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APOPHIS EXPLORER, TAKING THE OPPORTUNITY OF ITS 2029 FLYBY FOR A
CHARACTERIZATION MISSION

Abstract

The asteroid APOPHIS, discovered in 2004, is a 250 to 300 meter wide Potential Hazardous Asteroid that will come back very close to the Earth on April 13, 2029. The same way as a gravity assist maneuver is currently used for a deep space probe, the gravitational pull of the Earth during its pass will dramatically modify the APOPHIS orbit around the Sun. It will nevertheless remain a potential danger for the future, and, as such, will deserve special attention possibly for several generations.

During its 2029 pass, APOPHIS will be easily visible from the Earth and most of its geometry and thermal properties will be well determined from ground based observations. However, the characterization of its interior will not be achievable from purely terrestrial observations. Such a characterization, which can only be achieved through a space mission, is essential for planning mitigation operations, should these be necessary in the future.

The passage of APOPHIS close to the Earth in 2029 offers a great opportunity to better characterize this object and to observe the possible changes in its inner layout and its surface characteristics that could be triggered by the differential pull from the Earth at its closest approach.

The payload would consist of a suite of instruments designed for the following investigations:

- General features (shape, mass, spin, gravity) : radio science investigation, wide and narrow angle cameras in the visible domain
- Surface : cameras (VIS) and spectro imager (IR)
- Sub surface : monostatic radar (high frequency, reflecting mode), seismology (3 micro stations), artificial craterization
- Core : monostatic radar (low frequency, reflecting mode), seismology (same as above)

The deposit of a radar reflector for long term tracking purposes is also investigated.

A possible mission scenario would be a launch in 2027 with an arrival in December 2028 after a 1.7 year cruise with a plasma thruster propulsion system. This would allow around 4 months in the vicinity of APOPHIS to run a smooth characterization programme ending with the deposit of the surface instruments several weeks before the close approach.

As a member of the Space Mission Planning Advisory Group (SMPAG) that is being setup by the UN/COPUOS, CNES has studied a mission scenario that would dramatically improve our knowledge of APOPHIS characteristics, mandatory to define any mitigation mission.

This paper presents the objectives of the mission and its preliminary design.