FY 2007 WPI Project Progress Report
World Premier International Research Center (WPI) Initiative

Host Institution	The University of Tokyo	Host Institution Head	Hiroshi Komiyama
Research Center	Institute for the Physics and Mathematics of the Universe	Center Director	Hitoshi Murayama

Summary of center project progress

IPMU is on its way to become a world-visible, truly international and multi-disciplinary center to address fundamental questions about the universe using tools of mathematics, theoretical physics, experimental physics, and astronomy.

We have added two new principal investigators. Kyoji Saito is a senior mathematician who worked on the critical foundation for the mirror symmetry that became very important in physics (string theory). He will reside in Kashiwa and lead the local group of mathematicians with Akihiro Tsuchiya. Their presence will realize co-location of mathematicians and physicists on Kashiwa campus, a vast improvement in the synergistic activities since the proposal. Mihoko Nojiri from KEK is a theoretical physicist, the first woman among the PIs. She will build a critical mass of the LHC phenomenology group with the Director Murayama towards the stated research objectives.

We have announced positions worldwide, and attracted 562 applicants, including 414 non-Japanese. We have already secured at least 18 postdocs to join IPMU, including 13 non-Japanese (5 Asians) and 4 women. On April 1, full-time IPMU faculty will consist of five project professors, two project associate professors, and three project assistant professors, together with four non-Japanese students, and four postdocs (one female). About twenty more will join in the fall. Discussions are being finalized to share postdocs with world-leading institutions such as Berkeley, Caltech, CERN, DESY, IHES, Max-Planck Institute, Princeton.

We have six full-time administrators thanks to generous support by the University, together with ten part-time administrative staffs. Seven of them are bilingual, and the support staffs will be further added to help researchers, especially those from outside Japan. University will build a new research building for IPMU, expected for occupancy in fall 2009, with a budget of approximately $20M. Its design work is well under way, and it focuses on interactive environment to enable synergies among different subfields.

One of our research objectives is to decipher the nature of dark energy. For this purpose, we now participate in the SDSS-III project, to enhance our experience with large-scale cosmological data, to recruit best postdocs with the immediate data availability, and to prepare for future wide-field weak lensing survey with the HyperSuprimeCam project. We work closely with NAOJ to design the HSC camera.

We intend to enhance the existing SuperKamiokande and KamLAND experiments by appointing key persons to IPMU. One project professor will develop a method to detect relic supernova neutrinos by doping SuperKamiokande with a gadolinium compound. One distinguished postdoc will study if xenon can be dissolved into KamLAND to search for neutrinoless double beta decay in order to understand neutrino's role in the existence of matter in the universe. A satellite is being built on the Kamioka site to facilitate close collaboration with ICRR, Tokyo and RCNS, Tohoku.

We successfully organized the Opening Symposium and three international workshops. The number of non-Japanese visitors already exceeds sixty including numerous seminar speakers. The workshops led to formation of a new working group on LHC phenomenology that involves scientists from around the world. Another workshop focused on Asian researchers to strengthen the ties.

The science and unique structure of IPMU attracted high media interest, with 27 newspaper articles and a national TV coverage in Japan already, as well as many others in international media outlets. It is impacting public at large, resulting in a ¥1M private donation and strong interests from students through public lectures.

1. Summary of center project

<Initial plan>	<Results/progress/alternations from initial plan>
This center aims at establishing a multi-disciplinary research institute with the unifying goal of understanding the universe from the synergistic perspectives of physics, cosmology and mathematics. The institute brings the world's leading theoretical physicists and mathematicians together to develop new formulations of the fundamental laws of nature, a crucial step toward solving the mysteries of the universe. We will develop infinite analysis, the mathematics for systems with infinite dimensional degrees of freedom, which will be used to build new physical theories and derive their experimental predictions and to invent statistical methods to analyze geometric data. We will study dark energy, dark matter, neutrinos, and physics beyond the Standard Model of elementary particle physics. The institute builds on the state-of-the-art facilities (Super-Kamiokande, KamLAND, Subaru telescope, and LHC accelerator) that will produce an unprecedented amount of precision data for observational cosmology, astronomy and elementary particles physics. We aim to develop new mathematical tools to analyze the data by taking full advantage of collaboration between mathematicians and physicists, and will develop new experimental strategies to attack the mysteries. This center is a unique research institute in the world on the forefront of physics, cosmology and mathematics and will lead to a new paradigm of sciences in the 21st century. It will attract highly motivated young researchers, as well as established leading scientists from around the world and will greatly strengthen the foundation of mathematical and physical sciences in Japan. We will also bring topnotch female researchers as role model to inspire women in Japan and promote Asian diversity. - Include a chart that illustrates the center's overall structure including its collaborative linkages with other domestic and foreign institutions, its system of external evaluation, and its management framework	None of the initial plan has been changed, while we are making progress in implementing the plan. (1) We have added a new Principal Investigator, a senior mathematician Kyoji Saito whose work has provided critical foundation for the recent progress in mirror symmetry in algebraic geometry that was inspired from physics (string theory). He will reside in Kashiwa together with Tsuchiya, realizing co-location of mathematicians and physicists. (2) We have added a female Principal Investigator, Mihoko Nojiri from KEK, to build a critical mass for LHC phenomenology, who also serves as a role model to inspire women in Japan. (3) We convened a workshop for Asian mathematicians and mathematical physicists to promote Asian diversity. (4) We work with the university to design and build a new research building. It will provide 5900 square meters of space, and focuses in a large interaction area among researchers to encourage synergy among them in different subfields. (5) Science and structure of IPMU attracted strong media and public interest. There have been 27 newspaper articles and a national TV coverage in Japan about IPMU already, in addition to several international coverages. IPMU science is already inspiring young minds, *e.g.,* through public lectures by two of the PIs in Sendai. (6) We have successfully added UC Berkeley Physics Department as one of the collaborating institutions. We are also engaged in an active discussion with Fermilab management for collaborations.

2. Research fields

<Initial plan>
Physics and Mathematics

- Describe the importance of the proposed research, including domestic and international R&D trends in the field and Japan's advantages.
- If centers in similar fields already exist in Japan or overseas, please list them.

