IPMU Progress Report

First Site Visit

April 17, 2008
Thank you

• for taking your time to visit us
• We appreciate your constructive criticisms on our progress
• We would like to work with you in order to improve IPMU as well as the WPI program as a whole
Outline

• What We Proposed (exact copy of the presentation back on August 30, 2007)
• Where We Are (progress since then)
• Assembling Critical Mass (esp. non-Japanese)
What We Proposed
Institute for the Physics and Mathematics of the Universe (IPMU)
The University of Tokyo
Aug 30, 2007
Mathematics and Physics promote each other

Mathematics
- includ. statistics
  - new invariants in topology
  - vertex algebra
  - C*-algebra, q-groups
  - Monte Carlo method

Physics
- theory & expts
  - gauge theory
  - general relativity
  - string theory
  - quantum physics

quantitative foundation

inspiration prediction

7 out of 18 Fields Medals since 1990 were inspired by particle physics
The Science

• How did the Universe start?
• What is it made of?
• What is its fate?
• What are its fundamental laws?
• Why do we exist?

We need new data to address them

We need both new mathematics and new physics to describe them
Multi-faceted attack on the universe

Together with math and theory, unique combination in the world!

ICRR/Tohoku

LHC (CERN)

Subaru (NAOJ)
Possible Result

We can’t predict future but anticipate:

dark matter (DM) = 20% of universe, a big mystery

⇒ LHC discovers extra space dimensions beyond 3 and underground expts discover a DM candidate

⇒ new statistical methods needed to make best information from the data, that exhibit unusual properties

⇒ theoretical physicists conjecture new kind of geometry for a new description of spacetime

⇒ mathematicians develop a new branch of geometry for this

⇒ theoretical physicists predicts testable consequences from this spacetime

⇒ astronomical observations look for the signature

⇒ a full resolution of the dark matter puzzle, new spacetime
Possible Result

dark energy (DE) = 76% of universe, an even bigger mystery
• it is ripping the universe apart
• an apparently infinite source of energy!
• very little clues what it is
  • Einstein was wrong about gravity?
  • quantum vacuum energy?
• A negative pressure substance?
• At least we know where to start
  • Watch the sky more carefully with new technology
  • Look for a substance with negative pressure at LHC
  • And think!

\[ R^{\mu\nu} - \frac{1}{2} g^{\mu\nu} R \neq 8\pi G_N T^{\mu\nu} \]
Where We Are
Program Committee

- Japan already has **global reputation** and track record in the subject area.
- This is an **important research topic** that a country like Japan with a lot more resources can commit herself to.
- A constellation of **world class top-notch researchers** with meaningful commitment to the project is presented.
- The plan offers one of the **best chances for exerting a transformative effect** on Japan’s research landscape.
- **Young, highly articulate prospective center director** who is visionary and energetic is a very positive attribute.
- To organize joint collaboration between physicists and mathematicians is an interesting goal. A young director and young PIs could be good advocates for this goal. This will give a good public image for the WPI Initiative – **young, dynamic and exciting**.
- **Strong and substantial supports from the host institution** and University President are presented.
- University of Tokyo has a good reputation and Tokyo offers an attractive environment for international researchers.
Launch

• launched on 10/1, press conference start from scratch!
• 4 administrators on day one from the UT
• Administrative Director Kenzo Nakamura (KEK) appointed on 10/16
• advertised positions from end of October
• hired two assistant professors in December
• first international workshop Dec 17-21
• HM arrived on January 4
• Now we have 10 FTE faculty, 5 postdocs, 5 students, 21 staffs, 39 on joint appointments
IPMU Organization (as of Apr. 1, 2008)

Hiroshi Komiyama, President, University of Tokyo

Director
Hitoshi Murayama

External Advisory Committee

Scientific Advisory Committee

Administrative Director
Kenzo Nakamura

Deputy Directors
Hiroaki Aihara
Yoichiro Suzuki

Principal Investigators
H. Murayama
T. Kajita (Tokyo)
M. Fukugita (Tokyo)
H. Aihara (Tokyo)
K. Sato (Tokyo)
K. Nomoto
K. Saito
T. Yanagida (Tokyo)
M. Jimbo (Tokyo)
T. Kohno (Tokyo)
N. Sugiyama (Nagoya)
A. Tsuchiya
H. Ooguri (Caltech)
D. Spergel (Princeton)
M. Nojiri (KEK)

