



**FY 2015 Follow-up of WPI Program
By Program Committee**

February 2016

(This document reports on progress made under the WPI Program in FY 2014.)

In FY2015, there were three important achievements:

1. Nobel Prize in physics awarded to Dr. T. Kajita, PI of Kavli IPMU. (see section A, p2)
2. International Research Excellence Initiative (REI) workshop held jointly with Program committee meeting. (see section E, p5)
3. Future plan devised by the WPI program committee (see section E, p5)

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A. Dr. Takaaki Kajita, PI of Kavli IPMU, was awarded The 2015 Nobel Prize

We are pleased to announce that Kavli IPMU Principal Investigator and The University of Tokyo Institute for Cosmic Ray Research Director Takaaki Kajita has been awarded the 2015 Nobel Prize in Physics, jointly with Queen's University Professor Emeritus Arthur B. McDonald for discovering neutrino oscillations, which show that neutrinos have mass.

In 1998, Takaaki Kajita discovered that neutrinos from the atmosphere switch between two identities as they travelled to the Super-Kamiokande detector in central Japan. This metamorphosis could only occur if the neutrinos had mass.



Professor Takaaki Kajita, PI of Kavli IPMU

For particle physics this was a historic discovery, showing that the Standard Model, which assumed neutrinos were massless, could not be the complete theory of the fundamental constituents and their interactions of the universe. This research field was pioneered by Dr. Masatoshi Koshiba, and expanded greatly under the leadership of the late Dr. Yoji Totsuka, a previous member of WPI Program committee, Dr. Takaaki Kajita (then head of high-energy group), and Dr. Yoichiro Suzuki (then head of low-energy group). Both Kajita and Suzuki are PIs of Kavli IPMU, and were recognized by Breakthrough Prize this year.

Now the experiments are continuing and intense activity is underway worldwide in order to capture neutrinos and examine their properties. New discoveries about their deepest secrets are expected to change our current understanding of the evolution, structure and future fate of the universe.

B. Outline of WPI program

Research Excellence Initiatives (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.

WPI program

- In 2007, MEXT (Ministry of Education, Culture, Sports, Science and Technology) launched the World Premier International Research Center Initiative (WPI) Program.
- WPI research centers aim to establish “World Premium Institute” by
 - Crossing walls of countries and barriers of disciplines and traditional cultures
 - Achieving top-notch science
 - Serving as a hub of global brain circulations.

Missions

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

Supports

1.35 billion Yens (11 million US\$) a year per center

(700 million Yens (5.8 million US\$) a year per center for WPI Focus)

Research money is not included.

Support for 10 years with possible 5-year extension

C. 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

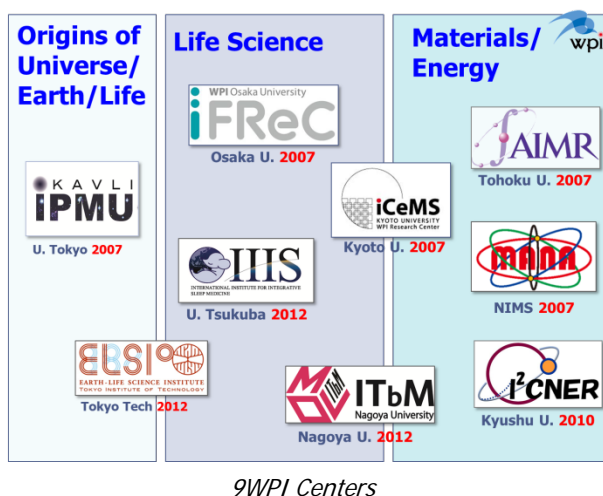
- **IIIS** on sleep, University of Tsukuba
- **ELSI** on Earth-Life, Tokyo Institute of Technology

- **ITbM** on Bio-Molecules, Nagoya University

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.

D. Follow up

The WPI program carries out a robust follow up system whose members are comprised of the International Program Committee, PDs, POs and working groups.



Program Committee

The Committee consists of 15 members and is chaired by Dr. Hiroo IMURA, Honorary Chairman of the Foundation for Biomedical Research and Innovation. The members are listed in the following URL:

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

Program directors (PDs) and Program officers (POs)

Dr. Toshio Kuroki, Japan Society for the Promotion of Science, and Dr. Akira Ukawa, RIKEN Advanced Institute for computational Science, serve as the program director (PD) and deputy PD.

The program officers (POs) are indicated in the summaries of each site visit report, shown below. They are also listed in the following URL:

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

Working groups (WG)

Working groups, organized for each WPI center, principally consist of 3 domestic and 3 international experts in the areas covering the center's activities. The working group members are listed in the above URL.

E. REI International Workshop and 2015 Program committee meeting

2015 Program committee meeting and the 3rd international workshop on REI were held jointly on 14-16 October 2015 in the Sheraton Hotel in Tokyo.

