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Simulation of HR GaAs:Cr Timepix3 detectors with Allpix2

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Recent advantages in crystal growth have facilitated the production of high resistivity (HR) chromium compensated gallium arsenide (GaAs:Cr), which has become an alternative to silicon, especially in X- and gammas-ray detection and imaging, where such sensors profit from their higher absorption efficiency.

To explore charge transport properties of the HR GaAs:Cr material we measured the dependence of the electrons and holes drift velocity on the electric field and the dependence of the diffusion coefficient on the electric field. It became possible by analyzing the HR GaAs:Cr-Timepix3 detector response to charged particles entering the detector at a grazing angle. The holes lifetime and their mobility were measured using the drift time information for the first time for HR GaAs:Cr material to be τ_h = 4.5±0.5 ns, μ_h = 320±10 cm^2/V/s at 300 V.

The measured dependencies were introduced into the Allpix^2 simulation framework. Simulated Timepix3 detector response was validated by comparison of the measured and the simulated data for various X- and gammas-ray sources in the energy range of 6 –60 keV, protons of 125 MeV, and pions of 120 GeV/c.

The talk will be divided into two parts: firstly I will tell about the performed experiments and following data analysis and then I will continue with a short tutorial on how to perform the simulation of HR GaAs:Cr Timepix3 detectors with Allpix^2.

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