Comparison of Radiation Dosage for Human Piloted Mars Missions Using Chemical, Nuclear Thermal, and Fusion Propulsion Systems

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Overview
- Radiation is a key danger that must be addressed during a manned mission to Mars.
- Possible sources include both man-made, such as the propulsion system, and naturally occurring, such as SPEs (Solar Particle Events) and GCRs (Galactic Cosmic Rays).
- Using a defined vehicle design, known as HOPE, the total effective dose over the mission timeline could be accurately modeled.
- Based on the effective dose, estimations can be made for the chance of cancerous and non-cancerous tumor growths and genetic mutation.

Impact
- This work will help identify the optimal propulsion system and shielding combination resulting in an effective dose within the same limits for humans.
- An accurate risk assessment may be created that outlines the doses to vital organs, demonstrating potential countermeasures that may be needed.

Key Findings
- Fusion propulsion allows for the lowest effective dose from GCR, which is the most abundant form.
- X-ray and neutron rays from the fusion propulsion system can be attenuated properly through the use of a water and metal combination shield at a thickness less than the proposed HOPE design.
- Proper attenuation creates relatively low probability coefficients for the hazards to health.

Explanation
- Fusion propulsion enables much safer trips to Mars for human piloted missions.
- The shorter the mission time, the less shielding material will be needed to provide a total effective dose below the annual limit.
- Radiation shield should be composed of both a light weight hydrogen rich source and a heavy metal with a high activation energy in order to protect from all aspects of radiation.

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