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# The transient degradation of neutron irradiation on CMOS image sensor: experiments and simulations

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When operating in the neutron radiation environments, CMOS image sensors (CISs) would be damaged. The neutron radiation damage mainly includes permanent damage and transient damage. The objective of this work is to analyze the transient degradation of CIS in neutron radiation environments by experiments and simulations. The sample (CIS) is manufactured in commercial 0.18 μm CMOS technology. The image array is made of 2048×2048 11-μm square pixels.

The experiments are carried out at Northwest Institute of Nuclear Technology, China. The ration of n/γ is 4.19×10ˆ9 n/(cmˆ2rad(Si)). The neutron spectra are measurement by the staff of the radiation facility. The angles of incident neutron (angle between incident neutron and the normal to the surface of the CIS) are 0°, 30°, 60°, and 75°.The raw image at different angles are captured during the neutron irradiation.

The simplified 3D CIS array is established by Monte Carlo code Geant4. The nuclear interactions are included in the physics process. The multiple scattering for any kinds of the charged particle are simulated. The ionizing doses of neutrons in the sensitive volume of the CIS are calculated. The simulated raw images are compared with the experimental raw images. The transient degradation mechanism of the neutron irradiation on the CIS is analyzed. The transient degradations of neutron irradiation on the CIS with different pixel pitches are also simulated.

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