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Cassini-Huygens-level science from NASA's "Neptune orbiter with probes" vision mission

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The "Neptune Orbiter with Probes" (NOP) mission concept is one of the 17 Vision Mission cases offered for study in NASA's 2003 Vision Missions Studies NRA (NRA-03-OSS-01-VM). The authors successfully proposed to study an implementation option for the NOP mission that uses a mix of Solar Electric Propulsion (SEP) and gravity assists to reach Neptune in 12 years or less, aerocapture for insertion into Neptune orbit, and Triton as the "tour engine" for a three-year orbital tour to perform Cassini-Huygens-level exploration of the Neptune system. Our Study Team includes a Science Team composed of experienced planetary scientists, many of whom helped draft the Neptune discussions in the U.S. National Research Council's "Solar System Exploration Decadal Survey" [1] and the Neptune white paper that supported it [2], and an Implementation Team with experienced engineers and technologists from multiple NASA Centers and JPL. Science Team members drafted a well-designed set of science objectives that guide a very capable science payload, including multiple Neptune entry probes and possibly a Triton lander. Although the NRA specified only that the mission must address only the "elemental composition and interior structure of Neptune," the team's opinion is that a mission of the complexity and duration needed to orbit Neptune must address all the major aspects of the Neptune system. The high-level science plan echoes that approach, specifically calling for investigation of Neptune's atmosphere and interior, Triton and the smaller satellites and rings, and the magnetosphere and its interaction with the solar wind. This science plan provided the basis for design studies in collaboration with JPL's "Team X" in June of 2004, with follow-up sessions in January of 2005.

Study results thus far are encouraging. The 2017-2019 time frame offers multiple tra-

jectories to Neptune with transfer durations from 8 to 12 years, some not requiring SEP. Spacecraft designs that accomplish all the science objectives can launch on current or soon-to-be-operational launch vehicles. Notably, a full-fidelity example tour design verifies that using Triton as a tour engine, in only two years the orbiter can visit all the locations needed. This provides an extra year for trajectory design flexibility, such as extended stays in particularly useful orbits, or modifications to certain segments of the tour for additional science. The presentation will discuss the mission's science objectives, and summarize study results to date.

This work was performed primarily at the Jet Propulsion Laboratory and its parent institution, the California Institute of Technology, under contract to NASA's Office of Space Science.

References: [1] National Research Council Space Studies Board (2003), *New Frontiers in the Solar System: An Integrated Exploration Strategy*, Michael J.S. Belton Ed. (National Academies Press, Washington, D.C.); Also available at http://www.nap.edu/catalog/10432.html. [2] Hammel, H.B., et al. (2002), "Exploration of the Neptune System," in *The Future of Solar System Exploration*, M. V. Sykes, Ed. (The Astronomical Society of the Pacific, San Francisco).