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ELECTRIC DIPOLES AS POSSIBLE APPROACH TO RADIATION SHIELDING

Abstract

The basic function of a radiation shield is to prevent energy deposition (or structural damage) of instruments and/or astronauts, by high-energy charged particles, within a given shielded volume. Further, any practical space shield must be implementable under the limitations placed on mass, volume and power for space flight. To answer this problem, an investigation into the efficacy of employing electric dipole fields to realize a practical space radiation shield was undertaken. A shield based on electric dipoles does not try to stop or absorb the radiation but deflects it from the shielded volume.

To exactly replicate space particle energies and fluxes is very difficult in the laboratory. An experiment with lower energies and volumes, given the correct model, can however be scaled to the energies and volumes expected in the space environment. The experiment beamed charged particles (positive and negative) which interacted with a field generated by an electric dipole and whose deflections could then be detected by a position sensitive detector. The net effects of attenuation (shield on vs. shield off) was measured for various beam energies, dipole orientations and strengths as well as relative positions to the shielded volume, from which the scaling laws for a complete model were developed. The proof-of-concept experimental results and modeling for a radiation shield produced by an electric dipole are very encouraging. The results point to field strengths that are many orders of magnitude less than the currently proposed concepts for radiation shielding. We discuss planned risk-reduction efforts that could lead to an eventual technology demonstration spaceflight.