E-1. REI Workshop

The REI workshop is undertaken to discuss current situations and future prospective of REIs as well as policies of science and technology under a similar concept to REI. Speakers and titles of presentations at REI workshop are as follows:

Current status of WPI Program: Dr. Toshio. Kuroki

German Research Excellence Initiative: Drs. Inka Spang-Grau and Julika Griem

French Research Excellence Initiative: Dr. Arnaud Torres

Canadian First Research Excellence Fund: Mr. Denis Leclerc

Israeli centers for Research Excellence: Ms. Noa Binstein

Academic Research Centers in US: Dr. Dragana Brzakovic

British Science Policies and systems: Dr. David Sweeney

Max Planck society: Dr. Klaus von Klitzing

Steps toward Building World-Class Research Centers in China: Dr. Luis C. Ho

On the second day morning, a round table discussion was held with the chair by Dr. R. Dasher, a member of Program committee, regarding the following 3 questions:

Question No. 1: What is a particularly important factor in justifying to stakeholders the contributions of an REI program?

Question No. 2: What are the best ways in which one can maximize the lasting benefits of an REI center after the term of its REI grant has finished?

Question No. 3: How do you see the future of REI programs?

E-2. Program committee meeting

The program committee meeting was convened on 15th and 16th to hold hearings on the scientific achievements and project implementations of the WPI centers in FY 2014. Last year, the program committee has nominated Kavli IPMU for a 5-year extension. Regarding the four WPI centers whose funding will end in FY2016, the committee heard from the presidents of their host institutions on their support to sustain the centers.

E-3. Future plan of WPI program

After extensive discussions and considering global trends in REI programs, the committee reached the following conclusions, which will be recommended to MEXT.

1. Continuation of WPI program

- 2007-WPI Centers have been established successfully as a “World Premier institute” in terms of scientific achievements and implementation of its missions.
- WPI program should be continued after reconsideration of its mission statements and support schemes.

- WPI program will be further accelerated by “Metabolism” of centers, as being agreed by the 2014-Program committee.
- A call for new WPI center proposals should be made in FY2017.

2. Support for the former centers

- Presidents of host institutions promised that WPI centers will be sustained by their efforts, providing facilities, researcher positions, and costs for their management.
- Considering the excellence that WPI centers achieved, PC recommends that Government keeps the WPI brand by setting up a grant scheme for the former centers.
- We suggest to establish a new system, “WPI Association or WPI Academy”, with members satisfying WPI standards.
- These WPI centers will be evaluated regularly (e.g. every 3 years) for their performance of the WPI standard.

F. Site visits

Site visits to the 3 WPI centers launched in FY2012 were conducted over 2-day periods during June-September 2015 by the Program Committee members, PD, PO, international WG members, MEXT officials and JSPS secretariats. All 21 WG members participated in the site visits. The visit schedule included a briefing by the center director, presentations by selected PIs, and poster presentations by young researchers, a guided tour of the new buildings, and comments/advice offered by the site-visit team members. Short version of site visits were conducted to the 6 WPI centers launched in FY2007 and 2010 by PD, PO, MEXT and JSPS. Detailed reports on the site visits were submitted to the Program Committee and disclosed to the respective WPI centers. The following is a summary of the site visit reports and the comments by the program committee members.

F-1. AIMR

Center director: Motoko KOTANI

Program officer: Yoshihito OSADA, RIKEN

1. Scientific achievements

- Continual effort is being made in compliance with WPI standards. The research is directed under a clear mission with continual organization improvements. The research results accomplished at AIMR remain at a top world-level of quality in many areas of materials science.

- Their excellence in science is evident from the list of publications, amount of external research funding, and number of international and domestic award winners.
- “Creation of new materials science that can predict new functions based on a mathematics-materials concept” and “mathematics-guided materials science” are steadily progressing.

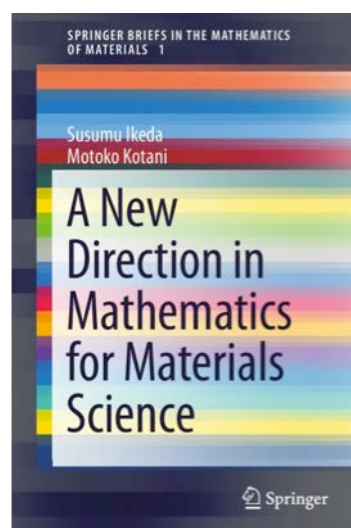
2. Implementation as a WPI center

Fusion of research areas

- The center is carrying out strategic activities in various Mathematics-Materials Science collaborations, and excellent fusion research is being advancing toward creating new fields of materials science. AIMR is now internationally well recognized as an institute that promotes Math–Mate collaboration.
- A Mathematical Science Group has been newly established by merging two existing units—Mathematics Unit and Interface Unit—with the expectation of making further progress in Math-Mate collaboration.

