IAF SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 1) (4A)

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NEST: A SMALL AND FAST-CLASS SCIENCE MISSION TO HOP MULTIPLE NEAR-EARTH ASTEROIDS

Abstract

Near-Earth Asteroids (NEA) are crucial repositories of information about life signature and fundamental processes that led to the solar system formation and early evolution. Being in the Earth proximity, NEAs are an attractive class of targets for fast, small and cost-limited missions. Recent results evidenced that small asteroids – tens to few hundreds meters in size – are different in morphology, mineralogy and petrography from larger objects, which leads to presume different forming mechanisms, dependent on object size. As a consequence, to plan a multiple, mixed-size NEAs visit within the same exploration mission would have a significant scientific return in terms of diversity effects.The paper presents the NEST (Near-Earth Space Trekker) mission, proposed by an INAF-led consortium as F-Class mission; NEST aims at rendezvous with multiple NEAs, necessarily different in size to magnify the diversity in science data return. The mission has the strong requirementto belong to the F class, that is to be small and cost contained. The baseline aims visiting 2 NEAs in a timeframe less than 5 years, potentially extending the mission to three targets. The first is a small NEAs (¡ 100 m), while the large target maybe the 370-m Potentially Hazardous Asteroid (99942) Apophis. The mission is driven by challenging technical and programmatic constraints: primarily cost and launch date caps, being a passenger of a larger mission to Sun-Earth L2, already planned. The available launch mass is imposed to be less than 1000 kg. To solve the challenging mission analysis a global search algorithm was employed to select the best candidate bodies, showing also the mission flexibility against delays or changes in the performances. Low thrust solution, implemented through electric propulsion, allowed being compliant with time and boundary constraints.A mother-daughter spacecraft configuration is proposed: the 820 kg mothercraft, with more than 6 kW available power at 1 AU, hosts the main scientific payloads, camera, high and low frequency radar and spectrometer; 25 kg daughters serve to complement and enhance the mother's science, hosting a camera, low frequency radar for tomography and miniaturized spectrometers as well. Daughters are released, one per asteroid, at each arrival. On board subsystems are selected to be compliant with high TRL, fast implementation and cost limitation. The paper overviews the whole mission architecture and goals, focusing on the mother-daughter platform and proximity operations design to answer the scientific payload requirements; main budgets, trajectory design and GNC strategy are discussed as well