Reveal the origin and fate of the Universe — elucidate the nature of dark matter and dark energy via imaging and spectroscopy — Hitoshi Murayama (IPMU) How did the Universe begin? Does it have an end? What is it made of? Why do we exist? Questions since the dawn of humankind now with sience!

Where do we come from?

Clark energy

What are we?

Where are we going?

### expansion







should slow down

- expansion started to speed up recently(~7Byr)
- energy is increasing!
- infinite source of energy ?? dark energy
- Was Einstein wrong ??
- new paradigm of the Universe, fundamental laws
- If the rate of energy increase very quick, eventually the expansion becomes infinitely fast
   ⇒ Will the Universe end??



Most profound mystery in basic science (Wilczek, Nobel Prize)



Number one on my list of problems to solve (Witten, Fields Medal)

# Revealing Dark Energy

- Japan is behind in this area
- measure the rate of acceleration
- ~100 million galaxies
- precision imaging of galaxy shapes
  ⇒world class
- precision wide field spectrograph to measure distances  $\Rightarrow$  world leading!
- push the Japanese technology in precision control, optics, detectors, materials
- Mitsubishi Electric, Canon, Hamamatsu, Kyocera have been involved in R&D



Subaru (NAOJ)













# Possible Results

- Problems with Einstein's theory of gravity?
- rate of increase in dark energy is further increasing

#### $\Rightarrow$ Universe has an end!

 rate of increase in dark energy is slowing down
 ⇒mysterious particle and

force with negative pressure

• birth of blackholes in early universe

## Hubble ST this proposal



## <u>Ripple Effect</u>: a wealth of intelligence

• Everybody knows Galileo : 400 years

ago, he changed the outlook of the Universe through the telescope, e.g. Copernican System.

- Revealing dark energy : a Japanese may appear in a textbook for upcoming many hundreds years
- More than 2000 people are included for the outreach activities for this one and half years. Public people are well interested in the Universe, elementary particles. Especially it restrains the moving away from the science for young people, enhances industrial technology in the next generation.
- Young scientists experienced world leading attract and lead the international big science in Japan
- Building the Nation of dreams and a wealth of intelligence.