Internationalization

- AIMR is making a continuous effort to develop a global research network with five overseas research centers in materials science, including University of Cambridge, University of California at Santa Barbara, and others. AIMR established joint laboratories with the University of Chicago in 2014.
- A number of frontline researchers (47% as of March 31, 2015) have been assembled from around the world through open international solicitations. These young scientists performed research at AIMR while pursuing their careers. Thus, the circulation of young scientists is working well.
- In FY 2015, AIMR is publishing a series of textbooks entitled “Springer Briefs in Mathematics of Materials.” This will enhance AIMR’s reputation as the first institute to advance Math-Mate collaboration in the world.



The first volume of the monograph series, Springer Briefs in the Mathematics of Materials. It will be published in December 2015.

System reform

- AIMR has instituted a number of reforms in Tohoku

University. "Organization for Advanced Studies (OAS)," where AIMR is modeled and placed as the first core institute, was established in July 2014. The AIMR administrative division is to be transferred to OAS' "International Administrative Office" to play a central role in the internationalization and organizational reform of the host organization. A new program "Graduate School of Spintronics" has been established and started to receive graduate students in FY 2015.

3. Support of host institution toward sustainability

- President Satomi confirmed that the host institution is committed to providing AIMR with resources sufficient to maintain its activities. President Satomi has also promised to maintain many of AIMR's aspects including the number of its scientists (10 tenured positions) and a budget for sustaining joint laboratories within a world-leading hub.
- The "OAS" and "Graduate School of Spintronics" have been established and the support pledged to AIMR for them by Tohoku University appears to be very solid.

4. Recommendations

- AIMR is expected to create "new materials science capable of predicting new functions based on a mathematics-materials concept." This is a really challenging and long-term target, with the full-fledged fusion of materials science and mathematics remaining a challenge for the future. In addition, benefits for materials science are evident but not visible to mathematics. A two-way cognitive effort, i.e. mathematician learning from materials science and vice versa, is desired to achieve the center's ultimate objectives.
- OAS is highly evaluated for establishing its International Administrative Office and Graduate School of Spintronics, although it is not clear at present how they will be implemented. Continued efforts on institutional reform would be desirable.

F-2. Kavli IPMU

Center director: Hitoshi MURAYAMA

Program officer: Ichiro SANDA, Nagoya University

1. Scientific achievements

- In a remarkably short time a highly productive interdisciplinary center has been created, and its prominence continues to grow. This center is known as a vibrant place to discuss ideas. The reputation and visibility of the Kavli IPMU is very high throughout the global community of mathematicians, physicists and astronomers. The particular combination of physics and mathematics makes it unique. Activities in physics and astronomy include

contributions from theorists and experimentalists.

- Noteworthy experiments are two major instruments on the Subaru telescope (HSC-PFS), three underground experiments (KamLAND Zen; Gadzooks!; Xmass) in the Kamioka Lab. These experiments were proposed by Kavli IPMU researchers.



GADZOOKS experiment was proposed by M. Vagins, professor at Kavli IPMU, to observe supernova neutrinos. Shown is a EGADS detector (Small scale Super Kamiokande) to demonstrate GADZOOKS capability. Credit Kamioka Observatory, ICRR, Univ. of Tokyo

2. Implementation as a WPI center

- Kavli IPMU is a beacon for university reform, both for the University of Tokyo (UTokyo), and for the whole of Japan. Reforms made by Kavli IPMU include the treatment of researchers (e.g. merit-based salary system, annual salary system), tenured positions with non-traditional external funding, the split appointment system, and establishing an international graduate school. These reforms are made under the leadership of Dr. Murayama and with strong support from the host institution UTokyo.
- We are pleased that Dr. Kajita was awarded 2015 Nobel Prize in physics. It is hoped that Kavli IPMU can exert an even larger impact, through ripple effects, on particle and space science research in Japan.

3. Support of host institution toward sustainability

- UTokyo has clearly demonstrated its commitment to securing a permanent future for Kavli IPMU by creating the University of Tokyo Institutes for Advanced Study (UTIAS). UTokyo transferred 13 Full Time Equivalent (FTE) positions, including 4 FTE positions provided by MEXT, to Kavli IPMU through UTIAS.
- It is gratifying that UTokyo has wise and inspirational leadership that recognizes Kavli IPMU as being a treasure of UTokyo.

4. Recommendations

- Regarding the reform on the way research is being done in Japan, the impact of Kavli IPMU could be even larger. The host institution's commitment needs to be more

proactive. The activities of Kavli IPMU should be used as a model to transform UTokyo as a whole and, in particular, its many research centers so that they will become more visible globally.

- Kavli IPMU's ambition to participate in large cutting-edge experiments is perfect, but the required technical support should be carefully determined and kept within budgetary limits. The technical people should remain as Kavli IPMU staff for longer periods than the theorists, who might more easily benefit from mobility to other institutions.
- The number of foreign PI should be increased; PIs should spend more time on site; the number of Japanese postdocs is too small (only one fourth); and the number of graduate students could be increased.
- Utilizing the locational advantage of Kashiwa campus in the future, Kavli IPMU's collaboration with Tsukuba University and other nearby institutions, as well as Chiba University, can be strengthened. This would push ahead reform further at the other institutions as well as at UTokyo.

