

THE SOLAR SYSTEM BODIES: FROM OPTICS TO GEOLOGY (2008)

NASA SPACE MISSIONS TO SMALL BODIES. L. Kolokolova, University of Maryland, College Park, MD, 20742, USA (ludmilla@astro.umd.edu)

Introduction: This presentation briefly describes current and future NASA missions to asteroids and comets. Special attention is given to the missions, which relate to the University of Maryland research projects where the author works. These are cometary missions: Stardust, Deep Impact, EPOXI, and NExT. Also, asteroid mission Dawn and New Horizons mission to Pluto and Kuiper Belt are discussed. NASA participation in the missions of other countries is considered. Scientific results of the missions will be briefly presented.

Stardust. (02.1999 – 01.2006). Sample-return mission to comet Wild 2. The re-entry capsule brought samples of comet and interstellar dust caught in the aerogel. Also, high-quality pictures of the Wild-2 nucleus were taken and analysis of the near-comet dust was performed by instruments DFMI (dust flux monitor) and CIDA (mass spectrometer).

Deep Impact (01.2005 – 07.2005). The University of Maryland was the leading organization for this mission whose spacecraft impacted the nucleus of comet Tempel-1 and took images and spectra of the excavated material. The ejecta cloud was also extensively studied by ground-based and space telescopes.

EPOXI (extended Deep Impact mission; ends 10.2010). This mission consists of two parts: EPOCH (studying extrasolar planets using the spacecraft high-resolution camera plus studying the Earth “as an extrasolar planet” with the spectrometer) and DIXI (fly by the comet Hartley 2 taking its images and NIR spectra).

NexT (extended Stardust mission, ends 02.2011) During this mission Stardust spacecraft will visit comet Tempel-1, the target of the Deep Impact mission, and take the images of the nucleus to see consequences of the Deep Impact and changes of the surface of comet Tempel-1 since 2005. Its dust instruments also will be working providing information about the dust around comet Tempel-1.

New Horizons (01.2006-07.2015 and beyond). This is a current NASA mission to Pluto with the following visits to some Kuiper Belt objects. On its way to Pluto the mission's instruments have been used to study Jupiter. This is one of the most well equipped NASA missions that has on board seven technologically advanced instruments: high resolution imaging cameras and spectrometers for UV, visible and infrared, plasma instruments, and dust counter. The results of Jupiter flyby and plans for Pluto studies are briefly discussed.

Dawn (09.2007 - 07.2015). The main goals of this mission are two rendezvous with large asteroids: Vesta (09.2011) and Ceres (02.2015-07.2015). Using three cameras, a visual and infrared spectrometer, and a Gamma Ray and Neutron Spectrometer, Dawn will take images and study the chemical composition of Ceres and Vesta.

NASA participation in the missions of other space agencies:

Hayabusa is a Japanese (JAXA) mission to asteroid Itokawa. Its main goal was returning samples of the Itokawa soil. The mission was launched 05.2003. On November 19, 2005 Hayabusa landed on the asteroid. During the landing phase the ground control was poor that prevented good understanding of how well the sample collection was performed. Now the spacecraft is on its way to the Earth and expected to re-entry in June 2010. Even though the landing part of the mission may failed, spectacular images of this unusual asteroid and information from NIR and X-ray spectrometers were obtained. NASA's scientists participated in the mission planning and design and now are involved in the data analysis.

Rosetta is European (ESA) mission whose main goal is landing on the nucleus of comet Churyumov-Gerasimenko. It was launched in February 2004 and will arrive to the comet in 2014. On its way to the comet, the mission flybys two asteroids: Stein (09.2008) and Lutetia (07.2010). The mission already obtained interesting scientific results during Mars flyby and also using its instruments to monitor the Deep Impact event. In the vicinity of the comet Churyumov-Gerasimenko the spacecraft will be separated into orbiter and lander. NASA has three instruments on board of Rosetta orbiter: ALICE (UV imaging spectrometer), MIRO (microwave radiometer), and IES (ion-electron sensor). NASA scientists are also in the science teams of some other Rosetta instruments (OSIRIS, VIRTIS, etc.)

Prospective NASA missions to small bodies:

Comet Hopper A mission suggested by the University of Maryland and approved for the feasibility study. The mission plans to escort one of short-period comets with 5-6 landings and then returning to orbiting during the whole orbit to study changes in the comet material at a variety of heliocentric distances.

NEAP (Near Earth Asteroid Prospector) is a spacecraft being built and operated by a private company, SpaceDev. Plans for the NEAP mission have not been finalized, but possibilities include a launch as a secondary payload on an Ariane 5 to the asteroid Nereus. May be launched in 2009-2011.

ANTS (Autonomous Nano-Technology Swarm) a NASA mission that will launch sometime between 2020 and 2030. The mission was an initiative of a small group working at the NASA Goddard Space Flight Center who proposed launching a massive colony of miniature spacecraft using social insect-inspired artificial intelligence to spend several years prospecting among perhaps 1000 of the main-belt asteroids.