Science's fundamental and historic search for the fundamental laws of Nature is built on the invention of new mathematics, and it has inspired many important developments in the field. Famous examples include the simultaneous invention of Calculus and Newton's mechanics and the use of Riemannian Geometry in General Relativity. The interface of physics and mathematics is alive and well. Approximately 40% of Fields Medalists in mathematics since 1990 have worked in areas closely related to quantum field theory and string theory. Conformal field theory in two dimensions, whose development was largely motivated by string theory, has been used to explain the remarkable identities about the Monster group (Field Medal to Borcherds) and to describe stochastic geometry (Fields Medal to Werner). Methods of topological string theory have revealed deep connections among the Gromov-Witten invariants, gauge theory instantons, and combinatorics (Fields Medals to Kontsevich and Okounkov). In return, these mathematical developments have provided powerful tools for quantum field theory and string theory.

No other area of science has had such a great impact on mathematics in the past few decades, and the rate of progress in this area suggests that this trend will only accelerate in future. As stressed, for example, in a recent National Research Council report, "Rising Above the Gathering Storm," in the United States, building up strength of mathematical and physical science is a key to lead in a highly competitive world scene of science and technology. Coincidentally, the Science Council of Japan warned recently that Japan's foundation of mathematics is at risk due to not attracting young talented minds into this fundamental field. At the proposed Institute, we will build a community of physicists and mathematicians, redefine the boundaries between them and help nurture future generations of mathematical scientists. Uniquely to this Institute, we anticipate cross-career development between mathematics and physics, such as a statistician moving to experimental physics.

<Results/progress/alternations from initial plan>
There are no changes in the research fields, while we are enhancing the synergy among them.

(1) We are building an IPMU satellite on the Kamioka site to enhance collaborations with ICRR (Tokyo) on SuperKamiokande and XMASS, and with RCNS (Tohoku) on KamLAND.

(2) We need to strengthen the data analysis skills in observational cosmology before we can effectively plan for the data pipeline of the dark energy study with a wide-field weak lensing survey planned with HyperSuprimeCam. We therefore will be involved in the SDSS-III project in the US, where the BOSS survey focuses on the better characterization of the dark energy parameter using baryon acoustic oscillation. This involvement will also allow for IPMU to host a mirror server for the current SDSS-I and SDSS-II data which will be a strong attraction for recruiting best researchers to IPMU.

(3) We are exploring ways to enhance the existing SuperKamiokande and KamLAND experiments. We decided to appoint an American professor who works on possible addition of gadolinium to the SuperKamiokande detector to detect relic supernova neutrinos, as well as a Russian distinguished postdoc who works on possible addition of xenon to the KamLAND detector to see if neutrinos could have produced matter asymmetry of the universe.

(4) In order to break down the intellectual barriers between mathematicians and physicists, we call a retreat annually and share research programs with each other. The first retreat in February was a big success in nurturing mutual understanding. We also run joint workshops for mathematicians and mathematical physicists. The first one in March featured Asian scientists and discussed common problems for geometers and string theorists.

Mathematicians and physicists have very different work styles. Although two PI's for mathematics stay in their current Komaba campus, Tsuchiya will spend time in Kashiwa as a Principal Investigator, and Saito will reside in Kashiwa, who facilitate communication between physicists and mathematicians and maintain activities in this area throughout the year. There will be semi-annual workshops that bring mathematicians and physicists together where they will share their common problems. Once that is established, they will keep communicating over phone and video on individual bases, visiting each other on as-needed basis, as well as organized seminars broadcast over the video to maintain mutual interest. We also plan to have a state-of-art video conference system and internet-blackboards between Kashiwa and Komaba that stay on 24/7 to make impromptu discussions possible.

Our advantage of experimental programs is evident. Japan continues to lead the field of underground physics including dark matter search and study of neutrinos by capitalizing on two major underground detectors (Super-Kamiokande and KamLAND) at Kamioka, where a satellite of the Institute will be established. Some principal investigators of the Institute are now building a new instrument that enables a wide-field, deep survey of galaxies at Subaru telescope. The data from this instrument will most likely dominate the field of observational cosmology and astronomy well into the next decade. Scientists in our Institute will have the first-hand access to high quality, high precision data available from these world premier facilities. LHC, the world highest energy accelerator, will become operational by the end of this year and the data of high energy collisions that mimic Big Bang, the birth of the Universe, will be available to us. By bringing together the world-leading mathematicians, theoretical physicists and experimental physicists and taking advantage of the data available at the Institute, we will take on challenges of solving the mysteries of the Universe. This is another reason why most active world-class scientists should come to work at the Institute.

The Institute we will establish is a unique research center in the world that spans pure mathematics, theoretical physics, experimental physics, astronomy, and applied mathematics. This kind of Institute will be truly unique in the world. Kavli Institute for Theoretical Physics is an excellent institution, yet does only theoretical physics. There are many first-rate institutions that combine research in mathematics and theoretical physics, such as Isaac Newton Institute for Mathematical Sciences in Cambridge, Institute for Advanced Study in Princeton, IHES in France, and MSRI in Berkeley, but none of them include experimental physics in their program.

There are also great institutions on both theoretical and experimental physics, such as CERN, Fermilab, SLAC, KEK, but none of them have mathematicians. The combination of science the proposed Institute will include should attract best people from the world because of its uniqueness and potential for major breakthroughs. This project is timely and important in that Japan has currently positioned herself to lead this research field and in that this initiative meets demand for Japan to keep a cutting edge in global and competitive Science and Technology environment.	

3. Research objectives

<Initial plan> - Describe in a clear and easy-to-understand manner the research objectives that the project seeks to achieve by the end of the grant period (in 10 years). In describing the objectives, the following should be articulated in an easily understandable manner: What new domains are expected to be pioneered by fusing the target fields. In the process, what world-level scientific issues are sought to be resolved. What is the expected impact of the scientific advances to be achieved on society in the future. - Describe concretely the research plan to achieve the objectives, and any related past achievements by the host institution. At this Institute we address big questions about the universe, its fundamental laws, its beginning, its fate, and its mysterious components, such as Dark Matter and Dark Energy. For this purpose, we will create new mathematics needed for the unified description of the universe. It will enable new physical theories with testable predictions. Technological innovations follow to make new experiments possible; whose data will further stimulate development in mathematics. This upward spiral will move the science forward, exciting the public at large and motivating students to enter mathematics, science, and engineering to become the next-generation workforce. Even though it is difficult to accurately predict the possible deliverables from this Institute aimed at basic (not applied) research, here are a few examples of new possible domains we may pioneer on the ten-year time scale:	<Results/progress/alternations from initial plan> There are no changes in the research objectives, while we took concrete steps to approach the stated objectives. (1) We conducted three international workshops. The first one focused on LHC phenomenology, where new working groups were formed with researchers from the US, Italy, England, Germany, Korea and China to enable data analyses of the anticipated data. The second one brought experts working on neutrino mass from completely different angles: cosmological data, supernova astrophysics, underground experiments, accelerator-based experiments, laboratory experiments, theoretical models, connection to matter asymmetry, nuclear physics, to enhance mutual understanding of systematic issues. The third one brings Asian mathematicians and mathematical physicists together to build stronger ties among Asian nations in this active area of research. (2) We conducted a worldwide search for 3-year regular postdocs, 5-year distinguished postdocs, assistant professors, associate professors, and full professors. We attracted 562 applicants, including 414 non-Japanese. We have already secured 18 postdocs to join IPMU, including 13 non-Japanese and 4 women. (3) On April 1, full-time IPMU faculty will consist of five project professors, two project associate professors, and three project assistant professors, together with four non-Japanese students, and four postdocs (one female). (4) We are bringing in topnotch researchers from around the world. One