F-3. iCeMS

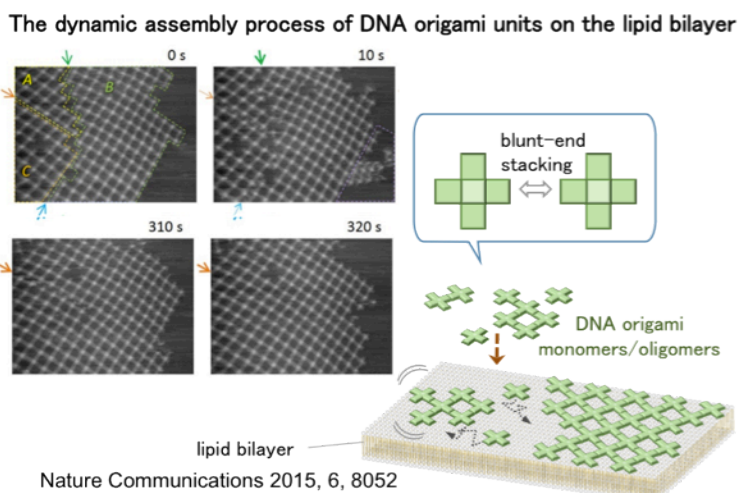
Center director: Susumu KITAGAWA

Program officer: Toru NAKANO, Osaka University.

1. Scientific achievements

- iCeMS is continuing to pursue a high level of research. In FY 2014, iCeMS published 255 peer-reviewed papers, 51 of which were published in journals with an impact factor of more than 10. 216 papers were published with co-authors outside of iCeMS. 1,237 papers have been published since the inauguration of the institute; about 4% of them are Top 1% cited papers, as compiled by Thomson Reuters.
- Synthesis of materials is critically important aspect of iCeMS' mission. iCeMS has synthesized about 1,500 new materials including Dr. Kitagawa's porous gas materials for gas biology, Dr. Sugiyama's SAHA-PI polyamide for histone modification, and Dr. Uesugi's cell adhesion molecules for regenerative medicine.

- In FY 2014, 17 iCeMS researchers received 19 awards including Dr. Kitagawa's 2014 Thomson Reuters Highly Cited Researcher, Dr. Motomu Tanaka's Philipp Franz von Siebold Award, and Dr. Heuser's E. B. Wilson Medal of the American Society for Cell Biology. As to the budget, the acquisition of external grants (a total of JPY 1.834 billion) is very good.



Origami structures rearrange at the lipid bilayer–solution interface through such phenomena as defect/boundary healing and reorganization-coupled growth. This constitutes a bottom-up nanotechnology expected to advance the integration/organization of nanodevices and the development of new molecular devices.

2. Implementation as a WPI center

- Based on iCeMS' self-evaluation, 35 and 92 out of 255 papers are regarded as highly interdisciplinary and interdisciplinary papers, respectively. Publication-based bibliometric methods show that the fusion of areas among biology, chemistry, and physics has steadily improved.
- Taken together with its high scientific level, iCeMS has been realizing the WPI criteria.

3. Support of host institution toward sustainability

- Prof. Yamagiwa, who assumed the office of Kyoto University President in October 2014, inaugurated "WINDOW" as a reform and future concept for the University. "I" of "WINDOW" stands for international and innovative, and the establishment of a leading research hub is one of the main objectives. For that purpose, Kyoto University Institute for Advanced Study (IAS) will start up in April 2016. iCeMS will be included within IAS, but will continue conducting its program as an independent institute, i.e., iCeMS will be consolidated as the core and hub for IAS' frontline research.
- The plan for support after the current WPI program ends is as follows. The institute will consist of 5 core research groups, 15 PI groups (10 younger researchers and 5 overseas researchers), and 10 adjunct research groups (10 PIs and 20 non-PIs). In addition, 20 postdoctoral researchers will be hired using external funding. In total, JPY 2.043 billion (including the salary of adjunct members, building depreciation, land

price, and so on) is secured.

4. Recommendations

- Although the scientific achievement is high, truly visible results, which will be regarded as iCeMS landmarks, may be missing.
- It is necessary to devise a concrete future plan of iCeMS as a major part of IAS of Kyoto University, which will commence next April.
- It is understandable that the fusion of material science and cell biology is quite difficult and contains various directionalities. However, still, the aim of iCeMS seems a little too divergent. More focused subjects would be desirable in view of the size reduction of the institute after the current WPI program funding.