H. Sobel (Irvine)
S. Katsanivas (Paris 7)

@Kamioka Satellite
K. Inoue (Tohoku)
Y. Suzuki (Tokyo)
M. Nakahata (Tokyo)

Mathematician, Theoretical Physicists, Experimental Physicist, Astronomer
Organization and Collaboration
Institute for the Physics and Mathematics of the Universe

Host Institute (Univ. of Tokyo)
- Institute for Cosmic Ray Research (Kashiwa and Kamioka)
- Department of Mathematics
- Department of Physics
- Department of Astronomy

Collaborating Institutions (domestic)
- National Astronomical Observatory of Japan
- Department of Physics Kyoto University
- High Energy Accelerator Research Organization (KEK)
- Yukawa Institute for Theoretical Physics Kyoto University
- Research Center for Neutrino Science Tohoku University

Collaborating Institutions (international)
- Department of Physics Univ. of California Berkeley, USA
- Department of Astrophysical Sciences Princeton University, USA
- Institut des Hautes Études Scientifiques (IHES), France
To Be Improved

- 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. Yes, I’m here.

- Expansion of the participation of female researchers is needed. Also inclusion of Asian scientists should be more actively pursued. New female PI, six Asian postdocs, Asian WS

- More clearly established collaboration (promises) from major experimental partners – LHC, Subaru, neutrino group, should be planned. New faculty members active in neutrino & Subaru, PI on LHC theory

- 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 need to be put in place. Two math PIs and all new math hires now in Kashiwa, progress since the original proposal
Another comment from Program Cmtee

- **Committee:** “Japanese system is hierarchical and does not nurture young researchers. What are you going to do about it?”

- **HM:** “Our fields are driven by young minds. I make the organization flat, give a large autonomy to young members, and promote them as much as I can.”
not interdisciplinary, too hierarchical
Instead, a flat organization emphasizes on interdisciplinary aspects. No strong hierarchy to promote young scientists. Successful institutions worldwide employ this model with porous boundaries to make it visible.
Inaugural Reception

- March 10, Crest Kashiwa Hotel
- Upper House Member Iwao Matsuda, former Science Minister
- Governor Akiko Domoto of Chiba pref.
- Mayor Akira Honda of Kashiwa City
- Sadanori Okamura Vice-President of UT
- Yasutaka Moriguchi from MEXT
- Young-Kee Kim, Fermilab Deputy Director
- David Gross, Nobel Laureate
- Shin-Tung Yau, Fields Medalist
• 3/11-12, Kashiwa campus
• 172 participants
• Speakers include David Gross (Nobel Prize), Shing-Tung Yau (Fields Prize), 3 Japanese and 10 non-Japanese altogether
External Advisory Committee

• Set up by the University administration
• March 13
  - John Ellis (CERN, theoretical particle physics)
  - Makoto Gonokami (Tokyo, Applied Physics)
  - Norio Kaifu (NAOJ, astronomy)
  - Young-Kee Kim (Fermilab, experimental particle physics)
  - Sadayoshi Kojima (TITECH, mathematics)
  - David Morrison (UC Santa Barbara, math/string)
  - Roberto Peccei (UCLA, Vice Chancellor for Research), chair
  - Nicolai Reshetikhin (UC Berkeley, mathematics)

“the organization of the Institute in the first few months of its existence is nothing less than spectacular.”
Review of the MEXT requirements

- We need additional resources that match the IPMU funding
- Need non-Japanese > 30% by citizenship
- Staff Members > 200
- WPI funding is for physical concentration of researchers, not projects (however, “frontier facility” or startup funding OK)
Prefab Building

- We rent space from General Sciences Building
- More people coming than initially thought
- Completely filled up!
- Prefab building by April (partially), May, ~800 m²
- Seminar room, admin room & library go to the basement, more offices on 6th floor
- New building design well underway
- Occupancy by fall 2009
Fall 2009 occupancy
IPMU Kamioka Satellite

