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DESIGNING A NUCLEAR ELECTRIC PROPULSION SYSTEM FOR FUTURE PLUTO MISSIONS

Abstract

The New Horizons spacecraft was the first to fly by Pluto and its moons, providing a close look at the dwarf planet. However, due to its inability to slow down the extremely high velocity of its flyby, it was unable to conduct a complete investigation. New Horizons flew by Pluto at 14 km/s; to slow down and insert into an orbit around Pluto, 232 tons of hydrazine fuel would have to be used, which is technically impossible. As a result, a new propulsion system is required. An optimal design for a Nuclear Electric Propulsion system for orbit insertion in future Pluto missions is presented in this study. The discussion includes design parameters such as a nuclear reactor for energy generation and a thermal-to-electric energy conversion system to power the ion propulsion for required thrust. Ion thrusters have exhaust velocities around 20–50 km/s (Isp 2000–5000 s), possess thrusts of 25–250 mN and propulsive efficiency of 65–80 percent , while typically consuming 1–7 kW of power, therefore these results indicate that we can successfully insert into an orbit around Pluto using ion thrusters. Hence a nuclear reactor is capable of this task. A controlled orbit around Pluto would facilitate the spacecraft to analyze the surface and different aspects related to Pluto (volcanically active, atmospheric activities, dunes, and many possible unknown parameters). Hence implementing the Nuclear Electric Propulsion system would overcome the obstacles faced by New Horizons spacecraft and follow through with the missions towards Pluto.