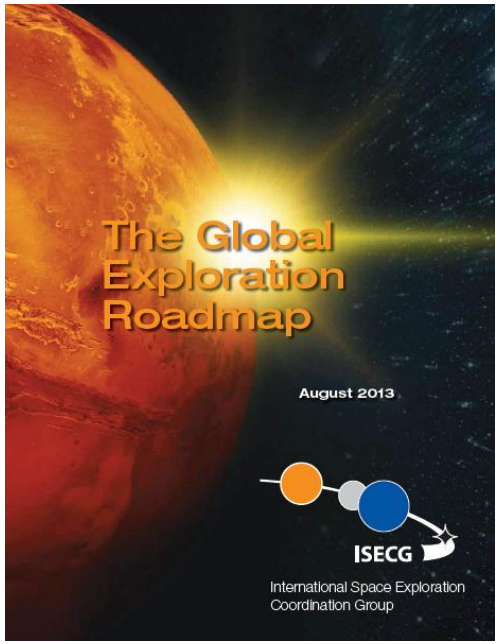
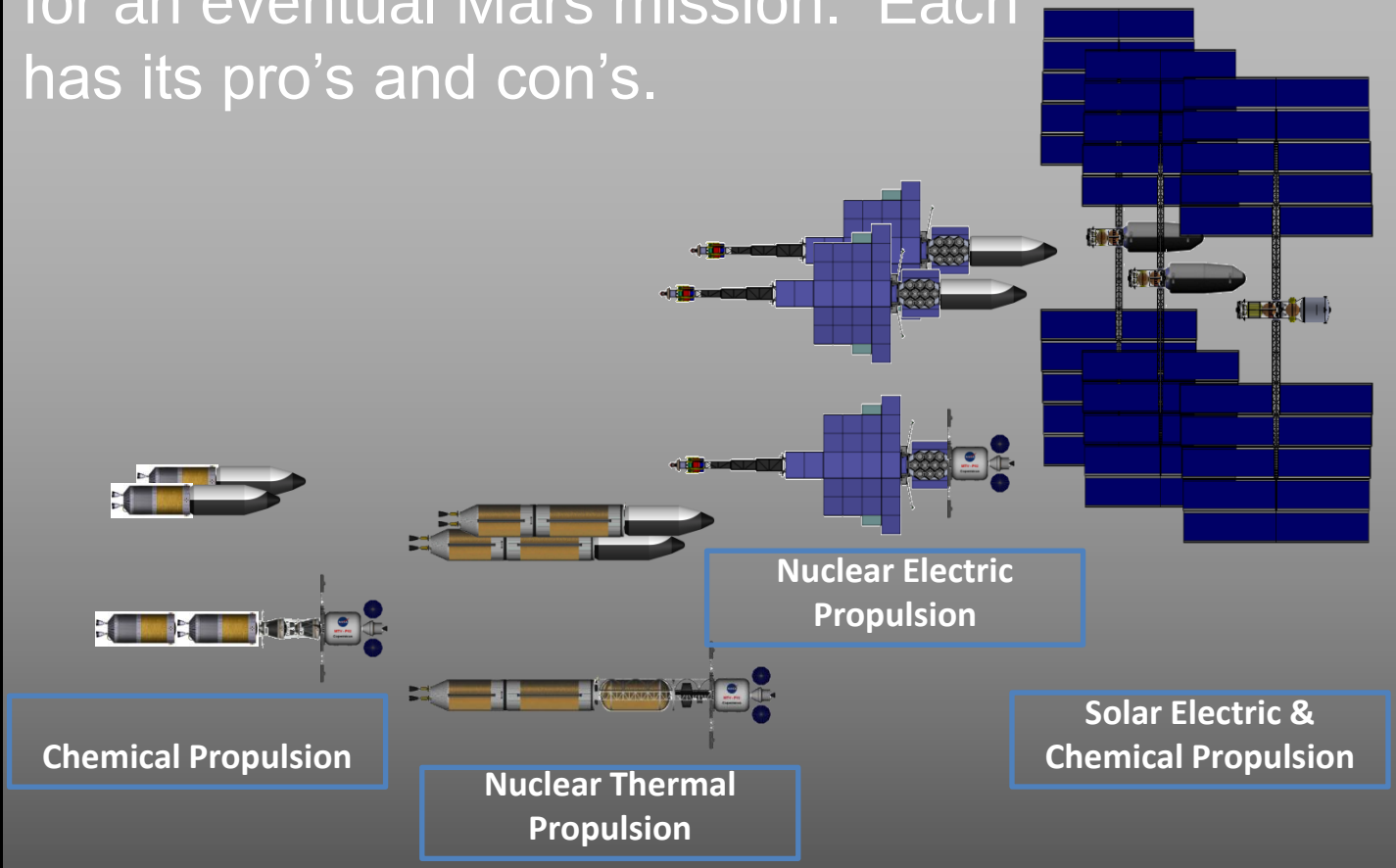
In Space Transportation Technologies Supporting the Global Exploration Roadmap



Les Johnson
(NASA George C. Marshall Space Flight Center)

Sending People To Mars – It's All About Moving Mass

There are many technical solutions for an eventual Mars mission. Each has its pro's and con's.

