東京大学
THE UNIVERSITY OF TOKYO

wpi World Premier International Research Center Initiative

Overview of IPMU

数物連携宇宙研究機構概観

清华大学 二千八年九月十九日

IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

WPI

東京大学
THE UNIVERSITY OF TOKYO

IPMU

WPI Initiative

wpi World Premier International Research Center Initiative

- World Premier International Research Center Initiative
- Cabinet → Science Council → MEXT → JSPS → Call for proposals March 2007

Solicitation

- "the centers should be *"globally visible research centers"* being able to attract top-level researchers from around the world"
- "To be "globally visible," the research center will need to have a *physical concentration (or core) of researchers* of a certain scale, one that possesses a high research level"
- English is the official language

Funding

- Five centers, ~$13M/year for 5+5 years
- possible extension for another 5 years
- main purpose: bring topnotch researchers to Japan
- allows for building infrastructure to attract them
- mandate: >200 staff members involved (including support & administrative staffs)
- mandate: >30% non-Japanese (researchers)

But no research money

- "To support the center's operations and its research activities, additional resources that match or exceed the amount of the project grant should be secured. This may take such forms as competitive funding obtained by the center's researchers, in-kind contributions and other forms of assistance by the host institution (including partial payment of salaries, provision of research space), and external donations."

Five winners

- The WPI Research Center for Atom-Molecule-Materials (Tohoku)
- Institute for the Physics and Mathematics of the Universe - IPMU (Tokyo)
- Institute for Integrated Cell-Material Sciences (Kyoto)
- Osaka University Immunology Frontier Research Center (Osaka)
- International Center for Materials Nanoarchitectonics (Natl Inst for Mat Sci)

World Premier International Research Center (WPI) Initiative
Selected Projects

Serial number	Host institution	Title of research center project	Head of host institution	Chief center-project officer	Prospective center director	Partner institutions
03	Tohoku University	The WPI Research Center for Atom・Molecule・Materials	Akihisa INOUE (President)	Yoshinori YAMAMOTO (Professor, Graduate School of Science, Tohoku University)	Yoshinori YAMAMOTO (Professor, Graduate School of Science, Tohoku University)	
05	The University of Tokyo	Institute for the Physics and Mathematics of the Universe	Hiroshi KOMIYAMA (President)	Yoichiro SUZUKI (Director and Professor, Institute for Cosmic Ray Research, The University of Tokyo)	Hitoshi MURAYAMA (MacAdams Professor of Physics, University of California at Berkeley, Faculty Senior Staff, Lawrence Berkeley National Laboratory)	Satellite activity centers will be established at Kamioka; the Astrophysical Sciences Department of Princeton University; IHES in France; the Physics and Mathematics Departments, and the YITP at Kyoto University. NAOJ, and KEK will be collaborating institutions.
13	Kyoto University	Institute for Integrated Cell-Material Sciences	Kazuo OIKE (President)	Norio NAKATSUJI (Director and Professor, Institute for Frontier Medical Sciences, Kyoto University)	Norio NAKATSUJI (Director and Professor, Institute for Frontier Medical Sciences, Kyoto University)	【Satellite Laboratory】Faculty of Applied Biological Sciences, Gifu University
17	Osaka University	Osaka University Immunology Frontier Research Center	Kiyokazu WASHIDA (President)	Shizuo AKIRA (Professor, Research Institute for Microbial Diseases, Osaka University)	Shizuo AKIRA (Professor, Research Institute for Microbial Diseases, Osaka University)	RIKEN Research Center for Allergy and Immunology, National Institutes of Health、Harvard University、New York University、Stanford University、California Institute of Technology、 University of California San Francisco
28	National Institute for Materials Science	International Center for Materials Nanoarchitectonics (MANA)	Teruo KISHI (President)	Masakazu AONO (Fellow, Coordinating Director of Key Nanotechnologies Field, and Managing Director of NanoSystem Functionality Center, National Institute for Materials Science (NIMS))	Masakazu AONO (Fellow, Coordinating Director of Key Nanotechnologies Field, and Managing Director of NanoSystem Functionality Center, National Institute for Materials Science (NIMS))	【Satellite】Univ. Tsukuba, Cambridge Univ., CNRS, Univ. California (UCLA), Georgia Inst. Tech 【Collaboration】Inst. Physics CAS (China), KAIST (Korea), Max Planck Inst., Charles Univ. (Czech), Univ. California (UCSB) etc

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

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

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quantitative foundation

new invariants in topology
vertex algebra
C*-algebra, q-groups
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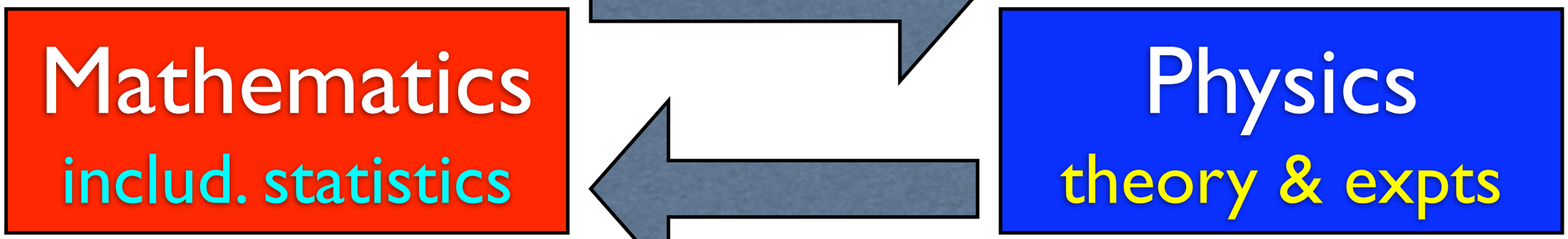

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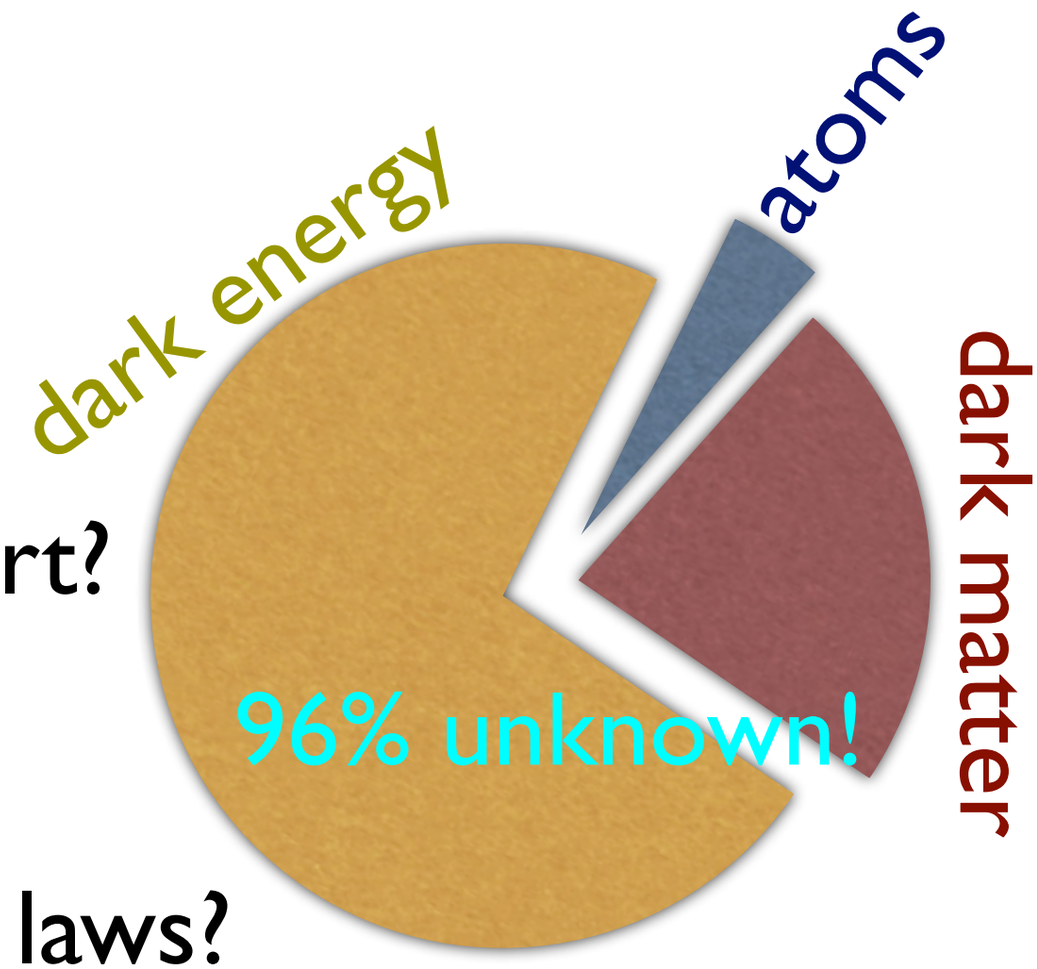
The Science

- 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

The Science



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growing field!
Nobel prizes in 1999, 2002, 2004, 2006

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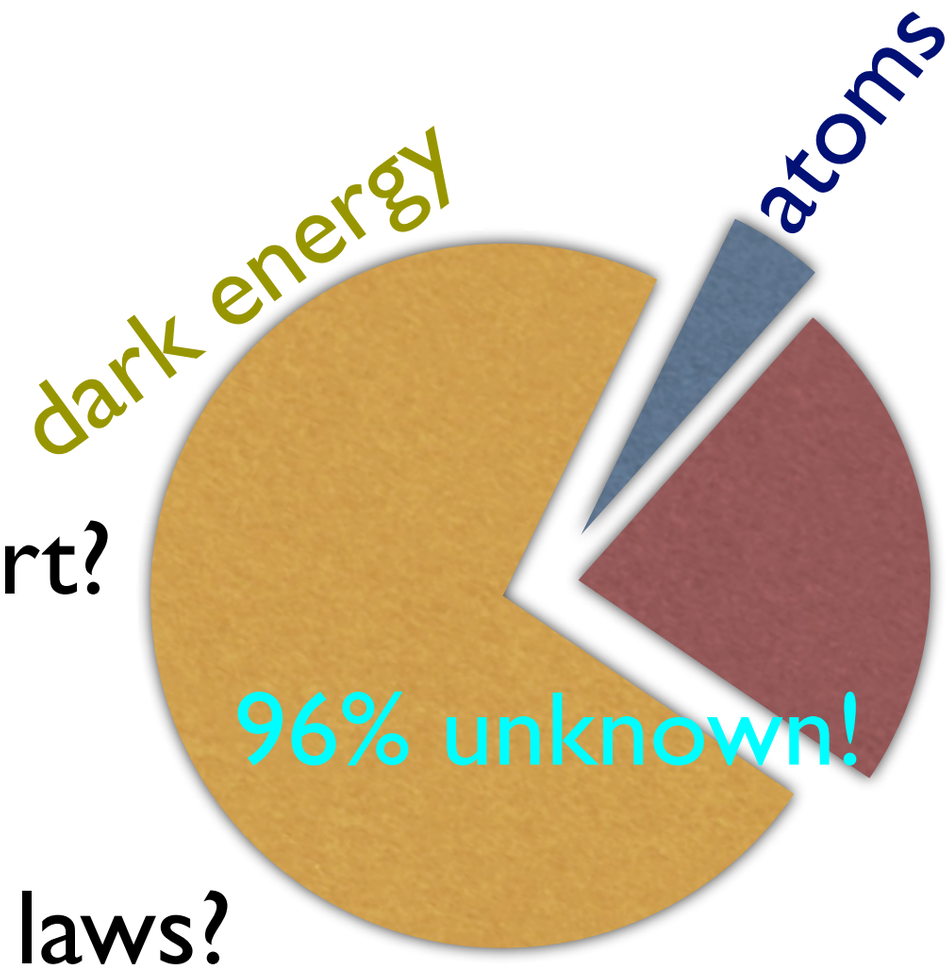

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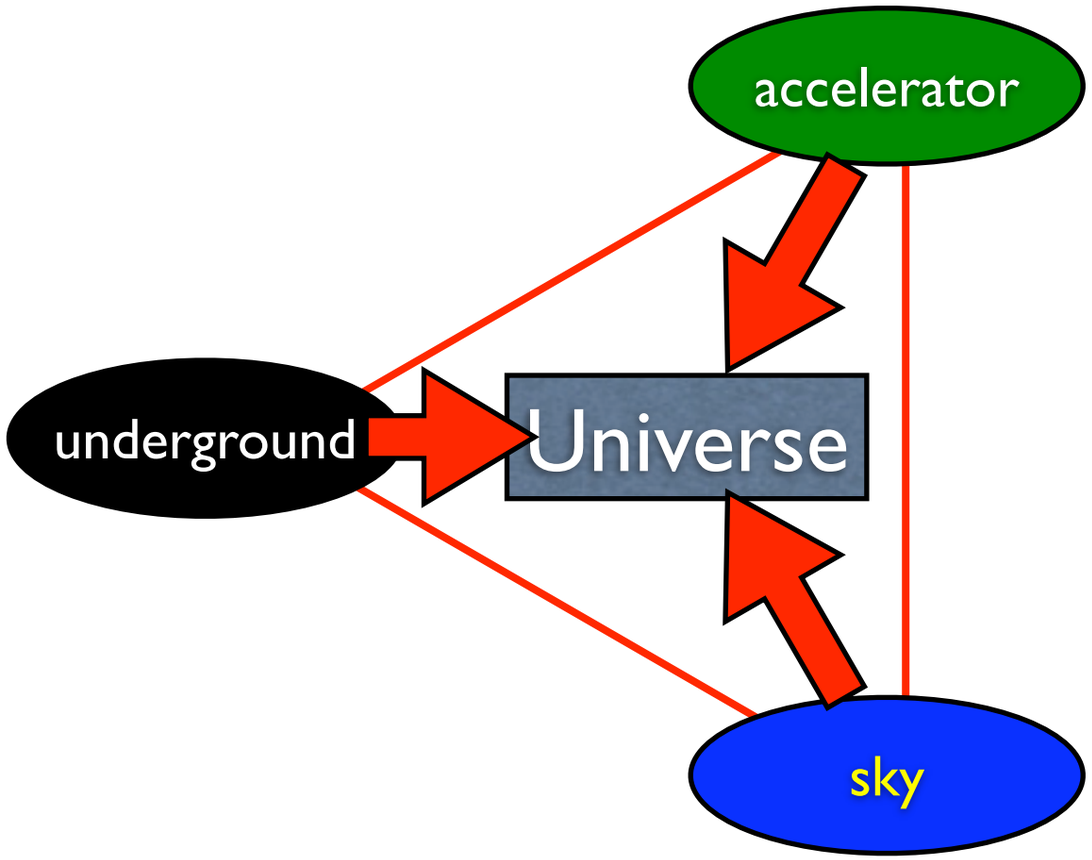
Multi-faceted attack on the universe



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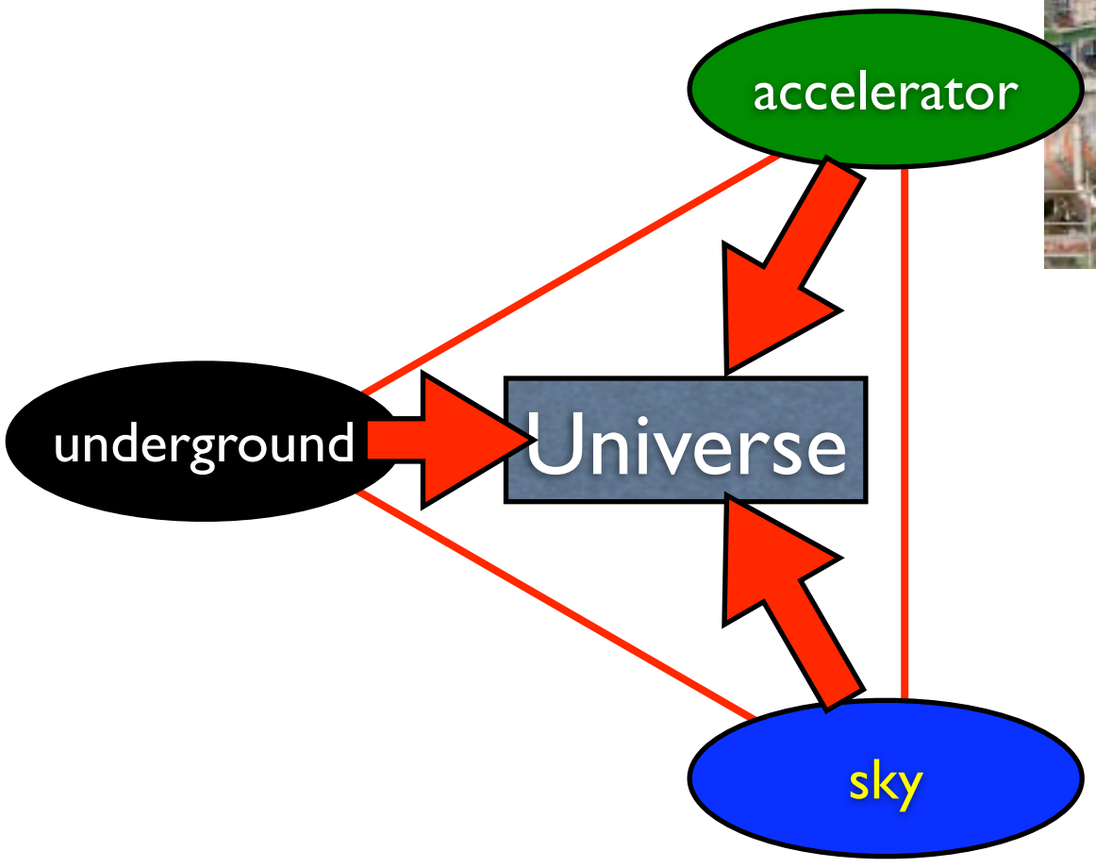

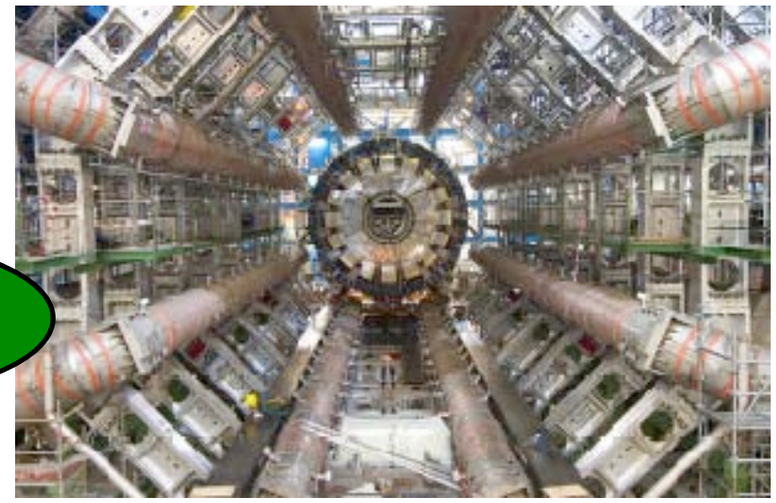

LHC
(CERN)

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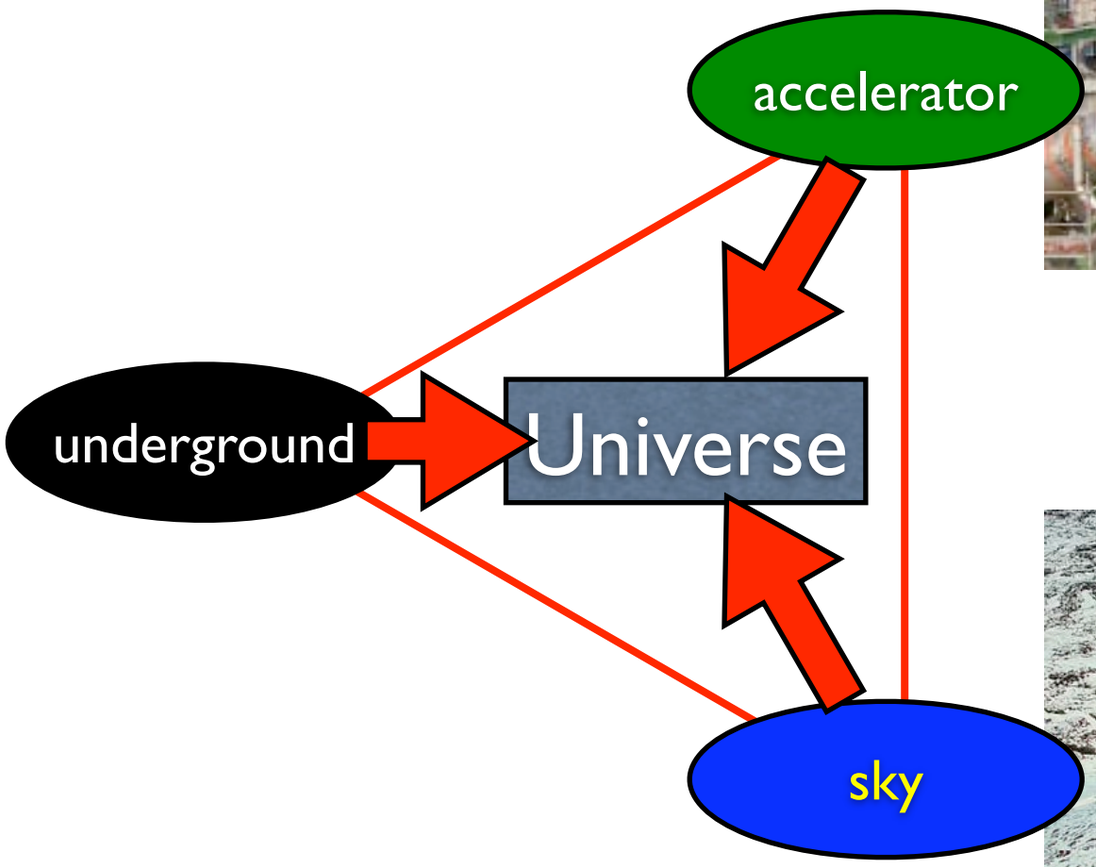

