19th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

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ADVANCED PROPULSION AS A CORNERSTONE FOR SPACE EXPLORATION AND INTERSTELLAR LIVING

Abstract

Advanced propulsion is required for humanity to travel to interplanetary and interstellar destinations, along with access to raw materials, transportation of scientific payloads, cargo, and more. This paper presents an all-encompassing mission concept and propulsion selection as a fundamental building block for human space exploration.

The proposed method, "Fast Transit", considers continuous acceleration of 0.2g through the entire trip duration, with a 180 flip in the middle of the journey to allow for a continuous slow down. This would reduce the Earth-to-Mars travel time to four to ten days total. Fast Transit can only be met by propulsion systems having high specific impulse (Isp) and suitable thrust to weight ratio (T/W) for the entire spacecraft. The proposed concept has an Isp of 19000s and a T/W of 2.94. After weighing the Technology Readiness Level (TRL) and capabilities of different propulsion concepts, two are considered: Magnetic Inertial Confinement Fusion (MICF) at TRL 2-3, and Antimatter Catalysed Fusion (ACF) at TRL 2. MICF propulsion uses a transient magnetic field that squeezes plasma leading to fusion. ACF propulsion system uses positron radioisotope sources in conjunction with an annihilation-catalyzed fusion.

Spacecraft subsystems like electrical, thermal control, radiation shielding, attitude control, and structure are modular, to suit the chosen propulsion system design. This concept does not address the landing and lift off from the celestial bodies under study.

An initial substantial investment, likely through a Public Private Partnership (PPP), would be required to demonstrate feasibility, leading to unlocking quick access to an abundance of raw materials for providing a return on investment.

From a medical perspective, the shorter travel duration and constant acceleration reduces cosmic radiation exposure and mitigates microgravity effects.

The proposed concept would impact the social construct and norms about space travel that we have grown accustomed to here on Earth, as it would provide access to a new undiscovered land at the grasp of all humanity — akin to how the "New World" once was. Therefore all nations would have to cooperate for this endeavour to flourish.

Overall, Fast Transit shows how humanity can attain a sustainable presence in the solar system and beyond. This concept relates important factors in propulsion, spacecraft, engineering, economics, and humanities, all back to the human travellers. Ultimately facilitating humanity becoming a multi-planetary species, bringing about a new era, all within our lifetimes.