Benchmark Study for Charge Deposition by High Energy Electrons in Thick Slabs

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Spacecrafts are always subjected to radiation environments of various sources that include the trapped particles, solar energetic particles and Galactic Cosmic Rays. Space mission design requires knowledge of (1) radiation environments in which the spacecraft will be operating and (2) accurate and reliable radiation transport tools. In the absence of reliable radiation models/transport tools, conservative design to assure reasonable prospects of mission success will generally require more massive shielding of electronic systems or sensors than might otherwise be unnecessary. Among many phenomena that are possible from space radiation interactions with spacecraft materials, electron charge deposition – either along the particle track or within the bulk of material – is one of the important design issues. It is closely related to Internal ESD or bulk charging.

This paper particularly addresses the high energy (1 to 100 MeV) electron transport in terms of charge-stopping profiles in several representative spacecraft shielding materials (aluminum, copper, and tungsten) in thick slab geometry by using the existing electron transport codes (ITS series, MCNP, and NOVICE). The main purpose is to benchmark the electron transport codes to gain a better understanding of their predictive capability for charge deposition calculations in high energy electron environment. Preliminary results indicate that NOVICE results are within +/-15% compared to the MCNP and ITS results for aluminum, and that NOVICE underestimates by ~10% for tungsten. There seems to be good agreement between the ITS and the MCNP results.

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