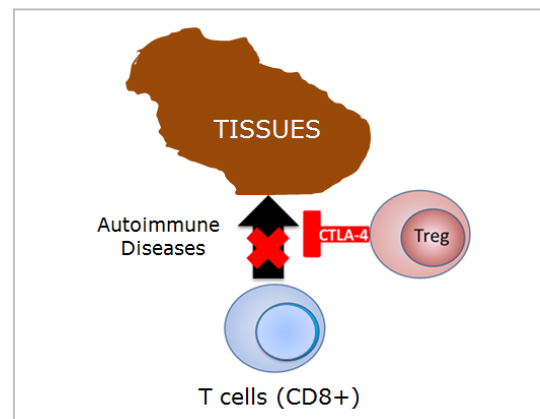
F-4. IFRcC

Center director: Shizuo AKIRA

Program officer: Takehiko SASAZUKI, Kyushu University

1. Scientific achievements

- IFRcC has been successfully pursuing its extremely high quality research in immunology combined with bioinformatics and imaging science. The total number of papers published in 2014 was 195. The number of papers published in high-impact journals (IF greater than 14) was 17 (8.7%).
- These papers include Sakaguchi's elucidation of a new mechanism in Treg cells for controlling antigen-specific humoral immune response through CTLA-4 (Immunity 2014) and for maintaining the self-reactive CD8+ T cells' anergic state in healthy individuals (Science 2014).
- The discovery of the regulatory function of IL-10 producing plasmablasts in autoimmune inflammation by Kurosaki's group and the new finding on the control of lymphocyte egress by β 2-adrenergic receptors by Suzuki's group together with Sakaguchi's findings show the importance of a multiplex concept of regulatory mechanisms in human immune response.



Tregs render self-reactive human CD8+ T cells anergic (Maeda et al. Science).

- It is also important to note that younger-generation PIs have contributed to areas of chronic inflammation, allergy and parasite infection by publishing high impact papers.
- In addition to these scientific achievements made through publications, Shizuo Akira was elected as a member of the Japan Academy, and Shimon Sakaguchi was awarded the Gairdner International Prize.

2. Implementation as a WPI center

Fusion of research areas

- IFRcC has established a platform that includes fusion research units, a research support program, dual mentor system, and interaction seminar series (9 seminars/ 2014) to further accelerate their tight interaction with scientific entities in the areas of informatics and imaging.
- IFRcC created an SPF animal facility equipped with an 11.7 T MRI. Furthermore, it is tightly engaged with QBIC and CiNet, which has a 7.0 T MRI for imaging analysis of the whole human body. All these strategic as well as bottom-up efforts resulted in fusion-research papers reaching 27% of all IFRcC publications.

Internationalization and global visibility

- Continuation of holding international symposia and the Winter School on Advanced Immunology for young researchers, and implementation of outreach activities including an online educational program (Massive Open Online Course, MOOC/ edX) have contributed much to IFRcC's global visibility.

System reform

- IFRcC has introduced a top-down decision system by the center director, which has provided a role model for the University's reform. It is evident that Osaka University regards IFRcC as a role model in terms of the internationalization and system reform of its research environment, which was restated and confirmed by the University's new President, Shojiro Nishio, during the site visit.

3. Support of host institution toward sustainability

- President Nishio clearly declared "Osaka University will construct world top-level research institutes and promote multidisciplinary research." This declaration is in perfect line with IFRcC's mission and activities. The University's central administration must continuously support the activities of IFRcC. President Nishio has indicated that constructive supervision and continuous support for the WPI program is a high priority

for his administrative team.

4. Recommendations

- For future challenge, IFReC should commit to leading translational and clinical research in immunology. This may require additional time, effort, and a substantial amount of financial support. IFReC will need to learn from the Osaka University's past successful experience in transitioning from bench to bedside to develop novel therapies.
- Osaka University is expected to create a new system/rules including for (intellectual interest) IP, freedom of research, etc. before entering into close interaction with private enterprises.

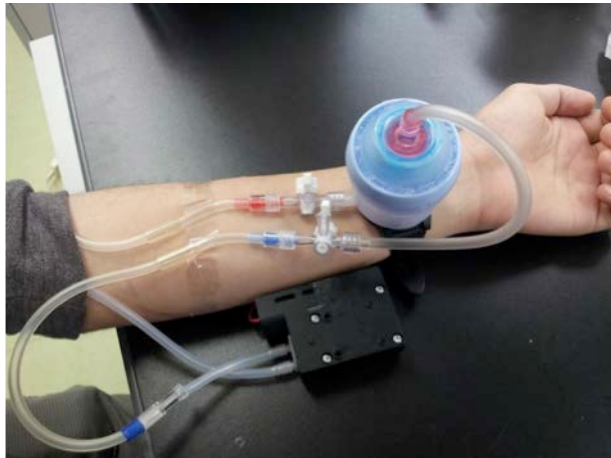
F-5. MANA

Center director: Masakazu AONO

Program officer: Gunji SAITO, Meijo University

1. Scientific achievements

- During the past 8 years, scientific achievements by MANA scientists have been outstanding. Total number of papers is 2,850 of which 106 papers are in the top 1% in the world by number of citations, and their field-weighted citation impact (2.44) is very high and at a world top level. Especially works on nano-photocatalytic materials by Dr. Ye, inorganic nano-tubes and nano-sheets by Drs. Bando, Golberg, and Sasaki, and nano-self-assemblies by Dr. Ariga are highly evaluated and cited. More than 50% of MANA's papers are internationally co-authored.



wrist-worn uremic toxin removal system with a high-performance nanofiber mesh, developed by Dr. Mitsuhiro Ebara and his colleagues.

