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Author: Mr. Micah Laughmiller
Univeristy of Alabama in Huntsville, United States

Dr. Jason Cassibry
Propulsion Research Center, University of Alabama in Huntsville, United States

FISSION-FUSION HYBRID PULSED PROPULSION SYSTEM FOR IMPROVED 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 a magnetized plasma to thermonuclear temperatures. Two of the primary challenges in thermonuclear fusion concepts are the confinement of a plasma at 10 to the 8 K to 10 to the 9 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 would be created by the fusion core alone. The neutrons produced by the fusion reactions in the plasma react with the surrounding thorium liner, undergoing fission and releasing additional energy. Much of the energy is redeposited in the liner, 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 of 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, as well as develop fission/fusion power balance diagrams. The paper will quantify the effect of fission liners on the system, additional fission energy out, and additional heating power to the fusion core. 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.