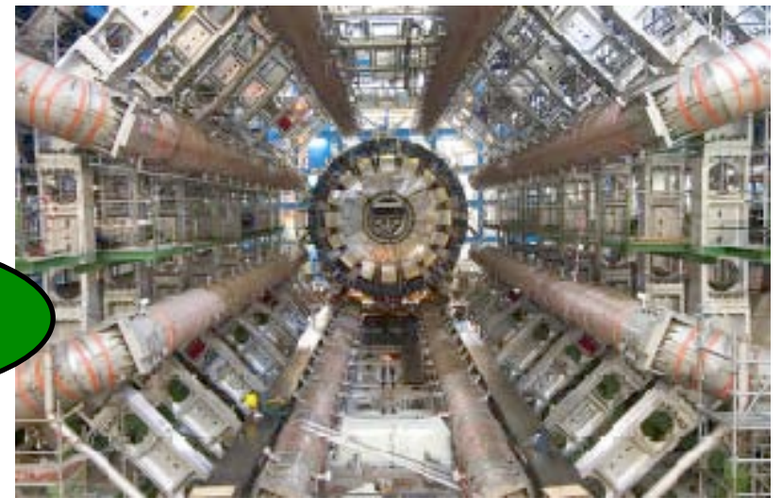

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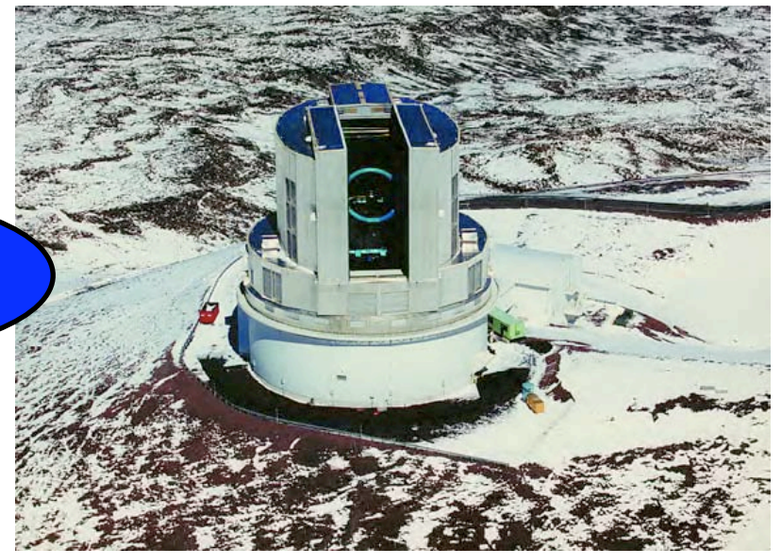
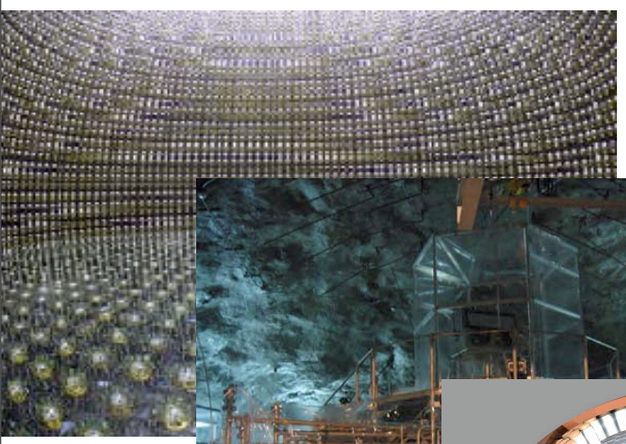
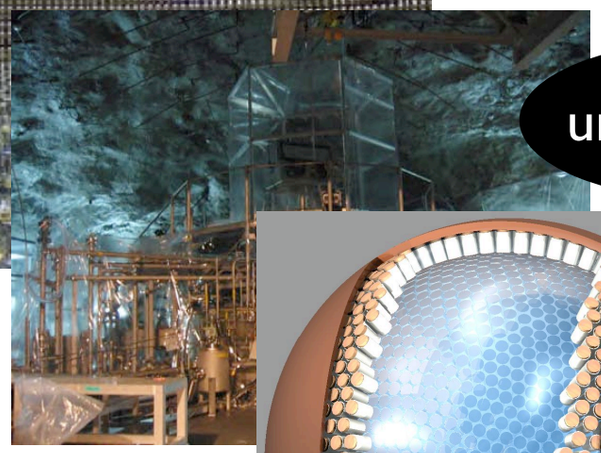
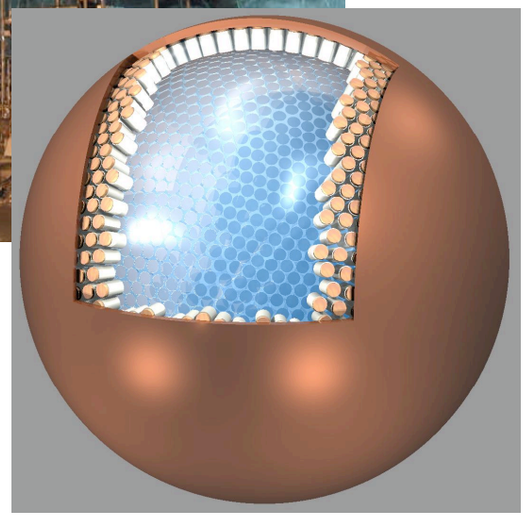


Subaru (NAOJ)

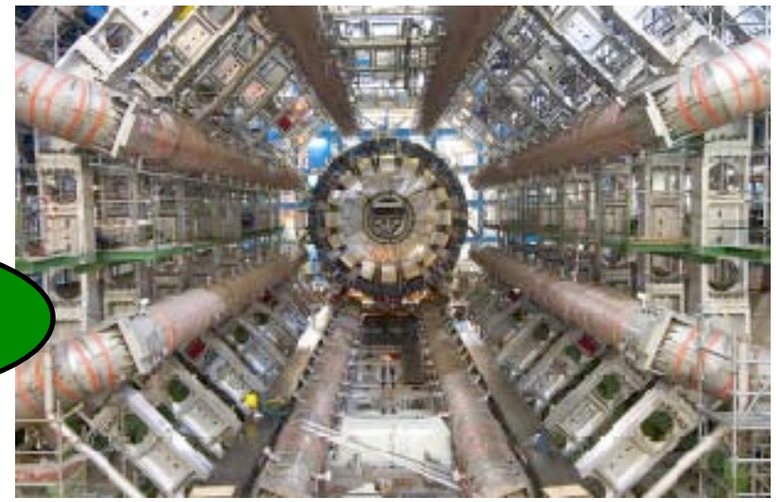
Multi-faceted attack on the universe







ICRR/Tohoku



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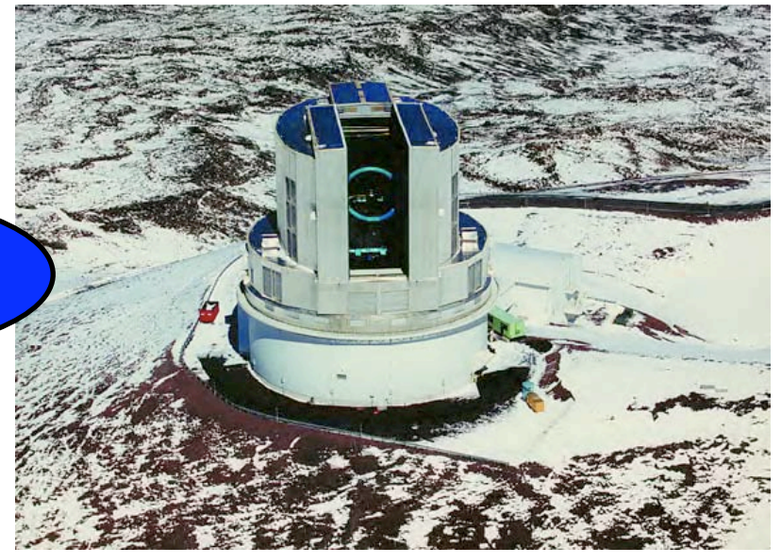

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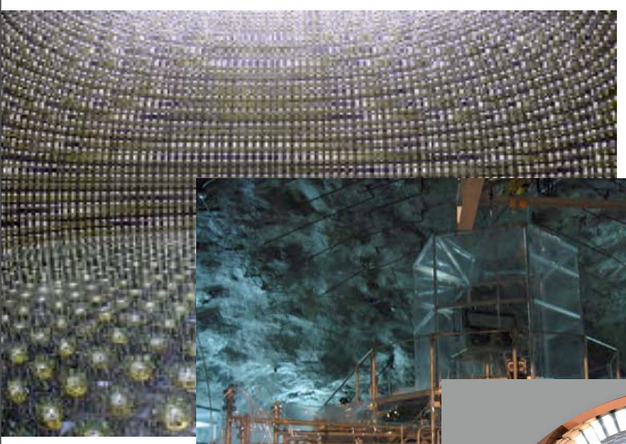
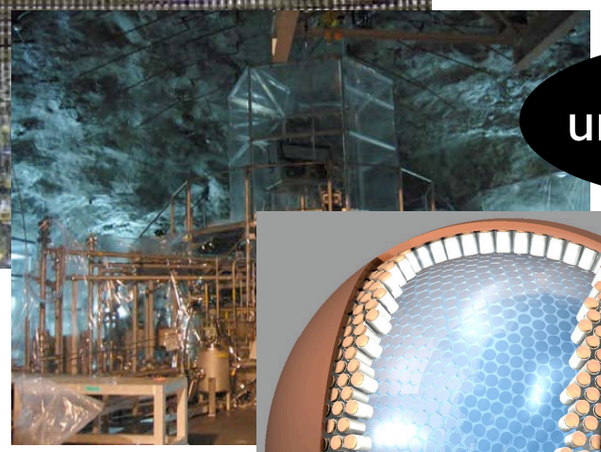
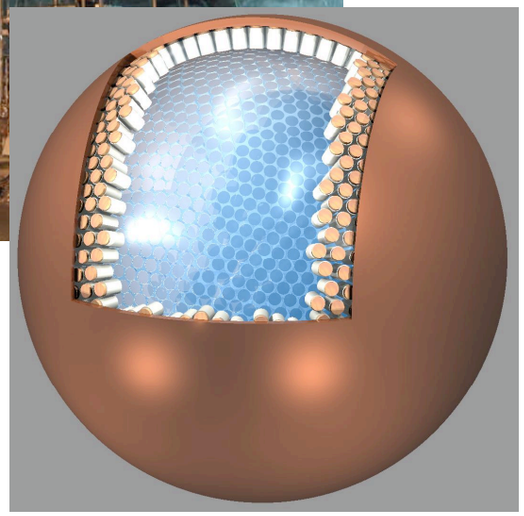
Multi-faceted attack on the universe

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







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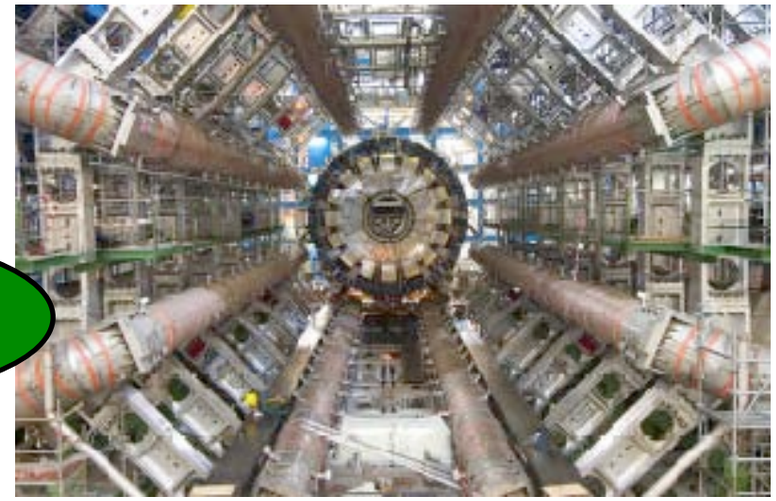

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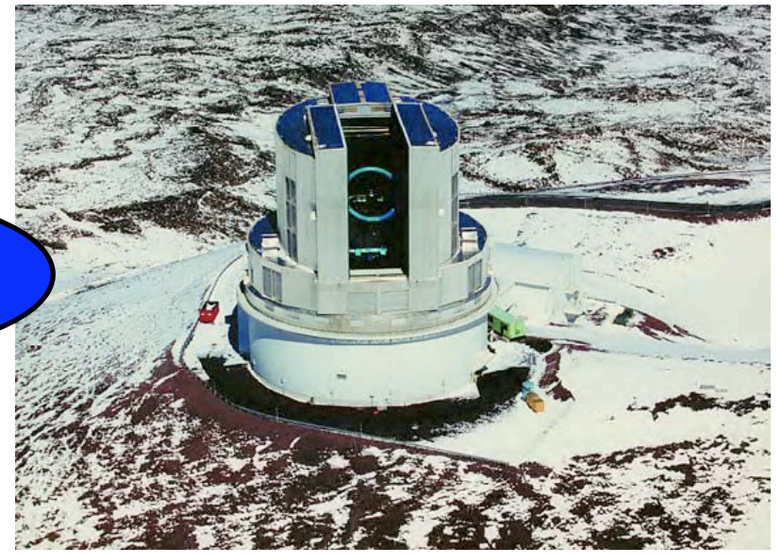

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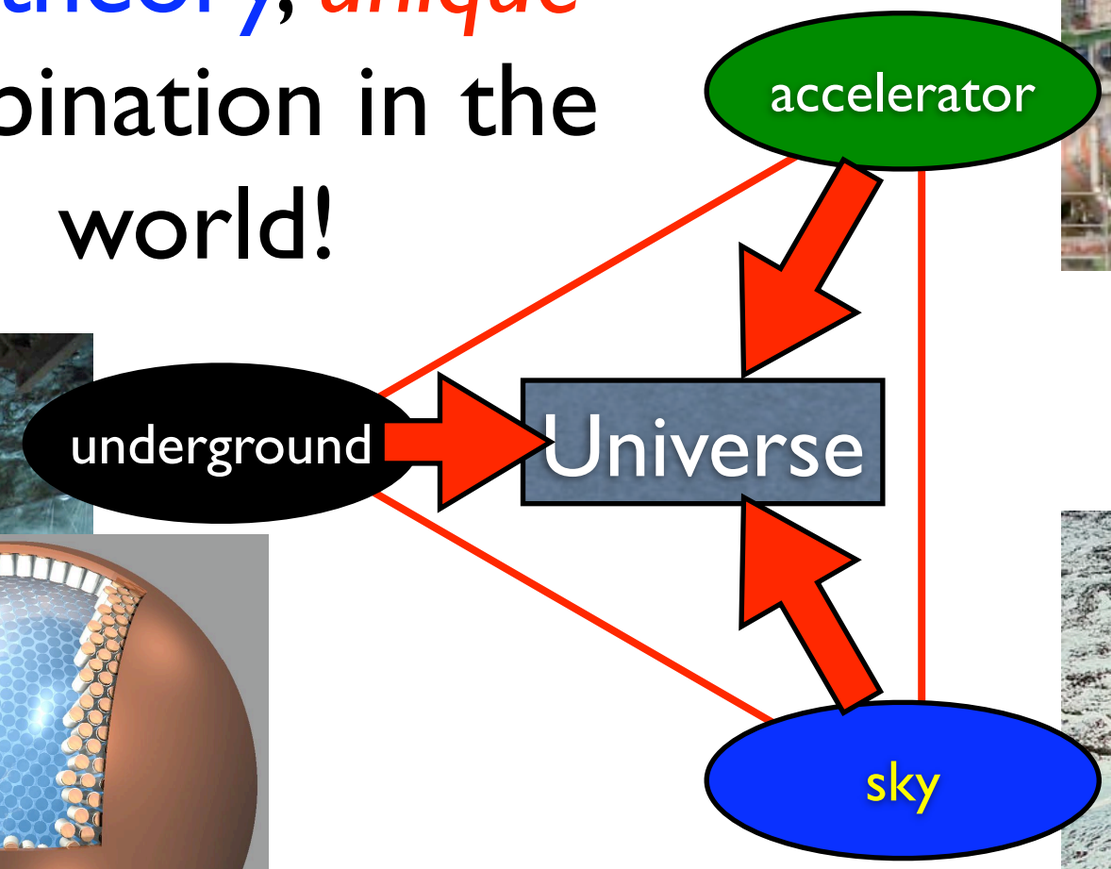

Possible Result

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

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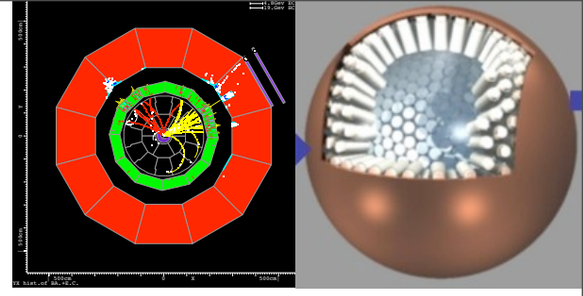

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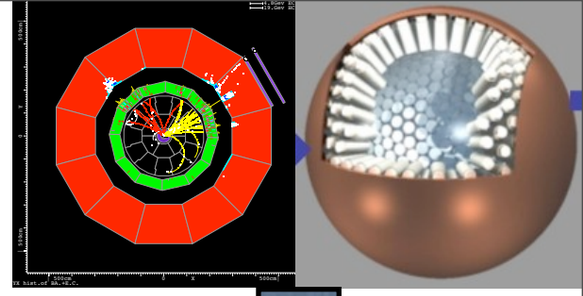

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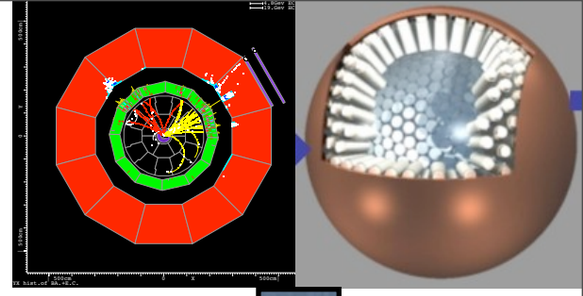

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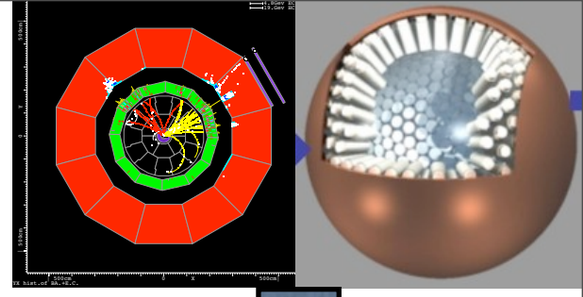

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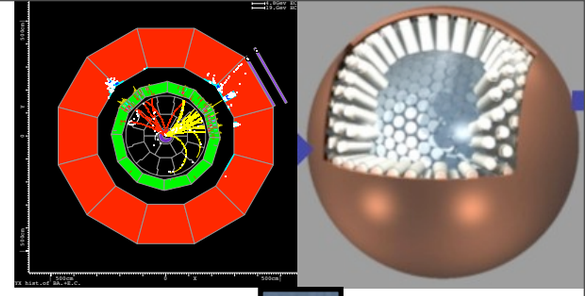

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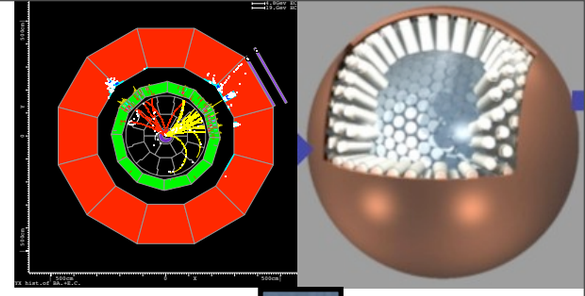

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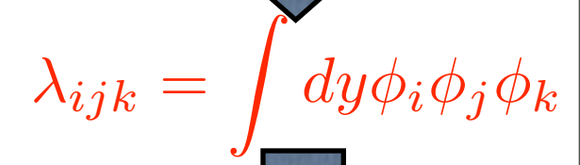

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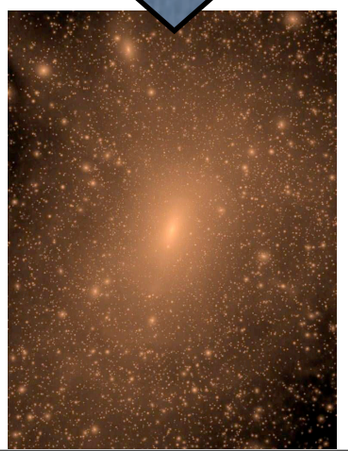

⇒ astronomical observations look for the signature

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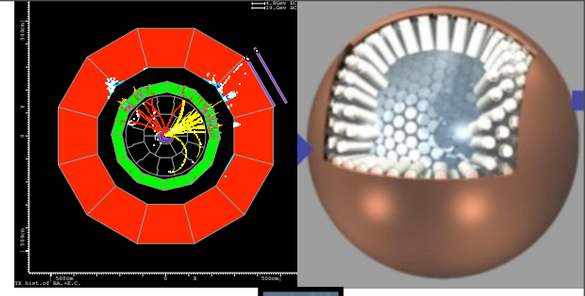

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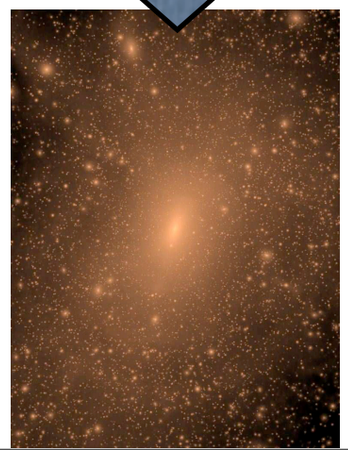

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⇒ theoretical physicists predicts testable consequences from this spacetime

⇒ 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

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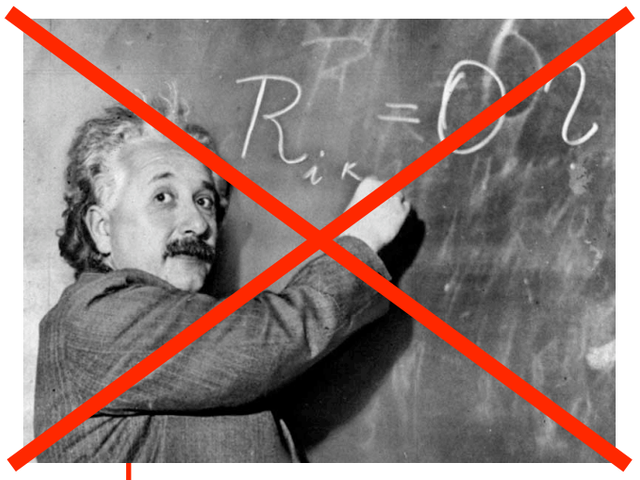

$$R^{\mu\nu} - \frac{1}{2} g^{\mu\nu} R \neq 8\pi G_N T^{\mu\nu}$$

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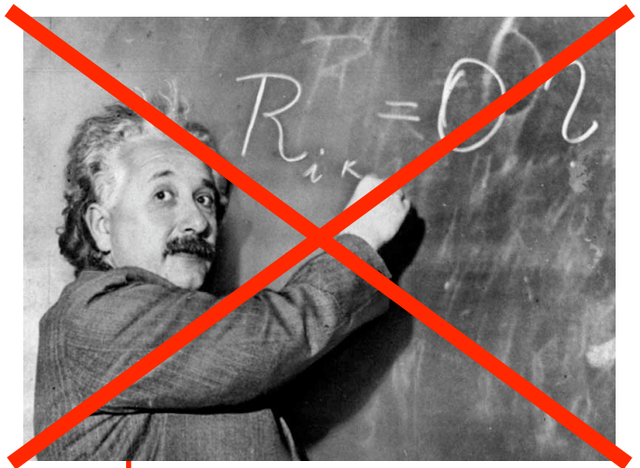

