Voyage to Troy: A mission concept for the exploration of the Trojan asteroids

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The Trojan asteroids, located at Jupiter's L4 and L5 Lagrange points, are a potential source of insights into long-standing questions on the origin and early history of the Solar System. The 2013 Planetary Science Decadal Survey recommends a Trojan Tour and Rendezvous mission as high-priority among medium-class missions. A dedicated mission to the Trojan asteroids could confirm or refute multiple theories to correctly explain the Trojan asteroids' current location, characteristics, and behavior. In-depth and conclusive evidence for the Trojan asteroids' internal and external make-up as well as dynamical behavior hav been challenging due to limitations of ground- and space-based observations. Notwithstanding these limitations, it has been inferred that there are two distinct sub- populations that are distinguishable in visible and near-infrared spectra (redder and less red) within the swarms. These spectral groupings have not yet been conclusively linked to physical characteristics (e.g. size) or other observed parameters (e.g. albedo) of the primordial bodies.

NASA's Jet Propulsion Laboratory's concept studies for Decadal Survey evaluated three concepts for missions to Trojan asteroids: each utilizing chemical- solar-electric, and radioisotope-electric for propulsion. Both Solar and Advanced Stirling Radioisotope Generators were considered for power [2]. We present a new conceptual mission to explore the Trojan asteroids that achieves the science goals prioritized in the 2013 Planetary Science Decadal Survey. The proposed mission aims to study both a redder and less red asteroid for the surface mineralogical and elemental composition, state of surface regolith, evidence and consequences of external modification processes such as collisional evolution, space weathering, and irradiation. Some potential targets in the L4 Greek camp currently under consideration for this mission include Achilles, Hektor and Agamemnon (redder) and Eurybates, Deipylos and Kalchas (less red). Hektor is currently thought to be a contact binary with a companion in an unusually inclined orbit and presents itself as a target with diverse knowledge to offer. The possibility of potentially gathering data from a Hilda asteroid en route to the Trojans is also being investigated. The mission would consist of the rendezvous of one or two Trojan asteroids along with further flybys. Candidate instruments are a thermal mapper, multispectral imagers, gamma-ray, neutron, and UV-spectrometers, and a LIDAR. The mission is designed within the constraints of NASA New Frontiers mission with a less than 10-year trajectory. The mission concept will help in the future Trojan mission concept studies.

References: [1] Squyres, S. et al., "Visions and Voyages for Planetary Science in the Decade 2013-2022 (Decadal Survey)," The National Academies Press, Washington, D.C., 2011. [2] Brown M., Trojan Tour Decadal Study, NASA, The National Academies Press, Washington, D.C., 2010.