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Radiation Testing Electronics with Heavy Ions–The Best Way to Hit a Target Moving Ever Exponentially Faster

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In 1972, when engineers at Hughes Aircraft Corporation discovered that errors in their satellite avionics were being caused by cosmic rays (so-called single-event effects, or SEE), Moore's Law was only 7 years old. Now, more than 45 years on, the scaling that drove Moore's Law for its first 35 years has reached its limits. However, electronics technology continues to evolve exponentially and SEE remain a formidable issue for use of electronics in space. SEE occur when a single ionizing particle passes through a sensitive volume in an active semiconductor device and generates sufficient charge to cause anomalous behavior or failure in the device. Because SEE can occur at any time during the mission, the emphasis of SEE risk management methodologies is ensuring that all SEE modes in a device under test are detected by the test. Because a particle's probability of causing an SEE generally increases as the particle becomes more ionizing, heavy-ion beams have been and remain the preferred tools for elucidating SEE vulnerabilities. In this talk we briefly discuss space radiation environments and SEE mechanisms, describe SEE test methodologies and discuss current and future challenges for use of heavy-ion beams for SEE testing in an era when the continued validity of Moore's law depends on innovation rather than CMOS scaling.