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Active Radiation Shielding in Space?

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When Jules Verne wrote about journeying to the Moon (in his 1865 book From the Earth to the Moon, in Ninety-seven Hours Twenty Minutes), and when communication satellites were first proposed by Arthur Clark in 1945, there was no discussion of the hostile environment that people and machines might encounter in space. This was the case for Clark even though the Austrian physicist Victor Hess had discovered galactic cosmic rays in 1912, using a high-altitude balloon that he manned himself. The discovery in 1957 by James Van Allen (who celebrated his 90th birthday in September) of Earth's radiation belts fundamentally changed everyone's perspectives of Earth's space environment and the radiation effects on systems that would fly within it. The principal concern of spacecraft designers, builders, and operators over the last 40-odd years has been to design systems that could be as immune as possible to the radiation encountered.

Other than specifically designing "hardness" into electronic components when possible, most procedures for mitigating space radiation effects have involved the clever use of passive shielding by materials of various types, which adds unnecessary weight to payloads. Obviously, designing hardness into humans who fly in space is not feasible, so shielding is mandatory. With the renewed interest in returning to the Moon, and with the ultimate objective of sending humans to Mars, the subject of protecting humans from space radiation has assumed new importance. Rather than employing passive shielding to protect astronauts on their journey, a NASA-sponsored workshop this summer explored in some detail the possible use of active shielding techniques to protect humans and their equipment on voyages of discovery (at the August 2004 Active Radiation Shielding for Human Space Exploration Workshop, held at the University of Michigan; http://aoss.engin.umich.edu/Radiation). Active shielding refers to the use of various types of electromagnetic shielding techniques.

The workshop, a follow-on to one held in 2000, attracted a number of intriguing ideas and concepts. These ranged from using superconducting magnets to produce magnetic Faraday cages, to designing artificial magnetospheres around the spacecraft, to employing electrostatic shielding. Professor Eugene Parker of the University of Chicago presented an interesting analysis of some of the energy requirements for active shielding, and concluded that an extreme amount of external energy would have to be brought along on a mission to protect humans during spaceflight. He commented that the "only hope" was for some future biomedical development that could stimulate the human body to repair ongoing radiation damage during the course of a trip.

I think that the discussion of ideas for active radiation shielding is an excellent path to pursue, at about the intensity level that the workshop explored, and the University of Michigan should be applauded for bringing together a stimulating and useful debate at the workshop. Professor Parker's conclusions may likely be valid, but continued clever thinking about difficult problems, provided they do not violate the laws of nature, often lead to interesting new insights into nature.

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