- Effort by string theorists to enumerate and classify solutions leads to development of new class of geometries.
- New data on dark matter from underground and accelerator experiments of the Institute require new paradigm in particle physics changing the course towards the unified theory in physics, and require new mathematics.
- Mathematical developments in integrable systems allow string theorists to work out new class of solutions that suggest a dynamical behavior of Dark Energy, and prompt new type of observational strategies in spectroscopic galaxy surveys.
- The vast data from the next-generation galaxy surveys nudge the applied mathematicians and statisticians to develop a novel method to extract subtle information from the last data set, uncovering an unanticipated new behavior of Dark Energy.

In all anticipated examples including those above, pure mathematics, theoretical physics, experimental physics underground, astrophysical, and accelerator-based, and instrumentation will motivate each other's efforts in a way not possible in the usual structure of academic institutions where these activities tend to be decoupled from each other. All of these scientific objectives are keenly shared worldwide, and any discoveries at the Institute will have immediate impacts on the global scale.

To ensure this cross-development of this type, we assembled an amazing group of researchers from around the world. They all have a strong track record in working on subjects not confined in their specific research areas, but extend well beyond the boundaries.

The Institute also builds on the strengths of the Japanese science community in many ways. University of Tokyo and Tohoku University lead the world in well-known success in neutrino physics and move to wider scopes of underground experiments such as dark matter searches. The Subaru telescope, the largest field of view among the world 8m class telescopes, will be exploited.
There is a long tradition for physicists and mathematics to work together which was especially true in the 90's and can be revamped in the 21st century. There is close relationship between theoretical and experimental particle physicists working on physics beyond the standard model which is unparalleled in the world.

Nobel laureate and Fields medalist came to the Opening Symposium, and we are making arrangements to bring in Princeton astrophysics faculty to IPMU on a regular basis. We attracted more than twenty interested in visiting professorship in the next fiscal year.

(5) We are making agreements to share postdocs with world-leading institutions such as IHES, Caltech, Berkeley, DESY, CERN, Max-Planck Institutes, Princeton. Two models are being implemented. One is to extend the term of postdocs up to five years that is split between IPMU and a partner institution. The other is an exchange program, *i.e.*, mutual visits by postdocs for a month or two periods.

The research plan is mostly about bringing in superb scientists in the relevant areas as termed professors, postdocs, and visitors. All Principal Investigators have a strong track record in securing and managing competitive grants for their research. Focused workshops at the interface of physics, mathematics, and astronomy will bring in worldwide leading scientists to the Institute and breed new directions in the fields and redefine their boundaries. Generous start-up packages and seed money for developing new ideas towards future experiments will bring in competitive grants further. Frequent interactions among the PI's ensure new directions will emerge at the interface of the traditional boundaries of the subfields. We anticipate big societal impacts of the Institute in the following way. The questions that the proposed Institute addresses are easy to relate to for laypersons. Excitement in the new paradigms in our understanding of the universe spark interest and imagination among young students and more of them enter the fields of mathematics, sciences and engineering to build a stronger future workforce. New experimental initiatives from the Institute will require new technologies in particular in instrumentations, which get transferred to the industry for new purposes. For instance, development in multi-fiber technology needed for future galaxy surveys may well lead to medical applications. It also reverses the tide of brain-drain from Japan not only by bringing back the Japanese researchers who left the country, but also bringing worldwide researchers to Japan because of the attractive research opportunities.	

4. Management

<Initial plan>

1) Composition of administrative staff

The administrative staff is an integral part of the Institute. The administrative organization belongs to Directorate that consists of the Director, Deputy Directors and Administrative director. Because this Institute belongs *directly* to the Office of the President (without any other intervening layers of administration), the University has committed to make administration resource at the University headquarter available to the Institute. The Institute directorate will have direct access to the administration office at the University headquarter and will share its resources. With this direct coupling to the Office of the President, we envision our administrative organization will be streamlined, yet very effective to provide the best possible environment to the researchers in the Institute.

On site, we will have, under the administrative director's supervision, offices devoted to 1) general affairs and human resources, 2) financial/budget planning and accounting 3) information and public communication/outreach, and 4) international affairs. Each office consists of a chief officer and a few assistants. These offices will perform day-to-day administrative function and will, whenever necessary, work directly with the directors of the institute. The office of international affairs is particularly important for the institute. It helps our foreign employees and visitors to find houses, international schools for their children, and helps for organizing international conferences and workshops. We hire skilled experts for many sections and plan to fill more than 50% of staff member positions by persons who are bilingual.

2) Decision-making system

As shown in the organization chart included in the section of Project Summary, except for personnel decisions regarding the center director and principal investigators (PI's), which will be made by the President, the center Director has a complete authority of making a wide range of decisions, including proposing recruitment of PI's to the President, appointing staff researchers, postdoctoral researchers, research support staff members and administrative employees. The Director will be assisted, whenever needed, by two deputy directors and by the administrative director.

The administrative director conducts administrative business and oversees the staff members who take care of visitors from other Japanese institutions and from abroad. His function enables the Director to spend more time to consider the Institute at large and to focus on the direction of the research.

<Results/progress/alternations from initial plan>

1) Composition of administrative staff

At the start of the center, one deputy division head and three chief officers were transferred from the university administration bureau. Subsequently, two more chief officers were transferred on November 2007, totaling six key staffs. The organization consists of administrative director (arrived October 16, 2007) and five divisions under its supervision: general affairs and human resources, accounting, international affairs, budget, and purchasing. One supporting staff assists each of these five divisions. In addition, we have one staff who handles the library, a secretary for the director, a supporting staff for the administrative director, and a project assistant professor whose responsibility is to manage computer, network, and other IT related items. One new secretary to support scientific staffs is expected to arrive in April, 2008. We are advertising four positions that specialize in public relation, outreach, international symposia, and documentations, under the supervision of the administrative director.

