IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Radiation Fields, Effects and Risks in Human Space Missions (5)

Author: Mr. Jack Rosenthal
University of Leicester, United Kingdom, jackrosenthal97@gmail.com

Mr. Luca Gramegna
Politecnico di Torino, Italy, s291619@studenti.polito.it
Mr. David Sulley
University of Leicester, United Kingdom, dcs22@student.le.ac.uk
Mr. Carlo Bianco
Politecnico di Torino, Italy, s291629@studenti.polito.it
Mr. Lee Shauffer-Ellis
University of Leicester, United Kingdom, lse2@student.le.ac.uk
Mr. Teddy Butscher
ISAE-Supaero University of Toulouse, France, teddy.butscher@student.isae-supaero.fr
Mr. Lanre Logan
University of Leicester, United Kingdom, lgkl1@student.le.ac.uk

PRELIMINARY RADIATION ENVIRONMENTAL ANALYSIS AND SHIELDING DESIGN STRATEGIES FOR FUTURE VENUS EXPLORATION MISSIONS

Abstract

The future decades will represent an important milestone for broadening human space exploration horizons, bringing mankind to our closest neighbours Mars and Venus. Their strong similarities with Earth have drawn the attention of the scientific community: nevertheless, the lack of a planetary magnetic field may seriously endanger future missions. While the magnetosphere provides partial shielding against radiation for operations in Low Earth Orbit (LEO), any mission beyond Earth orbit would have to manage an increased exposure to high energy protons and heavy ions during Solar Particle Events (SPE) and even more energetic Galactic Cosmic Rays (GCR). Under long exposure, ionizing radiation represents a major health problem due to its carcinogenic effect, thus making it one of the limiting factors for interplanetary human spaceflight. Moreover, material ageing and degradation due to incident particles lead to an increasing failure rate of both the onboard instrumentation and the spacecraft structural materials. Damage to one of the key components could develop into a safety risk for the crew and eventually jeopardize the success of the mission. This paper presents a preliminary analysis on the total radiation dose that both the crew and the spacecraft would have to sustain during an expedition to Venus, taking into account different transfer scenarios. To estimate the external radiation environment for the mission, the dose rate change with respect to a decreasing distance from the Sun is evaluated together with peak loads provided by SPE. The results of the assessment establish the starting point for a comparison of traditional and advanced shielding techniques with the ultimate goal of proposing a shielding design strategy able to comply with the mission requirements. In particular multi-purpose materials, i.e. capable of satisfying both structural and shielding demands, are sought to minimize the additional mass thus maximizing the payload. The study presented in this paper has been developed by an international group of students as part of the project work phase for the SpacE Exploration and Development Systems (SEEDS) Master Program. The SEEDS program relies on the collaboration of Politecnico di Torino (Italy), ISAE-Supaero (France), and University of Leicester (UK), with active support by Thales Alenia Space, the Italian Space Agency, and the European Space Agency.