Single-Event-Effects induced by pulsed X-rays in microelectronic components for space applications

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In space, Single Events are caused by heavy particles that penetrate in the material and ionise the target through their way. The generated charges form parasitic currents that are at the origin of SEE. Today, to perform ground test on SEE sensitivity, protons and heavy ions beams are used. A single event is manifested when the deposited charge is higher than the critical charge in the sensitive zone of the component. The unit that is used is the LET which characterize the Energy loss by length unit (dE/dx). A single event occurs above a LET threshold depending of the component.
With the breakthrough of 3D packaging and die stacking, the chip accessibility to standard heavy ion beams happens to be less and less feasible. For this reason, alternative methodologies have been proposed that employ high energy synchrotron X-ray pulses to emulate the effect of heavy ions. Preliminary experiments have been already carried out with success ([1][2][3]), nonetheless an important experimental and theoretical work is still needed to gain fundamental understanding of these interaction and derive a proper modelling of the interaction and the consequent correlation between the LET and the photon energy. The high spatial localisation and the short time deposition are likely to generate non linear behaviour which have not been investigated so far and need further understanding.
The present talk will offer a comprehensive review on the main mechanisms of interaction between ionising radiation and electronic devices, with particular emphasis for X-rays. The state of the art in the novel methodology of SEE measurement using pulsed X-rays will be introduced and some original results obtained at the ESRF will be also presented. Finally an overview on the perspectives of the methodology will be proposed, with particular emphasis on the unique opportunities offered by the EBS.

References

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