Interim Evaluation and Follow-up of WPI Program

By Program Committee

December 2011

Summary

The missions of the WPI program are ambitious; in addition to top quality of science, we requested internationalization, fusion studies and reform of existing systems, aiming to establish internationally opened and globally visible institutions in Japan.

Under these missions, 5 WPI centers were launched in October 2007; they are AIMR on

materials science at Tohoku University, IPMU on universe at University of Tokyo, iCeMS on cell biology at Kyoto University, IFReC on immunology at Osaka University and MANA on nanotechnology at National Institute for Materials Science. In December 2011, the sixth WPI center, I^2CNER, was established on energy issues at Kyushu University.

WPI centers have been followed up closely every year by site visit teams and the Program Committee. Their performance is guided by program director (PD) and program officers (POs). This year, the five initial WPI centers were subjected to an interim evaluation on their scientific achievement and implementation of the WPI missions.

The high performance of the WPI program was evidenced in the questionnaire surveys, in which WPI centers were well-recognized in the science community and highly reputed by scientists.

An assessment of their publications also indicates outstanding scientific achievements of these WPI centers as a whole. The average numbers of citations per paper is 13.9, being ranked fifth after Rockefeller, MIT, Harvard and Caltech. Among 2,500 publications during 2007-2010 period, 5.1% WPI papers are ranked in the "top 1% of papers", second to Rockefeller University.

Interim evaluation of the 5 WPI centers is as follows: AIMR, B; IPMU, S; iCeMS, A minus; IFReC, A; and MANA, A. Definition of scores S, A, B, C, and D is given in Section D-2 (page 8). Following this interim evaluation, these 5 WPI centers will be further supported for the next 5 years.

On the occasion of this interim evaluation, AIMR proposed a new strategy, in which mathematics is injected into traditional materials science of Tohoku University in order create a new materials science. Accordingly, the director will be changed to Dr. M. Kotani, a female mathematician, from FY2012.

A. Outline of WPI Program

In FY2007, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) initiated the WPI Program (World Premier International Research Center Initiative), a highly challenging and long-term program to support the establishment of world-leading research centers.

The WPI Program aims ambitiously at creating globally visible and internationally opened top-world research centers in Japan, in which the world's finest brains gather, outstanding research results are generated, and talented young researchers are nurtured. WPI research centers are expected to be highly innovative in both their concepts and practices.

Following four aspects are essential to being a WPI center.

- Top quality of science
- Internationalization
- Breakthroughs by fusion studies
- Reforming research and administration systems

In FY2007, the Program Committee selected the following five research centers to be funded under the WPI Program:

Advanced Institute for Materials Research (**AIMR**), Tohoku University
Institute for the Physics and Mathematics of the Universe (**IPMU**), The University of Tokyo
Institute for Integrated Cell-Material Sciences (**iCeMS**), Kyoto University
Immunology Frontier Research Center (**IFReC**), Osaka University
International Center for Materials Nanoarchitectonics (**MANA**), National Institute for Materials Science (NIMS)

These WPI centers initiated their research activities in October 2007.

In FY2010, the committee selected

International Institute for Carbon-Neutral Energy Research (**I^2CNER**), Kyushu University as a WPI center for advancing "green innovation". I^2CNER initiated its activity in December 2010.

These WPI centers are supported for a period of 10 years as they meet the above four requirements. This support may possibly be extended for another 5 years for projects with outstanding outcomes.

Interim evaluation of the 5 WPI centers that launched in October 2007 was carried out this time in the 5th year after 4 years after their launching.

B. Major Events in 2010-2011

B-1. M9.0 Earthquake, Tsunami and Nuclear Disasters

A magnitude (M) 9.0 earthquake struck east Japan in the afternoon (14:46) of March 11, 2011. The epicenter was located 130 km off the coast of Sendai and 24 km deep under the Pacific Ocean, causing a devastating tsunami.

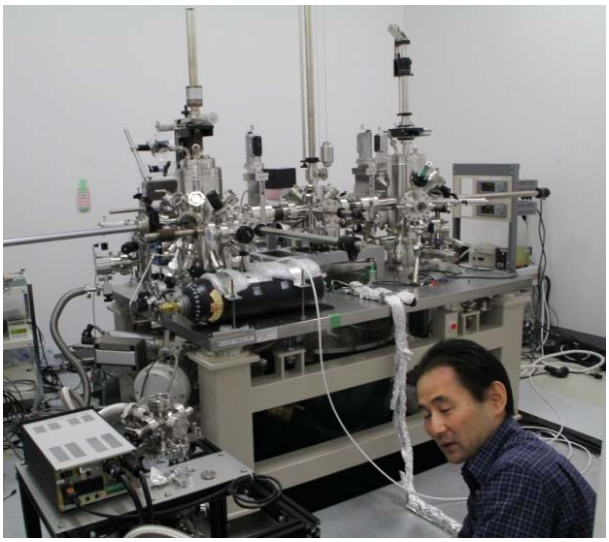

Figure 1: Dr. Hitosugi, AIMR, and his special STM, the optical axis of which was seriously damaged by the earthquake.

