

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Solar System Exploration including Ocean Worlds (5)

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MISSIONS TO TRITON AND PLUTO

## Abstract

Neptune's moon Triton is a fascinating object, a dynamic moon with a highly varied surface, a thin atmosphere, and geysers. Triton is unique of the moons in the outer solar system in that it is most likely a captured Kuiper belt object (KBO), a leftover building block of the solar system, of a size slightly larger than Pluto. At a temperature of 33 K, the surface is covered in ices made from nitrogen, water, and carbon dioxide, and shows surface deposits of tholins, organic compounds that may be precursor chemicals to the origin of life. The Triton Hopper is a NASA Innovative Advanced Concepts (NIAC) project to design a mission to not merely land, but repeatedly fly across the surface of Triton, utilizing the volatile surface ices (primarily nitrogen) as propellant to launch across the surface and explore all the moon's varied terrain. At a distance of over 30 astronomical units, it would be by far the most distant object ever landed on by a spacecraft, and the first detailed visit to a Kuiper-belt object. The hopper concept gathers surface nitrogen ice, which will provides sufficient propellant to allow this a 300-kg highly-instrumented lander to make repeated launches from the surface to hop using a radioisotope-thermal engine. Two years of hopping would allow this lander to accomplish a mission of traverse distance 150 km and visit 30 sites. More sophisticated propulsion could increase the flight range, potentially allowing pole-to-equator exploration. The Triton hopper is only one of many possible applications of the design of a vehicle able to use in-situ ices as fuel for a radioisotope thermal engine. Another mission possibility is a mission to the Pluto-Charon system. Use of an electric propulsion system energized by the Kilopower reactor was analyzed, showing that delivery of a hopper vehicle to Pluto is possible, bringing the possibility of a mission to this exciting near-Kuiper belt dwarf planet into the range of feasible missions.