

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Small Bodies Missions and Technologies (Part 2) (4B)

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APOPHIS EXPRESS, A UNIQUE OPPORTUNITY FOR VISITING APOPHIS IN 2029

**Abstract**

The purpose of the paper is to present a novel design for a space mission headed towards Apophis and taking advantage from its close Earth flyby in April 2029.

During its 2029 pass, Apophis will be easily visible from the Earth and it can be expected that its terrain model and most of its physical properties will be well determined from ground based observations. However, the characterization of its interior will not be achievable from purely terrestrial remote observations. Such a characterization is however essential for planning any mitigation operation of this Potentially Hazardous Asteroid, should it be necessary in the future.

This can be done only through a dedicated space mission delivering a set of instruments softly laid down on its surface. These instruments can be used for drilling, sounding the interior (like Consert on Rosetta). Some devices such as a laser reflectometer would be essential for long term orbit tracking.

The mission scheme that is proposed in this paper consists in a very fast mission, less than one month, from the launch to the delivery of a scientific payload on Apophis' surface, with a possible sample return option. From a few days before its close approach to the Earth to its departure from the Earth vicinity, Apophis would be followed by a spacecraft carrying a set of scientific modules.

In March 2029, just a few weeks before Apophis is coming close to the Earth, a mission is launched into a highly eccentric orbit, the direction of the line of apsis being towards the incoming asteroid with an apogee altitude about 1 million kilometers. It will take about 3 weeks to reach the region that will be crossed by Apophis just a few days before its close encounter. From there, a  $V$  of about 6 km/s is requested to cancel the relative velocity with respect to Apophis, and thus allow delivering a scientific payload at its surface during its short rendez-vous.

In the paper, we present some possible scientific scenarios depending on the capacities of the selected launcher (SLS, Ariane 5, Soyouz).