Physics and Astronomy with the Thirty Meter Telescope（TMT）

M. Iye, T. Yamashita, H. Akitaya, N. Ohshima, W. Aoki, N. Kahikawa, T. Kodama, M. Imanishi, T. Usuda, H. Takami, N. Takato, J. Nishikawa, T Sasaki

TMT is the next generation ground-based telescope having a 30-meter diameter mirror. The first light of the telescope is planed in 2018. The telescope with adaptive optics will achieve much higher resolving power and sensitivity than those with currently largest telescopes. The targets of the telescope not only cover almost all fields of astronomy, but will also extend to physics and biology by measuring the expansion of the Universe and investigating the atmospheres of extra-solar planets. TMT will be constructed by the collaboration between universities and institutes in USA, Canada and Asian countries. National Astronomical Observatory of Japan is planning to participate this project. Technical and Scientific cooperation with European Extremely Large Telescope will open new observational astronomy.

TMT is planed to begin operation in 2018 at the summit of Mauna Kea in Hawaii.

Primary Mirror	30m aperture（492 segments)
First Light	October 2018
Site	4100m, Mauna Kea, Hawaii
Construction cost	~ 1000M$
Partners	Caltech, Univ. California, ACURA
Potential Partners	Japan（NAOJ）, China (NAOC) , India,Brazil, Taiwan

July 2009	Mauna Kea site chosen
	Fund raising
Feb.2011	Construction Permit
Oct. 2011	Begin Construction
Oct. 2018	First light

•TMT' s resolution and light collecting power:

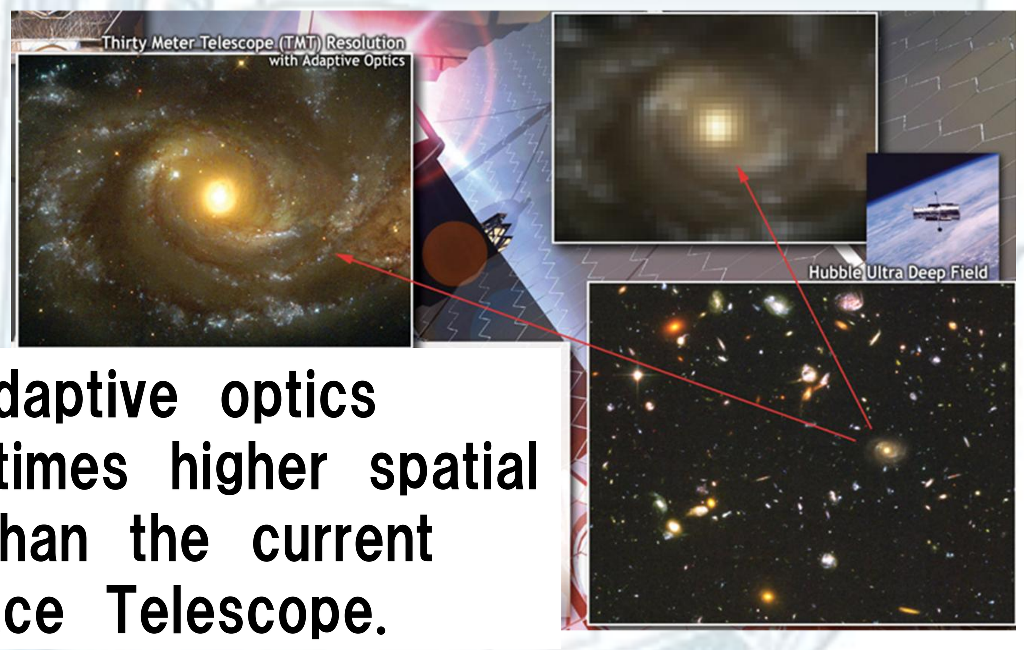
TMT will enable high resolution imaging with its adaptive optics system, 4 times sharper than current 8m-class telescopes (12 times sharper than Hubble Space Telescope [HST]). The light collecting power of TMT is 13 times larger than 8m-class telescopes (150 times larger than HST) and enables detection of extremely faint object.

•Japan' s contribution plan:

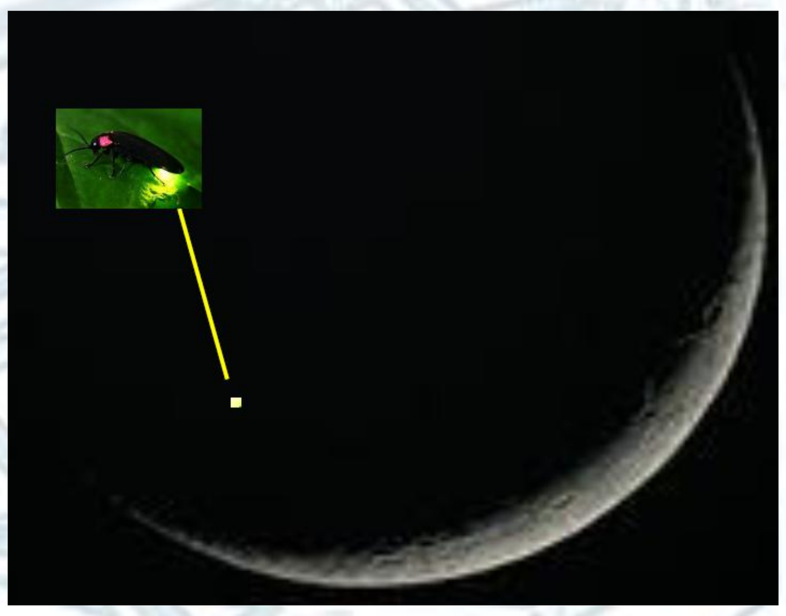
NAOJ is planning to contribute to the construction of TMT by providing its 574 aspheric mirror segments for the primary mirror, support structures for the secondary and tertiary mirrors, and scientific instruments. The Japanese 8m telescope Subaru at Mauna Kea will contribute to the science with TMT by its survey capability provided by the prime focus camera and spectrograph.

