The Analysis of the Effect of Input Power on the Efficiency of a Magnetoplasmadynamic Thruster Using Magnetic Deflection and Phosphor Screen Emission

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In modern spacecraft, hydrocarbon-based rockets can only reach a Specific Impulse (Isp) of 300-400s. This relatively low efficiency will be an issue on future, long-distance, space missions where a spacecraft cannot effectively carry the amount of propellant needed to produce the necessary change in velocity (delta V). A possible solution to this efficiency problem is electric propulsion. Magnetoplasmadynamic thrusters (MPDTs) use the Lorentz force to accelerate a plasma to very high velocities resulting in potential Isps of up to 4,000s. Currently, electric power sources onboard spacecraft are quite limited, so finding the optimal input power is key to maintaining a high efficiency. The hypothesis of this experiment was that if the input power to a radially configured magnetoplasmadynamic thruster is increased, then the efficiency will increase and then begin to decrease because, after a certain power input, the inefficiencies will result in diminishing returns. To test this hypothesis, a new MPDT and vacuum chamber were designed. Several prototypes were constructed and tested, with each iteration solving issues present in the previous. To date, the MPDT system was able to produce, maintain, and radially accelerate a plasma with the main beam being currently under refinement. Additionally, the phosphor screen data collection system was determined to be functioning as intended, making the project a successful work in progress.

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