

SPACE PROPULSION SYMPOSIUM (C4)
Joint Session on Nuclear Propulsion and Power (7-C3.5)

Author: Dr. Claudio Bruno
United Technologies Corp., United States

Prof. Marco Durante
Germany

Mr. Christian Dujarric
European Space Agency (ESA), France

PROPULSION REQUIREMENTS FOR A SAFE HUMAN EXPLORATION OF MARS

Abstract

1- The paper summarises space radiation environment encountered for a human trip to Mars and the recently quantified knowledge acquired from the radiation assessment detector of the Curiosity mission. It recalls the known effects on human body of space radiation and the limits of the experience acquired so far with the crew of Apollo and the ISS. It proposes specifications of the maximal radiation dose within which, with current knowledge, the human travel to Mars back and forth can be accomplished with minimised subsequent reduction of the health risks (e.g., anticipated life duration, or cancer probability) of the crew. 2- The consideration of mission and system design constraints leads to the conclusion that nuclear power is mandatory to enable manned exploration of Mars. Available options are summarised. The proposed radiation dose limitation is translated into a reasonable travel time limit and leads to the conclusion that nuclear thermal or an hybrid nuclear thermal/nuclear electric will be necessary. 3- Shortcomings of the conventional nuclear thermal propulsion is recalled; a way forward is proposed including an innovative hybrid propulsion design and a mission scenario taking full advantage of its capabilities. As a conclusion, it is recommended to compare this option to other available design options meeting the same time limit requirements.