Contribution ID: **152**

Type: **poster**

A large area gas proportional scintillation counter with a ring-shaped anode for x- and gamma-ray spectroscopy

Gas Proportional Scintillation Counters (GPSCs) are noble gas detectors in which the primary ionization charge generated by radiation interactions is amplified via electroluminescence (EL) in the gas. Under an external electric field, the primary electrons drift into a region where the field exceeds the gas scintillation threshold—known as the scintillation region. Compared to charge amplification via electron avalanches, EL amplification provides higher gain with improved signal-to-noise ratio, no space charge effects, and better immunity to radiofrequency noise and electrical discharges.

GPSCs have been widely used in applications such as X-ray fluorescence analysis, X- and γ-ray astrophysics, and planetary and asteroid exploration. Their high resistance to radiation damage, wide operational temperature range, simple yet flexible design, and large-area detection capability are notable advantages. However, the solid angle subtended by the photosensor varies with the EL emission position, causing the detected signal to depend on the radiation interaction location. This limits the size of the detector's radiation window relative to the photosensor.

Several compensation techniques have been proposed to mitigate this effect—at the cost of increased detector complexity. Examples include electrostatic focusing of primary electrons toward the photosensor axis and radial modulation of the electric field in the scintillation region to counteract the radial variation in solid angle.

To overcome these limitations, we recently proposed a novel and simple GPSC design that ensures a constant solid angle across the scintillation region. In this configuration, a single annular anode electrode, centered on the photosensor axis and held at high voltage, defines a localized scintillation region near its surface. As a result, the entire region maintains a fixed solid angle with respect to the photosensor, making the EL signal independent of the interaction position. This design enables a large window-to-photosensor size ratio while maintaining uniform response.

Previously, we developed a comprehensive simulation tool incorporating radiation absorption, electron drift, EL emission, and light detection, which was validated against an annular-anode GPSC prototype. The simulations showed good agreement with experimental results.

In this work, we use the simulation tool to explore the optimal geometrical parameters of the annular-anode GPSC, aiming to balance energy resolution and the anode-to-photosensor radius ratio. We also investigate the effect of the anode bias voltage on detector performance.

Workshop topics

Detector systems

Author: SILVA, Pedro

Co-authors: Dr BERNARDES MONTEIRO, Cristina (University of Coimbra); MARQUES FERREIRA DOS SANTOS, Joaquim (Universidade de Coimbra (PT)); Dr FERNANDES, Luís (Universidade de Coimbra)

Presenter: Dr BERNARDES MONTEIRO, Cristina (University of Coimbra)