The earthquake shook academic facilities in Sendai and Tsukuba. Although nobody was killed or injured and nor were the buildings badly damaged, AIMR and MANA sustained serious damage to their fine equipment including the STM (Scanning tunneling microscope) by the M9 earthquake and the following M7 aftershocks. The damaged equipment has almost been repaired by replacing parts or by realigning the optical axis, etc. (Figure 1).

Costs to restore them are estimated to be approximately 242 million yen (US$ 2.9 million) for AIMR and 200 million yen (US$ 2.4 million) for MANA, which are covered by the government's supplemental budget. However, the most serious loss for the researchers is the loss of time.

Although the TEPCO nuclear power plant accident in Fukushima was followed by the earthquake and tsunami, environmental radioactivity at WPI centers has been at the normal background level or only marginally higher, as shown in Table 1.

Table 1. Environmental radioactivity in 6 WPI centers.

WPI	City	Distance from Fukushima nuclear plants	Environmental dose (μSv/h)	
			Maximum(Mar. -Apr.)	7 months after
AIMR	Sendai	94 km	0.47	0.07
MANA	Tsukuba	170	0.32	0.14
IPMU	Kashiwa	196	0.80	0.22
iCeMS	Kyoto	540	0.13	0.08
IFReC	Suita(Osaka)	570	0.13	0.07
I^2CNER	Fukuoka	1065	0.05	0.04

(Normal range: 0.02-0.13μSv/h)

The triple disasters disquieted people especially those from abroad. Although about 40-70% overseas- researches in AIMR, MANA and IPMU evacuated to outside the country shortly after the disasters, most of them returned after a few months. Short-time visitors are much more affected by the disasters: the number of visitors to MANA, for example, was reduced by 90% compared to last summer. It is anticipated that visitors eventually come back to normal level.

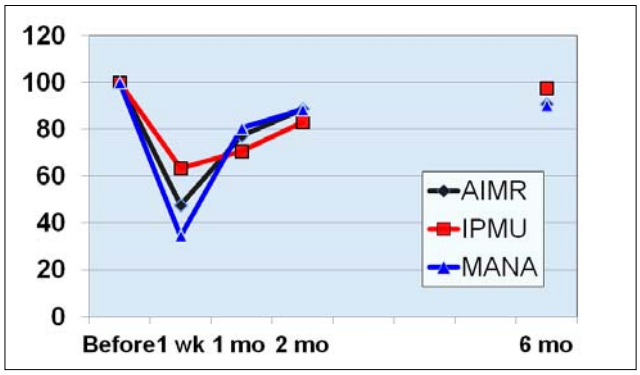

Figure 2: Evacuation and return of oversea researchers after the disasters.

B-2. New Facilities

In FY 2009, the government allocated a supplemental stimulus budget, which included 2 billion yen (approximately 22 million US$) per WPI center for building facilities. Five WPI centers now built new facilities, although those of AIMR and MANA are delayed due to the earthquake. Thanks to the budget, most of the PIs at those WPI centers are now able to work under one roof in their respective centers, although iCeMS is separated into nearby 3 buildings, because of space limitations on campus.

C. Assessment by Questionnaire Survey and Scientific Publications

The five initial WPI centers were surveyed by means of questionnaire and citations. The assessment indicated that the WPI centers are well-recognized and highly evaluated by the science community.

C-1. Questionnaire Survey

After the first survey in 2009, the second questionnaire survey was carried out in April-July 2011 to examine whether the initial 5 WPI centers are maintaining their global visibility and how they are evaluated by the science community. For each center, more than 1000 scientists who published paper(s) in top-ranked journals and 30 leading scientists were selected as respondents. Although response rate was lower (24.0% in 2011 vs. 32.4% in 2009), essentially the same results were obtained as the survey in 2009, as follows:

- Half or more than a half of the researchers (48.2-71.6%) recognized WPI centers of interest.
- A majority of leading scientists recognized WPI centers as places of their interest.
- Almost half (48.3%) of the researchers evaluated the science levels of the WPI centers as "outstanding".
- A majority of the researchers (79.1%) expressed interest in working in a WPI center. including a dual appointment.