The present administrative team successfully supported the Opening Symposium and three other international workshops, handled six cases of relocations for foreign researchers, including housings and international schools for the families.
Presently, 7 out of 17 staffs are bilingual. We have not achieved our goal of making it 50% by the end of FY2007. But we expect that 12 out of 22 staffs will be bilingual by early FY2008.

2) Decision-making system

The executive board meeting was set up with members consisting of the director, two deputy directors, and the administrative director.
The meeting is regularly held to ensure smooth and swift decision makings. The director has a complete authority regarding the organization and management of the Institute in accordance with the proposal of the project.

The Director will have direct access to the Office of the President and will be able to consult with the President and his assistant staff members. The Scientific Advisory Committee (SAC) reporting to the Director consists of four to five PI's of his choice. They advise the Director on planning of hiring staff members as well as scientific directions. The role is strictly advisory. The Director is solely responsible for making the final decisions. The PI's have a large autonomy in the research they conduct and they are encouraged to fund their research through competitive grants. They can make a proposal to the Director to hire postdocs and termed professors to help their research. The Director's approval on the proposed appointments will reflect the scientific vision and priorities set by the Director, who may consult the SAC as needed. Of particular importance is the External Advisory Board (EAB) who will review annually the scientific achievement and activities of the Institute and advise the Director on the scientific priorities and the research activities to keep the Institute stay on the course of the proposed science. At least half of EAB members consist of scientists from institutes other than the University of Tokyo. 3) Allocation of authority between center director and host institution We have agreement with the Office of the President that except for the appointment of the Director and approval of appointments of PIs, the center Director has the authority to make a wide range of decisions from how to compose and organize the institute to how to operate it.	A total of eight members of SAC were selected. They are the director, two deputy directors, and five among PI's. The committee is actively giving advice to the director based on the strategy set at the startup time. Selection of 2 project professors, 3 project associate professors, 3 project assistant professors, and 18 postdocs was completed according to the proposals from PI's and the final decisions by the director. Selection process for another project associate professors is under way, in addition to active discussions about approximately twenty more potential faculty candidates. The EAB which advises President of the University of Tokyo on the implementation of the project proposal was formed from 8 well-respected scientists in the fields related to this center. The first EAB, held on March 13, reviewed activities of the center since its startup and reported to the President. The director is making every possible effort to recruit young and brilliant researchers. He is doing his best to inform the scientific results which come out from the center by several press releases. Media is showing strong interest. 3) Allocation of authority between center director and host institution They are proceeding according to the initial plan.

5. Researchers and center staffs

i) “Core” to be established within host institution

Principal investigators

	At beginning	Planned for end of FY 2007	Final goal (Date: month, year)	Results at end of FY 2007	April, 2008
Researchers from within host institution	10	10	10 (Mar,2009)	10	10
Foreign researchers invited from abroad	5	5	7 (Mar,2009)	5	5
Researchers invited from other Japanese institutions	5	5	5	5	5
Total principal investigators	20	20	22 (Mar,2009)	20	20

All members

	At beginning	Planned for end of FY 2007	Final goal (Date: month, year)	Results at end of FY 2007	April, 2008
Researchers <Number of foreign researchers among them and their percentage> [Number of female researchers among them and their percentage]	20 <5, 25%>	68 <14, 21%>	195(Mar,2011) <69, 35%>	63 <17, 27%> [1, 2%]	73 <22,30%> [3,4%]
Principal investigators <Number of foreign researchers among them and their percentage> [Number of female researchers among them and their percentage]	20 <5, 25%>	20 <5, 25%>	22 (Mar,2009) <6, 27%>	20 <3, 15%> [1, 5%]	20 <3,15%> [1,5%]
Other researchers <Number of foreign researchers among them and their percentage> [Number of female researchers among them and their percentage]	0 < , %>	48 <9, 19%>	173(Mar,2011) <63, 36%>	43 <14, 33%> [0, 0%]	53 <19,36%> [2,4%]
Research support staffs	0	10	20 (Mar,2009)	10	11
Administrative staffs	3	10	10	7	8
Total	23	88	225	80	92

ii) Satellites <Initial plan> <u>Institution (1)</u> The institute establishes a satellite at Kamioka to promote closer collaboration with the neutrino group. It locates close to the Super-Kamiokande and KamLAND detectors. It gathers researchers who work on the underground experimental activities such as study of neutrino physics and XMASS, a new dark matter search experiment that has recently been funded. Two PI's, Professor Masayuki Nakahata of Kamioka Observatoy, ICRR, University of Tokyo and Professor Kunio Inoue of Research Center of Neutrino Science, Tohoku University, will be stationed at the satellite and we will have researches jointly appointed from neutrino group. One of the PI'S has already a grant with scientists at NAOJ to pursue the dark energy project. We also gather scientists from the world to conduct an analysis on the data from LHC. We have already a candidate for an associate professor. -Role -Personnel composition and structure -Collaborative framework	<Results/progress/alternations from initial plan> <u>Institution (1) IPMU Kamioka Satellite</u> -Role We are strengthening a tie with the neutrino group that is conducting the measurements of neutrino oscillation and searching for proton decay and dark matter using the existing SuperKamiokande (University of Tokyo) and KamLAND (Tohoku University) detectors, and the XMASS detector under construction. -Personnel composition and structure The team from the University of Tokyo, under the PI Masayuki Nakahata, consists of one professor, 3 associate professors, 7 assistant professors, and 3 postdocs. The team from the Tohoku University, under the PI Kunio Inoue, consists of 2 Associate professors, 3 Assistant professors, and 4 postdocs. -Collaborative framework All the members listed above actively join the effort of this center through the satellite, not only for the discussion of their new results but also for pursuing new possibilities of neutrino measurements which might give an impact to the understanding of the universe. There is no change to the above from the initial plan.
iii) Partner institutions <Initial plan> <u>Institution (1)</u> 1) IHES(Institut des Hautes Etudes Scientifiques) in France (for mathematics), 2) Yukawa Institute for Theoretical Physics, Kyoto University (for mathematics and theoretical physics), 3) Department of Physics, Kyoto University (for neutrino physics), 4) Department of Mathematics, Kyoto University (for mathematicians), 5) High Energy Accelerator Research Organization (KEK) (for neutrino physics) and	<Results/progress/alternations from initial plan> <u>Institution (1) National Astronomical Observatory</u> -Role A collaborative effort for the SUBARU telescope observation is being set up. A team lead by PI, Ken'ichi Nomoto, conducting observation of supernova and other astronomical objects and a team lead by PI, Hiroaki Aihara, exploring the dark energy, are setting up joint efforts in the R&D of a wide-angle camera and data acquisition system. The software development for the data acquisition system was the main effort this year.