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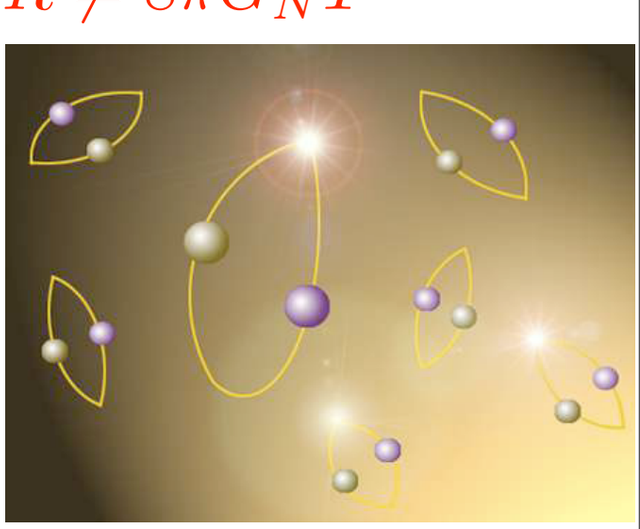

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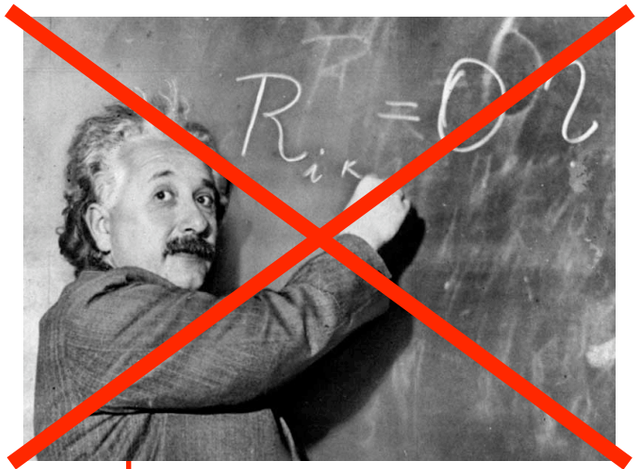

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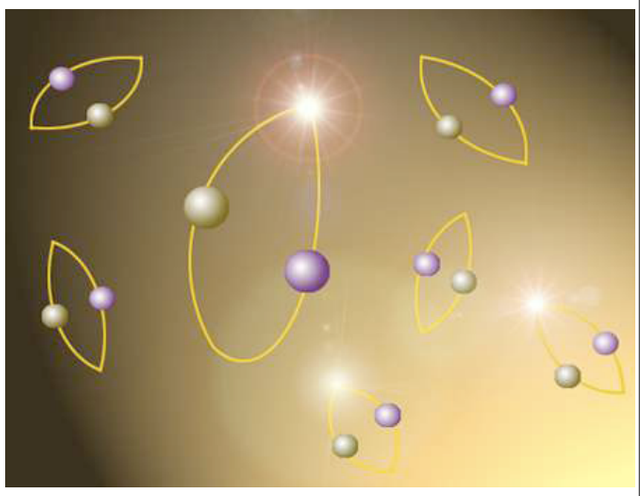

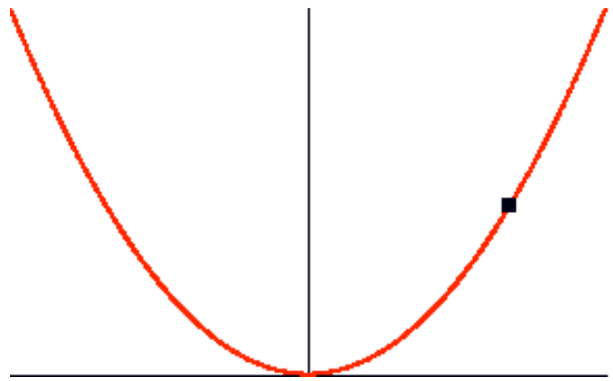

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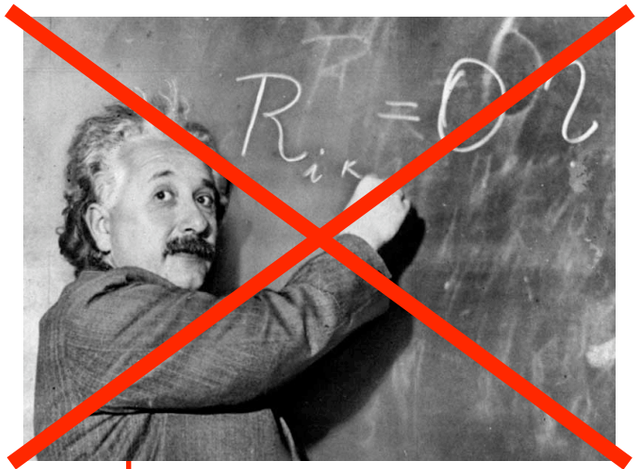
  - A negative pressure substance?
- At least we know where to start



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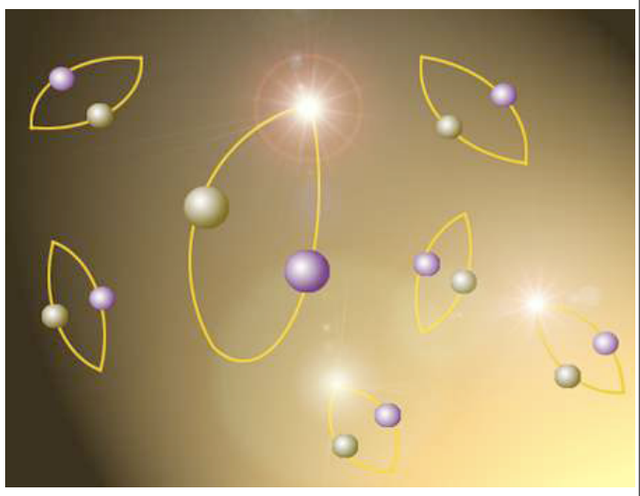

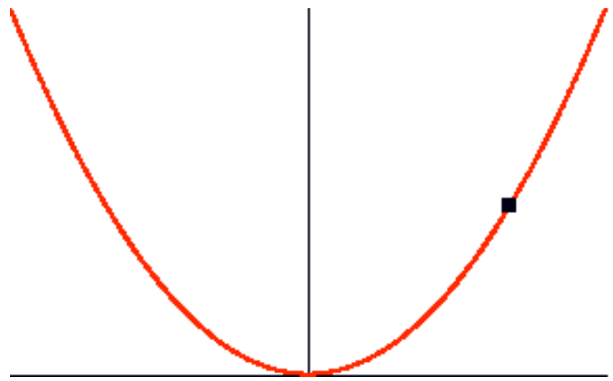

Possible Result

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
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  - quantum vacuum energy?
  - A negative pressure substance?
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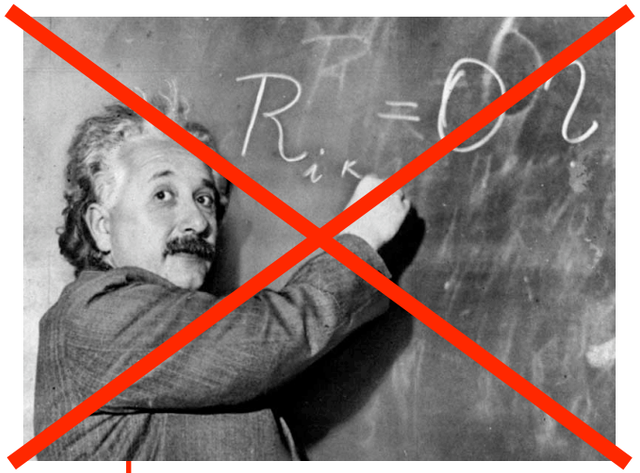

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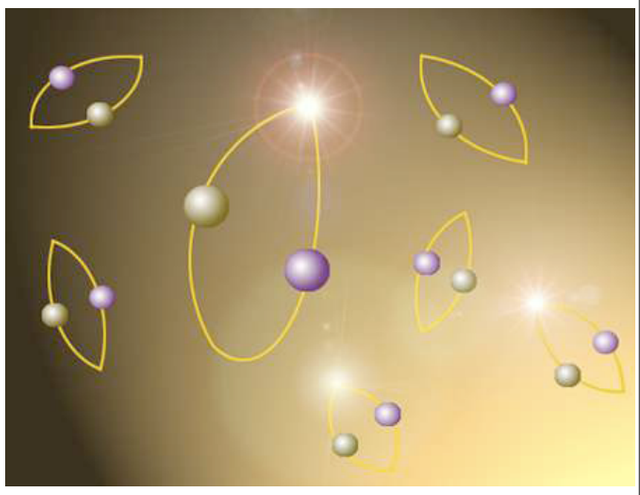

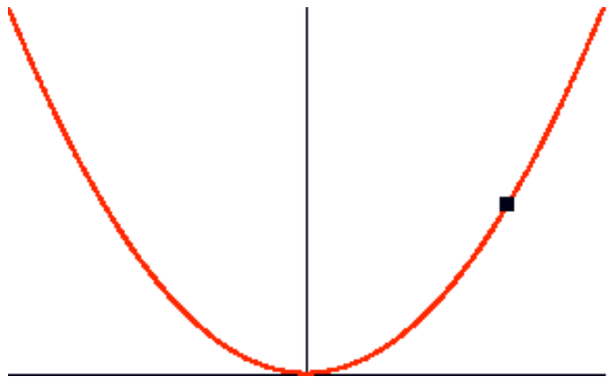

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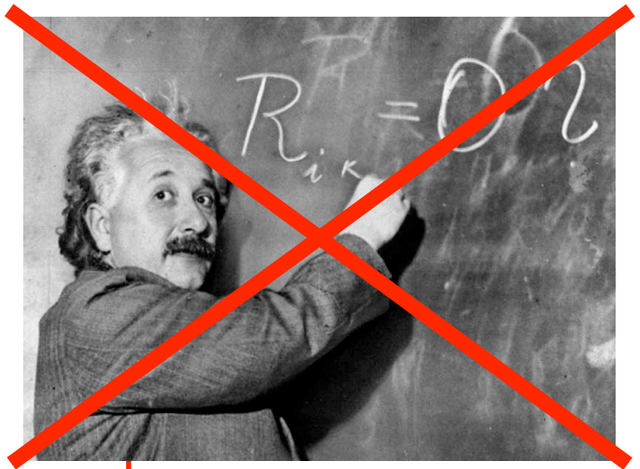

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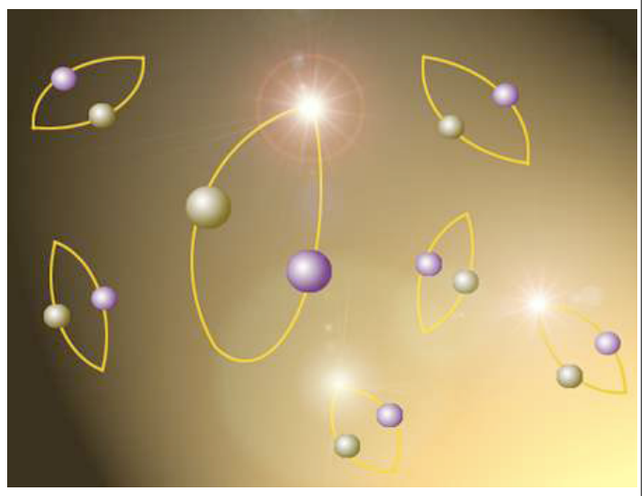

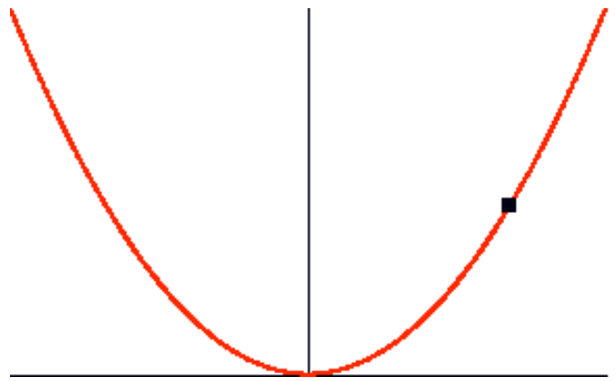

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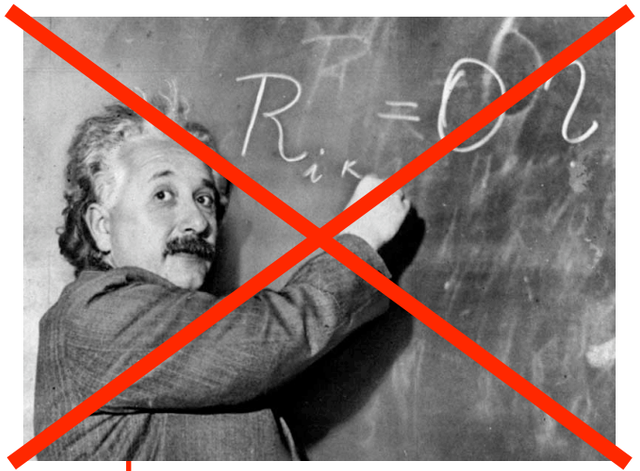
  - And think!



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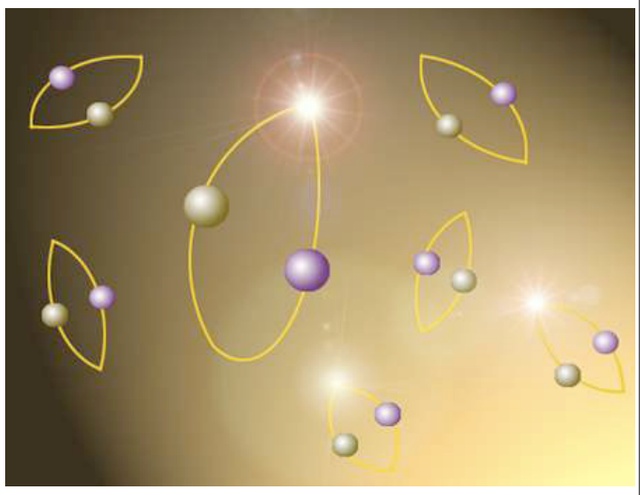

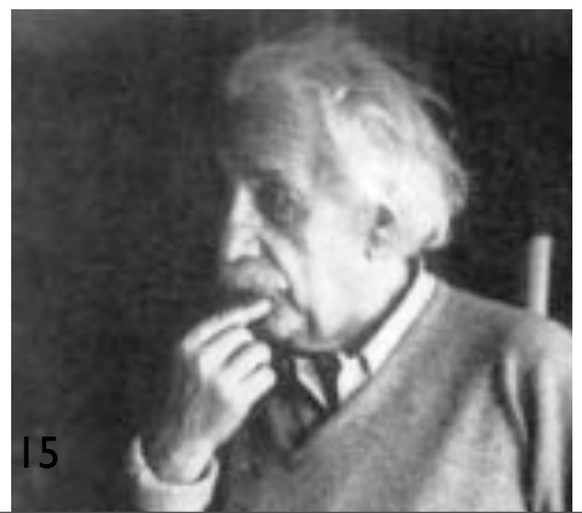

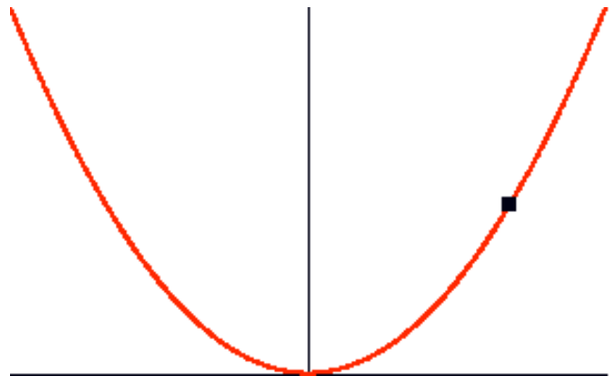

Where We Are

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start from scratch!

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- advertised positions from end of October
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- first international workshop Dec 17-21
- HM arrived on January 4
- Now we have 14 FTE faculty, 16 postdocs, 4 students, 39 on joint appointments

IPMU Organization (as of Apr. 1, 2008)

Hiroshi Komiyama, President , University of Tokyo

External Advisory Committee

Director
Hitoshi Murayama

Scientific Advisory Committee

Administrative Director
Kenzo Nakamura

Deputy Directors
Hiroaki Aihara
Yoichiro Suzuki

Principal Investigators

H. Murayama	T. Yanagida (Tokyo)	H. Sobel (Irvine)
T. Kajita (Tokyo)	M. Jimbo (Tokyo)	S. Katsanevas (Paris 7)
M. Fukugita (Tokyo)	T. Kohno (Tokyo)	
H. Aihara (Tokyo)	N. Sugiyama (Nagoya)	@Kamioka Satellite
K.Sato (Tokyo)	A. Tsuchiya	K. Inoue (Tohoku)
K. Nomoto	H. Ooguri (Caltech)	Y. Suzuki (Tokyo)
K. Saito	D. Spergel (Princeton)	M. Nakahata (Tokyo)
	M. Nojiri (KEK)	

Mathematician, Theoretical Physicists, Experimental Physicist, Astronomer








xternal
dvisory Committee

Director
Hitoshi Murayama

Scientific Advisory Committee

trative Director
zo Nakamura

Deputy Directors
Hiroaki Aihara
Yoichiro Suzuki


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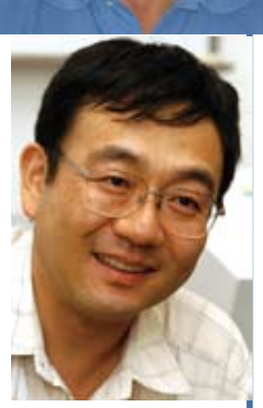






, Astronomer

14 PIs
40s & 50s

IPMU

IPMU

math department

theor phys department

exptl phys department

astronomy department

IPMU

math department	theor phys department	exptl phys department	astronomy department
PIs	PIs	PIs	PIs

IPMU

math department	theor phys department	exptl phys department	astronomy department
PIs	PIs	PIs	PIs
Profs	Profs	Profs	Profs
Assoc Profs	Assoc Profs	Assoc Profs	Assoc Profs
Assist Profs	Assist Profs	Assist Profs	Assist Profs
Postdocs	Postdocs	Postdocs	Postdocs
Students	Students	Students	Students

IPMU

math department	theor phys department	exptl phys department	astronomy department
PIs	PIs	PIs	PIs
Profs	Profs	Profs	Profs
Assoc Profs	Assoc Profs	Assoc Profs	Assoc Profs
Assist Profs	Assist Profs	Assist Profs	Assist Profs
Postdocs	Postdocs	Postdocs	Postdocs
Students	Students	Students	Students

not interdisciplinary, too hierarchical

Instead, a *flat* organization

emphasis on *interdisciplinary* aspect

no strong hierarchy to promote *young* scientists

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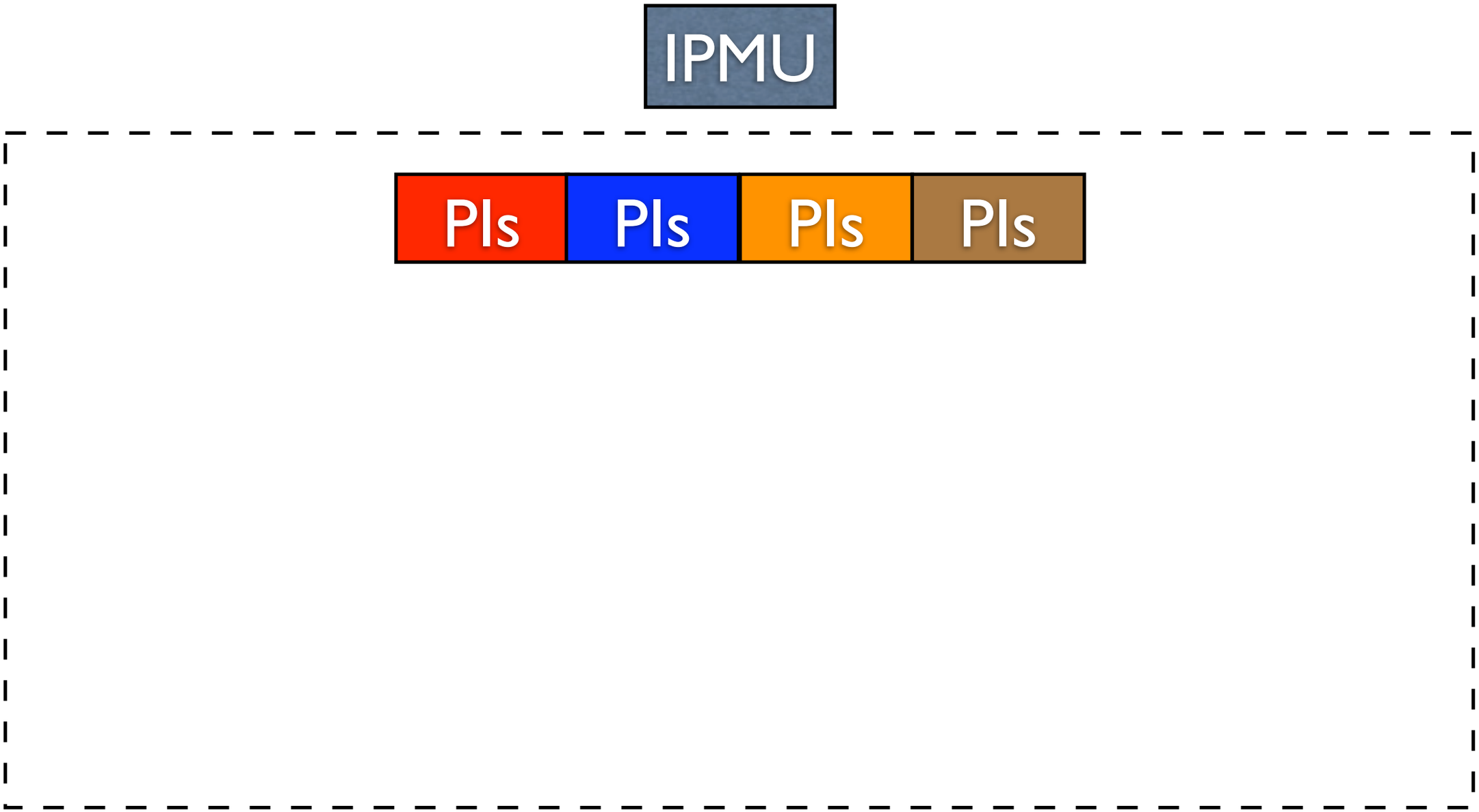

