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TMT (Thirty Meter Telescope) is an extremely large optical-infrared telescope project with a 30-meter aperture, planned for construction at the summit of Maunakea, Hawaii, through international collaboration in the 2030s. Its operational lifetime is expected to be about 50 years. Compared to existing ground-based large telescopes, TMT will offer over 10 times the light-gathering power and more than three times the spatial resolution, achieving sensitivity enhancements exceeding a factor of 100 for point sources. The TMT project has been widely recognized by the scientific community, including the planetary science field, and is regarded as a key facility for the future by the Japanese Society for Planetary Sciences.

One of TMT's top level science goals is to explore the diversity of exoplanets, thereby bringing a paradigm shift to planetary science, which has traditionally emerged from solar system observations. In particular, direct imaging and ultra-sensitive spectroscopy of Earth-like exoplanets will enable investigations of the surface and atmospheric compositions of exoplanets, shedding light on the uniqueness and universality of Earth as a life-bearing planet, and paving the way toward solving the mystery of the origin of life in the universe. Research in collaboration with TMT is expected to foster interdisciplinary exchange across a wide range of fields, including planetary science, astronomy, biology, and space environmental studies, and to serve as a catalyst for the emergence of a new era of integrated astrobiology that connects Earth, solar system bodies, and extrasolar planets.

TMT will also contribute to solar system exploration. Ground-based observations in conjunction with spacecraft missions have already yielded valuable results—such as coordinated observations with the Subaru Telescope during the Deep Impact comet collision experiment, and the selection of target asteroids for the Hayabusa 2 mission. Other achievements include the discovery of new satellites around Jupiter and Saturn, and investigations of Edgeworth-Kuiper Belt Objects and their properties through numerous ground-based observations. Looking ahead, ground-based observation is expected to advance solar system science by supporting planetary missions such as the Martian Moons eXploration (MMX), Demonstration and Experiment of Space Technology for INterplanetary voYage, Phaethon fLyby and dUst Science (DESTINY+), and JUpiter ICy Moons Explorer (JUICE).

Moreover, extremely large telescopes like the TMT holds the potential to contribute to humanity's future advancement to space, for example through observations relevant to small body resource exploration.

TMT and the Giant Magellan Telescope (GMT) will play complementary roles, covering the northern and southern skies, respectively. Both are essential assets for time-critical observations such as monitoring solar system transients and planetary defense. From this scientific standpoint, the two telescopes function as indispensable counterparts. The Japanese Society for Planetary Sciences strongly recommends that Japan continue to propel the TMT project forward with unwavering commitment.

Takeshi Imamura

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