•Collaborations with other next generation telescopes

Another extremely large telescope is planed by European countries, called E-ELT. Technical and scientific collaborations between TMT and E-ELT will promote new astronomy and astrophysics.



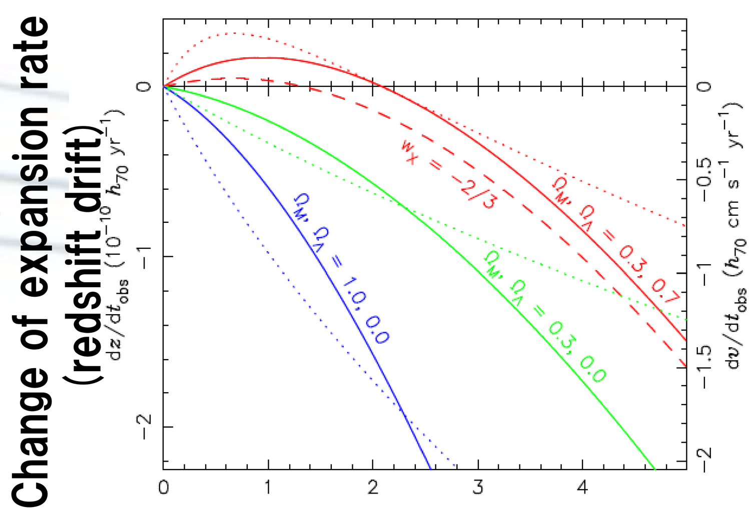
TMT with adaptive optics offers 13 times higher spatial resolution than the current Hubble Space Telescope.



TMT' s detection limit is 33 magnitude, which is approximately the brightness of a firefly on the moon.

•Direct measurements of the Universe' s expansion history

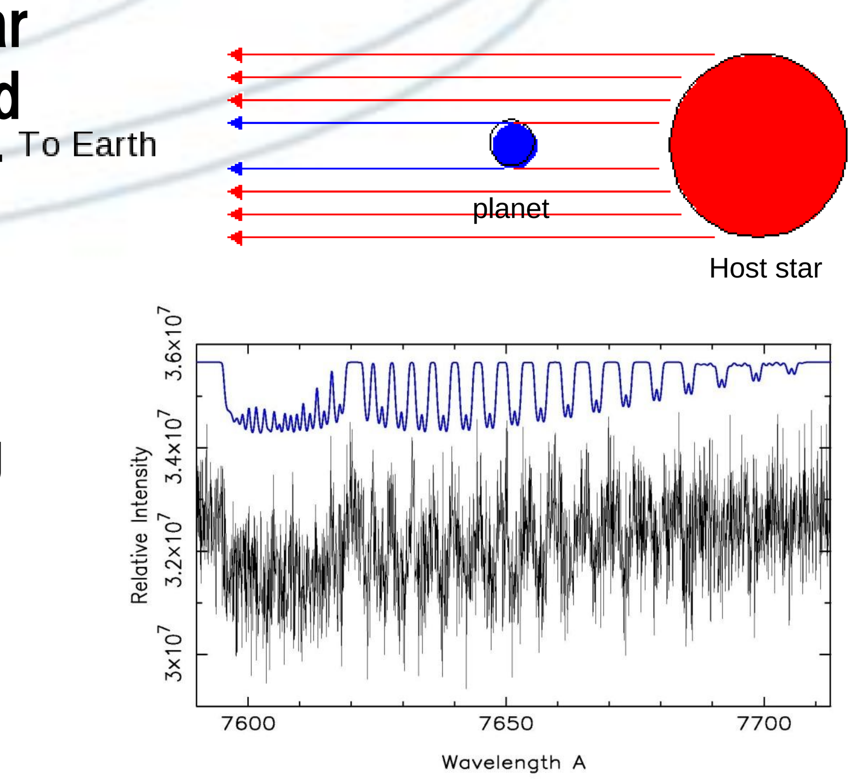
The changes of the Universe' s expansion rate can be measured by redshift drift for distant objects. Redshift changes of the order of 10^{-10} per year are expected for high redshift objects. 10 year-measurements for Ly-alpha clouds for redshift of 2-4 will provide a direct test for the acceleration of the Universe' s expansion reported previously from measurements of distant type Ia supernovae.



Cosmology models with different combinations of dark matter and dark energy predict different expansion history, which is distinguishable by measurements of redshift drift for distant objects. (adapted from Liske et al. 2008, MNRAS 386, 1192)

•Searches for signature of life in extra-solar planets

Atmospheres of extra-solar planets can be investigated by spectroscopy for stellar light during the planet' s transit. Detection oxygen (O2 molecule) is challenging, but is a strong signature of life in the atmosphere of the planet.



Absorption spectra of O2 molecule (simulation: adapted from Webb & Wormleaton 2001, PASA 18, 252)