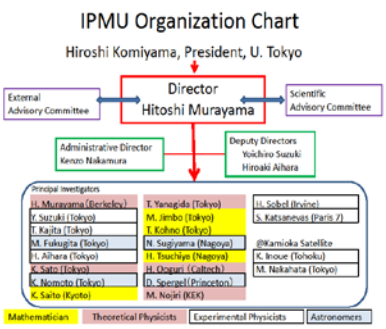
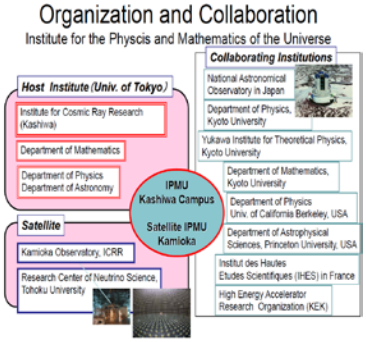
April 2012

3 . Research Center Project (in English)

Host institution	The University of Tokyo
Head of host institution	・ Name, position title Junichi Hamada (President, The University of Tokyo)
Research center	Institute for the Physics and Mathematics of the Universe
Center director	Hitoshi Murayama
Chief center-project officer(in October 2007)	・ Name, affiliation, position title (in October 2007) Yoichiro Suzuki, Institute for Cosmic Ray Research, The University of Tokyo, Director and Professor
Project summary	・ Briefly describe the general plan of the project. This center establishes a multi-disciplinary research institute with the unifying goal of understanding the universe from the synergistic perspectives of physics, cosmology and mathematics. The Center 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 develop infinite analysis, the mathematics for systems with infinite dimensional degrees of freedom, which is used to build new physical theories and derive their experimental predictions and to invent statistical methods to analyze geometric data. We study dark energy, dark matter, neutrinos, and physics beyond the Standard Model of elementary particle physics. The Center builds on the state-of-the-art facilities (Super-Kamiokande, KamLAND, XMASS, Subaru telescope, and SuperKEKB accelerator) that produce an unprecedented amount of precision data for observational cosmology, astronomy and elementary particles physics. We develop new mathematical tools to analyze the data by taking full advantage of collaboration between mathematicians and physicists, and 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 leads to a new paradigm of sciences in the 21st century. It attracts highly motivated young researchers, as well as established leading scientists from around the world and greatly strengthens the foundation of mathematical and physical sciences in Japan. We 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 October 2007  

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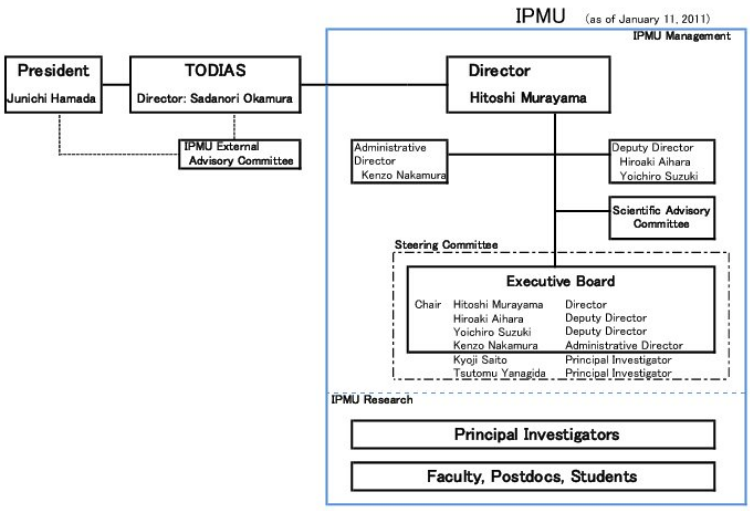
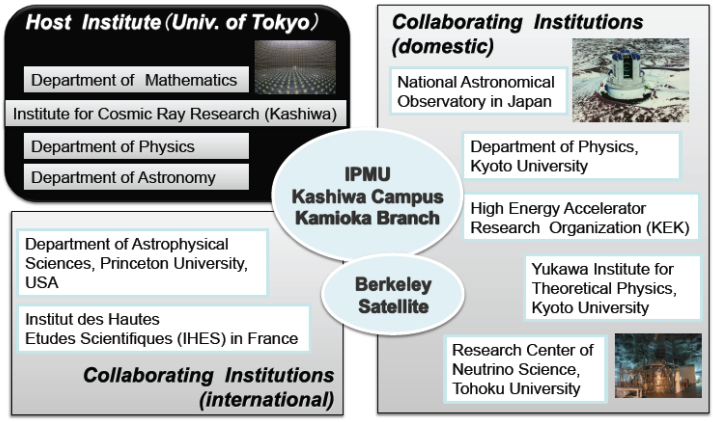




Major changes from initial project plan:

For the accelerator-based research, we plan to join the Belle II experiment at SuperKEKB for the study of supersymmetry and other new physics possiblities. The Center will participate in both detector construction and physics analysis. Involvement at LHC, on the other hand, is difficult for us to make an impact given its advanced stage, and is limited to phenomenology analysis using the released data.