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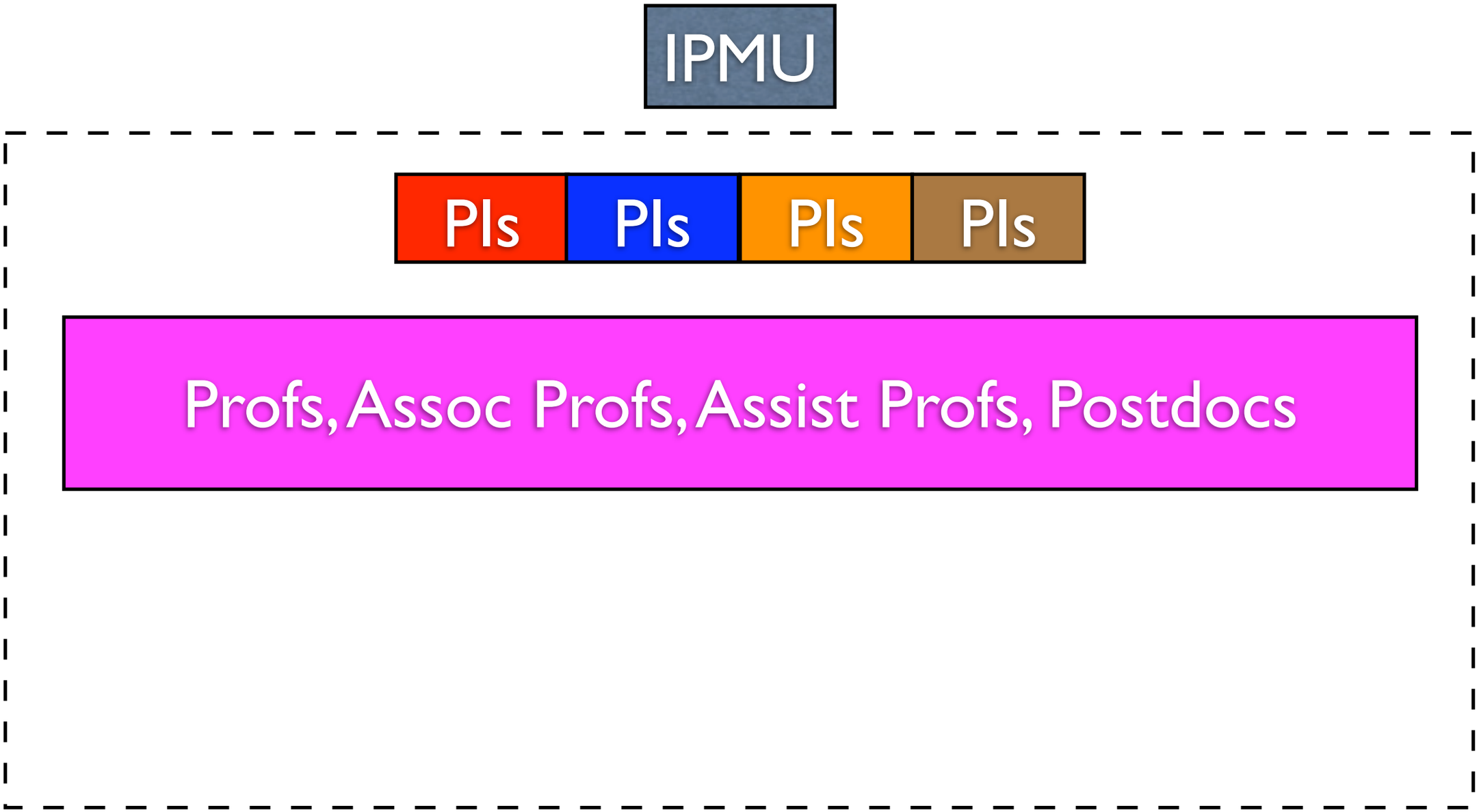

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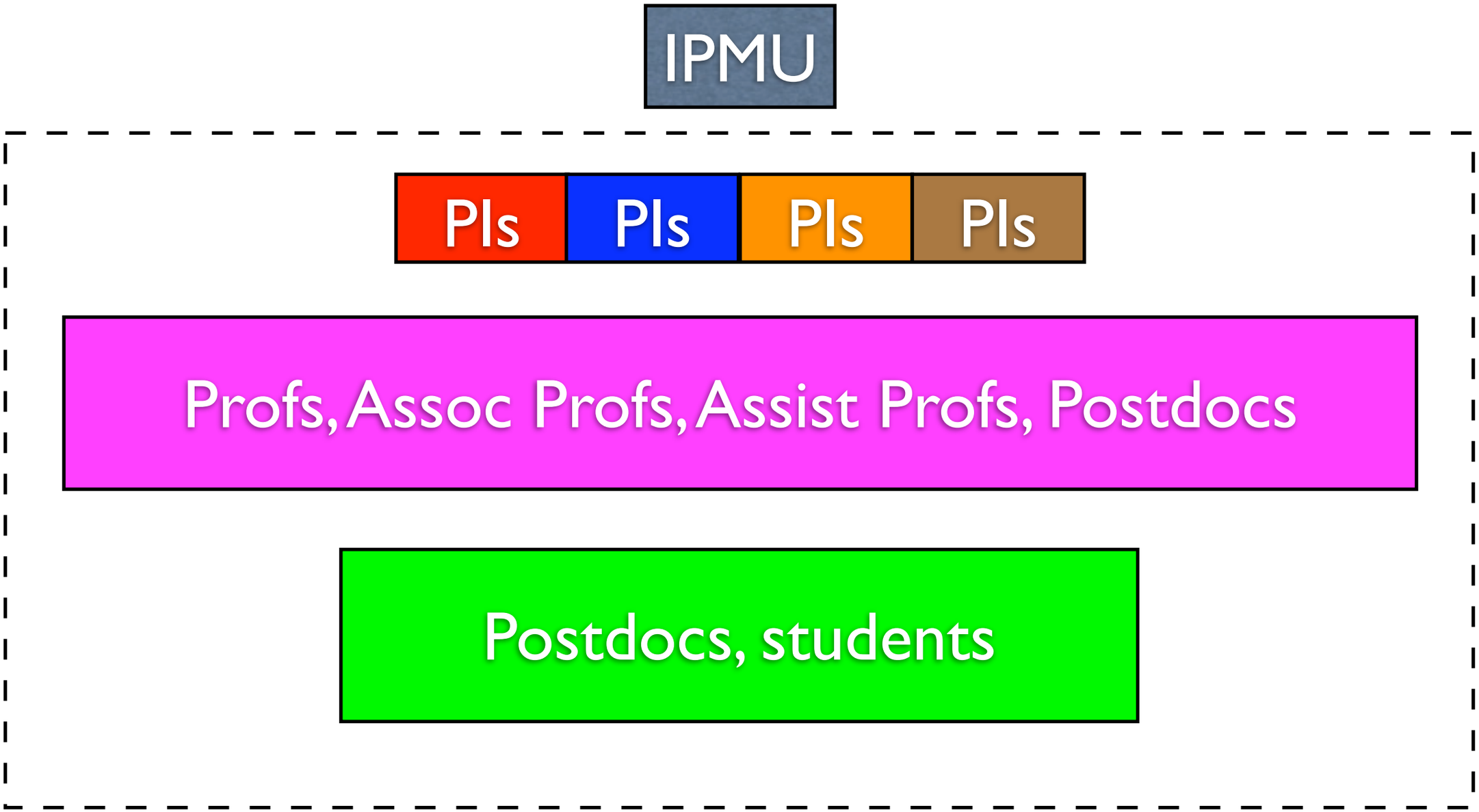

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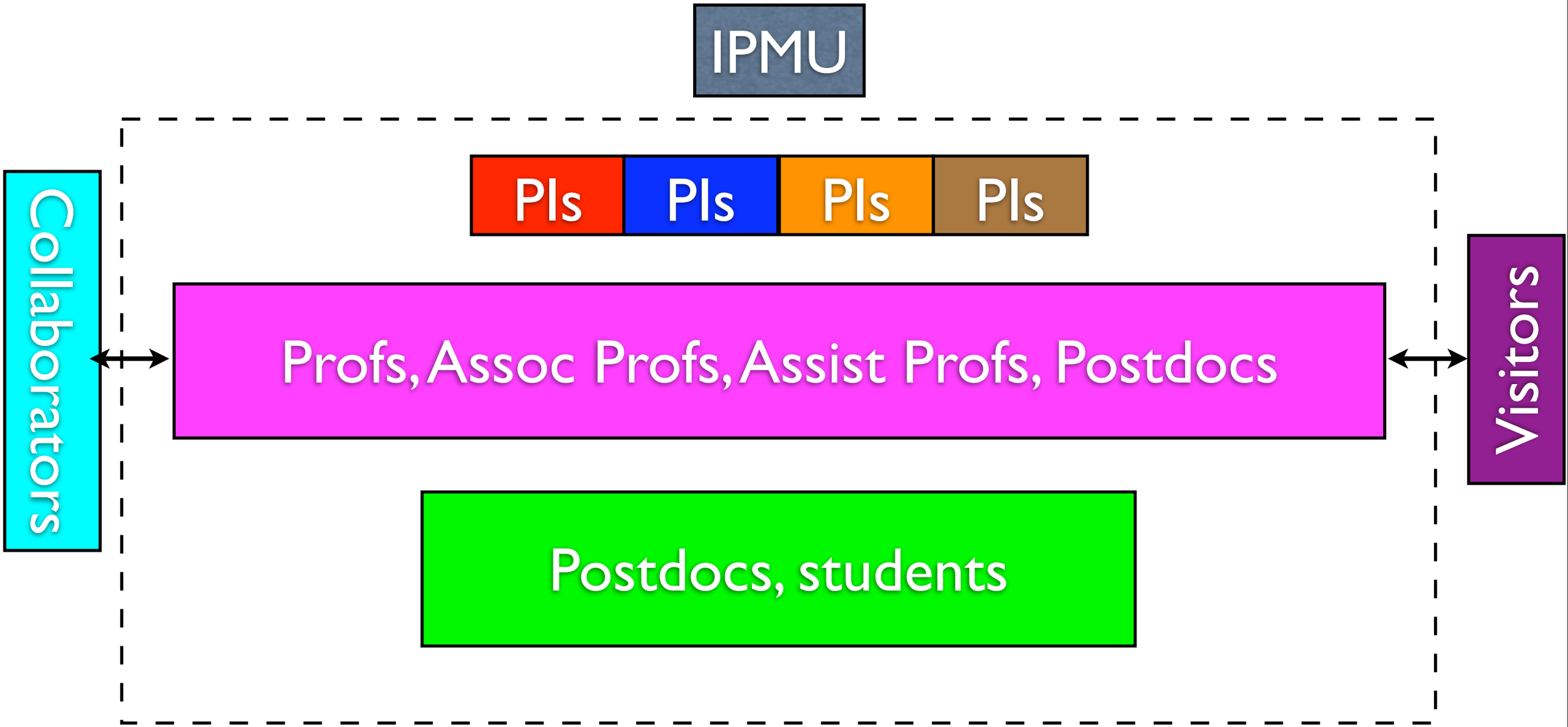

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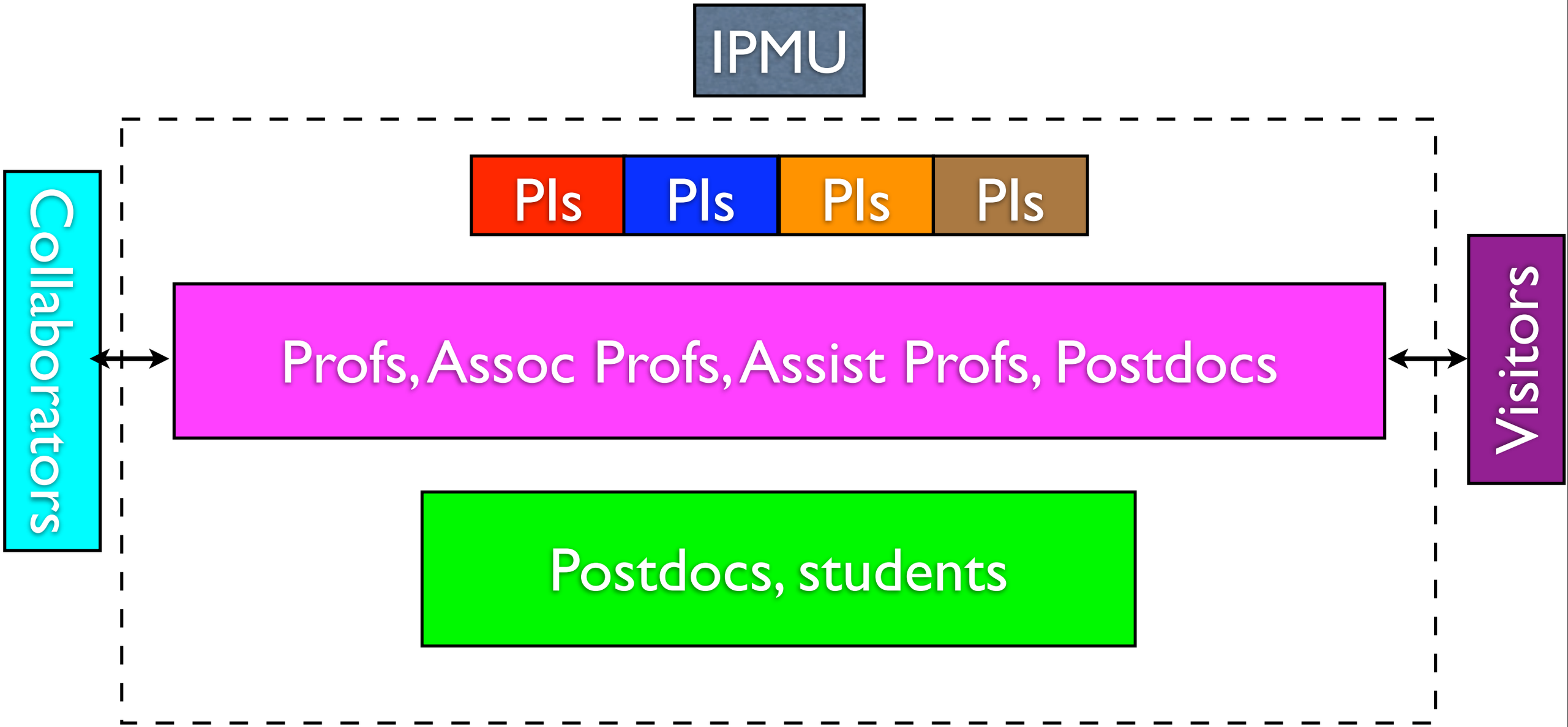

Successful institutions worldwide employ this model

porous boundaries to make it visible

MEXT requirements

- English is the official language
- 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)

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New Buildings

- We rent space from General Sciences Building
- More people coming than initially thought
- Completely filled up!
- prefab building by April (partially), May, ~800 m^2
- seminar room, admin room & library go to the basement, more offices on 6th floor
- new building design well underway
- occupancy by fall 2009

Prefab buildings

first ones occupied since April 14

next one for occupancy *today*

more people coming than anticipated

struggling for space!

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first ones occupied since April 14

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Fall 2009 occupancy ~5900m^2

emphasis on large interaction area

"like a European town square" ~400 m^2

IPMU Kamioka Satellite

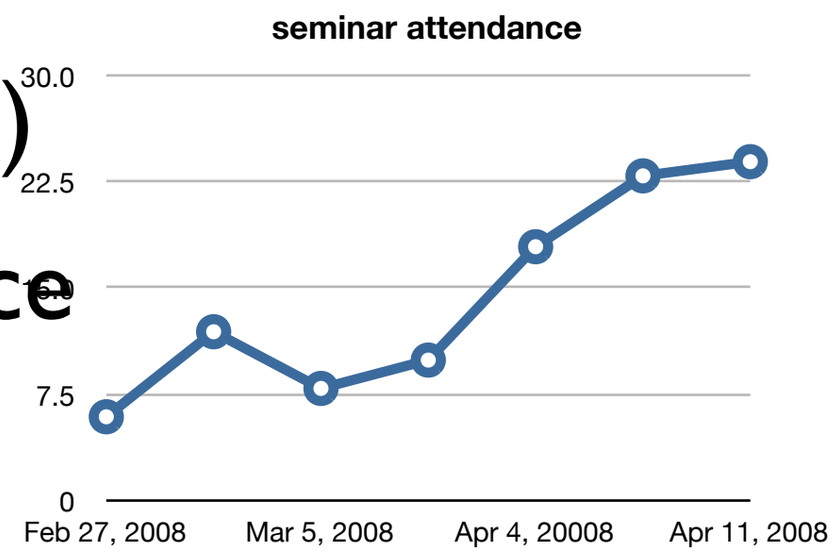
- New prefab structure will be built in Mozumi village, Kamioka
- supports resident scientists working on SuperK, KamLAND, XMASS, R&D for future underground experiments
- enhance collaboration with RCNS (Tohoku) and ICRR (Tokyo)

IPMU laboratory

- Underground lab already built by IPMU
- frontier clean facility
- R&D for future experiments

Activities
(as of 9/19/2008)

- 84 lectures (50 non-Japanese)
- 150 visitors (110 from abroad)
- regular seminars draw audience other institutions
- nine international meetings
- IPMU seminars in Komaba, joint workshops




quiescent stellar
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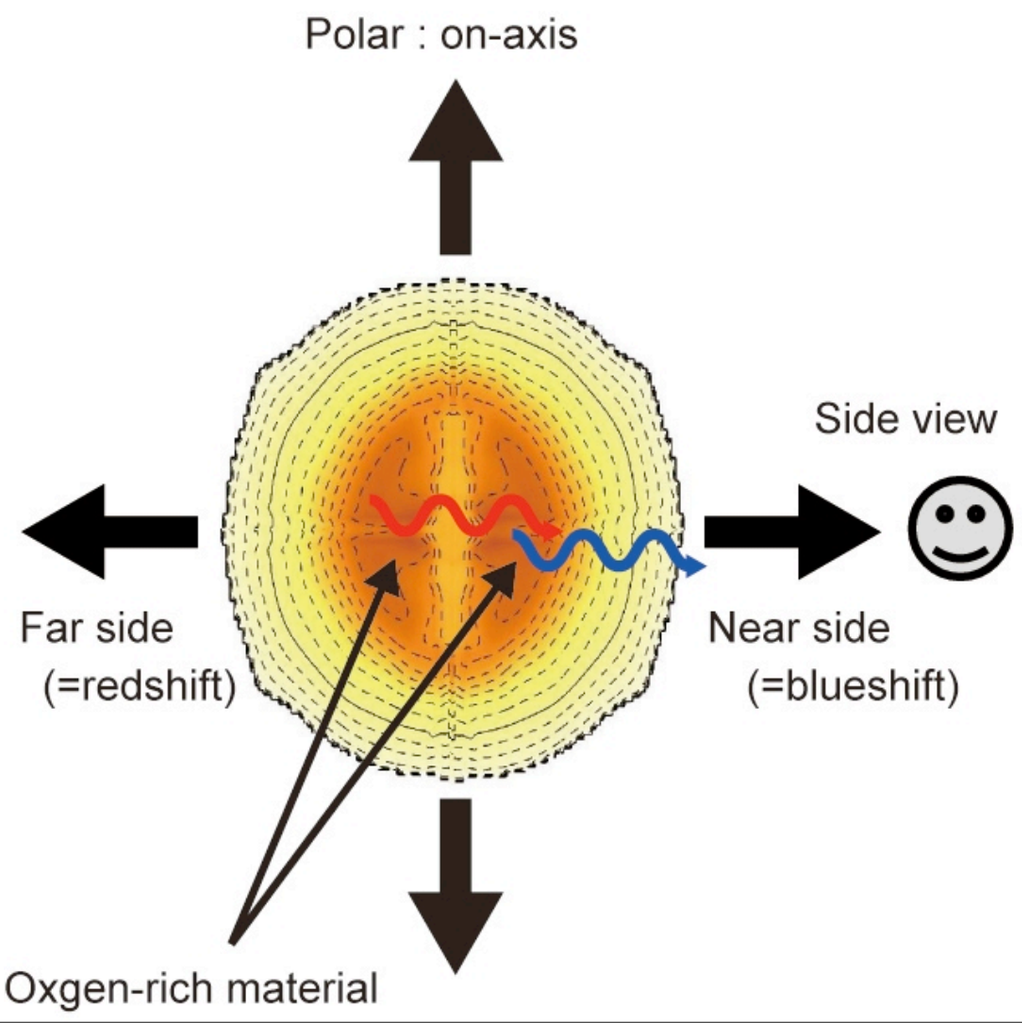
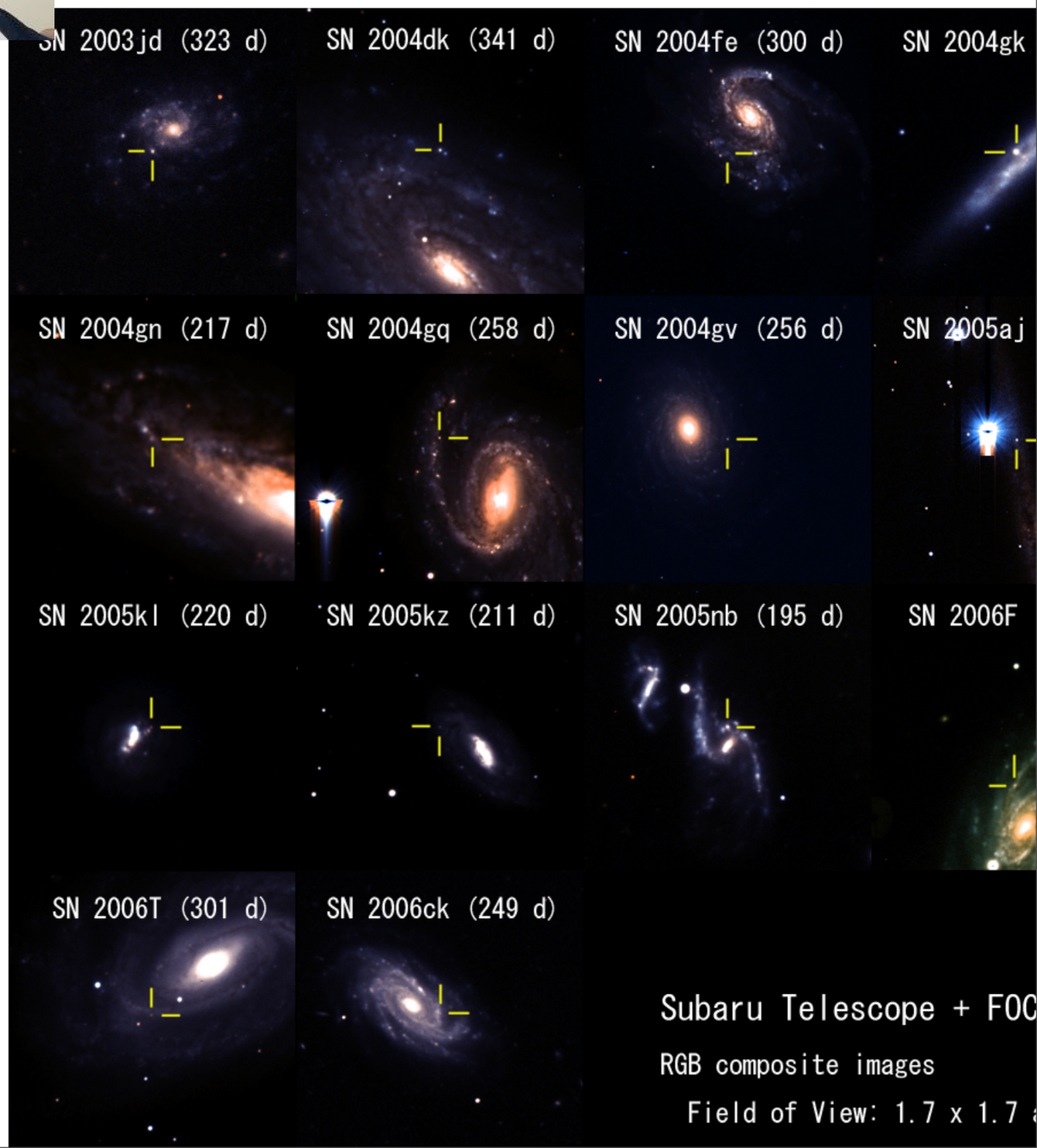
• The massive enc
a factor of ~8 be
• A significant frac
galaxies has act
• AGN hosts exhib
the decrease of
the star formatio
Mariska Kriek

