Heavy Ion Testing at the Galactic Cosmic Ray Energy Peak


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Abstract

A 1 GeV/u ⁵⁶Fe Ion beam allows for true 90° tilt irradiations of various microelectronic components and reveals relevant upset trends for an abundant element at the galactic cosmic ray (GCR) flux-energy peak.

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The galactic cosmic ray (GCR) environment has a flux-energy peak at 1 GeV/u. At this level of kinetic energy, LETs > 1 (MeV·cm²/mg) are dominated by Iron.

1 GeV/u ⁵⁶Fe has an LET of 1.2 (MeV·cm²/mg) and a range in silicon of 15 cm.

Static Random Access Memories

Note: Different scales for Vendor A's SOI and Vendor B's bulk CMOS.

Field Programmable Gate Array

• Extreme variation between configuration and BRAM cross section based on orientation
• Suspect physical layout is responsible

Conclusions

• First time the NSRL facility has been used to characterize highly-scaled commercial technologies
• 1 GeV/u ⁵⁶Fe beam allowed for true 90° tilt irradiations
• Extreme upset cross section variation observed as a function of roll angle, data pattern, and storage elements
• Data provides impetus to study these limiting irradiation conditions with radiation transport modeling since studies like these are not feasible on a regular basis

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