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Radiation Fields, Effects and Risks in Human Space Missions (5)

Author: Ms. Eleonora Zenobi
Fondazione E. Amaldi, Italy, eleonora.zenobi@fondazioneamaldi.it

Ms. Giulia Salvatore
Italy, giulias@mclink.it
Mrs. Federica Galante
Italy, federicagalante95@gmail.com
Dr. Luca Novello
Italy, luca.novello@cryolab.solgroup.com
Dr. Giuseppe Felici
Italy, giuseppefelici1971@gmail.com
Dr. antonio rinaldi
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy, antonio.rinaldi@enea.it
Dr. Ilaria De Stefano
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy, ilaria.destefano@enea.it
Mrs. Elisa Scatena
Fondazione E. Amaldi, Italy, elisa.scatena@fondazioneamaldi.it

INNOVATIVE SOLUTIONS FOR RADIATION SHIELDING

Abstract

This article focuses on the importance of developing innovative ionizing radiation shielding materials that are highly relevant for aerospace applications. The rationale for the development of these shields includes a focus on protecting living systems (human, animal) from the radiant environment present in space, through shielding media that are flexible, wearable, conformable/workable, modulable and - of course - capable of attenuating radiation at least as well as current commercial systems. It is well known that the radiant field on earth, dominated by photons (X and gamma), is different from that in space, dominated by charged particles with high atomic and mass numbers and neutrons. Based on the extensive theoretical and experimental work conducted over the past four decades to optimise shielding materials for space missions, it can be said that benefits could be obtained from new materials with the following characteristics - a matrix with a low atomic number and highly hydrogenated (to attenuate the particulate and neutron component), in which an element effective against photon radiation, e.g. tungsten, is inserted in a concentration and chemical-physical form to be studied. - This matrix must remain flexible, workable and wearable. This combination is ideal for the 'space environment', as one could finally have a shielding material that can be machined, shaped, and cut with conventional low-cost techniques. The studies shown in this paper aim to overcome these difficulties by engineering shielding through the use of tungsten powder or its compounds, manipulated with various advanced fabrication systems such as fused deposition modelling and electrospinning. Aspects of 'smart screen' will also be addressed, developing miniaturised radiation sensors that will be inserted into the 'screen' array with the aim of mapping the radiant field outside and inside the screen itself. This, in addition to enabling accurate verification of shielding effectiveness, will pave the way for applications of wearable screens that

incorporate the 'dosimetric' function for the radio-protection of the human subject, for the spin-offs that such screens may also have on the Earth in the clinical field.