

Study of time-dependent instrumental effects in IXPE: pressure variation and GEM charging inside Gas Pixel Detector

Friday, 31 May 2024 15:31 (1 minute)

Launched on December 9, 2021, the Imaging X-ray Polarimetry Explorer (IXPE) is the first mission entirely devoted to astronomical X-ray polarimetry in the 2–8 keV energy band. At the heart of the observatory is a set of three identical, sealed, gas pixel detectors (GPDs) sensitive to polarization. Alongside their primary function, GPDs offer simultaneous imaging, timing, and spectroscopic capabilities with moderate resolution. In this contribution we focus on two time-dependent instrumental phenomena, originally identified during the development phase of the mission, which necessitate continuous monitoring throughout the mission's operational phase. Firstly, a secular decrease of the pressure in the sealed gas cell, due to internal adsorption of the filling dimethyl ether (DME) with a time scale of months and an asymptotic pressure reduction of 10–20%, has been observed. Although largely saturated prior to launch, the residual, slow variations in quantum efficiency, gain and track size are still relevant enough that they need to be accounted for in the analysis. To this end, we have considered two parallel paths: the monitoring of a set of sealed control detectors, identical to those currently operating in space, and the analysis on fluxed detectors in a custom gas filling station, that allows to study the pressure dependence of the relevant metrics under controlled conditions. Secondly, we address charge build-up in the dielectric layer of the Gas Electron Multiplier (GEM), the amplification stage of the detector, with time scales ranging from hours to days. This charging phenomenon induces a decrease in detector gain under irradiation, gradually recovering once irradiation ceases, akin to the behaviour of a capacitor. To mitigate this effect, our data analysis pipeline incorporates a correction algorithm based on dedicated measurements performed on flight detectors pre-launch and updated through the continuous gain monitoring performed using onboard calibration sources.

Collaboration

Role of Submitter

I am the presenter

Primary authors: MANFREDA, Alberto (Istituto Nazionale di Fisica Nucleare); SGRO', Carmelo (Istituto Nazionale di Fisica Nucleare); TOMAIUOLO, Chiara (Università di Pisa / INFN); ORSINI, Leonardo (Istituto Nazionale di Fisica Nucleare); BALDINI, Luca (Istituto Nazionale di Fisica Nucleare); TUGLIANI, Stefano (INFN - Torino)

Presenter: TOMAIUOLO, Chiara (Università di Pisa / INFN)

Session Classification: Gas Detectors - Poster session

Track Classification: T6 - Gas Detectors