(For details, see: http://www.jsps.go.jp/english/e-toplevel/08_followup.html)

C-2. Scientific Publications

Publications from the first 5 WPI centers as a whole were assessed for their scientific impact using the data base of Thomson Reuters as follows:

- Target publications: Papers published during period 2007-2010 by researchers affiliated with WPI centers. Those that mentioned WPI only in acknowledgment are not included.
- Assessment: Number of citations during the above period and their share in the top 1% of papers.
- Compared with 14 overseas and 13 national institutions.
  Oversea institutions: Caltech, CNRS, Harvard, Max-Planck, MIT, NIH, Princeton, Rockefeller, Stanford, UCB, UCLA, Cambridge, Oxford, U. Washington
  National institutions: AIST, Hokkaido U., JST, Keio U., Kyoto U., Kyushu U., Nagoya U., Osaka U., Riken, Tohoku U., U.Tokyo, Tokyo Inst.Tech., Waseda U.

Index 1: Average Number of citations in all fields (Figure 3)

The 5 WPI centers published 2,497 during the above period, which were cited by 34,672 papers, counting 13.9 citations per paper. As seen in the Fig. 3, WPI is ranked in fifth place after Rockefeller, MIT, Harvard and Caltech.

Index 2: Productivity of the "Top 1%" papers in all fields (Figure 4)

Among 2,497 papers, 127 papers or 5.1 % are included in the top 1% of papers. Productivity of the top 1% of papers by WPI is remarkably high, ranking 2nd place after Rockefeller University.

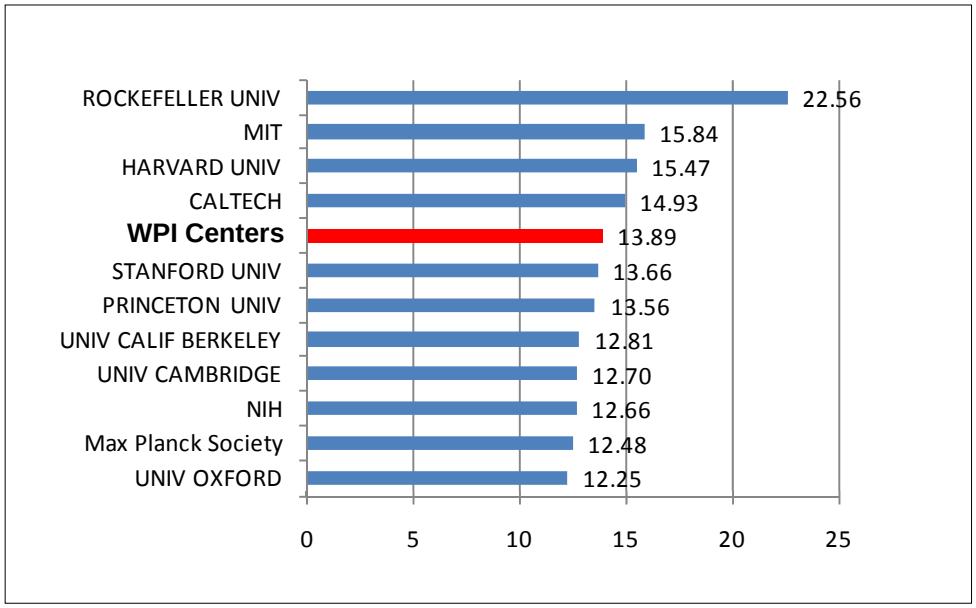

Figure 3: Average number of citations in all fields. WPI centers rank fifth among 27 world-leading institutions, of which 12 are indicated in the figure.

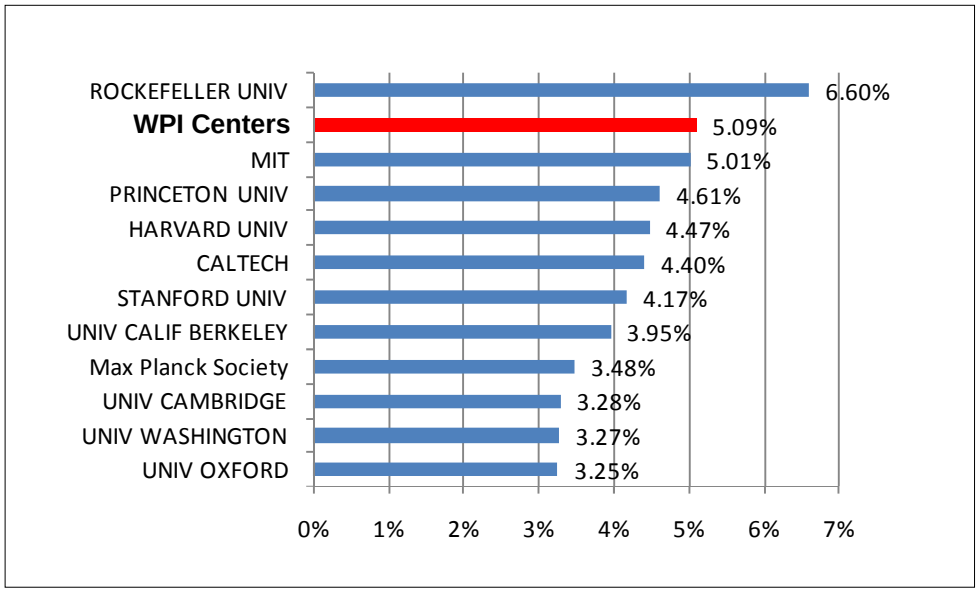

Figure 4: Productivity of "Top 1% of papers". WPI centers rank second among 27 world-leading institutions, of which 12 are indicated in the figure.