- New prefab structure will be built in Mozumi village, Kamioka
- supports resident scientists working on SuperK, KamLAND, XMASS, R&D for future underground experiments
- enhance collaboration with RCNS (Tohoku) and ICRR (Tokyo)
IPMU laboratory

- Underground lab already built by IPMU
- Frontier clean facility
- R&D for future experiments
Activities
(as of 4/16/2008)

- 81 lectures (54 non-Japanese)
- 171 visitors (64 from abroad)
- regular seminars draw audience also from other institutions
- four international meetings
  - focus week on LHC (30)
  - Opening Symposium (172)
  - focus week on neutrino mass (40)
  - Asian mathematicians and theoretical physicists (25)
- IPMU seminars in Komaba, joint workshops
- The massive end of the sequence quiescent stellar population place at $z\sim 2.3$.

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stats on papers

• 60 publications, 40 IPMU preprints
• already collaboration between mathematicians and physicists
  • Akihiro Tsuchiya and Akishi Kato
  • Yukinobu Toda and Taizan Watari
• on the computation of the direct push forward sheaf $R^1 \pi_* \wedge^2 V$ for an elliptically fibered Calabi-Yau 3-fold $\pi : Z \to B$, and $V$ is a vector bundle on $Z$ obtained via Fourier-Mukai transform to understand F-theory from heterotic string theory
• one joint math-physics paper
some science

- theory: supernovae do not explode if round
- observation: they are not round!

Polar: on-axis

Side view

Far side (=redshift)
Near side (=blueshift)

Oxygen-rich material

Science 29 February 2008
319: 1220-1223

Subaru Telescope + FOC
RGB composite images
Field of View: 1.7 x 1.7
Experimental Program

Together with math and theory, unique combination in the world!
SuperKamiokande

- Add Mark Vagins from UC Irvine as a Full Professor on May 16
- initiate new direction in SuperK
- detect neutrinos from past supernovae in the universe
- dark energy using neutrinos?
• Add Alexandre Kozlov as a distinguished postdoc on May 1
• convert KamLAND to a new kind of experiment
• Can anti-neutrinos turn into neutrinos?
• Why do we exist in our universe?
• Trying to detect dark matter directly

• PIs Suzuki and Nakahata lead the project

• plan to add another IPMU faculty on this project

• start data taking ~2010
HyperSuprimeCam

- New camera at Subaru
- IPMU, NAOJ, KEK, Princeton
- IPMU leads the design (Aihara)
- IPMU leads the analysis team (Takada, Yoshida)
- Map out distribution of dark matter
- Constrain dark energy properties
- Big draw for astronomers abroad

Lin  Kriek  Moro-Martin
• need data ASAP to attract the best astrophysicists
• we also need to nurture observational cosmology in Japan
• Sloan Digital Sky Survey III
• Build 3D map of galaxies
• constrain properties of the dark energy

Takada, Yoshida, Fukugita, Spergel
Power of Combination

- SDSS and HSC with very different systematics
- give confidence to the result
- How fast is dark energy creating energy?
- Is dark energy “alive”? 

How much dark energy there is
strong media interest

- 6 press releases (incl. 2 press conferences)
  - launch
  - 1st international workshop (LHC)
  - HM arrival
  - AMS Eisenbud prize to Ooguri
  - Maeda’s paper in Science
  - Opening Symposium
  - astronomy prize for Takada
- 67 media coverages (32 newspaper articles)
- one national TV news (NHK) coverage
public outreach

- Inspiring young minds is one of our missions
- Many PIs have been making effort in public outreach
- Met Governor Domoto, Mayor Honda, many publishers
- quarterly IPMU News
- Plans underway:
  - Public lecture arranged jointly with Kashiwa City
  - Lectures for students jointly with Kodansha
  - physics and philosophy with Asahi Newspaer?
「人間」を語る物理

とかく無味乾燥と思われがちな物理学の議論に「人間」が顔を出すことがある。先月、そんな場面に出くわした。

世界トップ級の研究拠点として東大に置かれた数物連携宇宙研究機構の開設記念シンポジウムでのことである。

きっかけは、「宇宙定数」という宇宙の膨張にかかわる数値が、なぜ今のようななのかという問いだった。値が違えば宇宙の姿は変わり、地球はなく、生命はなく、人もいなかったかもしれない。宇宙はあまりにも人に都合よくできている。

