

## Single Event Effects Studies on 28-nm SoC Induced by Low Energy Proton Irradiation

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Protons in earth's space radiation environment pose a serious threat to astronautics electronic system, where System on Chip (SoC) is widely used. Therefore, we carried out low energy proton experiments on 28-nm SoC and emulated typical modules influenced by incoming particles in SoC to explore proton Single Event Effects (SEE). In the radiation experiments, the SoC chip was irradiated by protons of different energies. The irradiation test results showed that SEE occurred in typical modules of SoC, including register, PL, Cache, etc. The Single Event Upset (SEU) cross sections at different proton energies were obtained. In the simulation, protons of different energies were simulated as pulsed current source in consideration of multilayer wiring and energy loss before reaching the sensitive area. Typical structure of register and inverter in SoC were built. The circuit modules were simulated as SEE occurred and malfunctioned when pulsed current source existed. The changes of the circuit modules output were observed when pulsed current signals were placed at different sensitive nodes, the parameters of pulsed current were altered, or the circuit was working under different conditions. The sensitive nodes in typical modules and the possible reasons of test program malfunction were primarily studied.

**Primary author:** ZHANG, Yao (Xi'an Jiaotong University)

**Co-authors:** HE, Chaohui (Xi'an Jiaotong University); LIU, Shuhuan (Xi'an Jiaotong University); REN, Xiaotang (Peking University); DU, Xiaozhi (Xi'an Jiaotong University); DU, Xuecheng (Xi'an Jiaotong University); LI, Yonghong (Xi'an Jiaotong University)

**Presenter:** ZHANG, Yao (Xi'an Jiaotong University)

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