some science

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

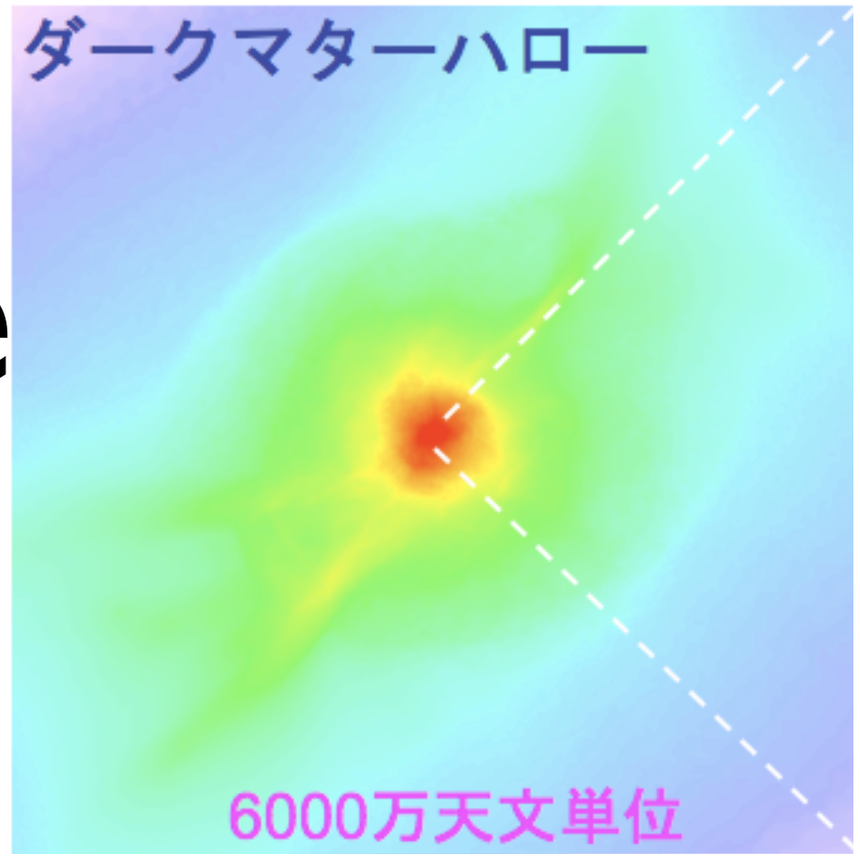


Science 29 February 2008
319: 1220-1223



some science

Birth of first stars



Science 1 August 2008
321: 669-671

some science

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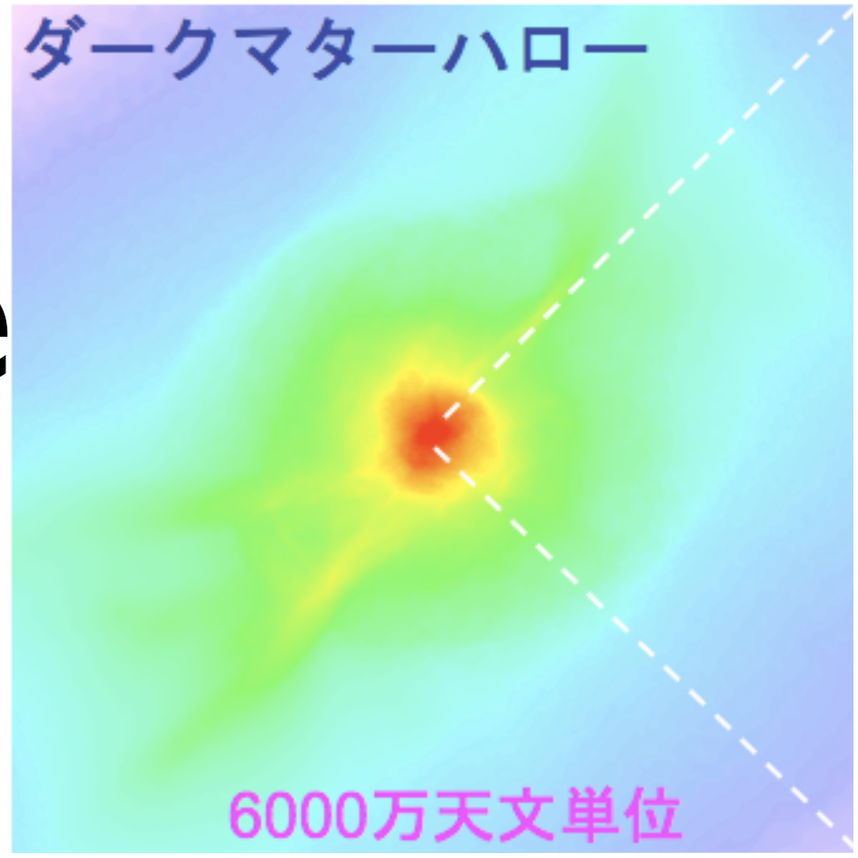

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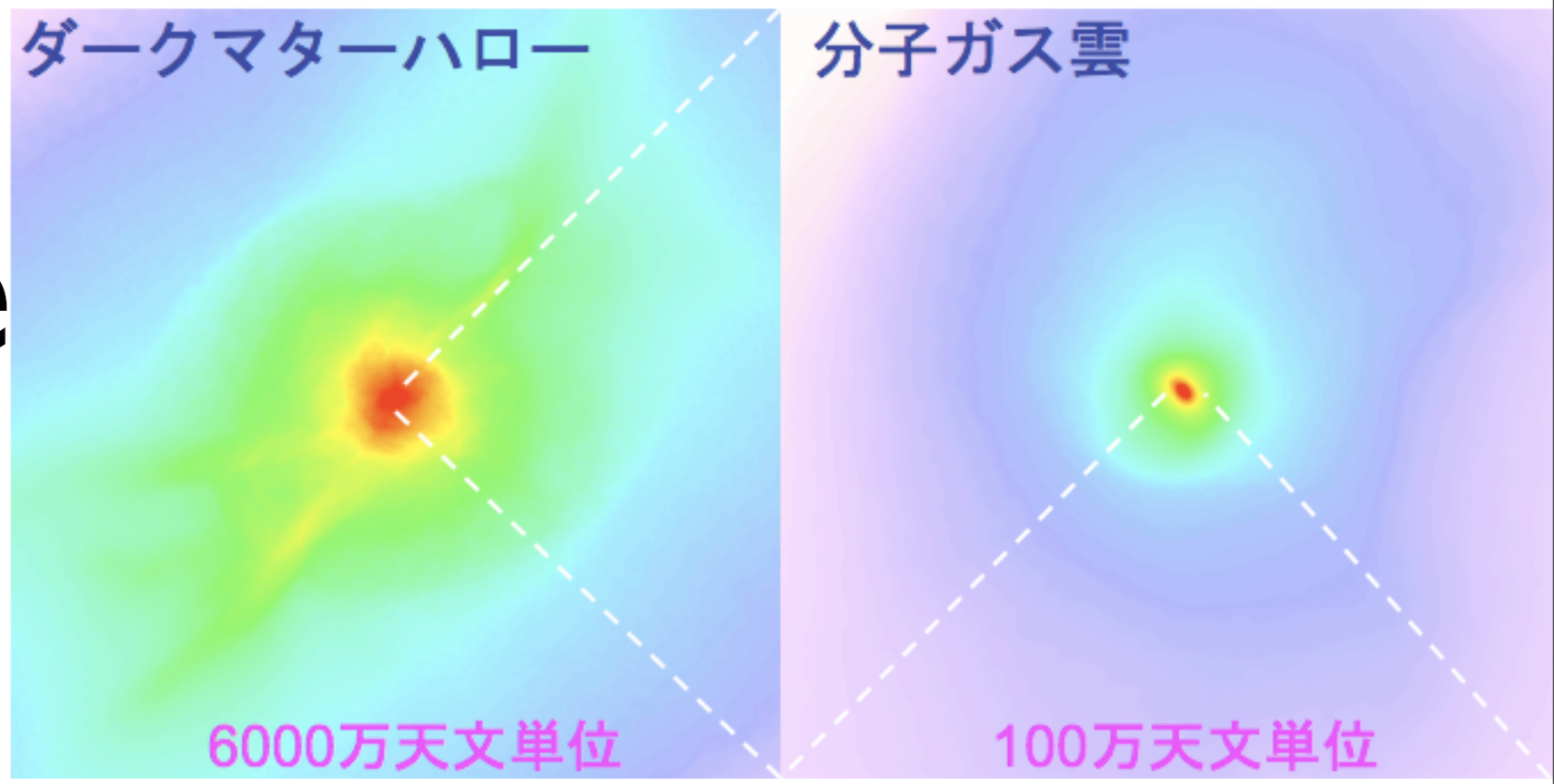

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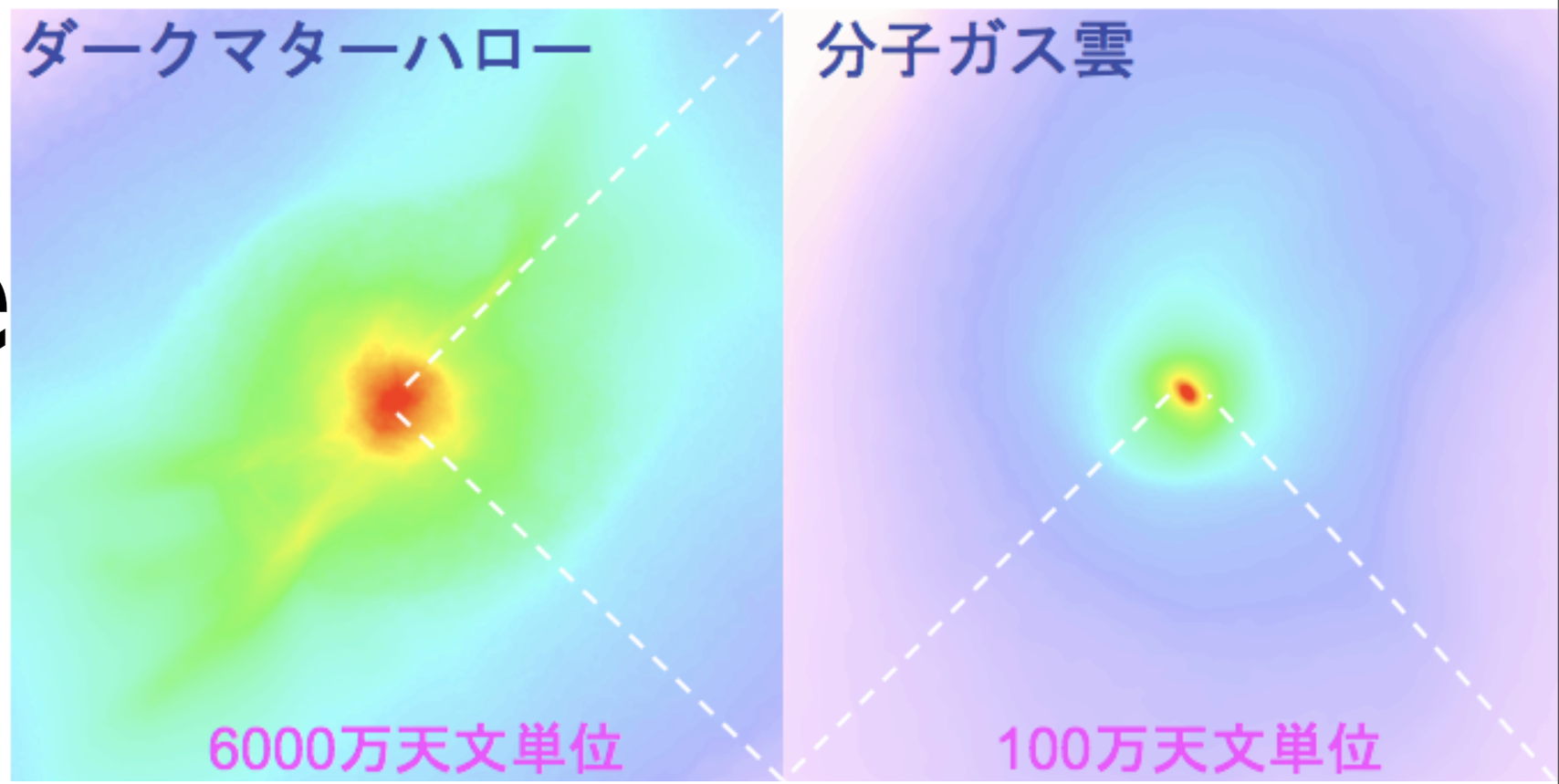

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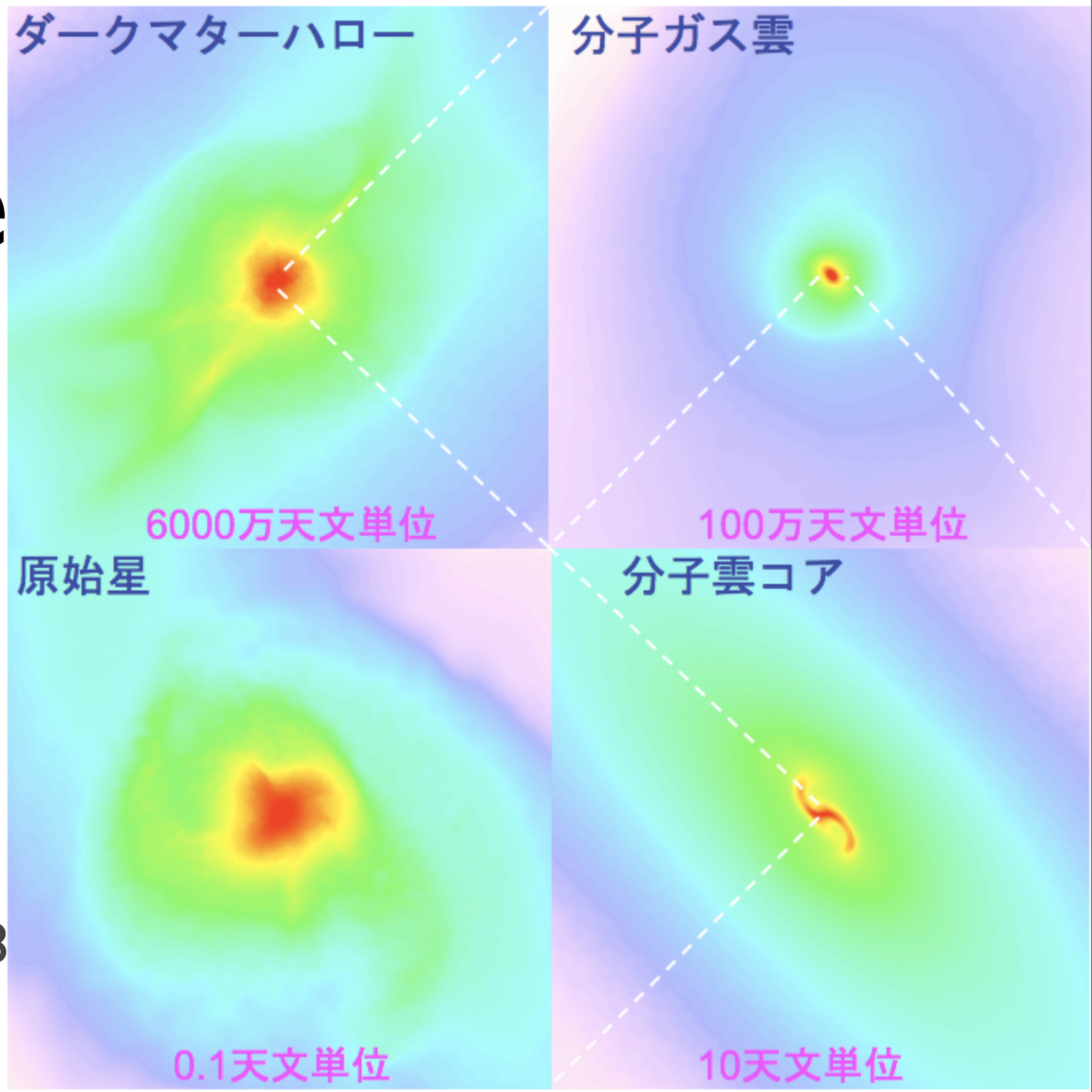

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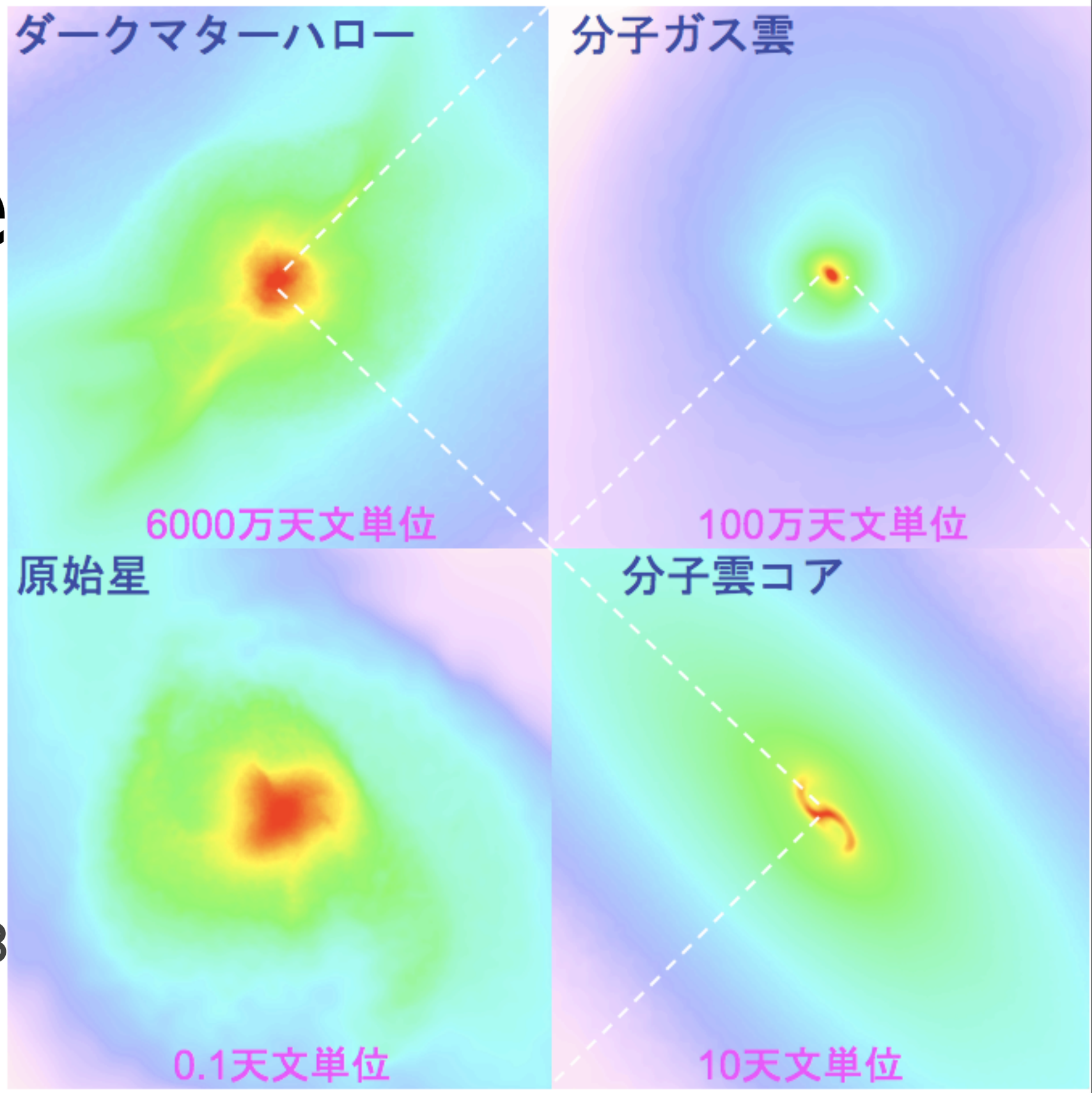
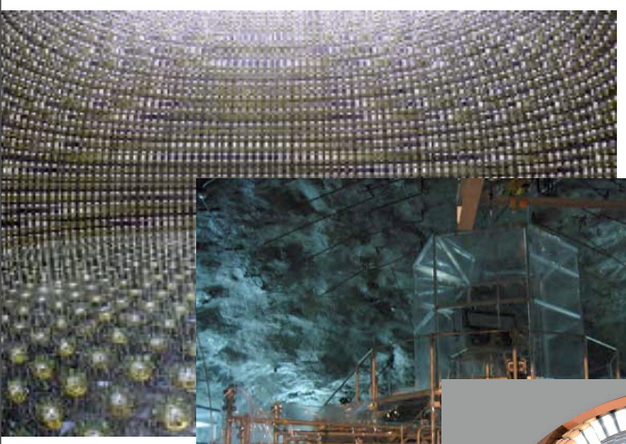
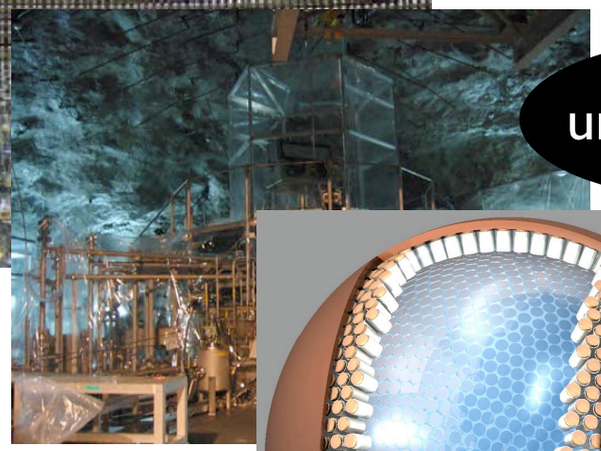
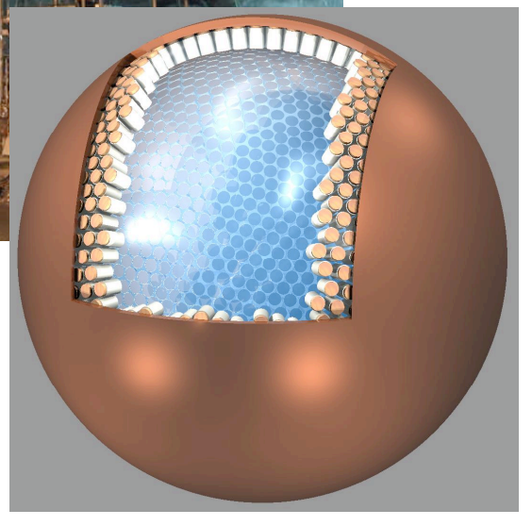


Experimental Program

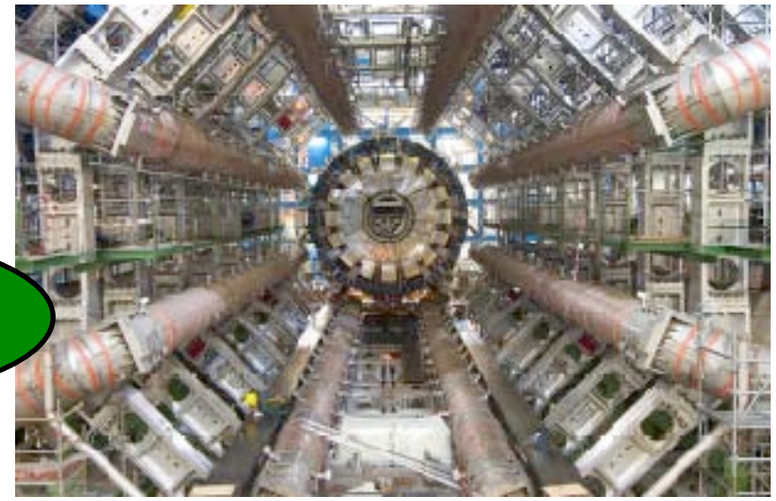
Together with math and theory, *unique* combination in the world!



