SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Space Transportation Solutions for Deep Space Missions (8-A5.4)

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ASTEROID-DERIVED STORABLE PROPELLANTS FOR FASTER, CHEAPER DEEP SPACE MISSIONS

Abstract

A NASA Innovative Advanced Concepts (NIAC) study completed this year found that near Earth asteroids (NEAs) could provide highly valuable storable propellants, produced solely from the water and carbon dioxide evolved through heating of NEA regolith on-site at target asteroids. A portion of the water would be used directly for propellant in a Solar Thermal Propulsion (STP) engine to return the remaining water and untouched CO2 to an Earth-orbit processing facility. There a series of processing steps would produce a highly effective storable oxidizer (refined hydrogen peroxide) and three different storable fuels. These innovations would enable a new space exploration architecture, based on refueling outbound missions in high Earth orbit. This approach avoids the mass penalties for months-long storage of cryogens on a deep space cruise. Compared to solar electric propulsion (SEP) that may require several planetary gravity assists to reach a distant target, an ample supply of storables added to missions in high Earth orbit will enable shorter cruises on more direct trajectories, significantly reducing operations costs and the risk of hardware failure en route. In addition, impulsive capture at the destination takes much less time than a series of SEP maneuvers, and may be the only feasible technology in some circumstances.

The techniques identified in the NIAC analysis also can be applied on the Mars surface, transforming the permafrost available at higher latitudes into storable propellants without requiring any consumables transported from Earth.