

Solid angle compensation in Gas proportional scintillation counters using an annular anode with azimuthal geometry.

Wednesday 3 July 2024 14:57 (1 minute)

Electroluminescence (EL) describes the scintillation emission by a material upon electron impact under an external electric field. Gas Proportional Scintillation Counters (GPSC) rely on EL produced in noble gases to amplify the ionization signal coming from the radiation interaction with the gas medium. Various detector geometries have been proposed for this type of detector, the most common using two parallel meshes to define the EL region with an uniform electric field. However, the dependency of the solid angle subtended by the photosensor relative to the EL emission position, thus on the primary electrons position and, consequently, on the radiation interaction position limits the GPSC window size when compared to the photosensor active area. This study proposes an annular EL region with an azimuthal geometry in respect to the photosensor to maintain constant the referred solid angle, facilitating the use of large radiation windows. Other advantages of this design are the simplicity of the GPSC construction, in respect to other solutions: only an annular anode, having its axis aligned with the photosensor axis, will be needed to bias the GPSC. Experimental results demonstrate good energy resolution for 5.9, 22.1 and 56.4 keV, and the capability of having a six times greater radiation window area compared to the 2 cm^2 sensitive area with an LAAPD as the photosensor. Simulation studies, using dedicated software for the primary charge generation, drift and diffusion, photon emission due to the increasing electric field and light propagation and collection in the photosensor, are also presented. These results corroborate experimental findings, highlighting the detector's viability for x-ray astronomy applications as a portable, room-temperature device with a large detection area and volume, rivaling solid-state detectors.

Keywords: Electroluminescence • Gas detectors • Scintillation counters • X-ray Detectors • GPSC •

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Session Classification: Poster Session