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D. Interim Evaluation and Follow-up

WPI centers are followed up once a year by site visit teams and the committee for their scientific achievement and implementation of its missions. Particularly in this year, interim evaluation was made for the preceding 5 WPI centers for 4 years achievement.

D-1. Site Visits

Site visits to the 6 WPI centers were conducted over 2 days in June-August 2011 by the PD, PO, international working group, MEXT and JSPS officials. The schedule included a briefing by the center director, presentations by selected PIs, and poster presentations by young researchers. The PD, POs and members of international working groups are listed in the following URL: http://www.jsps.go.jp/english/e-toplevel/08_followup.html.

For the 5 WPI centers launched in FY2007, an interim evaluation was made on the following WPI missions:

1. Science level,
2. Interdisciplinary research activities,
3. Globalization of the institution,
4. Organizational reform,
5. Future prospective of the centers' projects.

Reports on the site visits were submitted to the committee and disclosed to corresponding WPI centers.

D-2. Program Committee Meeting

A Program Committee meeting was conducted on October 19, 2011, by the members of the committee with the participation of the PD, POs and representatives of MEXT and JSPS. A hearing was conducted on the 6 WPI centers regarding their scientific achievements and mission implementation as WPI Research Centers. As for the interim evaluations of the first 5 WPI centers, overall scores were given for their implementation 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.

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.

Prior to the meeting, the members visited one or two of the 5 WPI center(s) and examined their activities and facilities.

Members of the Program Committee are listed in the following URL:
http://www.jsps.go.jp/english/e-toplevel/07_committee.html.

E. Interim Evaluation

E-1. AIMR

1. Achievement of science

- Several PIs have opened new frontiers and are recognized internationally as leaders in their fields. They have made outstanding contributions in their own research fields and are expected to pioneer a new field of materials science.
- Top-level and original equipment to investigate materials on the atom-nano-level have been successfully developed. This is one of the strong points characterizing AIMR. The center's work on cutting edge imaging techniques, including scanning tunneling microscopy and scanning electron microscopy, is one of its most important outputs to date. Mapping out electronic structures using angle-resolved photoemission spectroscopy is another of its outstanding work.
- Some projects have impressive links with industry. There are significant engineering applications of the science that will certainly be of practical value and impact to critical areas like energy and the environment.

2. Implementation as a WPI Center

- **Fusion:** Over the past four years, AIMR's interdisciplinary research activities have been continuously increasing. The number of joint papers and poster presentations by young researchers has increased considerably in FY 2010.
- **Fusion:** More systematic and strategic approaches to encourage fusion among the groups under the director's leadership are recommended.
- **Internationalization:** The high proportion of foreign researchers can be highly evaluated: Overseas researchers accounted for 50% (68/136) of researchers and 42% (14/33) of PIs in FY 2010. However, most overseas PIs belong to satellite or partner institutions, with very few working on-site.
- **Satellites:** It is recommended that AIMR examine and clarify the real benefits from the 3 satellites and 16 partners.
- **Earthquake:** The effects of the March 11 earthquake and tsunami on the operation of

AIMR were very significant, but it appears that the university/center management have been very effective repairing the extensive damage to facilities and equipment. The fact that major changes to the AIMR program were planned and put in place during this period is impressive.

3. Proposal for new strategy and director:

- We have repeatedly pointed out that AIMR's identification as a WPI center is not clear beyond the existing institute. Indeed, there had been little challenge toward new materials science.
- On the occasion of this interim evaluation, AIMR proposed a new strategy of "math-material science", in which mathematics is injected into materials science in order to create new materials science. This challenge called for a change of director to Professor M. Kotani, a female mathematician.
- Although this is an exciting proposal, the committee had initial concern about its feasibility as a science and about support to the director. Upon request by the committee, Professor Kotani presented a detailed strategy, in which 17 research proposals submitted by materials scientists are categorized into 3 mathematical models.
- Although it is too early to judge the success of this initiative, inclusion of a strong mathematics activity in AIMR, if things go well, will give it a distinct flavor and distinguish it from other materials centers around the world.
- At the same time, there is a risk of materials scientists investing too much in math instead of their core discipline in dream of a future breakthrough. A similar risk exists about mathematicians to be too optimistic for achieving goals.
- Success is largely dependent upon understanding and continuous efforts by both sides, materials scientists and mathematicians. A key issue is the appointment of mathematicians with the abilities required for theoretical materials science. It is important for the director to represent the entire group and embrace all aspects of AIMR's activities, not only in theoretical but also experimental materials science.
- Many members of the committee expressed both hopes and concerns, since it is ambitious and therefore, may be difficult to pursue.
- The committee finally accepted the proposal, but its approval being conditional on careful watch and an additional review of the performance over the next two years.

