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A UNIQUE OPPORTUNITY FOR A CONSTELLATION-BASED EXPLORATION MISSION TO THE
ASTEROID APOPHIS IN 2028/29

Abstract

In the years 2028/29 a unique opportunity for a crewed mission to the Potential Hazardous Asteroid 99942/Apophis will open up. This opportunity results from the near Earth fly-by of the asteroid in the year 2029, which provides for an almost free return of a vehicle visiting the asteroid prior to the fly-by and a relatively cheap launch opportunity in 2028, resulting in a mission lasting for one year and allowing for a one month stay time at 99942/Apophis. An End-to-end mission analysis from launch to Earth re-entry will be presented. Based on the outcome of the mission analysis, a preliminary design study utilizing the tools of the Space Station Design Workshop was performed in order to assess the mission objectives, requirements and constraints. These resulted in an assessment of available masses and budgets. Design to system level shows that the spacecraft components can and must be largely based on the planned Constellation programme hardware and available European components and expertise. This approach will minimize costly new developments while increasing the robustness of the mission design. A key element will be the development of a reliable Environmental Control and Life Support System due to the fact that the mission cannot be shortened significantly after launch. At an effort comparable to that of one manned moon mission, a real interplanetary mission to an asteroid is feasible, constituting a stepping stone and testing ground between lunar and Mars missions. The one month surface stay time will allow for scientific research and technology demonstration of impact mitigation technologies. The additional hardware required and experience and expertise gained during the mission can serve as a blueprint for further similar missions to asteroids posing a direct threat to Earth.