この答えの一つに「人間原理」がある。人がいない宇宙は、かりに存在したとしても観測できない。人がいるからこそ、この宇宙という見方である。

最近は、いくつもの宇宙があるという理論もあるので、その一つがこの宇宙だと考えればつじつまが合う。

米国の著名な理論物理学者D・グロスさんは、この考えを厳しく批判した。宇宙定数がこうなることは、理論によって説明できるという立場だ。会場の物理学者から反論も出たが、人間原理を「安易な逃げ道」と切って捨てた。

このときに感じたのは、こういうやりとりを哲学者など文系の人々にも聞いてもらったら、ということだった。

宇宙の物理学は、世間から「当座の役に立たない科学」と敬遠されやすい。だが、宇宙と人をどうみるか、は理系文系の違いを超えた知的関心事だ。そのことを、物理学者はもっとアピールしてもよいのではないか。〈尾関章〉
Assembling Critical Mass
Challenges

• We need to assemble a critical mass
• Staff Members > 200
• Non-Japanese > 30% of scientists
• needs to be world-class
• Make it visible worldwide
• How do we do it???????
Plan Approved by Program Committee

In addition, >100 collaborators who frequently visit IPMU for shorter periods
Challenges

• How can we attract world-class non-Japanese scientists to IPMU?

• Many challenges to overcome:
  • competitive terms of offer?
  • prejudice and lack of info about life in Japan
  • language & cultural barrier
  • logistical issues
  • lack of tenure
  • science must be attractive enough to overcome the challenges
New Faculty

- Faculty appointments so far
- Assist Profs: Takahashi, Maeda, Toda
- Assoc Profs: Takada (Tohoku), Mukohyama (Tokyo), Yoshida (Nagoya), Takayanagi (Kyoto),
- Prof: Sugimoto (Nagoya), Vagins (UCI)
- *Truly* excellent list, young & dynamic
- Many of them come here giving up tenure!
- clear vision, exciting scientific objectives
Different practices

- **Japan: buyers’ market**
  - application means commitment
  - once offer made, applicants expected to accept
  - no room for negotiation

- **US and Europe: sellers’ market**
  - application does not mean commitment
  - good candidates decide after receiving multiple (sometimes >10) offers
  - negotiation on start-up, salary, even housing and mortgage support
  - candidates need to “feel good” to accept
  - I’ve flown to the US just to meet a candidate
World-wide search

Institute for the Physics and Mathematics of the Universe at University of Tokyo was launched October 1, 2007, and intends to appoint approximately 20 people this round of hiring cycle. We have opening at all levels, 3-year postdocs, 5-year assistant professors with possible extension for 5 more years, and associate and full professors for 10 years. We have generous travel and research support to our staffs.

The goal of the institute is to discover the fundamental laws of nature and to understand the universe from the synergistic perspectives mathematics, statistics, theoretical and experimental physics, and astronomy. We are particularly interested in candidates with broad interests to interact with people from other subfields.

The initial focus of the Institute includes: all areas of mathematics that are relevant to our goal, including geometry, algebra, analysis, and statistics; string theory and mathematical physics; cosmology and astrophysics theory including cosmological inflation, stellar dynamics; observations on dark energy properties, galaxy surveys, cosmic microwave background; Water Cherenkov, organic liquid scintillator and Xenon experiments; ATLAS experiment at LHC, collider phenomenology, models of physics beyond the standard model, and particle cosmology. However candidates working on other related areas will also be considered.

The applications should include CV, research statement, publication list, and recommendation letters (at least three for postdocs and assistant professors, six for associate and full professors). They should be sent electronically to http://ipmu.u-tokyo.ac.jp/applications/ The search is open until filled, but we will start reviewing the applications starting Dec 1.

IPMU is an international center that seeks to build a diverse highly interactive faculty. We strongly encourage female and international applicants.
Application Form

Please fill in this form.

Your Full Name

Your e-mail

Institution

Supervisor's Name (if any)

Year of Ph.D.

