HAW05-2005-020155

Abstract for an Invited Paper
for the HAW05 Meeting of
the American Physical Society

Failures in Semiconductor Devices from Cosmic-Rays Induced Neutrons

S.A. WENDER, Los Alamos National Laboratory

Neutron-induced failures in semiconductor devices are an increasing concern in the semiconductor industry. Understanding these failures involve several areas of nuclear science. Neutrons are produced in the upper atmosphere by cosmic-ray bombardment of nuclei in the air. Because the neutrons are uncharged, they have long mean-free paths and can reach aircraft altitudes and below. Neutron interactions in semiconductor devices produce ionized recoils or reaction products that deposit charge in the vicinity of nodes and cause the devices to fail. The types of failures include bit flips, latchups and burnout. Predicting the failure rate depends on knowing the neutron flux in the environment of the semiconductor device and the response of the device to neutrons. Many companies have measured the system response at an accelerated rate by using the high-energy Los Alamos Neutron Science Center (LANSCE) spallation neutron source. The LANSCE source produces a neutron spectrum that is very similar in shape to the neutron spectrum produced by cosmic rays in the earth's atmosphere but is approximately 10^8 times more intense than the sea-level neutron flux. This acceleration factor allows testing of semiconductor devices to measure their response and development and testing of failure models and approaches to mitigation.