4. Actions Required and Recommendations

1) It is essential for Tohoku University to be sufficiently committed to supporting the new strategy and director.
2) AIMR's identity along with its new strategy in materials science should be clearly stated.
3) Firm supporting systems should be provided to the new director from material scientists

and mathematicians as well as from the host institution.

4) The performance of the center's science and management will need to be watched carefully over the next two years.

Interim evaluation: B

Beyond a doubt, each PI's activity is at a world-class level. However, it is difficult to judge whether or not the WPI as a whole is presently at a world-class level. The overall impression of AIMR is not as high compared to that based on achievements of its individual PIs. The main reason for this seems to be that the mission as a whole is not fully confirmed by the center members.

The activity of AIMR largely rests upon the strong tradition of materials science of Tohoku University. Individual PIs continue to produce the same high quality of science they are used to, but it is difficult to recognize the positive and interactive influence that AIMR should have as a WPI center.

For the past 4 years, the committee and the site visit team have pointed out that a clear strategy needs to be established under the strong leadership of the director in order to create a new materials science beyond the existing institute. However, AIMR had not taken this seriously until introducing the new proposal. Organizational failure in tackling a new challenge over past years is a major factor behind this "B" evaluation.

E-2. IPMU

1. Achievement of science

- IPMU is definitely on its way to being one of the top institutes of its kind in the world. The center is now running in a "creative mode," establishing itself as a peer among other "centers of excellence."
- The Institute is truly interdisciplinary: Physics, mathematics and astronomy, with contributions by theorists and experimentalists. The organization benefits from communication between the members of different disciplines; besides dailly coffee break, there are weekly (or more frequent) seminars, a retreat once a year, and semi-annual workshops, etc…

- In theoretical physics, the center's current scientific level is evaluated as excellent based on the number of papers and their citations, as compared to other top-class institutions around the world.
- In mathematics, all four PIs are world-leading mathematicians in their fields, and the accomplishments by them and the other five faculty staffs are of a top world-level. Interaction with physics is becoming more evident in their publications recently.
- In experimental physics, there are 3 experiments conducted at the Kamioka underground laboratory in which IPMU is playing a leading role: 1. Search for neutrinoless double beta decay (KamLAND-Zen); 2. Detection of low energy neutrinos from historic supernovae at cosmic distances (EGADS); and 3. Direct dark matter search (XMASS). As for observational cosmology using the SUBARU telescope, SuMIRe is led by IPMU's director and will become a front-runner in that field. All these projects are progressing on schedule.

2. Implementation as a WPI Center

- **Fusion:** At IPMU, young researchers with different backgrounds are brought together by top-down initiatives, with an expectation that their interactions will bear fruit through bottom-up efforts.
- **Fusion:** Strong effort being made to fuse string theory and mathematics, which has the potential to create a new branch of mathematics. We appreciate the efforts of the PIs who spend a great deal of time forming bridges between mathematics and physics. Young researchers are now going back and forth between math and physics over these bridges. Also, cosmology and particle physics have been stimulating each other for some time.
- **Globalization:** Success in globalization is clearly visible in many areas: (1) the ratio of scientists fully supported by IPMU is 50-50 between foreign and domestic; (2) the ratio is 34 foreign to 11 domestic for postdocs; (3) all scientists are encouraged to spend one month outside of Japan; (4) there is large number of foreign visitors; and (5) collaboration with overseas organizations is abundant in experimental projects.
- **Administration:** There is also good administrative support for the center's internationalization effort
- **Reform:** University of Tokyo (UT) announced in 2010 establishment of the Todai Institute for Advanced Study (TODIAS), in which IPMU is the first member institute.
- **Outreach:** The efforts in outreach are in all directions using all media tools , not only for the benefit of the Institute, but also for all scientific comunity.

3. Endowment from a Private Foundation

- We learned that a private foundation based abroad has recently proposed providing a multi-million dollar endowment to IPMU, of which 5% interests by management by the foundation will be given perpetually. Upon acceptance, IPMU will bear the name of the donor.
- The working group and the committee had discussions on various aspects of this matter including change of the name. As the prestige associated with the endowment will bring wider global recognition and help sustain the long-term success of IPMU, the committee supported the proposal.
- UT is willing to accept the endowment from the foundation.

4. Actions Required and Recommendations

1) With the establishment of TODIAS, UT is in a position to give a certain number of tenured positions to IPMU. The committee anticipates that researchers may be concerned about their futures and leave IPMU for more secure positions. We recommend that UT should put some care into adopting a globally accepted meaning of "tenure".
2) We strongly encourage foreign joint appointments at the faculty levels, which will enhance personnel exchanges. The director is a good example of this. Such appointments can offer benefits to the appointees.
3) IPMU could leverage advances in data mining and informatics in pursuing forthcoming exciting HSC observational cosmology research.

