Contribution ID: **162** Contribution code: **INSTR/SW** Type: **Oral**

Application of compact detectors composed of oriented crystals to the observation of VHE gamma rays in space

Wednesday 4 September 2024 16:45 (15 minutes)

High-density and high-Z crystals are a key element of most of the γ-ray telescopes operating at the GeV energy scale (such as Fermi-LAT). The lattice structure of these materials is usually ignored for all practical purposes, such as instrument calibration or simulation. However, recent studies performed by the STORM-OREO collaboration have shown that this is a rough approximation, since high-energy ($gtrsim5$ GeV) photons impinging along the axis of an oriented crystals interact differently from the ordinary. Specifically, if the angle between the photon trajectory and the crystal axis is smaller than $\sim 0.1^{\circ}$, a large enhancement of the pair production cross-section is observed, and even at angles as large as $\sim 1^{\circ}$ there exists a weaker but non negligible effect. The net consequence of this effect is the fact that the electromagnetic shower initiated by a high energy photon develops in a much more compact space than the ordinary.

These effects could be exploited to develop novel compact gamma-ray telescopes. For instance, a telescope composed of oriented crystals could achieve the same performance of a much thicker (and thus heavier and more expensive) non-oriented one, while pointing to a specific source. Otherwise, a larger effective area could be achieved, without increasing the overall volume. Moreover, even in the absence of pointing, the telescope would still perform ordinarily.

This detector concept is highly interesting for $\gamma-$ray astronomy: the enhanced sensitivity to $\gamma-$rays, coupled with a high spatial resolution, could allow to better identify unknown sources in the galactic plane and investigate the nature of the gamma excess in the galactic center. Moreover, the higher sensitivity to very high-energy photons could allow to extend the detector energy range well in the multi-TeV range, thus providing complementary and unique information to that expected in the next generation of ground-based IACTs.

In this contribution we discuss the scientific opportunities that will be opened by the use of oriented crystal in compact detectors for $\gamma-$ray astronomy, along with the techniques used to simulate and assemble such instruments.

Primary authors: SELMI, Alessia (University of Insubria (IT) and INFN Milano Bicocca (IT)); SYTOV, Alexey (INFN Ferrara (IT)); MAZZOLARI, Andrea (University of Ferrara (IT) and INFN Ferrara (IT)); CAVAZZUTI, Elisabetta (ASI); VALLAZZA, Erik (INFN Milano Bicocca (IT)); LONGO, Francesco (University of Trieste (IT) and INFN Trieste (IT)); PATERNÒ, Gianfranco (INFN Ferrara (IT)); MALAGUTTI, Lorenzo (INFN Ferrara (IT)); COSTAMANTE, Luigi (ASI); ROMAGNONI, Marco (University of Ferrara (IT) and INFN Ferrara (IT)); DI MAURO, Mattia (INFN Torino); SOLDANI, Mattia (INFN Laboratori Nazionali di Frascati (IT)); PREST, Michela (University of Insubria (IT) and INFN Milano Bicocca (IT)); CANALE, Nicola (University of Ferrara (IT) and INFN Ferrara (IT)); MONTI-GUARNIERI, Pietro (University of Trieste (IT) and INFN Trieste (IT)); NEGRELLO, Riccardo (University of Ferrara (IT) and INFN Ferrara (IT)); GAITSKELL, Richard (Brown University (US)); CUTINI, Sara (INFN Perugia (IT)); KOUSHIAPPAS, Savvas (Brown University (US)); CARSI, Stefano (Unimarconi (IT)); VAGELLI, Valerio (ASI); GUIDI, Vincenzo (University of Ferrara (IT) and INFN Ferrara (IT)); BANDIERA, Laura (INFN Ferrara (IT))

Presenter: MONTI-GUARNIERI, Pietro (University of Trieste (IT) and INFN Trieste (IT))

Session Classification: Parallel 2