Scope of the galaxy survey using the Subaru telescope is greatly expanded due to an approval of the SuMIRe (Subaru Measurement of Images and Redshifts) project. It combines the originally envisioned imaging survey using HyperSprimeCam with a newly proposed spectroscopic survey using a PrimeFocusSpectrograph (PFS). The Center leads the formation of PFS international collaboration and construction of the new spectrograph.

Much of the activities in mathematics had been envisioned to take place on the Komaba campus. To our pleasant surprise, mathematics activities at the Center are flourishing. This is a very positive development, and resulting regular contacts between mathematicians and physicists are generating unprecedented research opportunities.

The Center director is on a split appointment with the University of California, Berkeley, and the salary is split based on the effort levels. During the nine months from August to May, He is on 75% payroll from Berkeley, 25% from IPMU. During the remaining three summer months, he is on 100% payroll from the Center. It makes the two appointments nearly 50:50. In addition, the creation of the Berkeley IPMU satellite allows him to be engaged in the Center's research program even when he is physically in

	Berkeley, providing 85% effort overall in the Center activities. As for management, he is 100% on the directorship. With frequent trips, he has been able to maintain strong leadership in the Center management, as praised by the interim evaluation.
Mission statement and/or center's identity	・ Briefly and clearly describe the mission statement and/or the project's identity as WPI center. We address big questions about the universe, its fundamental laws, its beginning, its fate, and its mysterious components. For this purpose, we create this center and bring mathematicians, physicists and astronomers into one place. We make experimental explorations from underground, into sky, and at the accelerator. We tie them together using common threads of theoretical physics that is closely tied with highly advanced mathematics and of highly sophisticated technologies in detectors and data handlings. Our goals are improved understanding on dark energy and dark matter, improved understanding on physics beyond the standard model, exploring new astrophysical phenomena, deeper understanding on string theory, further developments in geometry and algebra. These are all important ingredients for addressing the fundamental questions of the universe.

(1) Research fields

・ Describe in simple words and phrases within one line the research field of the project.

We address the most fundamental questions of the universe using physics and mathematics.

・ Choose relevant fields from among ①－⑦ below, specifying the interdisciplinary field(s) that the project addresses.
①Biosciences, ②Chemistry, ③Material sciences, ④Electronics engineering and information sciences,
⑤Precision and mechanical engineering, ⑥Physics, ⑦Mathematics

Physics and Mathematics

・ Describe the importance of the proposed research, including domestic and international R&D trends in the field and Japan's advantages.

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 Center, we build a community of physicists and mathematicians, redefine the boundaries between them and help nurture future generations of mathematical scientists. Uniquely to this center, we anticipate cross-career development between mathematics and physics, such as a statistician moving to experimental physics.

Mathematicians and physicists have very different work styles. We started with four PIs for mathematics, Jimbo, Kohno, Tsuchiya, and Saito. Since then, Jimbo and Tsuchiya had stepped down while Bondal and Kobayashi joined. They together facilitate communication between physicists and mathematicians and maintain activities in this area throughout the year. Much of the activities in

mathematics had been envisioned to take place on the Komaba campus. To our pleasant surprise, mathematics activities at IPMU are flourishing. This is a very positive development, and resulting regular contacts between mathematicians and physicists are generating unprecedented research opportunities.

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 three major underground detectors (Super-Kamiokande, XMASS and KamLAND) at Kamioka, where IPMU Kamioka Branch is established. Some of our principal investigators are working on 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 of the Center will have the first-hand access to high quality, high precision data available from these world premier facilities. LHC, the world highest energy accelerator, is operating and the data of high energy collisions that mimic Big Bang and the birth of the Universe are now flowing in. Particle physics phenomenologists at the Center are engaged in analyzing the LHC data for a wide subject of particle physics including dark matter. Construction of another advanced new accelerator, SuperKEKB, has started at KEK. The Center plans to join the experiment at this facility and participate in both detector construction and physics analysis which aims to explore supersymmetry and other new physics possibilities.

