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DEVELOPMENT OF A HIGH-ENERGY ASTROPHYSICS PAYLOAD WITH POLARIMETRIC CAPABILITIES FOR CUBESATS.

Abstract

In recent years the scientific community has been developing new and more advanced facilities to observe the high-energy universe. From neutrino, gravitational wave, cosmic rays and multiwavelength light detection, multimessenger astrophysics is very well established. Recent studies in Compton polarimetry indicate that measuring gamma-ray transients' polarimetry, such as Gamma-Ray Bursts (GRB), supernova explosions, collision of massive bodies (ex:. neutron star merger), pulsars and active galactic nuclei (AGN) allows a deeper understanding of the emission mechanisms that are associated with these violent non-thermal events. Gamma-ray polarimetry missions such as POLAR (2016) showed that GRB's are polarized. We present the development of a payload able to perform gamma-ray polarimetric measurements to go onboard a 2U CubeSat. The gamma-ray detector works in the 100keV - 1 MeV energy range and is based on a CdTe (Cadmium Telluride) semiconductor configured in a 8 x 8 pixel matrix each being 2mm x 2mm x 5mm resulting in a 2.56cm^2 of sensitive area. The back-end electronics of this system will allow time coincidence event detection between pixels ($<2\mu$s), which enables Compton reconstruction and the determination of the Polarization Degree as well as the Polarization Angle of the cumulative incident gamma photons. With the use of MEGAlib tool we access the detector's ability to detect non-background sources, namely GRB's and Crab Nebula, and to perform polarimetric measurements. We also present tests with the detector's development model in the laboratory. By using radioactive sources, Ba-133 and Cs-137, we validate the imaging and spectroscopic performances of the detector and aid the design of the front-end and back-end electronics of the payload's detector. This work is inserted on the development of a 2U CubeSat, ANTAEUS, where the scientific experiment will contribute to the optimized design of future medium and large-size missions in high-energy polarimetry, as well as a possible constellation of CubeSats for real-time GRB identification and source localization.