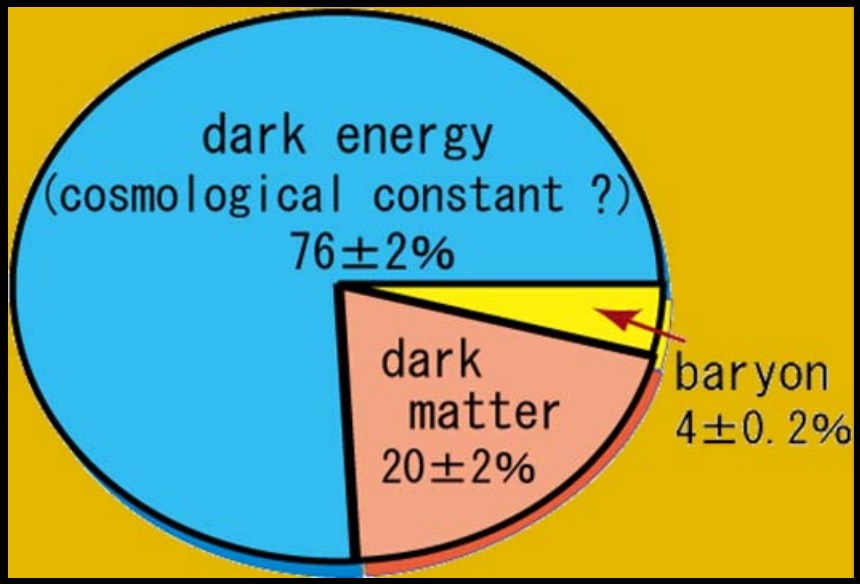
# Opening address

RESCEU & JSPS core-to-core program DENET Summer School

*Dark energy in the universe*

August 31-September 2, 2008





**Yasushi Suto**

*Department of Physics & RESCEU*

*The University of Tokyo*

# International Research Network for Dark Energy (JSPS, core-to-core program 2007-2009)

**Princeton U.**
**Dept. of Astrophys. Sci.**
**coordinator**
**Edwin Turner**

**Caltech**
**Dept. of Astron.**
**coordinator**
**Richard Ellis**

**Univ. of Tokyo**
**Res. Center for the Early Universe**
**coordinator**
**Yasushi Suto**

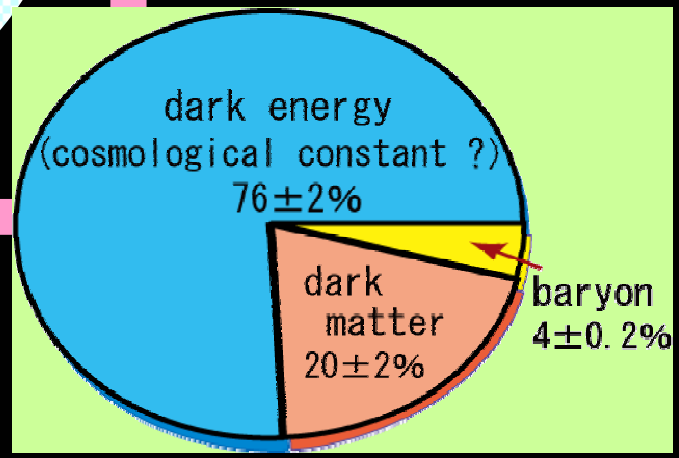
Tohoku Univ.
NAOJ
Hiroshima Univ.
Kyoto Univ.
Nagoya Univ.

CMB
Gravitational lens
Baryon oscillation

Supernova
Weak lens mapping

**Edingburgh U.**
**Royal Obs.**
**coordinator**
**John Peacock**

**Theoretical model**
**Baryon oscillation**
**Weak lens mapping**



RESEARCH CENTER FOR THE EARLY UNIVERSE
THE UNIVERSITY OF TOKYO
RESCEU

東京大学 大学院
理学系研究科・理学部
SCHOOL OF SCIENCE, THE UNIVERSITY OF TOKYO

JSPS 日本学術振興会
Core-to-Core Program
DENET
International Research
Network for Dark Energy

