

SPACE PROPULSION SYMPOSIUM (C4)

Poster Session (P)

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FUSION-FISSION HYBRID PULSED PROPULSION SYSTEM FOR IMPROVED SPACE
TRANSPORTATION

Abstract

The purpose of this paper is to give theoretical results (energy yield and impulse) from the simulation of a Fission-Fusion Hybrid Pulsed Propulsion System. This is achieved utilizing a thorium liner to compress magnetized plasma to thermonuclear temperatures. Two of the primary challenges in thermonuclear fusion concepts are the confinement of a plasma at 10⁸ K to 10⁹ K, and neutron activation of the plasma facing components. The other is the short confinement time of plasma, which limits the energy output and increases the mass of the drivers required to produce the very high temperature, high density fusion plasma. In the approach studied here, the thorium liner greatly amplifies the energy yield than what would be created by the fusion core alone. The neutrons produced by the fusion reactions in the plasma react with the surrounding fission liner, undergoing fission and releasing additional energy. Much of the energy is deposited in the liner, and this compresses and heats the inner fusion plasma. The energy feeds back into the fusion plasma, greatly enhancing the energy yield by increasing the confinement time. This propulsion system approach is very promising for deep space exploration due to the reduced travel time from the moderate thrusts of 10's kN, nearly optimal ISP (10,000 s), and vehicle specific power of 1 to 10 kW/kg. The criteria for liner properties and target properties are poorly understood. Fission fusion hybrids including material available in the open literature on weapons will be reviewed; fission/fusion power balance diagrams will be developed. The paper will quantify the effect of uranium and thorium fission liners on the system, the thermal management, and the preheating of the fuel to increase efficiency. Results from this study will provide guidance for future work involving 1D, 2D, and 3D simulations. The goal is major breakthroughs will occur as a result of these simulations.