorders via cohort studies, collaboration with and advice from clinicians and epidemiologists is needed. IIS should continue collaborating with clinical and human research teams in translating animal studies into humans.

Interim evaluation: A⁺

IIS is opening up a new area in understanding the molecular basis of sleep. By isolating and identifying 3 sleep genes involved in narcolepsy and in sleepy and dreamless syndromes, IIS has positioned itself as a leader in this field of science while creating new approaches to elucidate the mystery of sleep and cause of related diseases. Within a short span of 4 years, IIS has made excellent progress toward this goal.

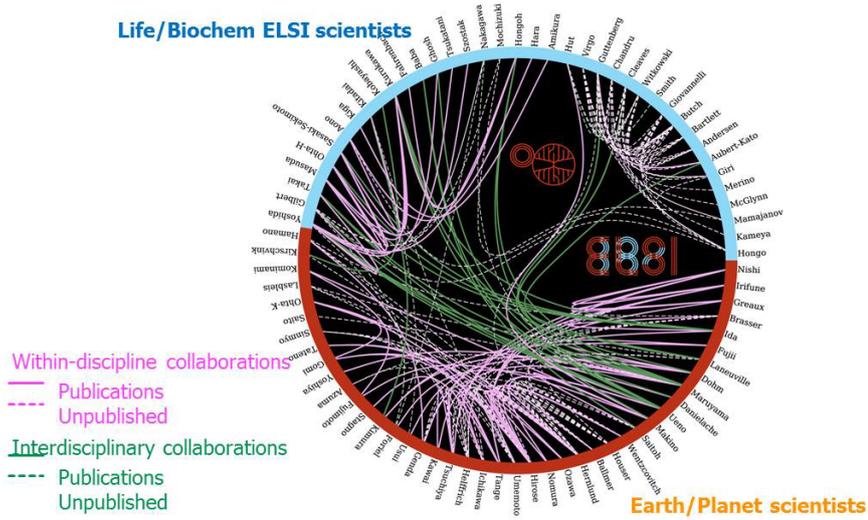
F-2. ELSI Interim evaluation

Center director: Kei HIROSE
 Program officer: Shoken MIYAMA

1. Scientific achievements

The science level of ELSI with regard to the origin of Earth, e.g., the core of the earth, is especially impressive. The work of Director Hirose provides many implications on the structure of the Earth's core and mantle, which spawn new views on the origin and evolution of the Earth.

Under a concept that the origin of life is closely associated with the primitive environment of the Earth's origins, ELSI is focusing on a very ambitious target, the origin of life. Its model is to be refined and validated within the next 5 years.



Papers of interdisciplinary research

2. Implementation as a WPI center

Interdisciplinary research: In ELSI, there are excellent interactions between two big fields, Life/Biochemistry and Earth/Planet. Good cooperative results are being achieved between chemistry, biology and geo-science research. This work is highly evaluated as an interdisciplinary research activity.

Internationalization: The center's internationalization effort is quite successful, evidenced by 36% foreign researchers, 5 fulltime foreign PIs, and 86% of its applications coming from abroad. The worldwide network hosted by ELSI is closely supported by the John Templeton Foundation.

System reform: Stimulus for system reform in Tokyo Tech is obvious. Although strong leadership by President Mishima has guided the university toward modernization, stronger motivation is still needed by the officers to push the university forward. Thus, the activity of ELSI is necessary.

3. Actions required and recommendations.

The center's open flat research organization is unique and innovative. A negative aspect of it is that younger scientists do not have a mentor (boss). The model appears to be working well, but the center should ensure that young researchers get structured feedback (not only in their yearly evaluation).

As the origins of Earth and life are both difficult problems to solve, steady and continuous studies by a highly heterogeneous community are essential. Accordingly, some remarks regarding host-university support after WPI program ends, which involve graduate student education, sound good.

A new satellite at the University of Tokyo was proposed by Dr. Hirose. Future activities conducted through that collaboration should be reported.

Interim Evaluation: A

The Earth-Life Science Institute (ELSI), Tokyo Institute of Technology (Tokyo Tech), has been well established as a WPI center within 4 years since its launching with a clear mission to identify the origins of Earth and life. Within a short span of 4 years, ELSI has made excellent progress toward this goal.

F-3. ITbM Interim evaluation

Center director: Kenichiro ITAMI

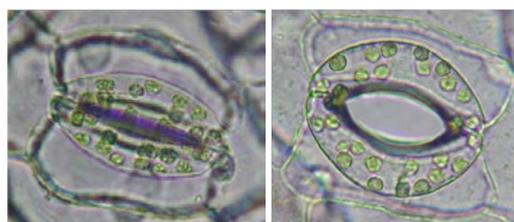
Program officer: Minoru YOSHIDA, RIKEN

1. Scientific achievements

The center has been extremely successful in carrying out world-leading research under the strong leadership of its director, especially within its three flagship research programs: plant chemical biology, chemical chronobiology, and chemistry-enabled live imaging. Although these three flagship projects are not directly interrelated, it appears that they exert favorable effects on each other.

2. Implementation as a WPI center

Interdisciplinary research: The productivity and impact quality of the research results are largely due to interdisciplinary research activities advanced by the Mix-lab under a concept of "idea creation through mixing of people."



Stomata (left; closed, right; opened)

Internationalization: ITbM has made strong efforts to achieve global visibility, and is clearly on a trajectory to becoming a globally visible research center. This was made possible not only by the excellence of its research, but also by a professional team of staff with skills in promoting research and developing effective outreach activities.

