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Modeling the transient effects of 60Co γ rays in CIS imaging system by Monte Carlo method based on Geant4

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CMOS image sensors (CISs) have lots of advantages such as low power consume, high integration, high TID radiation toleration et al. and become the main components of imaging system which is widely used in the 60Co γ rays source laboratory to monitored experiment process.
The objective of this work is to model the transient effects of 60Co γ rays in CIS imaging system. The CIS imaging system includes the separate board, evaluation board, shielding box, computer control system, lens, lens hold, and CIS et al. The evaluation board and separate sensor board are separated and connected by transmission circuit. The 60Co γ rays experiments are carried out at 60Co γ ray facility at Northwest Institute Nuclear Technology. The dose rates are calibrated by PTW-UNIDOS, and the dosimetry is accurate to better than 2.5%.
The Photoelectric effects, Pair effects and Compton scattering are considered in physics processes. The cross sections of each effect are calculated. The projected range and linear energy transfer of 60Co γ rays in Si and SiO2 are simulated. The ionizing dose distributions of the 60Co γ rays in Si and SiO2 along the radial direction are presented.
The simulation model of the CIS pixel is established according to the real pixel geometry, material and doping concentration. The pixel is composed of six layers. The layer of sensitive volume (SV) is where the charge collection happens. The transient effects of 60Co γ rays in the 100×100 CIS arrays are simulated. The simulated results are compared with the experimental results. The characteristics of transient effects induced by 60Co γ rays are analyzed.

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