6) National Astronomical Observatory in Japan (NAOJ) (for dark energy survey and astronomy), 7) Department of Astrophysical Sciences, Princeton University in USA (for dark energy survey and astronomy), -Role -Personnel composition and structure -Collaborative framework <u>Institution (2)</u>	-Personnel composition and structure The NAOJ team consists of professor Hiroshi Karouji (head), one associate professor, 2 assistant professors, and 3 postdocs. -Collaborative framework A close collaborative effort between NAOJ and PI's will be set up to achieve the mission described above. There is no change to the above from the initial plan. <u>Institution (2) High Energy Accelerator Research Organization</u> -Role A team of theorists at KEK examines new data of LHC experiments from the theoretical perspectives of Higgs particle, SUSY particles, and dark matter. -Personnel composition and structure The team lead by PI, Mihoko Nojiri, consists of one professor and 2 postdocs. -Collaborative framework The team tries to give an interpretation to the new data from accelerator experiments searching for dark matter under the framework of the supersymmetric theories, and conduct collaboration with other PI's for examining their relation to the questions of the universe. There is no change to the above from the initial plan. <u>Institution (3)</u> Department of Physics, Kyoto University -Role The team works with the SuperKamiokande experiment for the measurements of neutrino oscillation, searching for proton decay and dark matter. This year's effort was mainly to set up good communication with other PI's and to inform the present status of our knowledge and future direction. -Personnel composition and structure The team consists of Associate professor, Tsuyoshi Nakaya (head), one assistant professor, and 2 postdocs. -Collaborative framework Collaborative effort is set up with other PI's for the future direction of neutrino oscillation experiments.

	There is no change to the above from the initial plan. Institution (4) Department of Astrophysical Sciences, Princeton University -Role It collaborates with the team lead by Hiroaki Aihara to construct a new type of wide-angle camera for the exploration of dark energy. -Personnel composition and structure The team consists of PI, David Spergel, 4 professors, one assistant professor, and 3 postdocs. -Collaborative framework David Spergel, plays a key role to set up a strong tie between Princeton and IPMU. There is no change to the above from the initial plan. Institution (5) Department of Physics, University of California Berkeley -Role It examines the new data from LHC experiments and gives theoretical interpretation about Higgs particle, SUSY particles, and dark matter. -Personnel composition and structure The team consists of one professor, Lawrence Hall, one associate professor, Yasunori Nomura, and 5 students. -Collaborative framework The team works closely with the IPMU director Hitoshi Murayama. Hitoshi Murayama, Berkeley professor at the time of IPMU's startup, took an appointment as the IPMU director from January 2008. Consequently, Department of Physics, University of California Berkeley was added as a partner institution for the purpose of making close collaboration with IPMU. Institution (6) IHES (Institut des Hautes Etudes Scientifiques) -Role It collaborates with Hirosi Ooguri and Kyoji Saito on new developments in mathematics which are closely related to physics. -Personnel composition and structure Director and Professor Bourguignon. Negotiation is taking place to share

	postdocs between IHES and IPMU on this collaboration. -Collaborative framework A close collaboration is pursued through hosting of joint workshops and sharing of postdocs. There is no change to the above from the initial plan. Institution (7) Yukawa Institute for Theoretical Physics, Kyoto University -Role Collaboration in mathematical and theoretical physics with IPMU members. -Personnel composition and structure Director and Professor Tohru Eguchi and Associate Professor Ken'ichi Izawa. -Collaborative framework A close collaboration between Eguchi and PI Hirosi Ooguri, and between Izawa and PI Tsutomu Yanagida, are pursued through their joint appointments and frequent visits to IPMU. Institution (8) Research Center for Neutrino Science, Tohoku University -Role Collaboration in KamLAND experiment with IPMU members. -Personnel composition and structure The team lead by PI,Kunio Inoue consists of 2 Associate professors, 3 Assistant professors, and 4 postdocs. -Collaborative framework Operation, data analysis, R&D for the future upgrade of KamLAND. From the time of application, Research Center for Neutrino Science, Tohoku University was a collaborating institution to actively join the IPMU research activities through Kamioka Satellite, so that this Center was added as an IPMU partner institution.

	Institution (9) Department of Mathematics, Kyoto University Department wishes to stay in the role of collaboration at the individual levels rather than the institutional level, and we drop it from the list of collaborating institutions.

6. Summary of center's research environment

<Initial plan> 1) Environment in which researchers can devote themselves to their research The Director will secure the funds to hire administrative staff and research support staffs to assure that researchers of the Institute be exempt from paper works associated with conducing researchers. In addition, for PI's from University of Tokyo, the Office of the President will provide resources that enable PI's to substitute their teaching duties in their original departments. 2) Startup research funding Many of PI's of the Institute have already secured research fund by winning competitive grants. The Director will secure startup funds for young researchers and postdoctotal fellows hired by the Institute. 3) Postdoctoral positions through open international solicitations We will post all the job openings on major journals of the community such as Physics Today and will contact proactively via Emails leading scientists of the field, both in Japan and abroad, to solicit outstanding candidates. 4) Administrative personnel who can facilitate the use of English in the work process In the fields of particle physics, mathematics and astronomy it has been the standard practice for researchers to speak English for work-related communication. We will assemble administrative staff members as well as research support members who are fluent in English with help from the Office of the President.	<Results/progress/alternations from initial plan> 1) Environment in which researchers can devote themselves to their research The funds have been secured to hire administrative staffs and research support staffs to assure that researchers of the Institute be exempt from workload not related to their research. The university made a decision to provide a fund starting 2008 to hire substituting teaching staffs for fulfilling teaching duties of PI's belonging to the host institution. 2) Startup research funding We provide annual research fund of 500,000yen to each postdoc. We support researchers at or above assistant professor rank according to their needs. 3) Postdoctoral positions through open international solicitations We advertised for more than 20 positions. It was done through English language home page of IPMU, as well as Physics Today, CERN Courier, American Mathematical Society Magazine, American Astronomical Society Magazine, and numerous emails to leading researchers worldwide. 4) Administrative personnel who can facilitate the use of English in the work process Presently, 7 out of 17 administrative staffs are bilingual. It will be increased to 50% by early 2008.

