Nuclear data relevant to single event upsets in semiconductor memories induced by cosmic-ray neutrons and protons

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In recent years, nucleon-induced single-event upsets (SEUs) have been recognized as a key reliability concern for microelectronic devices used in various radiation environments. For instance, terrestrial cosmic-ray neutrons hitting the earth have the wide energy range from MeV to GeV, and are regarded as one of the major sources of SEUs in the devices used at the ground level or in airplanes. Also, cosmic-ray protons are known to have a serious influence on SEUs in the devices installed in artificial satellites.

The nucleon-induced SEU is initiated by an interaction of incident cosmic-ray particles with materials in microelectronic devices. Light-charged particles and heavy recoils are generated via a nuclear reaction with a constituent atomic nucleus, mainly 28Si, and then deposit the charge in a small sensitive volume (SV) of the device. The charge is collected at one of the nodes keeping the memory information and the resulting current transient generates an SEU. Knowledge on nuclear physics and radiation physics is important to understand the elementary processes involved in the SEU phenomena. Particularly, reliable nuclear reaction data are required in estimating the SEU rate by numerical simulation methods.

I will review the nucleon-induced SEU problems, and discuss the present status and outlook of the SEU research from the viewpoint of the relevant nuclear data.