Interested Position

- 3-year postdoc
- 3+2-year distinguished postdoc
- 5+5-year assistant professor
- 10+5-year associate professor
- 10+5-year professor

Subfield (all that apply)

- astrophysics
- mathematics
- statistics
- particle physics
- cosmology

Resume (or CV)

Choose File  no file selected

Statement of Research Interest

Choose File  no file selected

Publication List

Choose File  no file selected

List of References

Choose File  no file selected

Letters of recommendation

The letters of recommendation should be sent to ipmu_rec_letter@hep.phys.s.u-tokyo.ac.jp and should include in the subject line the applicant's name.
- reference letter for Steve Blanchet, Georg Raffelt
- Recommendation letter for Mr. Nima Khosravi, Siamak Sadat Gousheh
- Recommendation Letter for Dr. Kazunori Kohri, dadams
- Masaki Shigemori, Carol Silberstein
  - <Possible follow-ups>
  - Masaki Shigemori, Cumrun Vafa
- Letter of Recommendation - Watanabe, Yuki, Monica Kidd
- Reference David Kubiznak, Lee Grimard
  - <Possible follow-ups>
  - Reference David Kubiznak, Lee Grimard
- Letter of reference for Valerio Marra, Jennifer Smith
- Letter of Recommendation for Professor Ursul, Desmond Robbie
- Sugumi Kanno, Jiro Soda
  - <Possible follow-ups>
  - Sugumi Kanno, Misao Sasaki
- Hiroshi Isono Application, isono
- Recommendation letter for Mohab Abou Zeid, Chris Hull
- Rec. Lett. for N. Jafari, Amir H. Fatollahi
- Dr. Mihail Ursul, Wistar Comfort
- Recommendation letter for Yi Mao, Max Tegmark
- recommendation, Harald Grosse
  - <Possible follow-ups>
  - recommendation, Harald Grosse
  - recommendation, Octav Cornea
  - Recommendation, Hajime TSUJI
- recommendation for Nosrat ollah Jafari Sonbolabadi, Mohammad Khorrami
- Donald Mills, Gary L Mullen
- Dr. Maria Leite - letters of recommendation, Julie Morris
- Letters of reference for Dr. Anton Ilderton, Martin Lavelle
- Nikolas Akerblom, Ralph Blumenhagen
  - <Possible follow-ups>
  - Nikolas Akerblom, Rosita Jurgeleit
- Reference letter for Jing Zeng, Emanuele Berti
- Kanno, Sugumi, Robert Brandenberger
- Letter of recommendation for J. Zeng, Clifford Will
- Reference Letter for Valerio Marra, Paola Zenere
  - <Possible follow-ups>
  - Reference Letter for Valerio Marra, Paola Zenere
- E: Your Assistance Required, Mrs. Helen Mutambara
- Stefano Cremonesi, Carlos Nunez
  - <Possible follow-ups>
  - Stefano Cremonesi, Riccardo Argurio
- Letter of recommendation for Shirley Ho, Michael Strauss
- rec.lett.for Dr. Nowakowski, gorazd.cvetic
- Recommendation letter for Josse-Michaux, Antonio Riotto
- recommendation letter for So Matsuura, Masao NINOMIYA
- Recommendation letter, Alexander Dobbs
- E: Your Assistance Required, Mrs. Helen Mutambara
- Stefano Cremonesi, Carlos Nunez
  - <Possible follow-ups>
  - Stefano Cremonesi, Riccardo Argurio
Postdocs

• Made 35 offers, 21 accepted, 1 undecided (acceptance 60~70%@Princeton, Berkeley)
• Among 21, 17 non-Japanese, 5 women
• Coming from good Ph.D. institutions: Lyon, Southampton, Harvard, Wisconsin, Seoul, Paris, Princeton, Sussex, Chicago, etc
• Creative ideas to make the offer attractive: “shared” postdoc with Berkeley, Princeton, DESY, IHES, MPA, CERN (Marina Cortes)
Somber Truth

- Salaries in Japanese university system are much lower than competing US institutions
- even within the same US university, differences by x3
- good candidates wouldn’t even think about coming
- IPMU is a “special district” where merit-based salaries are allowed