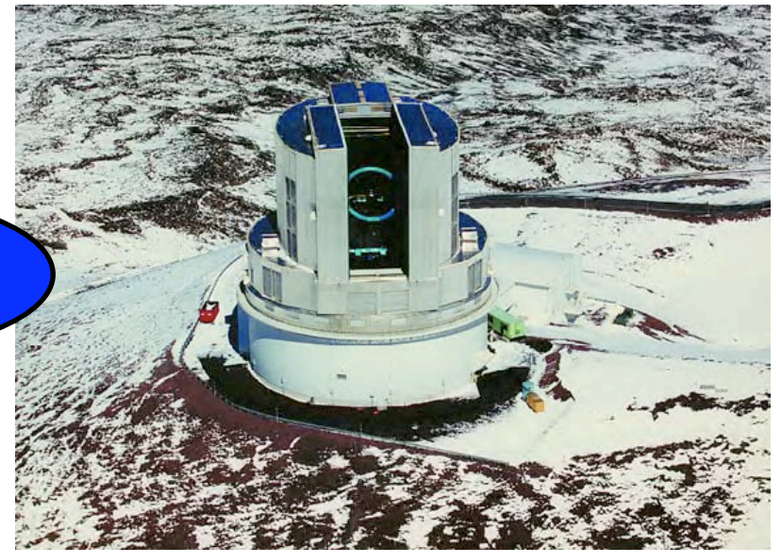




ICRR/Tohoku



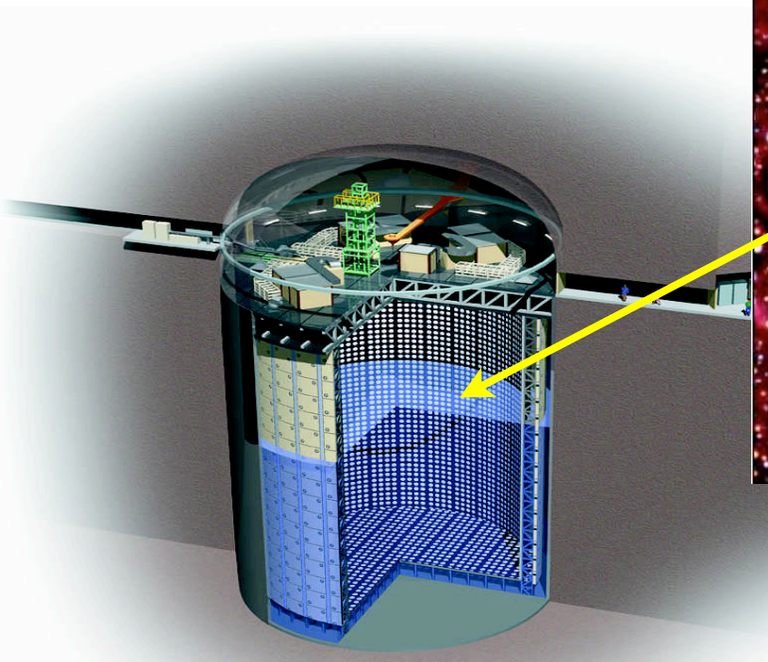
LHC (CERN)

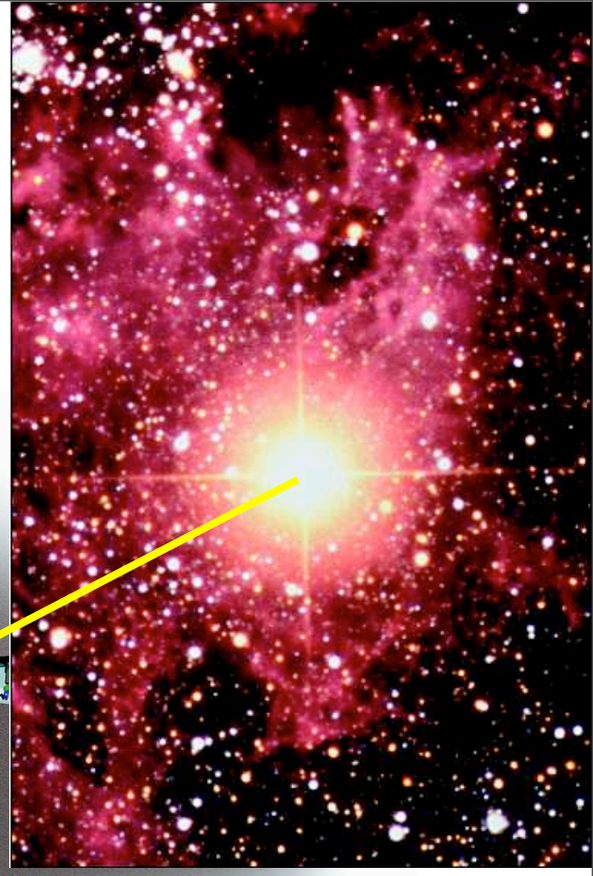


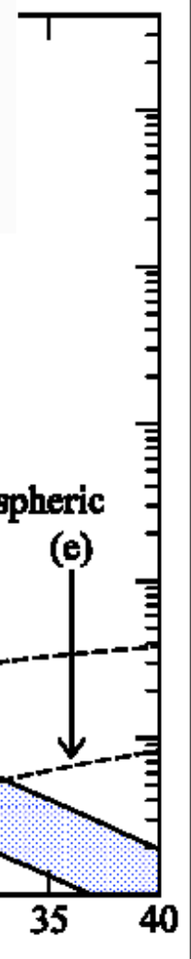
Subaru (NAOJ)

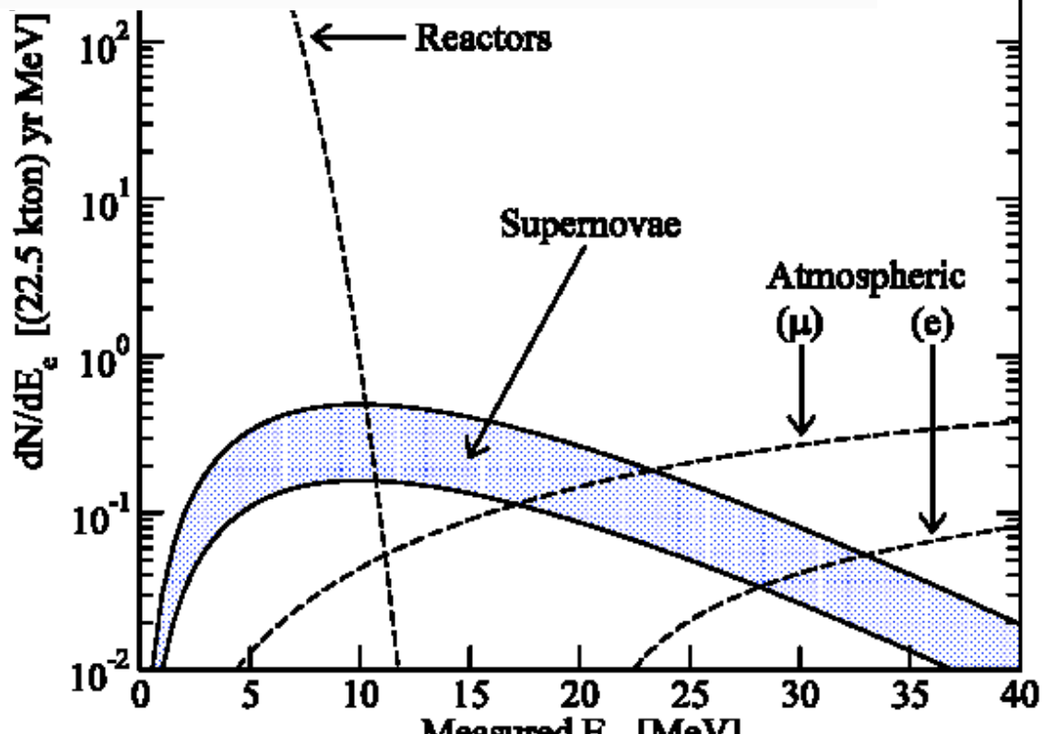
SuperKamiokande

- Mark Vagins from UC Irvine as a Full Professor
- initiate new direction in SuperK
- detect neutrinos from past supernovae in the universe
- dark energy using neutrinos?

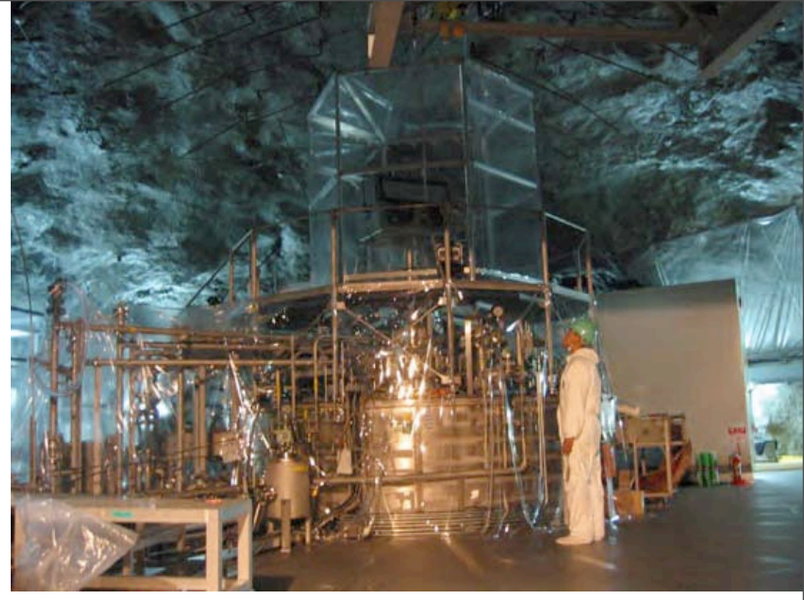




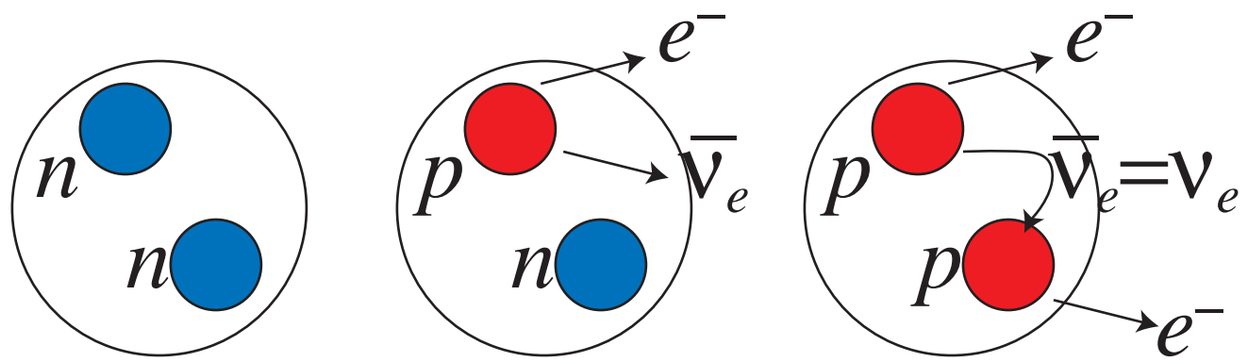


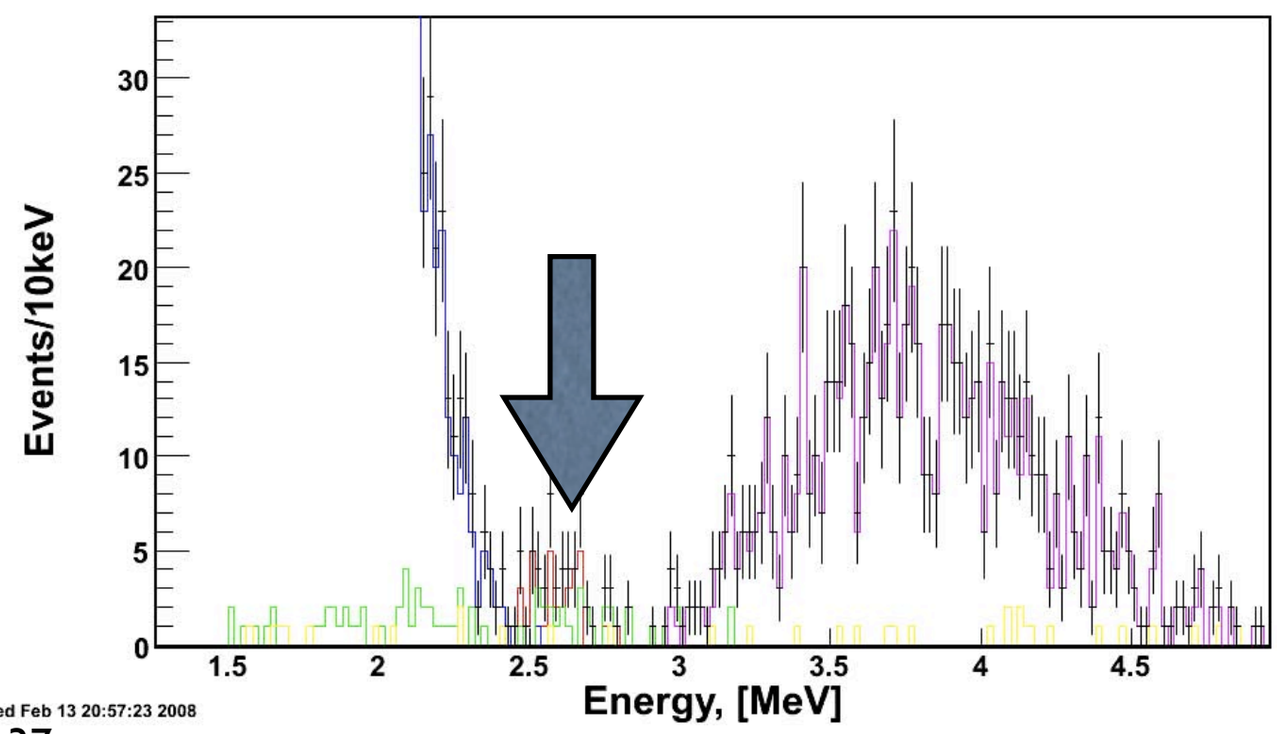


KamLAND

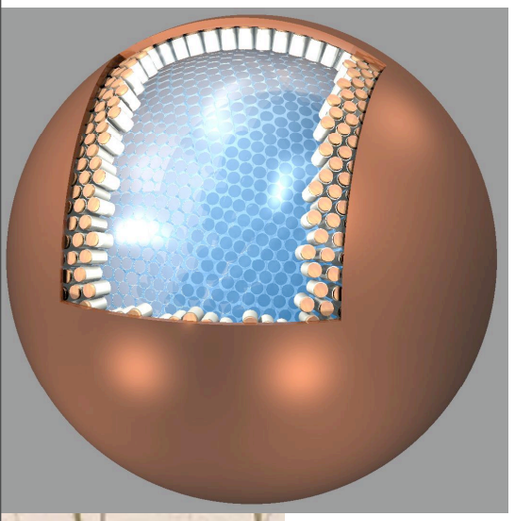


- Alexandre Kozlov as a distinguished postdoc
- convert KamLAND to a new kind of experiment
- Can anti-neutrinos turn into neutrinos?
- Why do we exist in our universe?

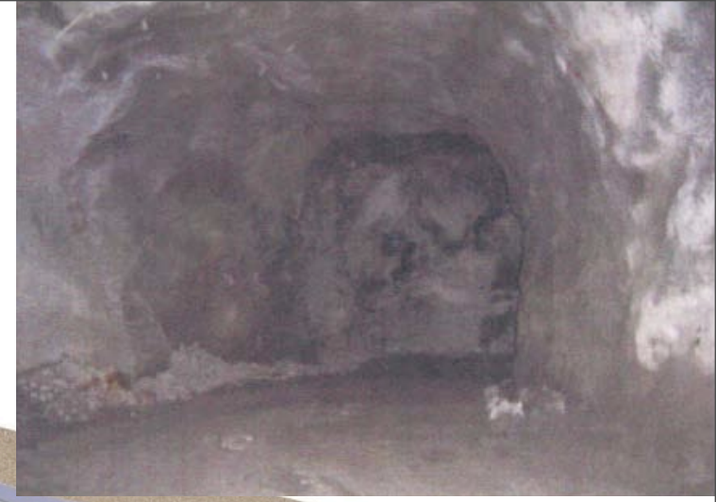


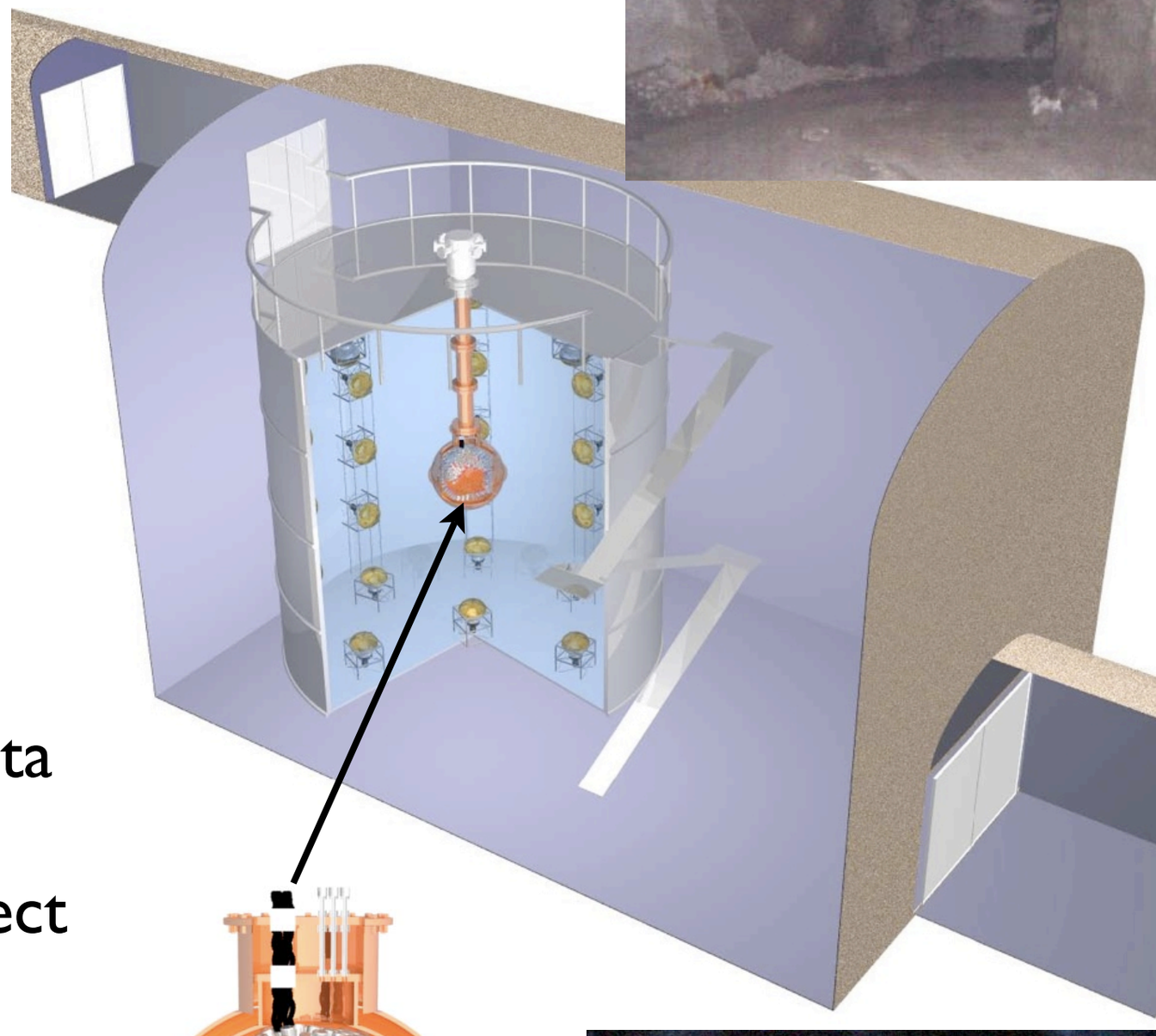


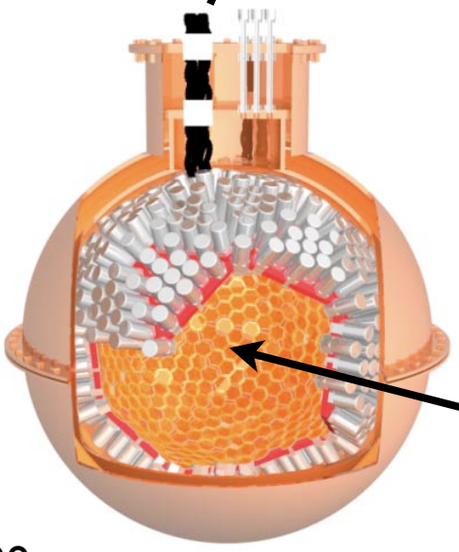
XMASS

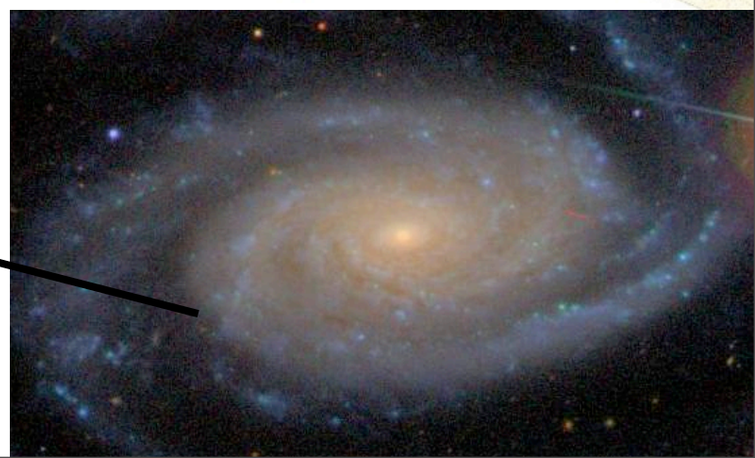


- Trying to detect dark matter directly
- 800kg liquid Xe
- PIs Suzuki and Nakahata and Assoc Prof. Kai Martens lead the project
- start data taking ~2010



