Using Geant4 To Find the Most Weight Effective Passive Radiation Shielding

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During space travel, space craft and the astronauts within are exposed to galactic cosmic rays; prolonged periods of exposure to these rays can cause cancer, injuries to the nervous system, and damage to devices. Conventional radiation shielding such as lead is far too heavy for use on spacecraft, creating a need for a lightweight radiation-attenuating material. The objective of this research was to evaluate potential radiation shielding using Geant4 software. Two shielding strategies were developed and examined in this project: Z-graded materials which shield against radiation by producing decreasingly energetic x-ray luminescence in each layer, and hydrogen rich materials. To test these, Geant4 was used to simulate the interactions between the shielding and 10 GeV protons and different dopant materials diluted into high-density polyethylene (HDPE). The kinetic energy, dosage, and type of particles detected were recorded to determine the best performing material. The lead control performed best in every category. However, the iron HDPE composite showed unexpectedly high performance and many generated particles. Continued testing must be done with different configurations to protect people and devices on spacecraft.

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