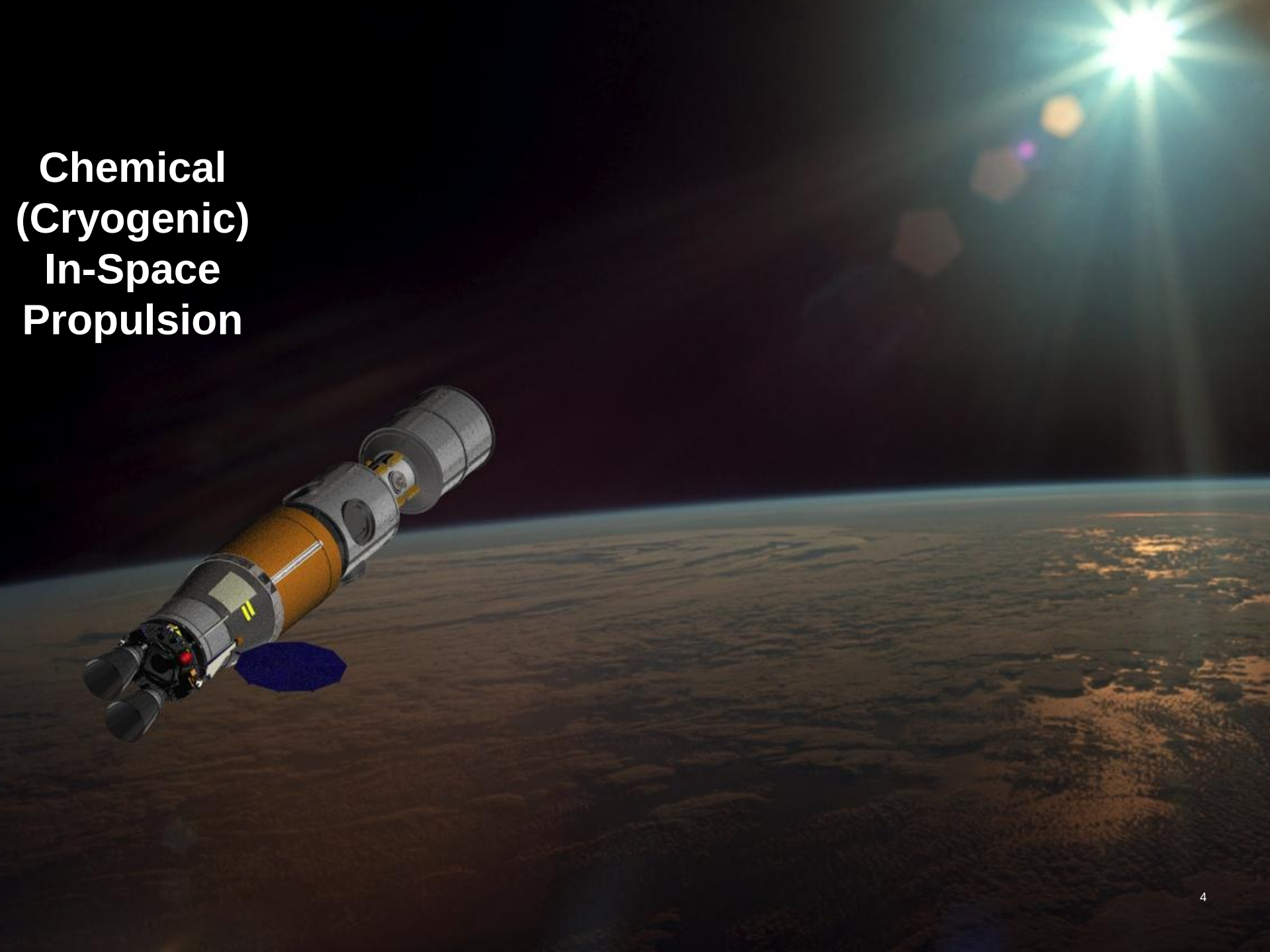


Human Exploration Preparatory Activities from the GER

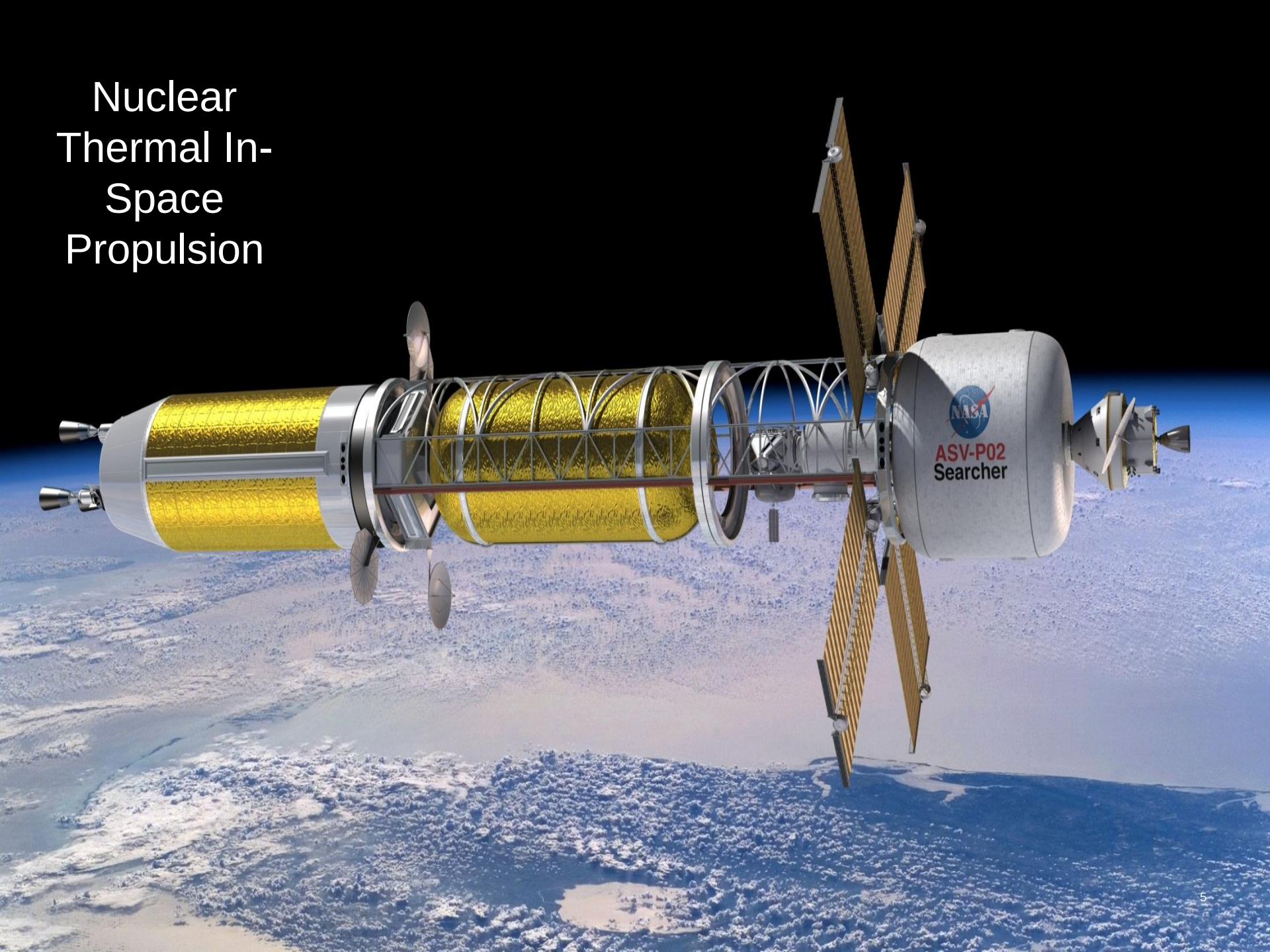
Critical Technology Needs by Technology Area[2]

In-Space Propulsion Technologies (TA02)	Life Support & Habitation Systems (TA06)
• Liquid Oxygen/Methane Cryogenic Propulsion System (Mars Lander)	• Closed-Loop & High Reliability Life Support Systems
• Advanced In-Space Cryogenic Propellant Storage & Liquid Acquisition	• Fire Prevention, Detection & Suppression (reduced Pressure)
• Electric Propulsion & Power Processing	• EVA Deep Space Suits, including lunar & Mars environment
• Nuclear Thermal Propulsion (NTP) Engine	• Advanced EVA Mobility (Suit Port)
Space Power & Energy Storage (TA03)	**Long Duration Human Health (TA06)**
• High Strength & Autonomously Deployable In-Space Solar Arrays	• Space Flight Medical Care, Behavioral Health & Performance
• Fission Power for Electric Propulsion & Surface Missions	• Microgravity Biomedical Countermeasures
• Regenerative Fuel Cells	• Human Factors & Habitability
• High Specific Energy & Long Life Batteries	• Space Radiation Protection/Shielding

