

IAF SPACE PROPULSION SYMPOSIUM (C4)  
New Missions Enabled by New Propulsion Technology and Systems (9)

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COMPARITIVE STUDY ON VARIOUS ADVANCED PROPULSION TECHNIQUES FOR  
INTERPLANETARY MISSIONS

**Abstract**

Technological advancements in the astronautical domain equip man to realize his age-old dream of interplanetary colonization. The increasing population has induced an increase in demand for non-renewable resources. Discovery of habitable planets and resources on the celestial bodies has further fueled this desire for interplanetary travel. Advanced propulsion systems, which are capable of both providing high specific impulse and producing high thrust, are instrumental in realizing interplanetary travel.

This paper compares various advanced propulsion systems that are in development and can be used for interplanetary missions. The time taken by each system to reach planets within the hem of our solar system, in accordance with their specific impulse and thrust, has been analyzed. The mass budget of each propulsion system has been calculated. The propulsion systems taken into consideration are (i) Antimatter propulsion: antimatter such as positron on annihilating electrons produces a tremendous amount of energy, owing to its high energy density, of 90 MJ/ $\mu\text{g}$ ; (ii) Plasma propulsion: the VASIMR technology delivers high specific impulse of about 12000 seconds; (iii) Nuclear-Thermal propulsion, in which energy of 200 MeV per nucleon has been observed; and (iv) Laser propulsion system: provides specific impulse up to 5000 seconds.

The results of this paper can be used to decide the most efficient propulsion systems for interplanetary missions. This paper also proposes combinations of propulsion systems which could theoretically overcome the disadvantages of single advanced propulsion systems.