By bringing together the world-leading mathematicians, theoretical physicists and experimental physicists and taking advantage of the data available at the Center, we 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 Center.

・ If centers in similar fields already exist in Japan or overseas, please list them.

This center　is a unique research center in the world that spans pure mathematics, theoretical physics, experimental physics, astronomy, and applied mathematics. This kind of Institute is 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 we include attracts best people from the world because of its uniqueness and potential for major breakthroughs.

This project has started in a timely manner and is 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.

(2) Research objectives

・ 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 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.

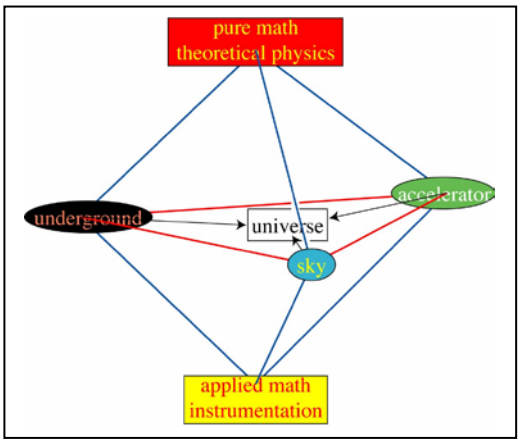
At this center we address big questions about the universe, its fundamental laws, its beginning, its fate, and its mysterious components, such as Dark Matter and Dark Energy. For this purpose, we create new mathematics needed for the unified description of the universe.　It enables new physical theories with testable predictions. Technological innovations follow to make new experiments possible; whose data further stimulate development in mathematics. This upward spiral moves 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 center aimed at basic (not applied) research, here are a few examples of new possible domains we may pioneer by the end of the funding period:

- 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 Center

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 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 Center 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 Center 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, is exploited. The KEKB accelerator, which was used for a definitive confirmation of Kobayashi-Maskawa theory of CP violation, is under conversion to a 40-fold more powerful facility for the study of supersymmetry and other new physics possibilities.

There is a long tradition for physicists and mathematicians to work together which was especially true in the 90s 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.

・ Describe concretely the research plan to achieve these objectives.

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 bring in worldwide leading scientists to the Center and breed new directions in the fields and redefine their boundaries. Generous start-up packages and seed money for developing new ideas towards advanced experiments bring in competitive grants further. Frequent interactions among the PIs ensure that new directions emerge at the interface of the traditional boundaries of the subfields.

We offer big societal impacts in the following way. The questions that we address 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 Center 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 advanced 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.

(3) Management

i) Center director

・ Provide the name of the center director, his/her age (as of 1 April 2012), , specialties, and brief career profile(within 5 lines).

Hitoshi Murayama (Age of 48),

Particle theory and Cosmology,
Ph.D. from University of Tokyo (1991, particle theory), assistant professor of Tohoku University (1991-1995), research associate of Lawrence Berkeley National Laboratory (1993-1995), assistant professor of University of California Berkeley (1995-1998), associate professor (1998-2000), professor (2000-present, MacAdams professor since 2005), IPMU director (2007-present), project professor of University of Tokyo (2008-present).

・ If there is a plan to change the center director, how does the new center director intend to construct the center and what is his/her vision of objectives to be achieved? Provide a synopsis written by the new center director (free format).

ii) Administrative director

・ Provide the name of the administrative director, his/her age (as of 1 April 2012), and his/her brief career profile(within 5 lines).

Kenzo Nakamura (Age of 67)

Ph.D. from University of Tokyo (1973, experimental high energy physics), assistant professor of University of Tokyo (1973-1984), associate professor of KEK (1984-1988), professor of ICRR, University of Tokyo (1988-1995), professor of KEK (1995-2007), IPMU administrative director (2007-present), a member of T2K collaboration.

iii) Composition of administrative staff

・ Concretely describe how the administrative staff is organized.

The administrative staff is an integral part of the Center. The administrative organization belongs to Directorate that consists of the Director, Deputy Directors and Administrative director. Because this center belongs *directly* to the Office of the President, that founded a university-wide organization, the Todai Institutes for Advanced Study (TODIAS) in January 2011 and approved this Center within it (without any other intervening layers of administration), the University has committed to make its administration resource available to the Center. The Center directorate has direct access to the administration office at the University headquarter and shares its resources. With this direct coupling to the Office of the President, we are streamlined, yet very effective to provide the best possible environment to the researchers in the Center.