5) Rigorous system for evaluating research and system of merit-based compensation Salary of the center director will be negotiated through the office of the President. Annual salaries for PI's will be decided by the Director. Salaries of researchers other than PI's will be decided by the Director with consultation to Deputy Directors. Evaluation of researchers will be strictly merit-based and will include citation counts, invited talks at international conference, cross-disciplinary papers, salaries at competing institutions abroad, and leadership roles at the Institute.	5) Rigorous system for evaluating research and system of merit-based compensation There is no change from the initial plan.
6) Equipment and facilities, including laboratory space, appropriate to a top world-level research center The University administration pledges to build a new building on Kashiwa campus for the Institute. The architecture will follow the style of Kavli Institute for Theoretical Physics at UC Santa Barbara and Center for Theoretical Physics at UC Berkeley with a large open area and amenities. It will provide an attractive and competitive environment for researchers from around the world. We plan to have a state-of-art video conference system and internet-blackboards among Kashiwa, Hongo, Komaba, Kamioka and other collaborating institutions that stay on 24hours a day, 7days a week to make impromptu discussions possible.	6) Equipment and facilities, including laboratory space, appropriate to a top world-level research center Conceptual design of the new laboratory building, which was intended to provide attractive and interactive atmosphere, is complete and the detailed design contract was given. The building is expected to be completed in fall, 2009.
7) International research conferences or symposiums held regularly to bring world's leading researchers together Annual international conference at the Institute as well as long-duration workshops à la Kavli Institute for Theoretical Physics and Aspen Center for Physics will be held. They will bring in visitors to further stimulate the intellectual activities and keep the Institute at the forefront of worldwide science.	7) International research conferences or symposiums held regularly to bring world's leading researchers together We hosted the opening symposium in March, 2008. Among the attendants were thirteen world-leading invited speakers including one Fields Medalist and one Nobel Laureate. The symposium was broadcasted worldwide via internet, and accessed by more than 200 viewers. We plan to host a symposium of equivalent quality annually.
8) Other measures, if any The University is constructing Kashiwa International Lodge that will be a main residential facility for foreign researchers who have moved to the Institute and short-term visitors. Meanwhile, the University will help the foreign researchers to find housings. The Institute's foreign affairs office will	8) Other measures, if any Kashiwa International Guesthouse is scheduled to open in April 2010.

fully conduct the business related to foreign researchers together with the Office of the President.	

7. Criteria and methods used to evaluate center's global standing

<Initial plan>	<Current assessment>
1) We introduce quantitative and objective methods to evaluate the Institute's global standing. The number of refereed journal papers, the number of citations of the papers the Institute researchers published, and the number of presentations our researchers deliver in the major international conferences will be kept monitored and tracked. These "numbers" form a base of evaluation of the center 's global standing. 2) The number of visitors and the number of foreign visitors among them are another objective indicator to measure the activity and visibility of the Institute. 3) In order to evaluate how effective the Institute is to bring mathematicians and physicists together, we plan to monitor the number of publications co-authored by mathematicians and physicists. It will be a measure of the synergy between the two disciplines. The proposed institute has already positioned itself as one of the most cited Institutions in Physics research. This is because all the principal investigators we assembled are leading scientists in their own discipline and the number of citations of each investigator is outstanding. Criteria 2 and 3 are, of course, yet to be applied. The goal to meet the criteria 1) is clear. We will maintain the statue of the most cited Institution in Physics and Mathematics. We aim to be one of the most visible research organizations in Physics and Mathematics.	1) Number of preprints that were presented on research directly related to IPMU objectives since the startup of IPMU is 54 from principal investigators and 6 from other full-time IPMU staffs, out of which 31 have IPMU preprint numbers. All except 2 mathematics papers were either submitted or to be submitted to refereed journals. However, we are using this method of totaling this time due to a short time period since the startup of IPMU. Number of talks that were given at major international conferences on IPMU related subjects is 43 from principal investigators and 3 from other full-time staffs. Number of public lectures on IPMU related subjects is 3 from principal investigators and 1 from other full-time staffs. In future, we add number of accepted papers and number of citations as we planned. 2) Total number of visitors was 168, of which 65 were from abroad. 3) There was 1 preprint that was jointly presented by mathematicians and physicists. It was submitted to a refereed journal.

8. Securing competitive research funding

<Initial plan>	<Results/progress/alternations from initial plan>
- Indicate the total amount of research funding (e.g., competitive funding) secured by principal investigators who will join the center project. Itemize	We secured $7.86M (using Exchange Rate JPY/USD=120) in FY2008.

by fiscal year (FY2002-2006) taking into account the percentage of time each will devote to research activities at the center vis-à-vis the total time they spend conducting research activities（"Effort (2)" in Appendix 2）. For example, if this percentage is 70%, then 70% of his/her research funds can be counted in calculating the total amount of research funds. FY2002: $9.7M, FY2003: $10.9M, FY2004: $9.5M, FY2005: $13.2M, FY2006: $13.6M (in units of US dollars, Exchange Rate: JPY/USD=120) Grand total of competitive funding awarded to PI's over past 5 years is $56.9M. ii) Prospects after establishment of the center - Based on the past record, describe the concrete prospects for securing resources that match or exceed the project grant. - Calculate the total amount of research funding (e.g., competitive funding) based on the percentage of time the researchers devote to research activities at the center vis-à-vis the total time they spend conducting research activities（"Effort (2)" in Appendix 2）. Be sure the prospects are realistically based on the past record. Principal Investigators of the Institute have already secured competitive funding that amounts to approximately $55M, the same level as that of the past five years. We are, therefore, confident to maintain the same funding profile well into the era of this new Institute.	

