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Solar System Exploration including Ocean Worlds (5)

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NOMAD: NEPTUNE ORBITER MISSION FOR AURORAL DETECTION

Abstract

The ice giants constitute a historically neglected part of our solar system, having only briefly been visited by Voyager 2 back in 1989. This limited exploration leaves many unanswered questions concerning their formation and evolution.

Neptune in particular has a unique magnetic field with strong multipolar components, in contrast to the mainly dipolar fields of the terrestrial planets. Its significant variations in magnitude and direction occasionally induce auroras through interactions with the ionosphere, a phenomenon that cannot be detected by Earth-based telescopes. In addition, the interaction between Neptune's and Triton's (induced) magnetic fields could reveal the presence of a long-theorized subsurface ocean, confirming Triton to be an ocean world. Since Neptune also serves as a local analog for a common class of exoplanets, a better understanding of its characteristics and how they evolve could reveal new signatures that would aid in the detection and classification of exoplanets.

To address these questions, the Neptune Orbiter Mission for Auroral Detection (NOMAD) mission concept is proposed, which aims to send a small orbiter to visit Neptune and Triton. Targeting a launch in 2033 to capitalize on the conjunction between Jupiter and Neptune, the spacecraft will perform a gravity assist around Jupiter before arriving at Neptune with the help of an aerocapture maneuver in 2045.

A science case is laid out providing the background and justification for the mission, as well as clear mission goals. These are in turn converted into scientific requirements that define the parameters and capabilities that the instruments should have. This is followed by an elaboration of the payload selection process. Finally, the mission architecture, including the trajectories and configuration of the spacecraft, is described. Addressing the shortfalls that led to the selection of Uranus over Neptune as the next NASA Flagship mission destination in the 2023-2032 Decadal Survey, the NOMAD mission will make extensive use of heritage instruments and target a currently commercially available launch vehicle to lower costs and increase readiness.