System Reform: Nagoya University (NU) is very supportive of ITbM, adopting many of its new practices and using WPI initiatives to drive internal changes. NU has committed to continuing ITbM after the end of the WPI program, which will be of considerable benefit to NU considering the visibility and attention that ITbM has already brought to the university.

3. Actions required and recommendations.

ITbM has proven that the concept of transformative bio-molecules is valuable in plant biology and chronobiology. The scientific direction and challenges that ITbM should pursue over the next 5 years should be laid out more clearly than in the simple statement of its three flagship research areas.

It is obviously important for the center to make strategic plans for its translational research. For instance, field studies are an essential step in applying transformative bio-molecules in plant biology to practice. At the same time, while it is very tempting to invest in the commercialization of potential leads, a critical balance in both manpower and resources must be maintained to ensure that ITbM's quality of science and reputation of excellence are not compromised.

Interim evaluation: S

ITbM aims to develop “transformative bio-molecules” that will create a marked change in the form and nature of biological science and technology. Within a short span of 4 years, ITbM has made outstanding progress toward this goal. The quality of its science is world class and actually transformative across several disciplines

G. Future plan of WPI program

In 2015, the Program Committee made recommendations to MEXT to continue the WPI program because of its success in establishing “world premier institutes” in terms of scientific achievement and mission implementation. The Committee’s recommendation included the following:

- Moving forward the WPI program by calling for new WPI centers.
- Establishing a new system, “WPI Academy”, to sustain the WPI brand. The Academy will include four hubs, the centers approaching their final year of WPI subsidy support.

(Details are given in the “WPI Follow-Up Report 2015”)

Responding to the above aspects of the Committee’s recommendation, MEXT announced a future WPI policy at latest Program Committee meeting, including the following points:

- It was stated that the WPI Program’s aim is to build top world-level research centers, create hubs for international brain circulation, and hurdle borders and barriers encircling Japan’s science community. The four missions of WPI Program are to achieve top-level science, fusion, internationalization, and system reform.
- The WPI can be evaluated as successful as it has established world premier institutes that are successfully implementing the four program missions. Accordingly, it is deemed that the WPI program should be further developed based on a long-term WPI Plan.
- The long-term Plan of WPI includes (i) calling for new centers to metabolically activate the program, while setting a final number of WPI centers (ii) establishing a new framework, WPI Academy, to sustain and advance the WPI brand. The Academy will initially include four hubs, the centers approaching their final year of WPI subsidy support.
- Our aim is to recruit two new centers in FY 2017 and more new centers in and after FY 2018, each in basic research fields.
- The maximum number of WPI centers will be around 20, taking into account the capacity and capability of Japanese institutions to implement them.

- The WPI Academy is to develop the WPI brand of the overall WPI program. It will serve as a nationwide hub for brain-circulation. By accelerating the dissemination and application of WPI program achievements while networking the activities of the various WPI centers, the Academy will play a vanguard role in internationalizing and reforming Japan's research environment.
- The member institutes of WPI Academy will be those that have attained a "world premier status." They will receive periodic evaluation by the WPI Program Committee.

The government's FY2017 budget proposal includes funding for the above policy.

H. Outreach activities in commemorating 10th year of the WPI program

In December 2016, the 10th anniversary of the WPI program was commemorated by publishing a book and holding a symposium for the general public including high school students.

The commemorative book, entitled 10 Years of WPI Program, Shaping Future Science beyond Borders and Barriers, covers the activities of nine WPI centers and gives an overview of WPI Program's first decade. An English version will be published in FY 2017.

The commemorative symposium was held on December 17 in MEXT's auditorium. Like previous symposia, the target audience was the younger generation including high school students, to whom the future of science will be entrusted. Indeed, among the 440 participants, 40% were under 19 year old. They eagerly participated in the after-symposium discussion with the presenters.

The symposium featured three themes:

- 1) "Science is deep and beautiful"

Origin and end of the Universe

Dr. H. Murayama, Kavli IPMU

Origin of earth

Dr. S. Ida, ELSI

Mathematic is beautiful

Dr. M. Kotani, AIMR

- 2) "Mystery of life"

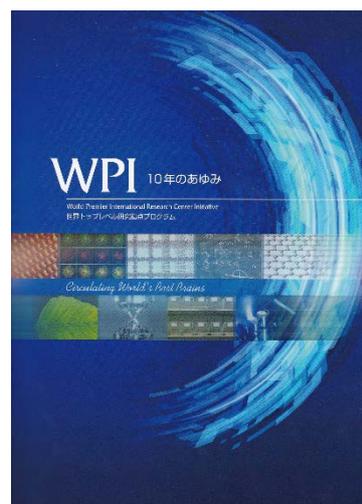
From a fertilized egg to body

Dr. R. Kageyama, iCeMS

Mystery of sleep and awake

Dr. M. Yanagisawa, IIIS

Recognition of self and non-self by immune cells



*10 Years of WPI Program,
Shaping Future Science
beyond Borders and Barriers*

Dr. S. Sakaguchi, IFRcC

3) "Contribution to society"

Materials contribute to society

Dr. M. Aono, MANA

Creating powerful chemicals

Dr. K. Itami, ITbM

Contribution to energy issues

Dr. S. Ogo, I²CNER

In addition, MEXT officials, Program Committee members and the program director spoke about the significance of the WPI Program and their expectations regarding the younger generation, upon whom future of science will rely.



Commemorative symposium at MEXT's auditorium on 17 December 2016.