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Title: AX-PET: Demonstration of an Axial PET Concept for Brain and Small Animal Imaging

Abstract (max 300 words)
The AX-PET collaboration is developing a novel concept for high resolution PET imaging to overcome some of the performance limitations of classical PET cameras.
Our detector consists of a matrix of long LYSO scintillation crystals, axially arranged around the field of view, and Wave Length Shifter (WLS) plastic strips, orthogonal to the crystals. The energy measurement and the transverse coordinates (x, y) are provided by the crystals, while the axial coordinate (z) is obtained from the strips. Crystals and WLSs are individually read out by (B-field insensitive) G-APDs. The AX-PET concept allows for a true 3D and parallax free reconstruction of the photon's interaction point(s) in the crystal matrix with a spatial resolution which is in first approximation determined by the width of crystals and strips. The sensitivity of the detector can be increased by adding (radially) crystal layers, without compromising the spatial resolution. The photon tracking capability allows identifying Compton interactions in the matrix (Inter Crystal Scatter). Simulations indicate that approximately 70% of those events can be fully reconstructed; the others can be discarded in order to maintain the full spatial resolution.
Two AX-PET modules – each with 48 crystals and 156 WLS strips – have been built. Dedicated front-end electronics and specific simulation and reconstruction software have been developed. The results of characterization measurements in the lab indicate a position resolution of better than 2mm in each of the three coordinates, excellent energy resolution (~12%) and a coincidence time resolution of 1.8 ns (all values are FWHM at 511 keV). Coincidence measurements with point-like sources and with PET phantoms are in preparation.