<table>
<thead>
<tr>
<th>competition</th>
<th>9 months</th>
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<tr>
<td>Harvard</td>
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<tr>
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<td>JHU</td>
<td>$124K</td>
</tr>
<tr>
<td>東大</td>
<td>$82K</td>
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</table>

x(9/12)+indirect cost, benefits
Salaries

- **Postdocs**: apply postdoc salary scales of Lawrence Berkeley National Laboratory, competitive worldwide
- **merit-based salary on faculty**: completely new concept to University of Tokyo
- **accountability**!
- University of California grapples with the same issues, yet competes with Harvard, Princeton, Caltech, MIT
- 1/20 agreement with administration
- **Now we can get started!**
Culture and Language

• Can we attract non-Japanese scientists?
• Lack of information, ungrounded fear
• Unfamiliar culture and language for many scientists
• Fear of losing exposure
• Spouse job issue particularly severe
• “Crazy” custom with housing search
• Education of children
• Lack of tenure
This is an unofficial page for scientists to work at IPMU. The information here is largely based on the author's personal experience. The author or IPMU disavows any responsibility for the information contained herein. Use it at your own risk. See also the Unofficial IPMU Page for Visitors.

You can find much information from the official page hosted by University of Tokyo and Chiba University. This site is meant to be an addendum with some extra information.
The employment at the University of Tokyo automatically comes with benefits whose costs are equally split between the employee and the employer. It is part of the MEXT “kyosai” system, which unfortunately does not have an English web site.

The “short-term” benefits consist of insurance against illnesses, injuries, pregnancy, death, disaster. The “long-term” benefits consist of pension investment and post-retirement coverage. The coverage for immediate family members is included if they are supported by you financially.

The insurance covers 70% of the medical and dental cost (including prescribed medications), and the remaining 30% is borne by the patient. It sounds high, but it is also useful to know that the medical costs in Japan are relatively low. According to an AIU study in 2005, an operation on appendicitis costs ¥2M in New York, ¥0.9M in Paris, and ¥0.4M in Tokyo. (I had an accident and a skin graft on my left index finger that was a two-hours long operation. The total cost was only ¥60K, and hence ¥20K out of my pocket. I don’t want to think how much it would have costed in the US.) In addition, if your cost exceeds ¥25K per incident within a month, the excess amount will be reimbursed.
Solutions

Fear of losing exposure
• Full-time IPMU members *must* spend a month outside Japan
• Up to 3 months absence allowed
• Postdocs are given $5K/year research funds
• need to go out to make IPMU *world visible!*

Issues with children
• *International schools* in Tokyo, Tsukuba within commuting (<1 hour) distance
• used *private donation* to fly in family for school interviews and housing search
Solutions

Housing
• found volunteer groups as translators to work with real estate agents
• luckily housing not expensive in Kashiwa
• if guarantor needed, it’s the Director
• University is building a new international guesthouse, ready in April 2010

job of the spouse
• we do our best to gather information
• i.e. Templeton University
Culture and Language

- Can we attract non-Japanese scientists?
  - Lack of information, ungrounded fear
  - Unfamiliar culture and language for many scientists
  - Fear of losing exposure
  - Spouse job issue particularly severe
  - “crazy” custom with housing search
  - Education of children
  - Lack of tenure
  - Raise endowment
## On track

### number of staffs

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<th>Oct 08</th>
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<td>65</td>
<td>96</td>
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<td>Japanese</td>
<td>17</td>
<td>52</td>
<td>49</td>
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<td>3</td>
<td>14</td>
<td>16</td>
<td>22</td>
<td>69</td>
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<tr>
<td>support &amp; admin</td>
<td>4</td>
<td>20</td>
<td>17</td>
<td>31</td>
<td>30</td>
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<tr>
<td>Total</td>
<td>24</td>
<td>88</td>
<td>82</td>
<td>127</td>
<td>225</td>
</tr>
</tbody>
</table>

Including long-term visitors

61
Towards 30%, >200

With admins, support

#scientists

Japanese, Asian, American, European

Mar 09, Oct 09
Conclusions

• Mathematicians now resident in Kashiwa. 
  *Huge progress since the proposal.*
• added *excellent & diverse core faculty*
• big success in hiring *non-Japanese scientists*
• on track with the proposed hiring
• highly *visible*
  • in scientific community worldwide
  • both in media inside and outside Japan
• *Already a lot of fun being at IPMU!*