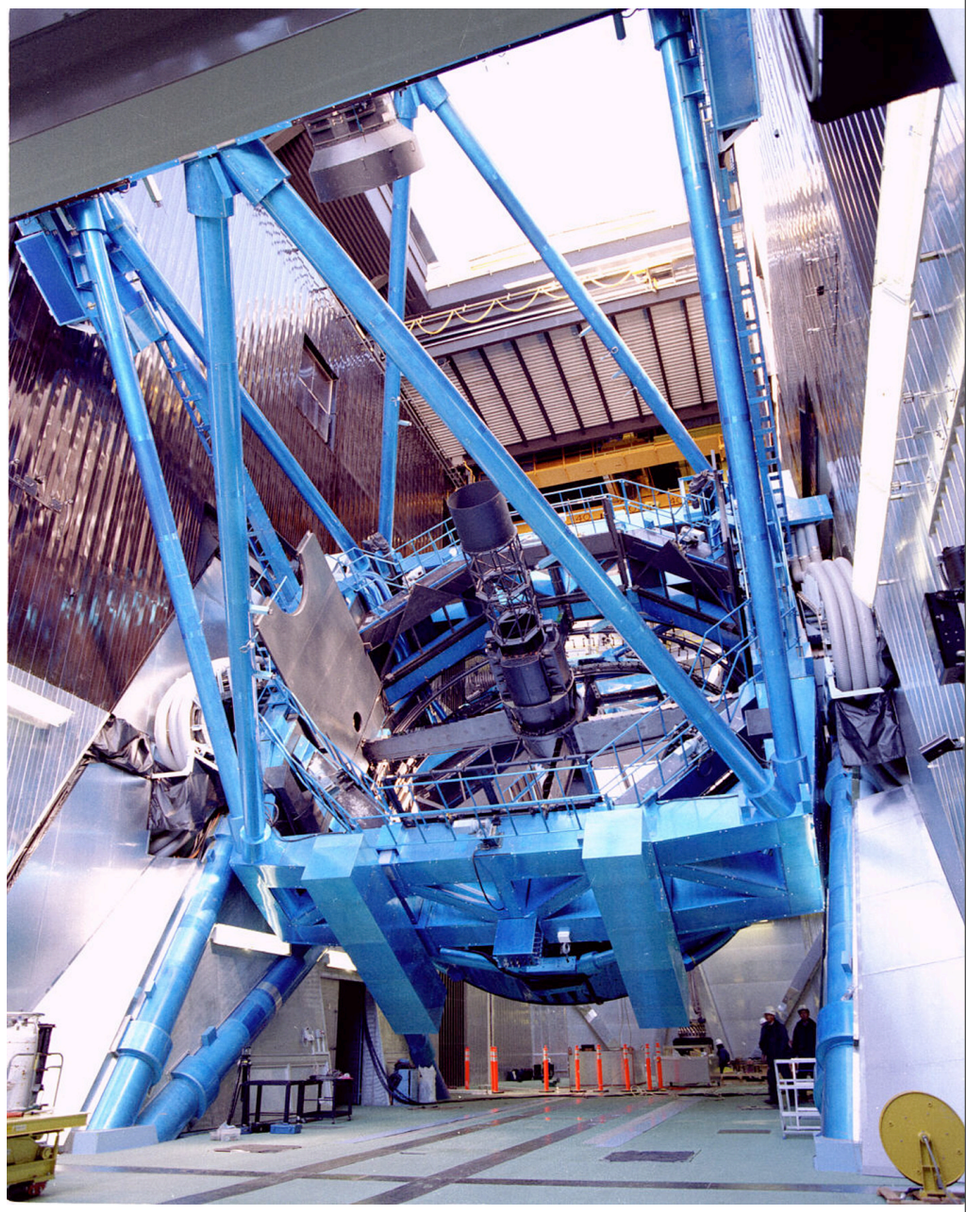






HyperSuprimeCam

- 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



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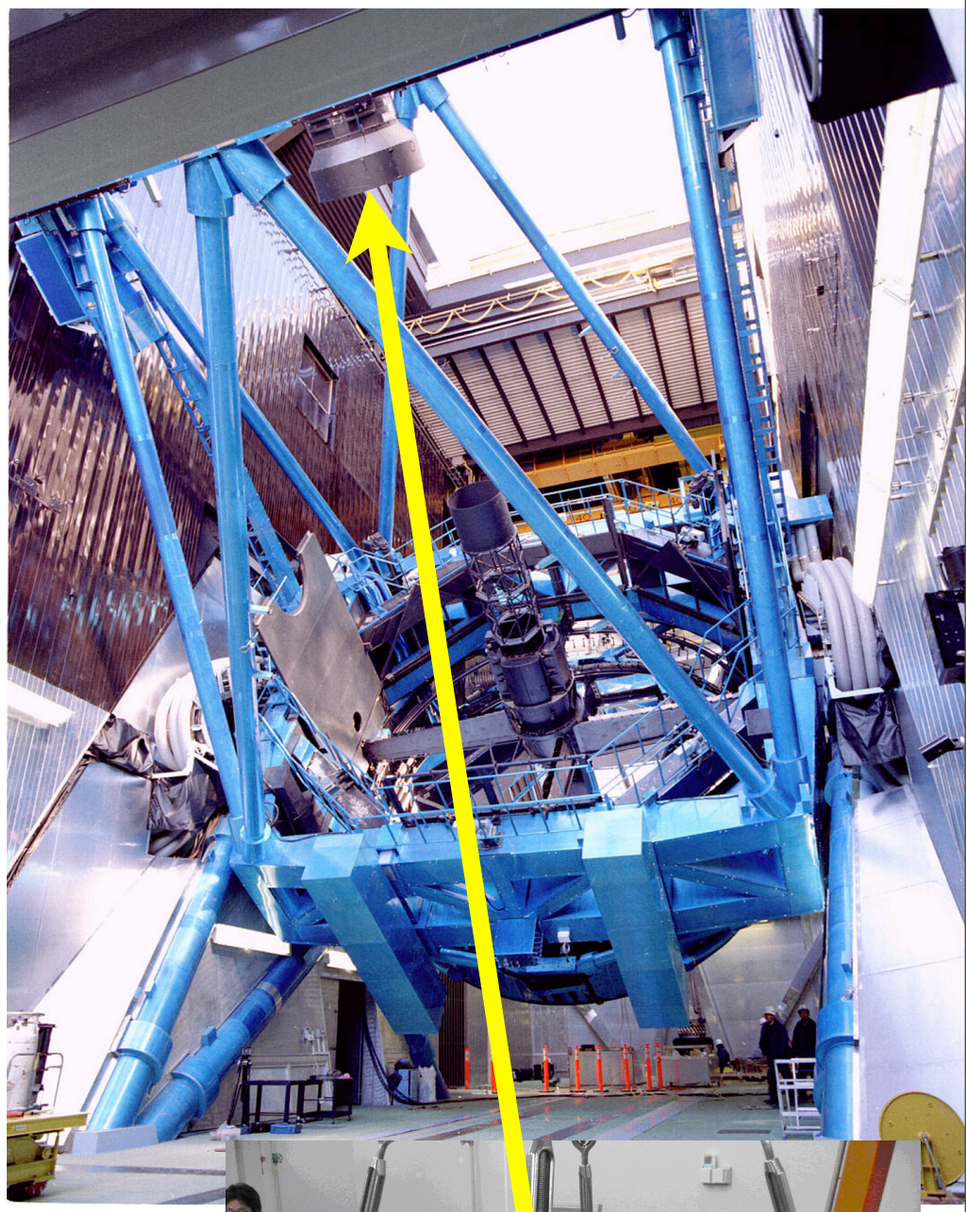

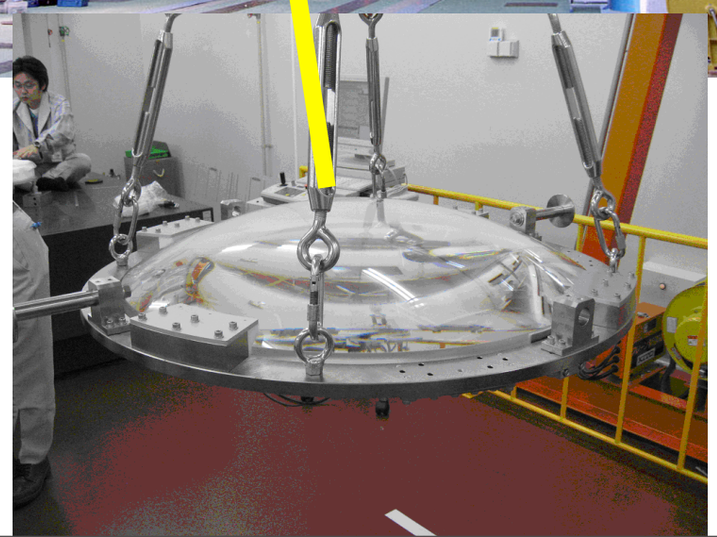

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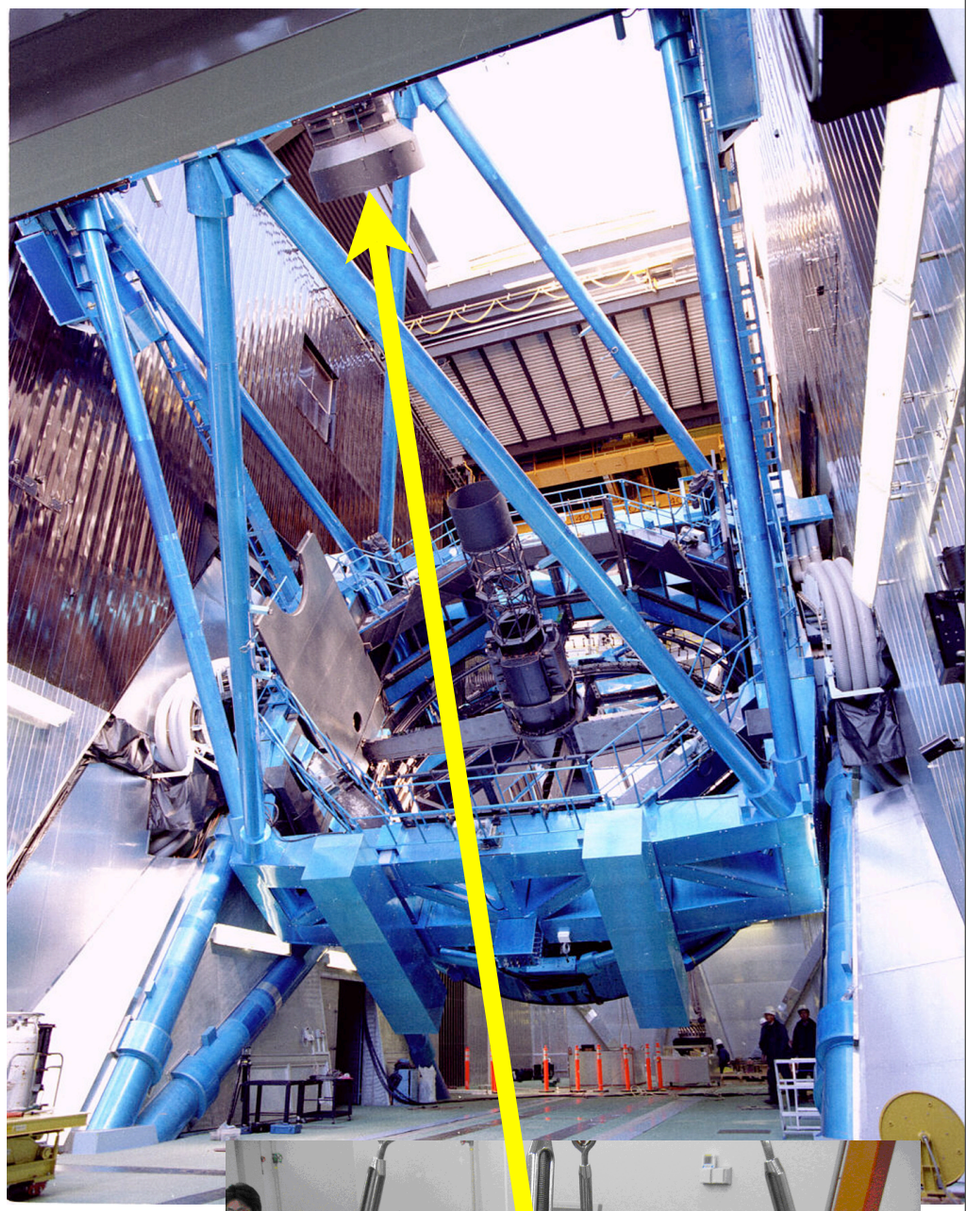

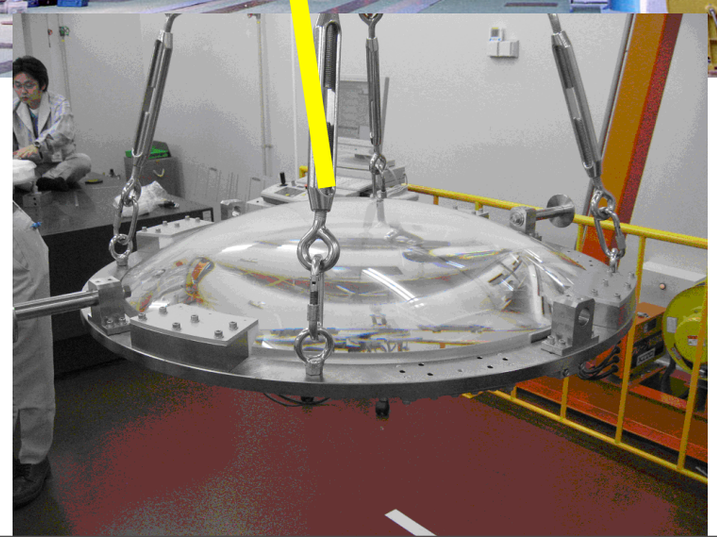

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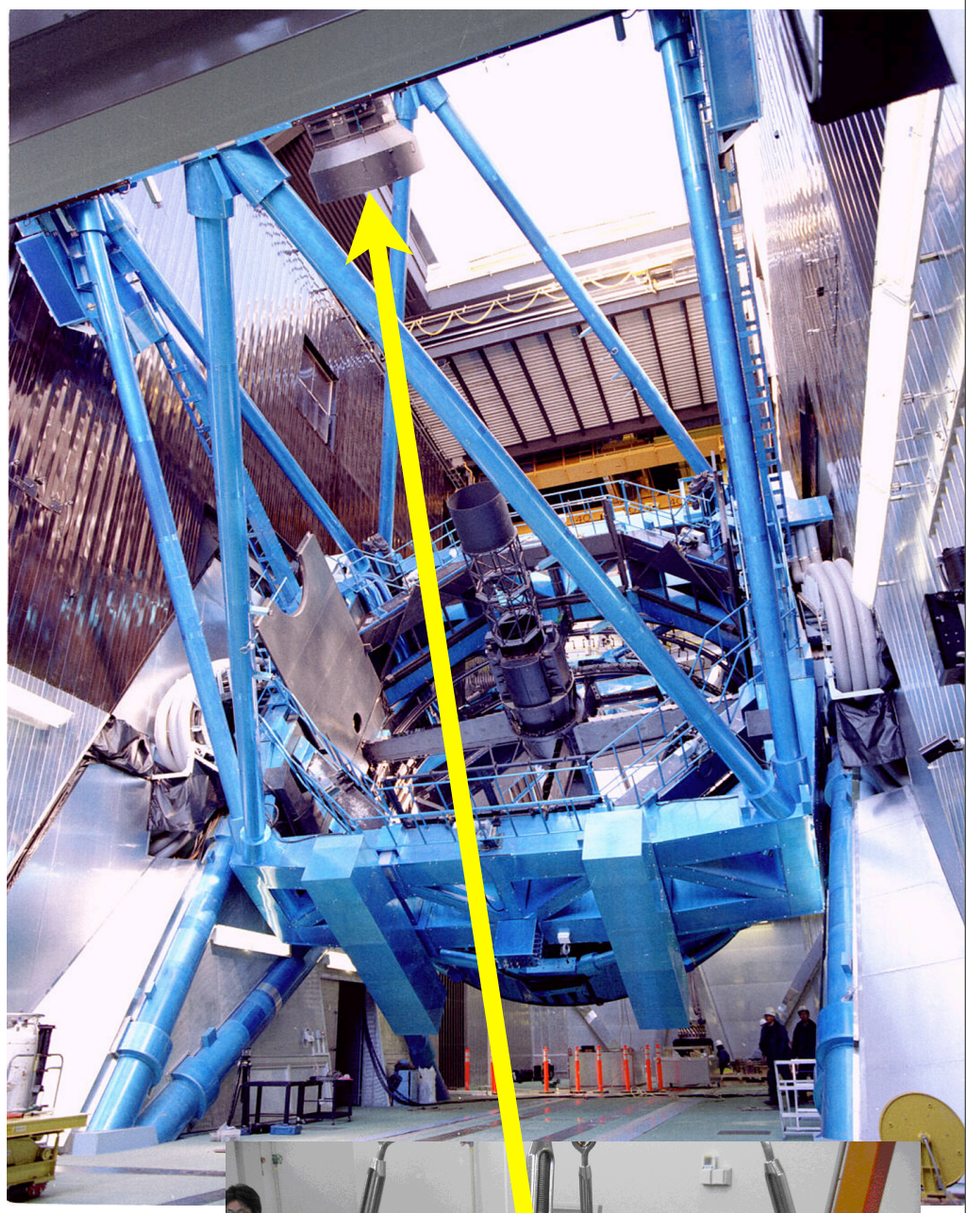