The number of administrative staff is 38, of which 9 belong to the administrative staff of the University. While big items of the administrative matter are handled by the Directorate in direct contact with the office of the President, day-to-day function is performed by the administrative division that is supervised by the Administrative Director with the help of the General Manager. There are 6 staff members in the general affairs section (including Director's secretary), 3 in the accounting section, 8 in

the international relations and researcher's support section, 2 in the financing section, 4 in the purchasing section, 3 for the SuMIRe project (including 1 engineer), 4 in the Kamioka Branch office, 2 for the IT support, 2 for the public communication, 1 for the library and 1 for the documentation. Out of 38, 4 have particle physics background, and they assist researchers for filling grant applications and other research-related paper works.

iv) Decision-making system

・ Concretely describe the center's decision-making system.

Except for personnel decisions regarding the Center director and principal investigators (PIs), which are made by the President, the Center director has a complete authority of making a wide range of decisions, including proposing recruitment of PIs to the President, appointing faculty staff, postdoctoral researchers, research support staff members and administrative employees. The Director is 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 Center at large and to focus on the direction of the research. The Director has direct access to the Office of the President and is 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 PIs 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 PIs 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 reflects the scientific vision and priorities set by the Director, who may consult the SAC as needed.

Of particular importance is the External Advisory Committee (EAC) that reviews annually the scientific achievement and activities of the Center and advises the Director on the scientific priorities and the research activities to keep the Center stay on the course of the proposed science. At least half of EAC members consist of scientists from institutions other than the University of Tokyo.

Although the Center is now a member institute within TODIAS, this introduces no difference in the decision-making system at the Center. The Center director merely reports to the Director of TODIAS when appointment of a new principal investigator or employment of a new faculty member is decided. Also, to clear the university's formality in employing faculty members, the Center director's decision has to be endorsed by the Center's Steering Committee.

v) Allocation of authority between the center director and the host institution's side

・ Concretely describe how authority is allocated between the center director and the host institution's side.

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 Center to how to operate it.

(4) Researchers and other center staffs, satellites, partner institutions

i) The "core" to be established within the host institution

a) Principal Investigators (full professors, associate professors or other researchers of comparable standing)

	numbers		
	At beginning	At end of FY 2011	Final goal (Date: month, year)
Researchers from within the host institution	10	11	11
Foreign researchers invited from abroad	5	5	8

Researchers invited from other Japanese institutions	5	3	3
Total principal investigators	20	19	22

・ Describe the concrete plan to achieve final staffing goal, including steps and timetables.
・ Attach a list of principal investigators using the Appendix. Place an asterisk (*) by names of the investigators considered to be ranked among the world's top researchers. Describe the policy and strategy for inviting the PIs who are to be included after 1 April 2012.

b) Total members

	Numbers		
	At beginning	At end of FY 2011	Final goal (Date:□month, year)
Researchers	20 < 5, 25%> [, %]	209 <79, 38%> [4, 2%]	213 < 83, 39%> [5, 2%]
Principal investigators	20 < 5, 25%> [, %]	19 < 4, 21%> [1, 5%]	22 < 8, 36%> [1, 5%]
Other researchers	0 < , %> [, %]	190 < 75, 39%> [3, 2%]	191 <75, 39%> [4, 2%]
Research support staffs	0	28	28
Administrative staffs	3	10	10
Total number of people who form the "core" of the research center	23	247	251

・ Enter the total number of people in the columns above. In the "Researchers" column, put the number and percentage of overseas researchers in the < > brackets and the number and percentage of female researchers in the [ ] brackets.
・ Enter matters warranting special mention, such as concrete plans for achieving the Center's goals, established schedules for employing the main researchers, particularly principal investigators.

ii) Collaboration with other institutions

・ If the "core" forms linkages with other institutions, domestic and/or foreign, by establishing satellite functions, Provide the name of the partner institution(s), and describe the role of the satellite functions, personnel composition and structure, and collaborative framework between the host institution and the said partner institutions (e.g., contracts to be concluded, scheme for resource transfer).
・ If some of the principal investigators will be stationed at satellites, attach a list of these principal investigators and the name of their satellite organizations using the Appendix.
・ If the "core" forms organic linkages with other institutions, domestic and/or foreign, without establishing satellite functions, provide the names of the partner institutions and describe their roles and linkages within the center project.