JSPS core-to-core program workshop

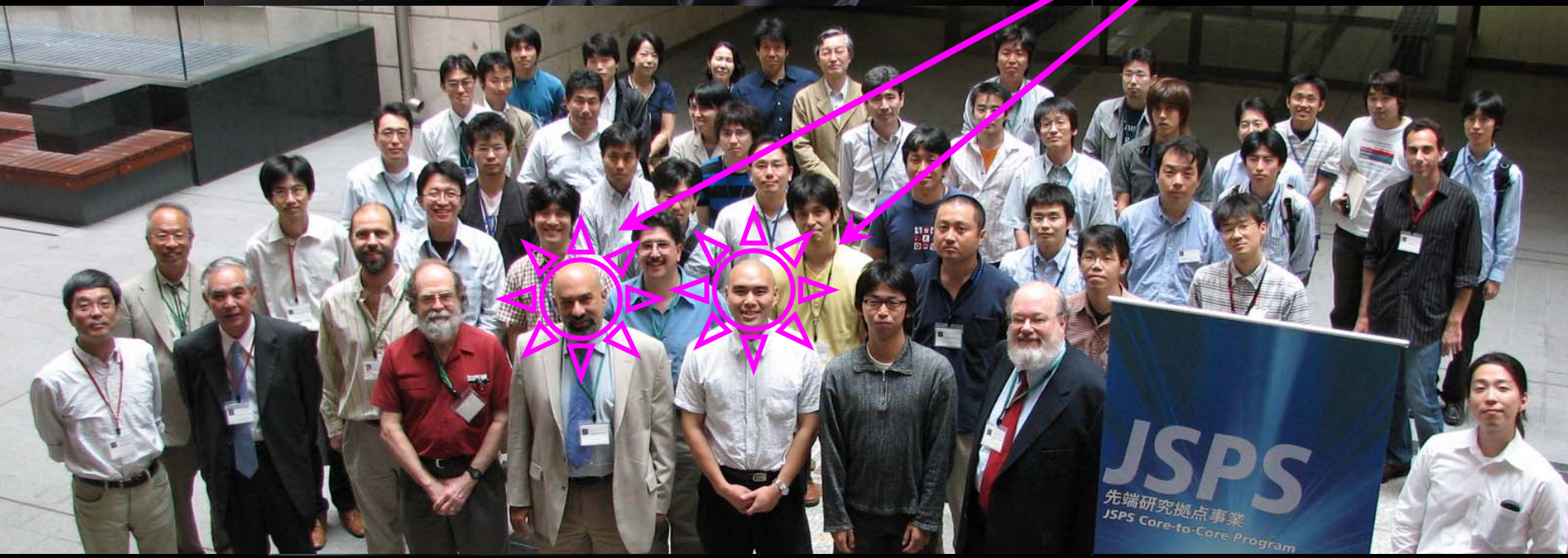
# Cosmology with wide-field imaging surveys of galaxies

June 7 - 8, 2007, Koshiba Hall
The University of Tokyo

Invited Speakers

**Hongo campus**
**Univ. of Tokyo**

standard candle



# Decrypting the Universe

## Large Surveys for Cosmology

*Invited Speakers*
D. Spergel
S. Cole
E. Copeland
M. Doi
A. Helmi
O. Lahav
R. Maartens
Y. Mellier
S. Miyazaki
A. Murphy
M. Takada
T. Yamada

24th-26th October 2007
Edinburgh, Scotland

Joint Royal Observatory Edinburgh / JSPS
Core-to-Core Program Workshop
www.roe.ac.uk/roe/workshop/2007

**Royal Observatory Edinburgh Scotland**

*Local Organising Committee*
A. Heavens
R. Ivison
A. Nicol
P. Norberg (Chair)
P. Simon
F. Simpson
A. Taylor