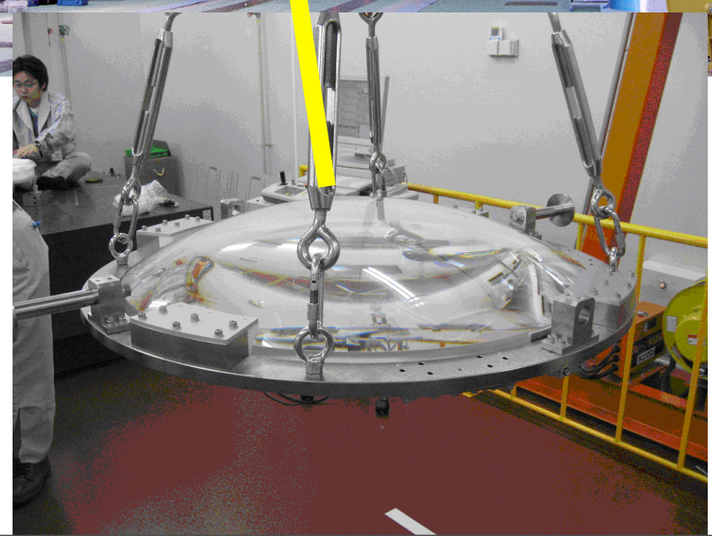

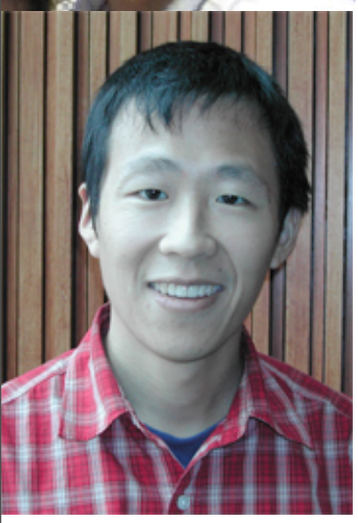

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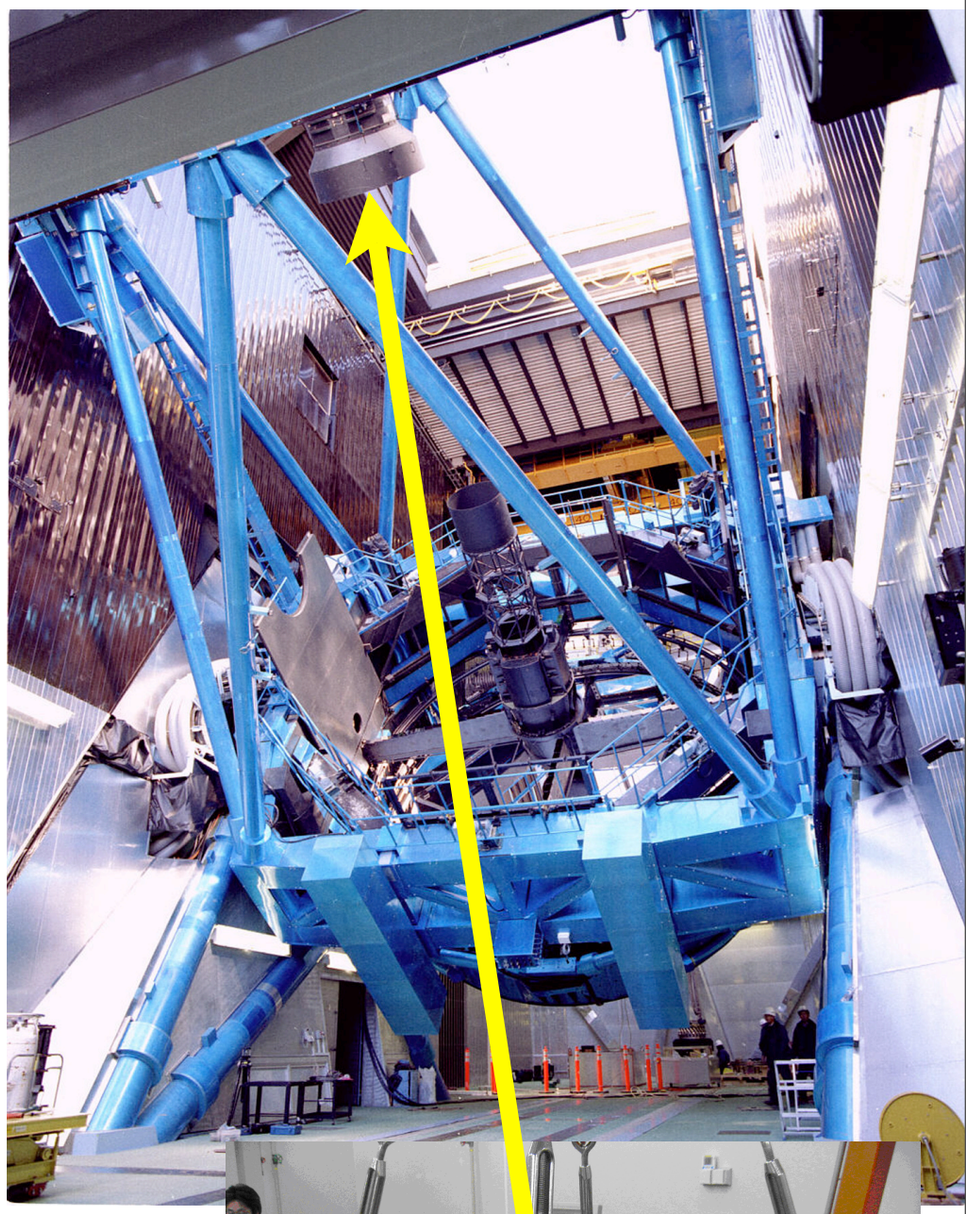

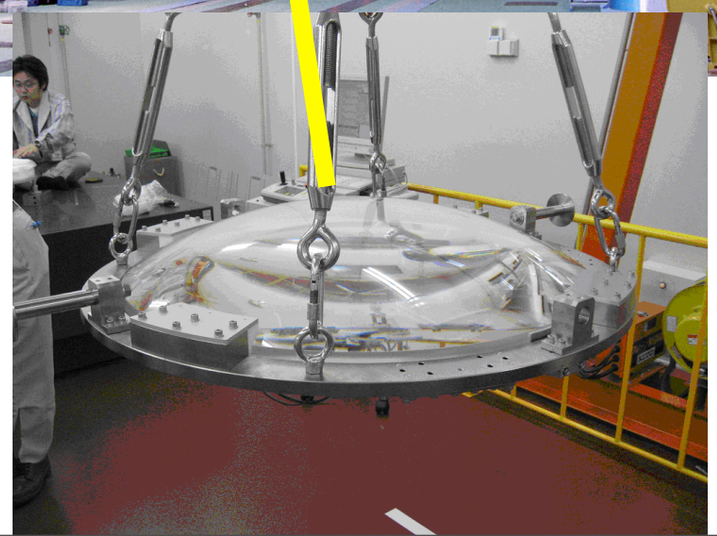

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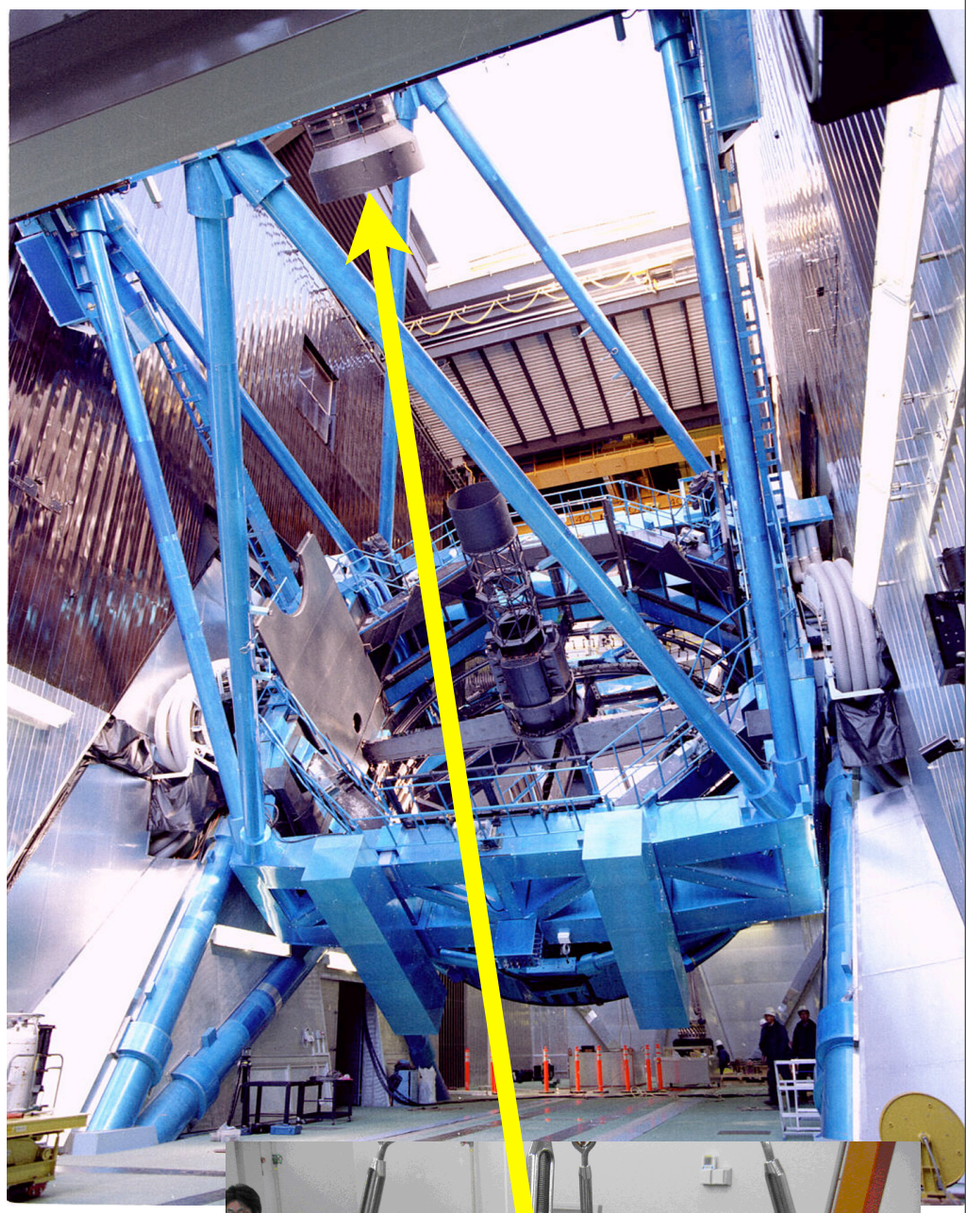

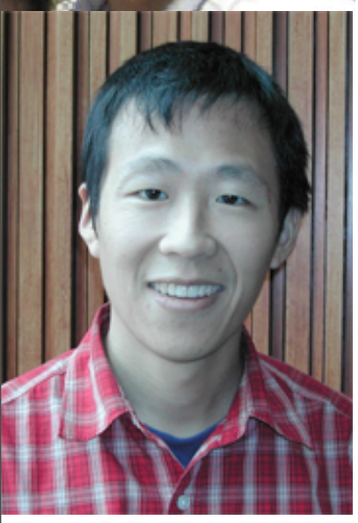

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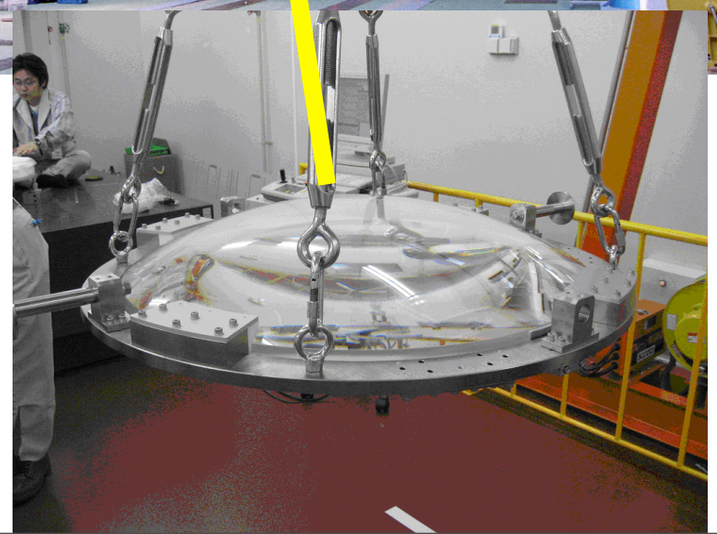
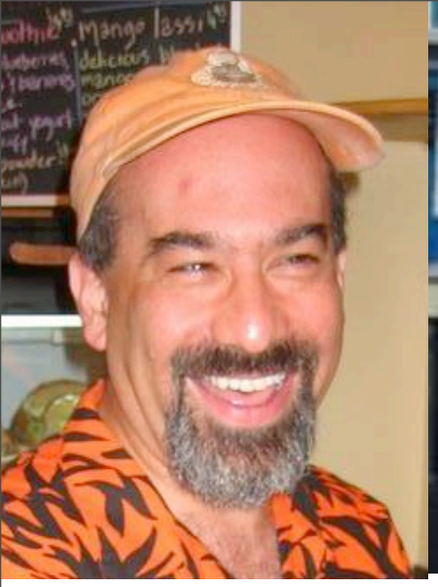
Kriek

Moro-Martin





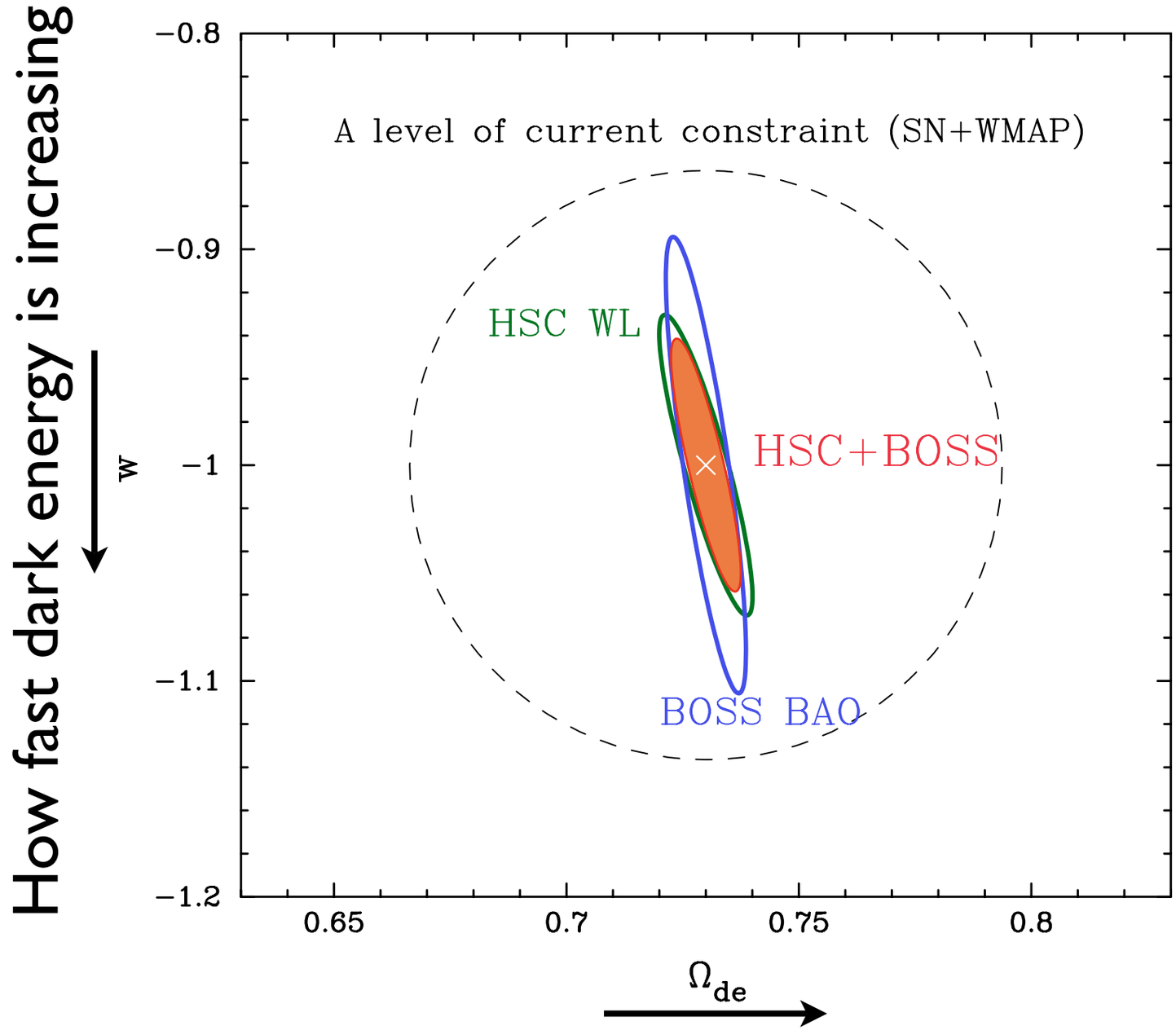
SDSS-III

- 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"?*



Assembling Critical Mass

New Faculty

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

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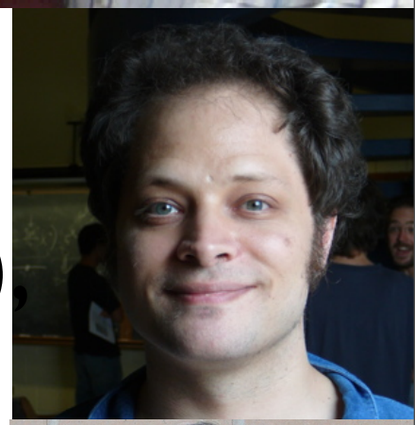





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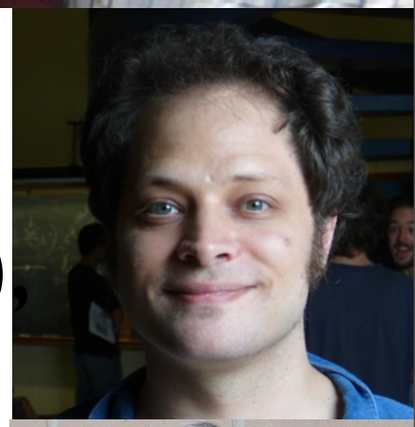
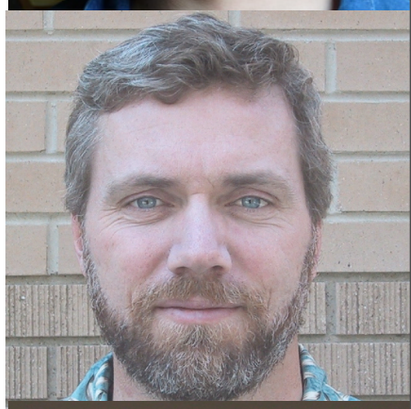





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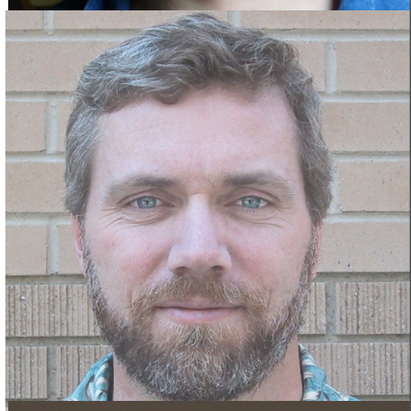

Since Launch

Hirosi Ooguri (PI)

- AMS (American Mathematical Society) Inaugural Eisenbud Prize
- Humboldt Research Award

Masahiro Takada (Assoc Prof)

- ASJ (Astronomical Society of Japan) Young Astronomer Award

Naoki Yoshida (Assoc Prof)

- IUPAP (International Union of Pure and Applied Physics) Young Physicist's Award

117 media coverages (67 newspaper articles

one national TV news (NHK) coverage

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.

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>600 applicants
>410 non-Japanese

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Postdocs

- Made 36 offers, 23 accepted (acceptance 60~70%@Princeton, Berkeley)
- Among 23, 19 non-Japanese, 5 women
- Coming from good Ph.D. institutions: Lyon, Southampton, Harvard, Wisconsin, Seoul, Paris, Princeton, Sussex, Chicago, etc

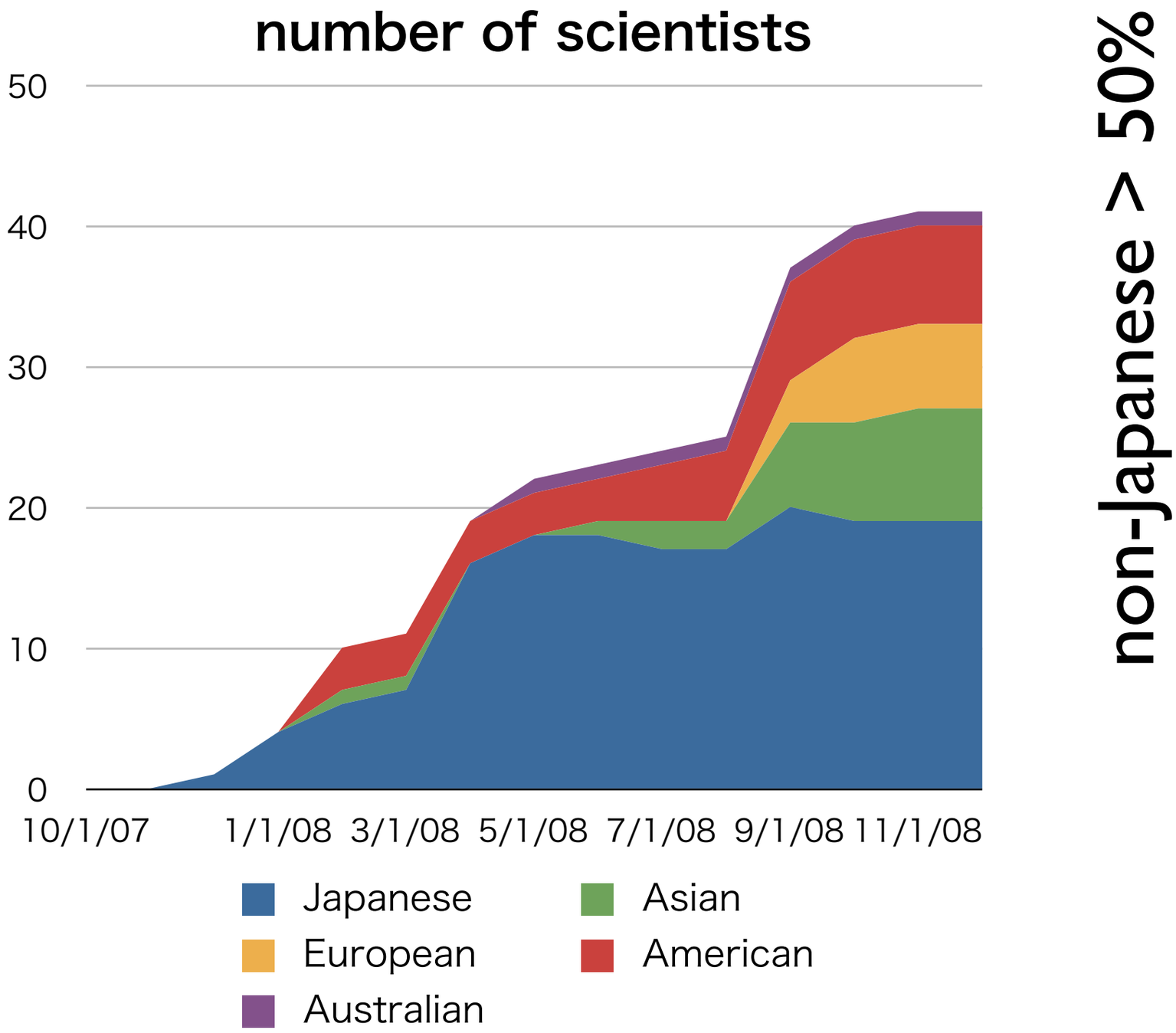
Creative ideas to make the offer attractive

- "shared" postdoc with Berkeley (Marina Cortes), Princeton, DESY, IHES, MPA, CERN
- "*a month a year out of Japan*" policy

We make it easy

- practical information about life in Japan at http://www.ipmu.jp
- help getting bank accounts, credit cards
- translators to meet real estate agents
- new intl guesthouse by April 2010
- free Japanese language classes
- merit-based competitive salaries

Full-Time Scientists



non-Japanese > 50%

東京大学
THE UNIVERSITY OF TOKYO

IPMU

Reviews '08

"*The Institute for the Physics and Mathematics of the Universe (IPMU), the University of Tokyo, has achieved remarkable visibility in a very short time. It has introduced innovative practices not seen elsewhere in Japan. Unlike the four other WPI programs, IPMU is on its way to developing into a global research institute of a type unprecedented in Japan. It is totally new, and truly global.*"

They gave us $0.5M this year!

Conclusions

- IPMU a new institution on basic research in math, particle physics, astrophysics
- English is the official language
- ~$14M/year budget
- will have ~65 FTE, >35 non-Japanese
- with joint appointments and postdocs on grants, aims at 200 heads
- will have workshops (~once a month), visitor program, postdoc exchanges
- underground, sky, laboratory & theory/math
- looking for collaborative opportunities!

Invitation

- Faculty members can visit
- Postdocs are encouraged to apply to our positions
- Chinese Academy of Sciences has a program to sent graduate students abroad. We particularly welcome students who have passed qualifying exam!