Interim evaluation: S

We all highly evaluate IPMU's past 4 years of activities and scientific achievements. During a short period, IPMU has established itself as a world-renown institute from scratch.

IPMU has demonstrated outstanding progress toward achieving the goals of the WPI program in all areas – quality of science, globalization, interdisciplinary approach, and organizational reform.

The leadership of Professor Murayama is highly appreciated.

E-3. iCeMS

1. Achievement of science

- Overall scientific level is excellent, especially the publications of Drs. Yamanaka on iPS cells and Dr. Kitagawa on porous structure are outstanding. Honors awarded to PIs are also impressive: Lasker Award to Dr. Yamanaka, Humboldt Award to Dr. Kitagawa and National Academy of Sciences membership for Drs. Yamanaka and Heuser.
- Cell-materials integration is a major target of iCeMS's research, as indicated in its title. iCeMS should pursue this aim with more interdisciplinary collaboration.
- Most of the presentations by PIs during the site visits addressed technological innovations (which themselves are fine), but they failed to identify biologically important questions that remain unsolved in the field of stem cell research.
- A series of review and original articles on "meso science" is being prepared, which will contribute to wide recognition of the biological significance of "meso" within the community of biologists.
- Institutional collaboration between iCeMS and CiRA, which is essential in elucidating basic mechanisms of ES/iPS cells, has been promoted only recently.

2. Implementation as a WPI Center

- **Fusion:** It is plausible that a lot of potentially interesting interdisciplinary and in-wall collaborative projects are being carried out. Especially, the topics of many young investigators are in interdisciplinary research fields.
- **Fusion:** Remarkable progress was noted in iPS studies through collaboration with chemistry. These include chemical probes for iPS cells and chemical transcriptional switch.
- **Fusion:** Discovery of small-molecule absorbing porous materials by Dr. Kitagawa is starting to contribute to biology through interdisciplinary collaboration.
- **Internationalization:** The percentage of foreign researchers and efforts of foreign PIs in iCeMS are gradually increasing. One third of researchers including 3 PIs and 3 Kyoto-fellow (junior PIs) are from overseas. Dr. Heuser now spends more time (50% of his time effort) in Kyoto.
- **Young researchers:** One of the important aims of this kind of institute should be to cultivate of young investigators. Raising such scientists from a post-graduate level and recruiting those students is imperative for the future of iCeMS.
- **Future prospects:** Future prospects of the center are not clearly mentioned. It seems that it will continue its present studies without any alteration or emphasis.

3. Actions Required and Recommendations

1) iCeMS's identity is seen as being diverse and ambiguous. There seems to be three

pillars for research subjects at iCeMS, i.e. cell-material integration, meso-scale control in cell, and ES/iPS cells. A clear mission statement for integrating these important subjects is needed.

2) Integration of cells and materials should be given high priority as a subject to be studied.
3) In order for iCeMS to better establish itself as a WPI institute, it will be essential for all its members to understand and implement its mission.
4) Environments for the active participation of young researchers should be created.
5) Future prospects for the next five years should be clearly stipulated. The ongoing research subjects should be critically reviewed over the next 2 years.

Interim evaluation: A$^-$

Scientific results are outstanding, at least in iPS cell research, functional porous structures, new probes and control of stem cells. They are recognized by honors, awards and grants, which increase the global visibility of the WPI.

In past years, however, we have expressed concern about two issues: one being "meso-scale control of cells" and the other the relationship between iCeMS and CiRA.

Meso-scale architectures in cell are undoubtedly an important subject, but its concept in biology is still premature, compared with chemistry and physics. At present, only prefatory reports have been published from iCeMS, being still far from a whole picture of "meso-control".

The relationship between iCeMS and CiRA has become clearer than before: one of the four groups of CiRA with 6 researchers is now involved in iCeMS and studies on basic mechanisms of iPS cells. However, in order to maintain a productive relationship between them, continuous leadership and collaboration by the two directors will be required.

Following the advice of the International Advisory Committee, Cell-Material Sciences is now more emphasized as a mission of iCeMS. Indeed, it is the name of iCeMS, i.e. "Institute for Integrated Cell-Material Science". However, there are still a few visible interacting studies between cells and materials.

Final evaluation of iCeMS is "A$^-$ (A minus)." This is because of iCeMS's diverse and ambiguous undertakings, with insufficient integration among disciplines up to now, although breakthrough publications by Drs. Yamanaka and Kitagawa are highly evaluated.