9. Other important measures taken to create a world premier international research center	
<Initial plan> - Describe activities and initiatives to be taken after project funding ends. We intend to keep the Institute as the advanced institute of the University, a permanent entity that belongs to the University. We plan to work, with the Office of the President, to raise the fund. - Describe expected ripple effects（e.g., how the proposed research center project will have trailblazing components that can be referred to by other departments in the host institution and/or other research institutions when attempting to build their own top world-level research centers）.	<Results/progress/alternations from initial plan> We believe fundraising is an important aspect in both the operation of the institute as well as securing the future after the WPI funding ends. We started to work on raising funds. So far, we managed to obtain a private donation of ¥1M, and are actively approaching private foundations to raise funds for future endowment. Successful recruiting of a large number of non-Japanese researchers will provide guidance to other departments as a model case. Some of the PIs actively worked on Global COE proposals in physical

We are confident that our aggressive approach to assemble the world-leading scientists from other institutions from within Japan or from abroad and our ambitious organization will have significant impact to the University. Also the merit-based evaluation system we introduce would be so attractive to young researchers that it could become a model that other institutions would follow. - Describe other important measures to be taken in creating a world premier international research center, if any. We will be proactive to raise funding for the Institute. In particular, we engage fundraising from the private sector both in Japan and abroad. In order to promote competitive atmosphere among PI's and senior researchers, we plan to institute a named distinguished professorship. It will be awarded by the Institute Director to an Institute professor after rigorous evaluation of his/her performance at the Institute. - If one or more of the projects applying for Global COE program have some connections with this research center project, list the project title(s) , outline(s), group leader(s) and the relationship(s) with this project. Since the call for proposal of Global COE program for the disciplines related to the Institute, which are mathematics and physics, is scheduled for FY2008, there are no Global COE programs to list. Some of PI's, however, will definitely be involved in some of Global COE proposals that are under consideration. We as the Institute will seek close collaboration with such Global COE programs once they have been more developed and its relevance to the Institute has become more evident.	sciences. Two of them are the lead PIs of their respective proposal. These proposals are an important step for IPMU to provide support to Research Assistants, and to give teaching opportunities for faculty.

10. Host institution's commitment	
<Initial plan> -Provision in host institution's mid-to-long-term plan The University of Tokyo's medium-term research objectives include "investigating exploratory and advanced research and unconventional research areas or actively approaching a new fusion of different academic	<Results/progress/alternations from initial plan> -Provision in host institution's mid-to-long-term plan A clear statement was added to the University of Tokyo's medium-term research objectives, saying "We give one of the highest priorities to the setting up of the World Premier International Research Center, Institute for

fields with full respect for research schematization and succession, thereby playing a role to drive forward network-based research with a global perspective." The accompanying medium-term plan states that the university is dedicated to "promoting the establishment of a center for advanced research of excellent creativity and originality in new fields, while fostering the development of new academic areas through interdisciplinary research and collaboration" and "in response to issues newly rising out of academic development and social changes, promoting the establishment of an international research center to deal with such issues in a pioneering, flexible, and practical manner beyond existing academic areas and organizational frameworks."	the Physics and Mathematics of the Universe, for investigating the origin and evolution of the universe through close collaboration among mathematics, physics, and astronomy.
In order to implement the medium-term plan mentioned above, the University of Tokyo has set up the Integrated Research System for Sustainability Science, the Network for Life Science Research, and other inter-departmental organizations under Office of the President to establish a system to promote multi-disciplinary research. Institute for the Physics and Mathematics of the Universe (IPMU), facilitated by the WPI Initiative, most appropriately meets the University's medium-term goals and plans, hence it shall be positioned as the largest and most important organization among those under Office of the President, and enjoy university-wide support under the specific achievement targets.	In order to achieve the goal of the medium-term objectives, the university placed the IPMU directly under the office of the president as the highest priority cross-disciplined research center.
-Concrete Measures (1) Competitive grants obtained by researchers participating in the project and in-kind contributions, etc.	-Concrete Measures (1) Competitive grants obtained by researchers participating in the project and in-kind contributions, etc.
The University of Tokyo will position the IPMU as an organization directly under Office of the President working as a natural facilitator with existing university organizations. The Administration Bureau shall develop an ideal research environment to ensure that chief researchers engaged in research at the IPMU have minimum possible university duties to allow ample time for them to fully focus on research activities, and that research funding may be more readily secured. As part of developing such an environment, with the aim of securing excellent researchers as well as high-caliber support staff, a new employment scheme has already been implemented whereby it is even possible to recruit exceptionally qualified staff at salaries higher than that of the President. Priority is also given for the use of school research space. Furthermore, the Administration Bureau shall have an organization named the Financial Strategy Office whose task is to develop plans strategically to obtain external funding and to allocate it	We secured a temporary space in Kashiwa where the researchers and staffs can conduct their activities until a new building is completed. We also set up the IPMU administrative division with 6 staffs within the Kashiwa campus administration department. This organization ensured a smooth startup of the institute. Financial Strategy Office, which was set up within the university administration, should also help to support the institute financially.

effectively. This shall allow the maximum financial support for the IPMU, while making full use of university resources including overhead costs for the program.	
(2) System under which the center's director is able to make substantive personnel and budget allocation decisions The University of Tokyo has newly developed an innovative scheme to allow the positioning of the IPMU as an organization directly under Office of the President working in an organic linkage with existing university organizations. Under this scheme, the IPMU may take charge in the operation of the organization under the managerial supervision of the director of IPMU, including for the recruitment of researchers.	(2) System under which the center's director is able to make substantive personnel and budget allocation decisions The center's director is able to make all decisions including hiring of scientific staffs because the center is placed directly under the university president's office.
(3) Support for the center director in coordinating with other departments at host institution when recruiting researchers, while giving reasonable regard to the educational and research activities of those departments In order to ensure that education and research activities may be implemented smoothly with no disturbance to the university faculties and institutions from which the researchers are gathered for the IPMU, the Administration Bureau shall provide any necessary financial support, such as for personnel expenses of substitute teaching staff, to the concerned university departments and divisions. This shall not only allow such departments and divisions to take measurements including securing substitute teaching staff, but the mobility of researchers within the university may be further improved.	(3) Support for the center director in coordinating with other departments at host institution when recruiting researchers, while giving reasonable regard to the educational and research activities of those departments The university Administration decided to provide any necessary financial support for hiring substitute teaching staffs starting 2008.
(4) Revamping host institution's internal systems to allow introducing of new management methods (e.g., English-language environment, merit-based pay, top-down decision making) unfettered by conventional modes of operation As described above, the University of Tokyo has developed an innovative scheme to allow positioning of the IPMU as an organization directly under Office of the President working as a natural facilitator with existing university organizations. Under this scheme, the IPMU may take charge in the operation of the organization under the managerial supervision of the director of IPMU, including for the recruitment of researchers, while new special regulations are also to be established designating the IPMU as a special zone in which participating researchers and support staff members	(4) Revamping host institution's internal systems to allow introducing of new management methods (e.g., English-language environment, merit-based pay, top-down decision making) unfettered by conventional modes of operation Placing the center directly under the office of the university president made it possible for the director's management to make all decisions including hiring of scientific staffs. We also set up a separate salary scale to attract top class researcher from both Japan and abroad. Specifically, we adopt a system which guarantees the salary level of their previous positions, and

