

Panel Discussion on Missions to the Solar System's Small Bodies

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Our panel of experts will discuss how small bodies provide unique scientific opportunities to investigate the formation of the Solar System. They represent remnants of the building blocks of the planets and provide insight into the conditions of the earliest history of the Solar System and the factors that gave rise to the origin of life. Small bodies also experience a myriad of processes, providing numerous natural science laboratories to gain knowledge into the evolution of the Solar System. Indeed, research and exploration enabled by small bodies will help advance our knowledge of the Solar System's formation and evolution and about the early Solar System conditions necessary for the origin of life.

Missions to small bodies are clearly one of the major pillars of ISAS/JAXA space science program and indeed, the recent DISCOVERY selection result projects that two more of the kind will be added to the NASA Planetary Science Small Bodies Program. JAXA's Hayabusa 2 is expected to arrive to its target asteroid 162173 in July 2018. JAXA is also reviewing a new spacecraft mission to the Martian system; a sample return mission to Phobos called MMX (Martian Moons Explorer). First revealed in 9 June 2015, MMX's primary goal is to determine the origin of the Martian moons. Alongside collecting samples from Phobos, MMX will perform remote sensing of Deimos, and may also observe the atmosphere of Mars as well. As of January 2016, MMX was announced to be launched in fiscal year 2022. In addition, DESTINY+, a small scale technology demonstrator which will also conduct scientific observation of asteroid 3200 Phaethon is also being discussed.

Similarly, NASA also continues its exploration of small bodies. The Dawn spacecraft after orbiting Vesta for more than a year is now orbiting the largest asteroid, Ceres. In addition, the robotic asteroid rendezvous and sample return mission, OSIRIS-REx (Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer), was launched in September 2016. The first U.S. mission of its kind, OSIRIS-REx will approach the near-Near Earth Asteroid 1999 RQ36 (Bennu), in October of 2019. It will collect at least 60 g of pristine regolith/surface material and return it to Earth in September 2023. Finally, NASA announced two new Discovery class missions which will study small bodies.

Psyche is an orbiter mission that will explore the origin of planetary cores by studying the metallic asteroid 16 Psyche. This asteroid may be the exposed iron core of a protoplanet, likely the remnant of a violent collision with another object that stripped off the outer crust. This mission was just selected by NASA's Discovery Program.

The Lucy mission will tour six Jupiter Trojans. The mission is named after the iconic 'Lucy' hominin skeleton, because the study of Trojans could reveal the "fossils of planet formation": materials that clumped together in the early history of the Solar System to form planets and other bodies. The *Australopithecus* itself was named for a Beatles song, "Lucy in the Sky with Diamonds". On 4 January 2017, *Lucy* was chosen, along with the *Psyche* mission, as NASA's next Discovery class missions.

This is truly an exciting time for Small Bodies' science and these are true missions of discovery that integrate into our investigations and understanding of how the Solar System formed and evolved. In this session we will look at results from active missions, status of the missions in progress to their target, and overview the newly announced missions.

Keywords: Small Bodies, NASA, JAXA, Missions