- In 2014, five PIs (Drs. Ariga, Bando, Golberg, Wang, Yaghi) were selected for "Thomson Reuter's Highly Cited Researchers 2014."

2. Implementation as a WPI center

- Internationalization: MANA is a role model for the internationalization of WPI centers. MANA has 102 permanent researchers (22 PIs, 2 Associate PIs, and 78 MANA Scientists),

78 postdoc researchers, 33 graduate students, and 31 technical and administrative staff (as of March 2015). The proportion of foreign PIs is 36% and foreign researchers is 51%. It is worthwhile to mention that world top-level PIs have joined from satellite institutes such as CNRS, UCLA, Georgia Tech and University of Montreal.

- Fusion research: The following are examples of fusion research between Nano-system and Nano-life Fields in 2014: a) Nanomechanical sensors for detecting cancer from breath by using an array of functionalized membrane-type surface stress sensors (piezoresistive cantilever devices) developed by Dr. Yoshikawa and Swiss scientists. b) A simple way to treat kidney failure by purifying blood using a zeolite-polymer composite nanofiber mesh developed by Dr. Ebara and co-workers at MANA. These examples indicate that interdisciplinary research bridging Nano-Materials and Nano-System to Nano-Life is expanding steadily at MANA.
- International workshops on specific topics: MANA held a topology workshop (174 participants, April) and a nanostructures workshop (214 participants, November). At the spring meeting of the European Materials Research Society (Lille, France, May), four WPI centers (MANA, AIMR, iCeMS, I2CNER) participated in giving the scientific presentations.

3. Support of host institution toward sustainability

- Under NIMS' next seven-year plan, MANA will remain a core research center in charge of one of NIMS' strategic research areas.
- Approximately 90 core members of MANA are assigned to MANA as NIMS permanent staff. NIMS intends to cover MANA's necessary expenditures for research projects, MANA Foundry operating expenses, researcher invitation and dispatch expenses, utilities, and conducting basic research.

4. Recommendations

- Fusion Research: Further promotion of interdisciplinary activities bridging Nano-Materials and Nano-System to Nano-Life, Nano-Power, and the new field Nano-Theory (which will be established from FY 2016) is desired. One issue is how to go about advancing research in the field of Nano-Life.
- Fostering Young Scientists: In order to maintain the number of postdocs and graduate students from Japanese and overseas universities and institutes, it is desired to increase interaction with these organizations. Also, it is important to increase researcher

exchanges between MANA and prestigious overseas research institutes including satellites.

- MANA in NIMS: The program committee would encourage NIMS to maintain MANA as a distinct organizational unit after the end of the WPI grant, so that its unique culture can continue to have a positive influence on the parent organization. It will be important for NIMS to develop a more concrete plan for how to sustain the international approach, commitment to empowering young researchers, and reputation that MANA has developed.

F-6. I²CNER

Center Director: Petros Sofronis

Program officer: Kazunari DOMEN, The University of Tokyo

1. Scientific achievements

- The scientific activity of I²CNER has been significantly improved and it is now producing many world top-level research works in most of its research divisions. Evidence can be seen in its 318 journal publications in 2014, of which, 28 were published in journals with an impact factor greater than 10.
- Each research division has an “I²CNER Division Roadmap”, and the research targets of each division are well aligned with them.
- In Molecular Photoconversion Devices Division, rare-metal free molecules that create light from nearly all currents injected into organic light emitting-devices were synthesized for the first time.
- In Hydrogen Materials Compatibility Division, research revealed a continuously transforming microstructure of metals by hydrogen, which will provide a solid physically-based model of hydrogen-induced degradation of metals.

2. Implementation as a WPI center

- I²CNER has reorganized 4 divisions, i.e. two are new divisions and other two are reconfigured ones. This reorganization has made the divisions’ research targets much clearer, and is expected to push the scientific level of each division up to a world top-level in a near future.



I²CNER's second new building

- Continuous progress is being made in I²CNER's globalization and the international visibility of I²CNER has been enhanced. In addition to a strong connection with the United States, I²CNER has established a large network of excellent quality with European and Asian institutions. But at present, it is not clear how their research will fully benefit from collaboration/competition with foreign Labs.

3. Support of host institution toward sustainability

- In Kyusyu University (KU) President's vision, I²CNER is planned to secure 10 tenured PI positions by 2020, which includes 3-4 foreign PIs, out of 20-25 PIs. As of April 2015, 9 tenured positions (2 full Profs. and 7 Assoc. Profs.) are employed as full-time faculty members.
- KU's Executive Vice President and I²CNER's Director will have a face-to-face meeting every month, so they should discuss the continuous reform of I²CNER as well as KU.