may be allowed a limited exemption from some restrictions under the work rules that are generally applied within the university. (5) Accommodation of center's requirements for infrastructural support (facilities, e.g., laboratory space; equipment; land, etc.) The University of Tokyo places great importance on the development of an environment to permit excellent researchers from overseas to steadily concentrate on their research activities. Currently, active initiatives to promote a more international campus are under way under the leadership of the President, and several residential facilities for foreigners are being developed near the campus and are due to open in a few years' time. Priority allocation of such residences for researchers invited to the IPMU from overseas has also been under discussion. The University also develops a number of world-class research facilities and actively promotes sharing the use of such facilities. Measures shall be taken to ensure the priority use of such research facilities. Top priority shall be given to the appropriation of land for a research building for the IPMU and its financing. Until the new research building is constructed in Kashiwa Campus, Chiba Prefecture, rooms and other space of the Kashiwa General Research Building shall be provided in priority for activities of the IPMU. (6) Support for other types of assistance With the aim of supporting the establishment of an internationally competitive center through the program, the University of Tokyo has set up a committee headed by the board member in charge of the program. The committee, in addition to ensuring university-wide support for the IPMU, shall work in close cooperation with the Global COE (Centers of Excellence) Program and other schemes, as part of its role to produce maximum synergy. The administrative functions of the Administrative Bureau are to be reorganized in July 2007, where the Research Network Support Group is to be set up to intensively support the IPMU, among other organizations. With these schemes, the University shall provide the maximum possible consistent support for the promotion of the IPMU concept.	can add incentives (for example, salary of the director, who held a professorship in US is sufficiently higher than his previous salary, and as a result, exceeds that of the university president). We adopt English as the official language and include that statement in our hiring advertisements. (5) Accommodation of center's requirements for infrastructural support (facilities, e.g., laboratory space; equipment; land, etc.) We secured a necessary land in Kashiwa campus for a new research building, and decided that the university builds it. The building will be completed in 2009. Temporary space for the institute is already provided in Kashiwa campus, which will be further expanded by more temporary building in 2008. (6) Support for other types of assistance President's Committee chaired by a board member supports creation of internationally competitive research center within the WPI program. This committee provides a university-wide support to IPMU, as well as close coordination with Global COE programs in order to maximize the synergy among various entities within the university. The university administration was restructured in July 2007, and Research Network Support Group was set up directly under the President's office. Using this new structure, the university provides a maximum and stable support to IPMU.

11. FY 2007 funding

(Exchange Rate: JPY/USD=120)

Cost Items	Details	Costs (ten thousand dollars)
Personnel	Center director and Administrative director	15
	Principal investigators (no. of persons):11	59
	Other researchers (no. of persons):6	8
	Research support staffs (no. of persons):2	2
	Administrative staffs (no. of persons):16	26
	Total	110
Project activities	Gratuities and honoraria paid to invited principal investigators (no. of persons):7	4
	Cost of dispatching scientists (no. of persons):	0
	Research startup cost (no. of persons):3	22
	Cost of satellite organizations (no. of satellite organizations):1	19
	Cost of international symposiums (no. of symposiums):1	7
	Rental fees for facilities	5
	Cost of consumables	18

Dollars (Exchange Rate: JPY/USD=120)

WPI grant for FY 2007	459
Costs of establishing and maintaining facilities in FY 2007	51
Temorary Building (Number of facilities: ,300m²) Costs paid:	51
Cost of equipment procured in FY 2007	124
Liguid Nitrgen plant Number of units: 1set Costs paid:	8
Semiconductor Detector Number of units: 1set Costs paid:	4
Arbitrary Waveform Generator Number of units: 1set Costs paid:	4
TV Conference System Number of units: 2set Costs paid:	6
S.K. Water Pump Number of units: 1set Costs paid:	7
Entrance Security System Number of units: 1set Costs paid:	23

	Cost of utilities	1	Others	72
	Other costs	164		
	Total	240		
Travel	Domestic travel costs	1		
	Overseas travel costs	2		
	Travel and accommodations cost for invited scientists (no. of domestic scientists):25 (no. of overseas scientists):61	16		
	Travel cost for scientists on secondment (no. of domestic scientists):3 (no. of overseas scientists):4	3		
	Total	22		
Equipment	Depreciation of buildings	0		
	Depreciation of equipment	4		
	Total	4		
Other research projects	Projects supported by other government subsidies, etc.	212		
	Comissioned research projects, etc.	30		
	Grants-in-Aid for Scientific Research, etc.	461		
	Total	703		
Total		1,079		

12. Efforts to improve points indicated as requiring improvement in application review and results of such efforts	
-Points specified as needing improvement	-Efforts to improve them and results
1. It should be confirmed that Dr. Murayama will return to the University of Tokyo in January 2008 and will work for the project as its full-time director, as stated in the hearing process.	1. Professor Murayama has returned to the University of Tokyo in January 2008 and has been working since as its full-time director.
2. Expansion of the participation of female researchers is needed. Also inclusion of Asian scientists should be more actively pursued.	2. We have added Mihoko Nojiri of KEK as a Principal Investigator. She will build a critical mass for LHC phenomenology and also serve as a role model to inspire women in Japan. Among 18 postdocs so far secured, 4 are women, and 5 Asians (non-Japanese). We convened a workshop for Asian mathematicians and mathematical physicists to promote Asian diversity.
3. More clearly established collaboration (promises) from major experimental partners - LHC, Subaru, neutrino group, should be planned.	3. A satellite is being built on the Kamioka site to facilitate close collaboration with ICRR, Tokyo and RCNS, Tohoku. We intend to enhance the existing SuperKamiokande and KamLAND experiments by appointing key persons to IPMU. A collaborative effort for the SUBARU telescope observation is being set up between Nomoto's team and Aihara's team. A possibility for closer collaboration with LHC experimentalists is being pursued.
4. Co-locating the mathematicians and theoretical physicist is necessary for the success envisioned for the project - it should be planned. In addition, to such co-location, explicit plans for breaking down intellectual barriers to be put in place.	4. We have added, a senior mathematician Kyoji Saito, as a new Principal Investigator of IPMU since the proposal. His work has provided foundation for the recent progress in mirror symmetry that was inspired from physics (string theory). He will reside in Kashiwa together with Tsuchiya, realizing co-location of mathematicians and physicists. In order to break down the intellectual barriers between mathematicians and physicists, we call a retreat annually and share research programs with each other. The first retreat in February was a big success in nurturing mutual understanding. We also run joint workshops for mathematicians and mathematical physicists. The first one in March featured Asian scientists and discussed common problems for geometers and string theorists.