E-4. IFReC

1. Achievement of science

- IFReC has had a very high scientific standard from the start. There continues to be impressive progress as documented by the fact that publications by several of its members are top ranking and among the internationally most cited papers in immunology.
- In the last 2 years, the center's immunology-imaging fusion projects have made great progress by introducing substantial technological innovations to immunology-imaging science. The Informatics group has also made significant contributions to immunobiology studies in the center.
- The research environment of IFReC is excellent and has been very much enhanced by the completion of the new research and animal facility buildings. The immunology and imaging facilities are now under one roof, thereby facilitating intensive interactions between immunology and imaging experts.

2. Implementation as a WPI Center

- **Fusion :** The center is highly appraised for its strong effort to promote "fusion" in the fields of immunology, imaging science, and informatics, by such means as establishing the "Research Support Program for Fusion of Different Fields" and "Double Mentor Program" for young researchers.
- **Fusion :** The new IFReC research building (8000m^2) contains immunology laboratories, imaging facilities, and bioinformatics facilities. Thus, scientists from these different research fields can easily meet and engage in joint projects.
- **Internationalization:** IFReC has been very successful in recruiting foreign researchers. Presently, the total number of non-Japanese researchers is 56 out of 173 (32%).
- **Young researchers :** A seed funding program encourages younger researchers to take on grand challenges within IFReC's scope. The Center director is to be applauded for giving younger researchers freedom and mentoring.
- **Fellowship:** The Kishimoto Fellowship Foundation is praised for the important role it plays in recruiting ambitious and able young scientists.
- **Visibility:** The scientific reputation of IFReC has been growing on a very broad

international level, thereby generating even more visibility within the international scientific community. Thus, IFReC in Osaka is emerging as a top world institution.

3. Actions Required and Recommendations

1) Imaging and informatics communities are making rapid progress worldwide, and strong imaging and informatics efforts at IFReC could add greatly to the center's overall goals. The center should consider strong measures to attract the very best candidates in bio-imaging and bio-informatics.
2) It is critical for imaging and bioinformatics scientists to ask immunological questions, which would foster the development of new tools and approaches for basic immunology as well as clinical immunology.
3) Although the center's self-evaluation report emphasized medical immunology as a future plan, no detailed strategy on targeted areas was provided. A clear strategy, roadmap and millstones for innovative medical immunology over the next five years should be presented.
4) The gender issue has not been sufficiently pursued. IFReC needs to intensify its efforts to hire more female PIs and junior researchers. Only one female PI, Dr. Coban, has been listed throughout these years.

Interim evaluation: A

During its first phase of its operation, IFReC has made remarkable progress. The center's many superb scientists, its combination of immunology, imaging, and bioinformatics, its stimulating scientific environment, and the support it receives from Osaka University provide a unique platform for innovative and excellent science in the future.

By maintaining its current performance, IFReC will yield highly productive and superb science in immunology-related work.

Osaka University has set up two distinct but deeply connected institutions; the Center for Information and Neural Network (CiNET), and the Quantitative Biology Center (QBiC). Deputy director of IFReC, Professor Yanagida, has taken responsibility to direct both centers. Through these actions and plans, IFReC will have a productive and fruitful future.

E-5. MANA

1. Achievement of science

- Remarkable subjects of MANA include atomic switch, terahertz radiation from Josephson junctions using high Tc superconductor, STM and AFM manipulation technologies (Nano-system group), nano-sheets including high-*k* nanodielectrics, nano-tubes (Nano-materials group), photocatalytic materials (Nano-green group), and their applications.
- The shift of nanoarchitectonics from the nano-scale world to an integrated view is specific for MANA, which is based on NIMS, making it possible to achieve a specified research program.
- Researchers in the nano-bio area are relatively new and are not yet fully integrated into the MANA culture or fully engaged in the top level vision of the institute.

2. Implementation as a WPI Center

- **Fusion:** The MANA Fusion Research Fund is a successful top down approach to encouraging interdisciplinary research. Even more innovative is the idea of holding regular "Grand Challenge Meetings" and "Melting Pot Activities". At such meetings, scientists are to present "crazy" ideas and discuss the main obstacles to realize them, so that other scientists can contribute to unsolved problems and start collaboration.
- **Globalization:** MANA has established 6 satellites at such universities as Cambridge, UCLA, etc. These satellites have served as initially planned to assemble researchers from around the world, and also as venues for training MANA's researchers. MANA has accepted almost 90 interns, of whom 80 are foreigners. It provides both technical and clerical support to facilitate their research.
- **Support:** MANA's research environment is well-functioning and well-organized in a manner that provides all researchers with full technical and clerical support bilingually.
- **Earthquake:** Although MANA's facilities were damaged by the earthquake, they have been recovered by the efforts of its staffs and financial support from the government.
- **Management:** The management appears exemplary, maintaining a nice balance between top-down actions for efficiency and bottom-up proposals for curiosity.
- **Future plans:** The director listed the following three research areas as primary targets for the next five years: 1) neuromorphic computational circuits, 2) room temperature superconductivity, and 3) artificial photosynthesis. These challenging future projects in MANA are excellent.

