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Study of the charge sharing effect and the energy resolution in a hybrid based on GaAs:Cr Timepix detector

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Among the most modern ionizing radiation detectors, the hybrid based on GaAs:Cr Timepix stands out as one of the most competitive due to its characteristics, such as its high Z and its strong resistance to radiational damage. In addition to their use in high energy physics research, they have been effectively employed in the medical visualization, spatial technologies, geological prospecting, among others advanced fields. The target of this work is a 900 μm GaAs:Cr detector with Timepix read-out technology. Some detector characteristics for three experimental conditions were measured and studied using the X-rays generated by a synchrotron and by an X-ray tube provided with different materials for obtaining the corresponding fluorescence photons. A composite function was used to decompose the differential spectra in to the most important involved contributions. As an additional tool in the investigation, the mathematical modeling of the movement within the detector active volume of the generated by radiation charge carriers was used. The results of the charge-sharing studies showed a noticeable prevalence in the detector of this phenomenon, changing its contribution according to the experiment characteristics. The detector was calibrated for all the planned experiments and the energy resolution of the system was calculated. From the analysis of all obtained results and their comparison with the previously reported in literature data, it was confirmed that the detector has a marked charge-sharing effect between neighboring pixels, seeing its performance more affected as the energy of the incident photons growths.

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