4. Recommendations

- A study should be advanced on societal needs to include experts in environment, sociology and mathematics.
- The theme "environment" embodies a concrete domain of research, whose advancement can be expected to contribute to society. In this context, collaboration with industry is extremely important. Some of the technologies regarded as matured should be transferred to industry. A Technology Transfer plan should be considered.
- The increase of full-time researchers at I²CNER is highly appraised, but the number of foreign researchers still needs to be increased.

F-7. IIIS

Center director: Masashi YANAGISAWA

Program officer: Kozo KAIBUCHI, Nagoya University

1. Scientific achievements

- IIIS has progressed steadily in advancing sleep medicine with various approaches to sleep and related areas, such as emotion, memory, behavior, circadian rhythms, etc. Such a comprehensive approach may facilitate an in-depth understanding of sleep, promising fruitful outcomes applicable to clinical applications and drug development.
- The most impressive project remains the ENU mutagenesis and the isolation of sleepy 1, 2 and dreamless by Drs Yanagisawa & Funato and the orexin agonists. Verification of three mutants (Sleepy 1, 2 and Dreamless) has been presented using gene-modified mice; however, no biology of the genes has been shown yet.
- Although we have signed “Non-disclosure agreement” (NDA), most of the data on sleep-associated genes and drugs are not made fully available to us. Because these genes are of significant importance in understanding the molecular mechanisms of REM and non-REM sleep, publication of all these data should be done promptly.

2. Implementation as a WPI center

Fusion of research areas

- There are clear synergies among the PIs, and the overall environment promotes excellence and cutting-edge approaches. The integration of medicinal chemistry and compound development provides important opportunities for translation of the basic findings.



IIIS' new building

Internationalization and global visibility

- Foreign researchers will be 33% (20/61) at the end of FY 2015, exceeding the WPI target number of 30%. Foreign students are also increasing steadily. The holding of an international symposium in collaboration with Northwestern U., U. Tokyo and RIKEN has obviously contributed to IIIS' international visibility. This annual international

symposium provides junior IIS investigators access to world leaders in neuroscience and genetic research.

System reform

- Under a financially difficult situation, University of Tsukuba (U. Tsukuba) has provided great support from its own budget in building a new facility, in addition to support from the government.
- The Director draws upon his lengthy experience in the United States (US), and he appears to have successfully implemented a US-style institute that is well-supported by a very capable internal administrative staff and by the U. Tsukuba.

3. Recommendations

- Mutant mice isolated by forward genetics and their responsible genes should be published before the next interim-evaluation site visit.
- Drs. Yanagisawa and Funato should describe their strategies for dissecting the functional roles of sleepy 1, 2 and dreamless genes at the molecular levels (signal transduction, expression profile, etc.)
- Reduced external funding in FY 2015 is a big concern but should be recovered in FY 2016 and later. It is necessary for each PI to obtain a larger budget. Supporting grant applications for non-Japanese PIs may be an important issue.

F-8. ELSI

Center director: Kei HIROSE

Program officer: Shoken MIYAMA

1. Scientific achievements

- The Earth-Life Science Institute (ELSI), Tokyo Institute of Technology (Tokyo Tech), has been well established as a WPI center under the robust leadership of Dr. Kei Hirose. From the PIs' presentations and young researchers' posters it is evident that first-class science is being advanced toward achieving ELSI's aims, i.e. elucidating the origins of earth and life.
- The goal of advancing multidisciplinary research projects is itself ELSI's objective. The center is expected to achieve excellent results by advancing joint research that combines the techniques, approaches and theories of outstanding researchers and research groups in different research domains. In addition to a significant number of

peer-reviewed papers published by ELSI members in international journals, the preliminary results, especially those related to geosciences, planetary sciences, and work to understand the Earth's structure and its evolution, presented during the site visit were indeed very encouraging. On the other hand, while their studies on the evolution of life appeared to have been nicely launched, those on the origin of life are still in the process of finding a direction. Members of this area, including a newly joined PI, are expected to produce results in the future.

2. Implementation as a WPI center

Fusion of research areas

- The theme of ELSI research is of itself interdisciplinary, as it covers multiple disciplines: physics, chemistry, geoscience, life science, and complex science. The spectrum of ELSI researchers embodies all these areas, and is in this sense interdisciplinary.
- The acceptance of the research grant “Hadean biosphere” has spurred specific research activities such as the ONSEN project at Hakuba Happou hot-springs, which are examples of achieving success in fusion.