3. Actions Required and Recommendations

1) In comparison to other WPI centers, MANA's goals seem modest and not "earthshaking" outside of the material science community. It needs to create greater exposure outside of that field.
2) Nono-bio is still not well adopted in MANA, in which "nanoarchitectronics" expertise is not intensively used. Further efforts are needed to advance highly competitive research subjects e.g. nano-DDS and drug-eluting stent.
3) More theoreticians should be integrated into the projects in order to guide and support the research.
4) There is a concern about so few PI's choosing to take sabbaticals to high quality foreign laboratories and institutions staffed with high-caliber researchers.
5) MANA relies on support by NIMS. Especially, shared use of big equipment and delivery of high-quality starting materials are essential for research at MANA. The high percentage of foreign scientists at MANA can only be maintained if the technical support by NIMS continues.

Interim evaluation: A

MANA has made considerable progress over these 4 years, becoming a world-leading institute in materials science attracting scientists from all over. Its proposal to become the hub of a network linking nanotechnology bases is being actually demonstrated.

The succession of ICYS (International Center for Young Scientists) has worked to secure able postdocs and young researchers internationally. The high proportion of foreign researcher (57%) is highly evaluated and MANA seems to be one of the best research organizations in Japan in terms of internationalization.

MANA has established very effective programs for fostering young scientists, such as "3D program" (Double mentor, Double affiliation, Double discipline), "MANA short-term research program", "International graduate schools", and teaching program at universities.

F. Follow-up

F-1. I^{2}CNER

1. Achievement of science

- It is too early to evaluate any scientific achievement in the research projects at I^{2}CNER just half a year since it started.
- Research is going fairly well with collaboration of University of Illinois and Kyushu University (KU). Some PIs' scientific research levels are very high in the relevant fields, especially those of hydrogen storage and materials transformation.
- The young research members are very active and excellent in their achievements. However, the WPI program generally requires a core-mass of 10-20 world top class PIs. I^{2}CNER still does not meet this criterion.
- The effort rates of the PIs are generally not large enough for a WPI center. A commitment by the PIs at a higher than present percentage of time is mandatory to perform the planned research. They range from 15 to 90% among KU PIs, of which only two KU PIs belong to I^{2}CNER, while the rest are affiliated with other faculties of KU. At least 10-20% of center-residing foreign PIs should be achieved.
- There was no PI from Illinois participating at the time of the site visit. Although 9 foreign PIs are listed, their effort rates are low ranging from 3 to 35%. They should be more proactively participating in the activities of I^{2}CNER.

2. Implementation as a WPI Center

- **Director:** The center director needs to devote more time to the Center during this phase in which PI's are being identified and engaged. At a minimum, a strong local (associate) director should be emphasized. This solution is essential if the director cannot devote 50% of his time sooner than planned (three years).
- **Director:** The initial network and leadership by the director seems to be a critical catalyst for connecting center's activities to the outside the world. Such expansion to wider domains may not have been possible within such a short time span without a director from outside Japan.
- **Visibility:** The visibility of I^{2}CNER has steadily increased with director Sofronis' effort to publicize the center as well as to cultivate a collaborative framework with many research institutions in the US and Europe.

- **Fusion:** I^2CNER should initiate appropriate action toward the creation of fusion studies. New interdisciplinary projects should be created to cover the gap between existing team projects by top-down suggestions from I^2CNER leader and senior PIs. To do this, issue-driven research would be a promising pathway. As the bottom-up approach, frank discussion should be most important for developing fusion.
- **Faculty:** Various ambitious trials, such as the appointment procedure, the independent working style of all faculty members including young members, and the research proposal assessment based on a white paper, should be pursued further. One full professor and four associate professor positions are provided to I^2CNER by KU. This indicates that the host institute regards I^2CNER equally with its other existing faculties and institutes.
- **Budget:** As for the funding committed, it is necessary to define a clear structure for finances, money allocation etc. for both center partners, and to define rules for accountability. Illinois partners must use allocated resources as leverage to secure additional block funding from the US, which is critical to the success of the partnership.

3. Actions Required and Recommendations

1) The physical presence of director Sofronis in KU should be at least more than 50% of his time, which should be reached earlier.
2) The number of researchers is not yet at the required level. At this early stage it is critical that the Institute's recruitment of additional researchers proceeds expeditiously but at the same time attracts the very best candidates.
3) The effort rates of PIs should be raised to a reasonable level, at least more than 50%, as a WPI center. More active participation from Illinois is necessary. At least 10-20% of center-residing foreign PIs should be achieved.
4) I^2CNER should establish its own vision and roadmap toward a carbon-neutral society over time scales of short, middle and long ranges.
5) The mission of the WPI program does not seem to be exactly understood among scientific and administrative staff members.