Chemical (Cryogenic) In-Space Propulsion

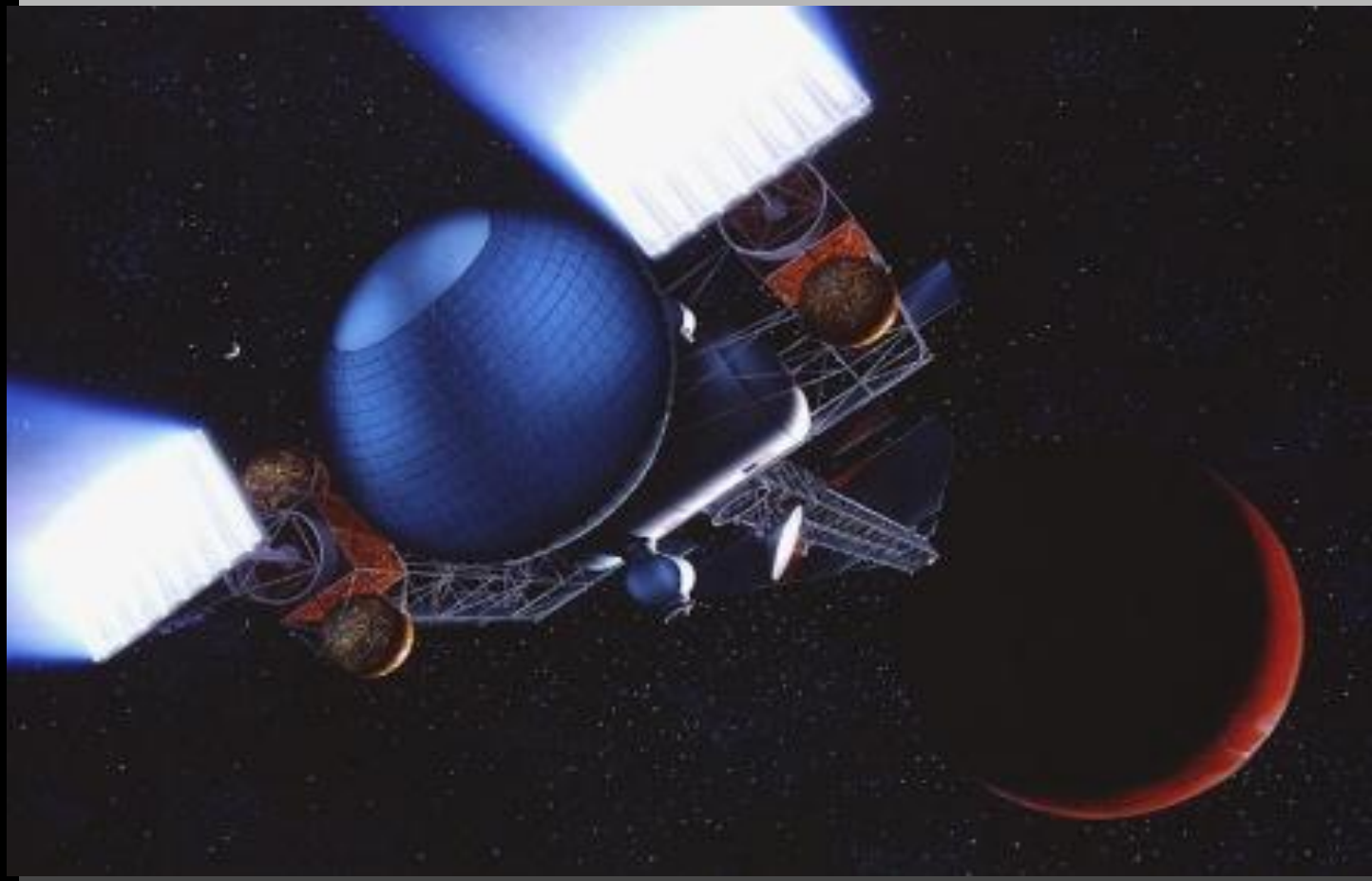


Nuclear Thermal In-Space Propulsion



Solar Electric In-Space Propulsion

Nuclear Electric In-Space Propulsion



Another Option Breakthrough!