# Cosmology Near & Far: Science With WFMOS

**May 19-21, 2008 @Marriot, Kona, Hawaii**


GEMINI OBSERVATORY

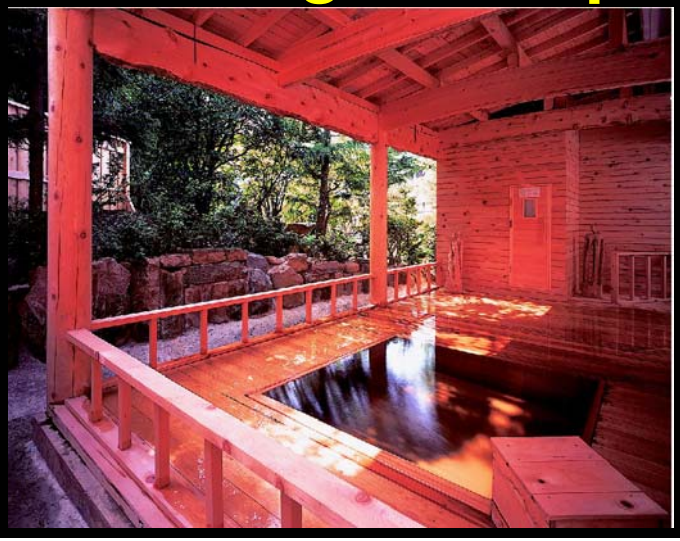
NOAO

Astronomy Australia Ltd.

SUBARU

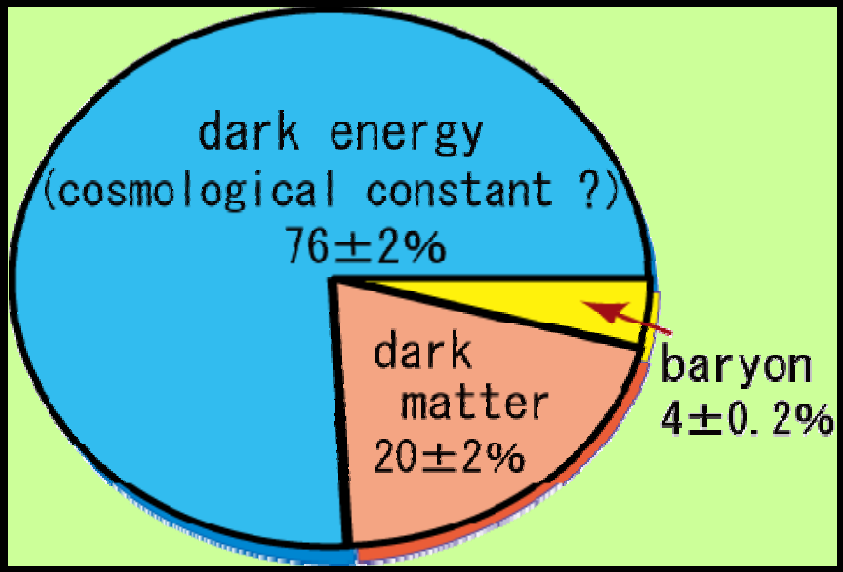
Science & Technology Facilities Council


# Aug. 31-Sept. 2, 2008 @Asamushi, Aomori

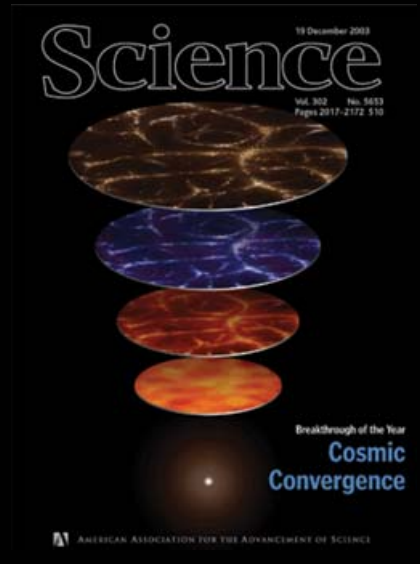


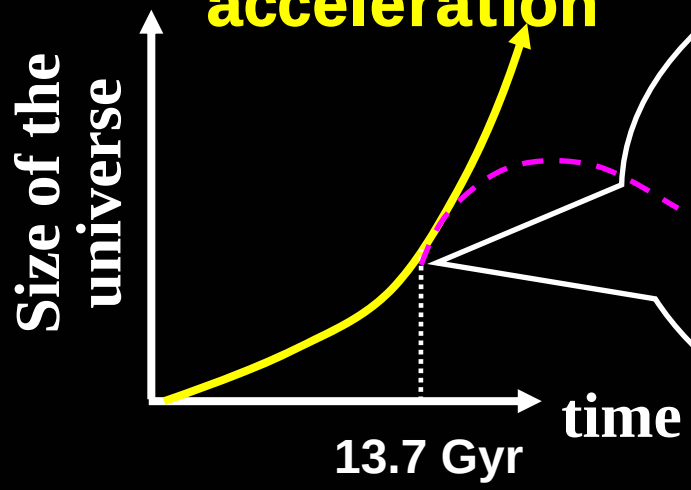
本陣の宿 柳の湯

# Dark energy in the universe








Universal repulsion?
Cosmological constant?
Dark energy?
Modified gravity?