The Center established a satellite at Kamioka to promote closer collaboration with the neutrino group (This is now called IPMU Kamioka Branch due to the new WPI definition of Satellite in which Kamioka Satellite does not qualify because of its close relation to ICRR, a part of the host institution). 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. Two PI's, Professor Masayuki Nakahata of Kamioka Observatory, ICRR, University of Tokyo and Professor Kunio Inoue of Research Center of Neutrino Science, Tohoku University, are stationed at the "satellite" and have researches jointly appointed from neutrino group.

We set up the Center's Berkeley Satellite on Berkeley campus. It provides a framework for conducting collaboration between the Center and Berkeley physics department in a wide range of

fields involving particle physics, cosmology and mathematics. Initial activity is in the field of particle theory involving string theory and phenomenology. Director Murayama spends approximately a half of his time at the satellite during his stay at Berkeley which is 30% a year, and supervises overall activity with the help of two Research Directors, Tsutomu Yanagida of the Center and Lawrence Hall of the Berkeley side. It has also been helpful in recruiting researchers.

The Center's Principal Investigators also collaborate with scientists from the following institutions:

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) High Energy Accelerator Research Organization (KEK) (for high energy physics physics)
5) National Astronomical Observatory in Japan (NAOJ) (for dark energy survey and astronomy),
6) Department of Astrophysical Sciences, Princeton University in USA (for dark energy survey and astronomy),
7) Research Center for Neutrino Science, Tohoku University (for neutrino physics)

(5) Research Environment

・ Concretely describe measures to be taken to satisfy each of the requirements outlined below, including steps and timetables.

○ Provide an environment in which researchers can devote themselves exclusively to their research, by exempting them from other duties and providing them with adequate staff support to handle paperwork and other administrative functions.

The Director secures the funds to hire administrative staff and research support staffs to assure that researchers of the Center be exempt from paper works associated with conducting research. In addition, for PI's from University of Tokyo, the Office of the President provides resources that enable PI's to substitute their teaching duties in their original departments.

○ Provide startup research funding as necessary to ensure that top-caliber researchers invited to the center do not upon arrival lose momentum in vigorously pursuing their work out of concern over the need to apply immediately for competitive grants.

Many of PIs came to the Center with secured research fund by winning competitive grants. The Director secures startup funds for researchers at or above assistant professor rank according to their needs. All postdoctoral fellows hired by the Center receive annual research fund of 500,000 yen.

○ As a rule, fill postdoctoral positions through open international solicitations.

We post all the job openings on major journals of the community such as Physics Today and contact proactively via Emails leading scientists of the field, both in Japan and abroad, to solicit outstanding candidates.

○ Establish English as the primary language for work-related communication, and appoint 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 assemble administrative staff members as well as research support members who are fluent in English with help from the Office of the President. Among the 38 administrative and research support staff, 23 are bilingual. We set up a system to handle all of work-related communication in English. We have been constantly improving our official website which contains information ranging from seminar notices to daily living. The same website is also used for registering publications and conference talks, as well as filling paper works such as trip reports.

○ Adopt a rigorous system for evaluating research and a system of merit-based compensation. (For example, institute a merit-based annual salary system primarily for researchers from outside the host institution. As a basic rule, the salaries of researchers who were already employed at the host institution prior to the centers' establishment are to be paid by the host

institution.)

Salary of the Center director is negotiated through the office of the President. Annual salaries for PIs are decided by the Director. Salaries of researchers other than PIs are decided by the Director with consultation to Deputy Directors. Evaluation of the researchers is strictly merit-based and includes citation counts, invited talks at international conference, cross-disciplinary papers, salaries at competing institutions abroad, and leadership roles at the Center. In order to assist the Director for evaluating the accomplishments of individual researchers, we construct a comprehensive database containing all relevant information of individual researchers. We also correctly evaluate types of activities which may not necessarily appear on such record. Our system of "mentor", in which one of the principal investigators closely follows each of young staff's performance, nicely covers this aspect.

○ Provide equipment and facilities, including laboratory space, appropriate to a top world-level research center.

The University administration built a new building on Kashiwa campus for the Center. The architecture follows 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 provides an attractive and competitive environment for researchers from around the world. Kamioka Branch office was also built and has been functioning as a base for the Center's researchers working at Super-Kamiokande, KamLAND and XMASS.
We 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.

○ Hold international research conferences or symposiums regularly (at least once a year) to bring the world's leading researchers together at the center.