ELSI's new building

Internationalization and global visibility

- ELSI offers a role model for the WPI program by hiring on-site full-time foreign PIs (John Hernlund, George Helffrich, Eric Smith, Irena Mamajanov). As a matter of fact, the WPI program encourages the recruitment of full-time PIs, whereas only a few centers are successful in securing on-site foreign PIs. This is one of the indications that ELSI is a globally visible research center.
- Support of 5.6 million US\$ by John Templeton Foundation is another strong indication of ELSI's international visibility. In addition, ELSI is a certified partner Institute of NASA's Astrobiology Institute (NAI). ELSI is expected to cohost a workshop and hold international conferences in cooperation with NAI. Such activities will raise even further

ELSI's global visibility in the future.

System reform

- ELSI is leading system reform within the entire Tokyo Institute of Technology (Tokyo Tech) operation. In fact, Tokyo Tech should be praised for using ELSI as an engine for driving its system reform. The spillover effects from ELSI to Tokyo Tech include a number of items such as the "International Center", "Special Research Zone", and the new faculty-based administration system.

3. Recommendations

- The Working Group (WG) understands well that solving the "origin of life" problem is very difficult and quite a big challenge. Nevertheless, in next year's interim evaluation, ELSI is expected to give some clues as to how it is moving forward in tackling this challenge.
- It is recommended that ELSI center members carry out appropriate communication with an eye to working toward satisfying the young researchers' desires. It is important for the Japanese administrative staffs to assist in improving research funds for foreign researchers.
- Crossing disciplinary boundaries is notoriously difficult, time consuming and ultimately risky. Young researchers at ELSI need to be given the "room" they need to take risks without gambling away their careers. Such a system would be an extremely powerful recruitment tool for hiring the very best young scientists into positions at ELSI. Management should very seriously consider implementing such long-duration postdoctoral appointments as the norm at ELSI.

F-9. ITbM

Center director: Kenichiro ITAMI

Program officer: Minoru YOSHIDA, RIKEN

1. Scientific achievements

- The progress of the center's research is impressive; ITbM has developed enormous scientific momentum that is resulting in highly visible papers published in top journals.
- The four core and six seed projects currently running at ITbM are challenging and exciting, and their enabling platforms are innovative. ITbM has clearly demonstrated that rapid progress can be made through synergistic interaction between chemists and biologists.

- This is most nicely exemplified by the marked progress made in identifying small molecule modulators of the mammalian circadian clock, seed germination of the parasitic plant *Striga*, and pollen tube guidance.

2. Implementation as a WPI center

Fusion of research areas

- Considerable effort has been devoted to strengthening the fusion aspects of the program. Among ITbM's remarkable achievements emerging from fusion is its recent visualization and identification of the strigolactone receptor in *Striga* using Yoshimulactone, which will pave the way to controlling the devastating global problem caused by this parasitic plant.



ITbM's Mix-Lab in the new building

- Dr. Itami's vision of fusion between chemistry and biology is expected to be further realized through ITbM's well-organized research environment including the "Mix-Lab", where chemists and biologists work together in the new building.

Internationalization and global visibility

- Within an impressively short time ITbM has built a strong national and international identity, supported by a proactive research promotion team.
- The symposia organized by ITbM in Nagoya and its awarding of the Nagoya Medal and other prizes to eminent scientists are quickly raising ITbM's visibility, as are the world-class publications from ITbM scientists.

System reform

- Nagoya University strongly supports ITbM by providing a budget for the construction of its new building. ITbM is having an impact on the entire university as a role model. Indeed, Nagoya University has already established internal "mini"-WPI centers by supporting competitive projects using intramural funds.

3. Recommendations

- ITbM should create a strong identity that distinguishes it from other national and international centers with similar research focuses. Considering the fact that fusion is ITbM's hallmark in creating transformative biomolecules, the number of joint publications is an important parameter for measuring the center's success and identity.
- Development of a strategic plan for the next several years is important.
- It would be worthwhile to consider a summer school and a graduate program, which would further increase the center's international visibility and promote interdisciplinary education that will enhance the effectiveness of its Mix-Lab strategy.
- Strategies for spin-off companies and commercialization of the most promising molecules should be established for the translation of basic achievements.

G. Outreach activities

The WPI Program recognizes the importance of outreach activities, aiming at increasing public awareness and understanding of science. All the WPI centers employ scientists/specialists dedicated to outreach activities. These activities include publishing brochures and pamphlets, providing lectures to the general public, teaching high school students, organizing science cafés, and holding press conferences.

In February 2015, nine WPI centers jointly presented their activities at the "AAAS Annual Meeting" in San Jose, USA.

The highlight of the WPI outreach activities was a joint symposium for high school students held in December 2015 in Kyoto. More than 400 people, including many high school students, enthusiastically participated in it. The Symposium started with an introduction by Mr. Pavel Hejcik, a science communicator, on what is science, followed by lectures by three young researchers of WPI centers (Drs. K. Nagata, iCeMS, K. Yamashita, IFReC, and K. Takai, ELSI) and by Dr. J. Yamagiwa, President



Poster for the joint symposium in 2015

of Kyoto University. It was wrapped up by a panel discussion between the 4 speakers, Mr. Pavel Hejcik, and Ms. Aya Ohta, a science writer, on research notebooks.