Paper ID: 88037
student

IAF SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations - IAF SPACE PROPULSION SYMPOSIUM (IP)

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REVIEW OF NUCLEAR ELECTRIC PROPULSION FOR INTERPLANETARY MISSIONS

Abstract

Deep space exploration has been of great interest since the start of the space age. Being able to travel beyond Earth pushes all sorts of boundaries for humanity and opens a realm of curiosity. To do so, there have been efforts made to find an alternative to chemical propulsion for interplanetary missions. One such effort introduced the idea of using nuclear propulsion technology for space missions in the 1950s. In the 1960s as a part of the Rover/Nuclear Engine for Rocket Vehicle Application (NERVA) program, nuclear technology was first developed and demonstrated. Nuclear propulsion can be categorized into two types - Nuclear Electric Propulsion (NEP) and Nuclear Thermal Propulsion (NTP). This paper focuses on the development of the NEP system through the years. It provides a review of the NEP mission concepts which have been worked on and the challenges associated with them. Some of them are Jupiter Icy Moons Orbiter (JIMO), crewed Mars mission, cislunar mission and missions to the outer planets and their moons. This review identifies the knowledge gaps in using NEP for interplanetary missions with direct trajectories. It also provides an overview of the electric thrusters, such as ion, Hall and magnetoplasmadynamic (MPD), considered in the NEP mission studies.