More than ten international conferences as well as long-duration workshops à la Kavli Institute for Theoretical Physics and Aspen Center for Physics are held at the Center each year. Attendees of these meetings are typically at least 1/3 from abroad. These meetings bring in visitors to further stimulate the intellectual activities and keep the Center at the forefront of worldwide science. Some are organized to enhance interdisciplinary discussion between physicists and mathematicians, between particle physicists and condensed matter physicists, or between specialists of different areas discussing a subject of common interest. Some of these activities lead to continuing collaborations among traditionally different research fields and important publications.

○ Other measures to ensure that top-caliber researchers from around the world can comfortably devote themselves to their research in a competitive international environment, if any.

The Center takes its role in helping foreign researchers with life in Japan very seriously, so that they can concentrate on their research. For full-time researchers, support consists of the assistance needed to get their life in Japan started, such as foreign resident's registration, housing, and opening a bank account, as well as various needs in daily life. For visitors, we help to solve various problems they encounter during their stay. Kashiwa International Guesthouse opened in March 2010.

We continue to organize a group of volunteers who help our foreign staff for registering at the city hall, getting bank account, and looking for housing. We continue to offer free Japanese lessons to newly arriving foreign research staff and their family members. To enhance these services, the Center offers a support desk for foreigners and a 24-hour emergency assistance on the telephone, both run by outside contract.

(6) Indicators for evaluating a center's global standing

・ Describe concretely the following points.

i) Criteria and methods to be used for evaluating the center's global standing in the subject field

We introduce quantitative and objective methods to evaluate the Center's global standing. The number of refereed journal papers, the number of citations of the papers the Center researchers published, and the number of presentations our researchers deliver in the major international

conferences are kept monitored and tracked. These “numbers” form a base of evaluation of the Center’s global standing, as well as for following through the career development of our former members. To evaluate research activities in mathematics and synergies between physics and mathematics, on the other hand, a periodic peer review is held instead of the publications metrics which are well acknowledged in physics and astronomy.

ii) Results of current assessment made using said criteria and methods

Our publication metrics are comparable to those of other leading research institutes of similar fields in the world, indicating that the Center has definitely joined the ranks of top-level institutes researching fundamental questions about the universe.

iii) Goals to be achieved through the project (at time of final evaluation)

Our goal is to stay as one of the most visible research center in physics and mathematics. For this purpose, we continue monitoring publication metrics and conducting periodic peer reviews.

(7) Securing research funding

Future prospects

・ Describe the concrete prospects for securing resources that match or exceed the project grant.

In the past, IPMU secured resources which approximately matched the project grant. We will make continuous efforts to secure competitive funding (see below) as well as other kind of resources as much as possible.

・ 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. Be sure the prospects are realistically based on the past record.

In the past, we have secured 5.3 M$ (422 Myen) in FY2007, 10.5 M$ (840 Myen) in FY2008, 7.4 M$ (594 Myen) in FY2009, 12.3 M$ (980 Myen) in FY2010, and 17.6 M$ (1411 Myen) in FY2011. These numbers are based on the percentage of the time the researchers devote to research activities at the center vis-à-vis the total time they spend conducting research activities.
The total of competitive fund that we have already secured so far is 5.6 M$ (446.1Myen) in FY2012, 12.3 M$ (987.2Myen) in FY2013, 8.1 M$ (650.2Myen) in FY2014. We are confident that about the same amount of competitive funding will be secured by the IPMU researchers.

Others

・ Describe activities and initiatives to be taken after project funding ends.

This center was approved as the first member Institute of the TODAI Institutes for Advanced Study (TODIAS), which is a new and permanent university-wide organization. This is a critical step for the Center to become a permanent entity within the university.

・ Describe expected ripple effects（e.g., how the 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）.

Launch of this center expedited the establishment of TODAI Institutes for Advanced Study (TODIAS). Other advanced institutes are expected to be created and join this framework. We established a scheme to construct and maintain a publication database mainly by the support staff and with minimum load to the researchers, which enables our research results easily visible to the world and monitor our former staff’s career development. This approach should become a trend at different departments and research institutions. Our bilingual administration team established a system of assisting foreign researchers to apply for JSPS grant-in-aid. We have pushed English translation of the Kyousai benefit package, various bulletin board notices and restaurant menu, and also lobbied setting up a foreigner-friendly Citibank ATM on campus.

・ Describe other important measures to be taken in creating a world premier international research center, if any.