# Dark energy and the equation of state of the universe

- **Parameterized equation of state**
  - (pressure) = **w** x (density)
    - w=0: dark matter,
    - w=1/3: radiation
    - **w=-1: cosmological constant**
  - Poisson eq. in GR :

    $\Delta \phi = 4\pi G(\rho + 3p) = 4\pi G \rho (1+3w)$

    **w<-1/3 ⇒ repulsion force**
  - Negative pressure: dark energy
  - More generally w may change with time

# Three invited lecturers

- Kazuya Koyama (Univ. of Portsmouth)
  - *Modified gravity as an alternative to dark energy*
- Alan Heavens (Univ. of Edinburgh)
  - *Probing dark energy with weak lensing*
- Andrei Frolov (Simon Fraser Univ.)
  - *Dark energy models in f(R) gravity*

# an organizer of the JSPS summer school

- Finally, may I add that the main purpose of **this school** has not been to prepare for some examination -- it was not even to prepare you to serve **JSPS, DENET or RESCEU** I wanted most to give you some appreciation of **cosmic acceleration** and the physicist's way of looking at it, which, I believe, is a major part of the true culture of modern times. *(There are probably professors of other subjects who would object, but I believe that they are completely wrong.)*

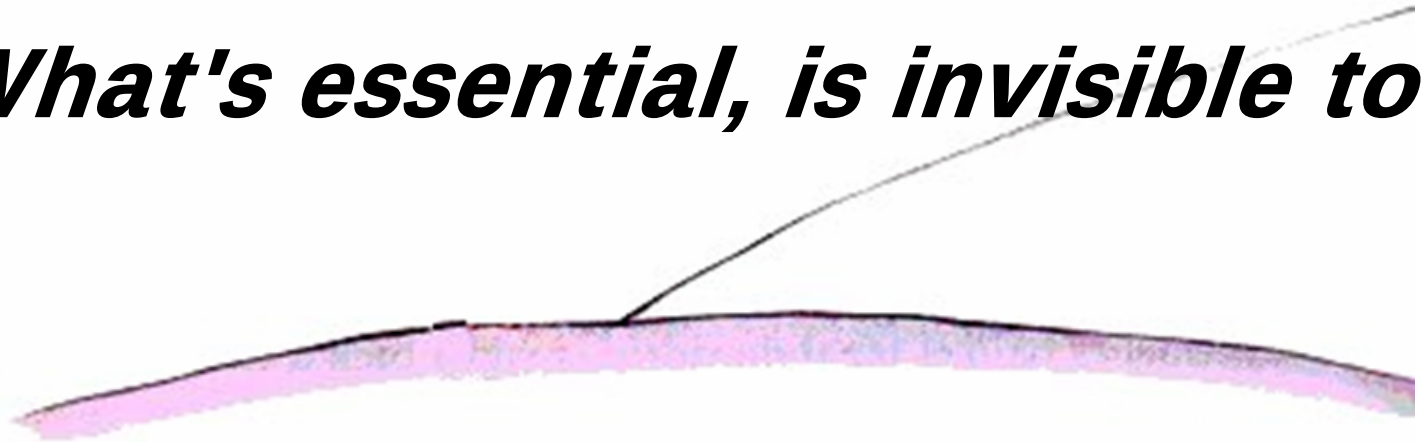
Dark energy

Modified gravity

**The Fox said**

***It's only with the heart***
***that one can see clearly***

***What's essential, is invisible to the eye***



# Richard Feynman
## (The Feynman lectures on physics, volume III, Feynman's Epilogue)

- Perhaps you will not only have some appreciation of this culture; it is even possible that you may want to join in the greatest adventure that the human mind has ever begun.