

Exploration of Near-Earth Asteroids (4)
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APOPHEUS RENDEZVOUS MISSION FOR SCIENTIFIC INVESTIGATION AND PLANETARY
 DEFENSE

Abstract

Shortly after the discovery of (99942) Apophis, this Potentially Hazardous Asteroid (PHA) triggered concerns for impact threat. However, coordinated astrometric measurements to track this asteroid provided significantly improved predictions over the decades, and the possibility of an impact in 2029 was completely removed. Apophis will approach the Earth to come within the geostationary orbit during the upcoming encounter. Thus it is expected to offer a unique opportunity to study either its 1) global properties (mass, shape, surface topography, internal structure, and rotation and spin states), 2) the surface arrangements (craters, regolith and boulder distributions, distributions of space weathered and newly exposed un-weathered regolith on the surface), or 3) their detectable changes expected to happen on the body during the approach. The encounter in 2029 is expected to alter its surface topography with

material movement such as landslide and mass ejection, due to the tidal forces caused by Earth's gravity field. Hence the only possible way to quantitatively study tidally induced effects is in-situ measurement by a dedicated space mission aimed at the encounter. This is why we propose a rendezvous mission to Apophis to monitor such changes before, during, and after the encounter. The proposed mission is based on the third revision of the Basic Plan for Promotion of Space Development (2018) of the Korean Government. We are under pre-Phase A study and currently preparing for a budget application for this mission. In order to achieve our scientific goals, the science definition team has drafted the science requirements for candidate payloads. We also conducted a preliminary mission analysis for the proposed mission, and found that the launch windows in July 2026 and in January 2027 are the most probable opportunities. Our tentative plan is 1) to design (2022-2023), 2) to build, integrate, and test (2024-2026), 3) to launch (2026/27), and to perform 4) science operations (2026/27-2029) with universities, research institutes, and companies in Korea. However, it is opened to overseas institutes for joint scientific studies. One of our current options for the launcher is to use the KSLV (Korea Space Launch Vehicle) series rocket in development.