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Designing Radiation Shields Based on Jovian Radiation Models for the Juno JADE Instrument

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Abstract

The extreme radiation environment of Jupiter presents significant challenges to the design of energetic particle instruments with microchannel plates (MCPs), especially with typical mission mass constraints. Radiation shielding is necessary in order to minimize the noise generated by penetrating electrons as well as secondary particles. The Jovian Auroral Distributions Experiment (JADE), on the Juno mission to Jupiter, has been designed with shielding optimized to give the highest expected signal to noise ratio while minimizing the instrument mass.

Two different radiation models are merged and the resulting electron fluxes over the Juno orbit input into Geant 4, determining the transmission of primary and secondary particles for various shielding thicknesses and compositions, including high-Z/low-Z combinations. The target material areal density needed to stop the primary electrons that could overwhelm the MCPs (less than 15 MeV) is calculated. Finally, background count rates are developed from the expected particle transmissions and estimated MCP efficiencies, for a range of high-Z/low-Z ratios, and are evaluated versus areal densities, revealing an optimum material ratio for a given areal density.