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DEVELOPMENT OF A GAMMA RAY SCATTERING POLARIMETRY DETECTOR FOR CUBESATS

Abstract

Polarization is a new frontier in high energy astrophysics that offers exciting insight into the most extreme regions of space. Few high energy polarization instruments have been flown, and to date the polarization of hard X-ray to soft gamma ray regime is largely unexplored. Our proposed instrument is a scattering polarimetry detector, which operates by detecting Compton scattered photons to determine polarization percentage of a source in a given observation window. When gamma rays scatter, the azimuthal angular distribution will be peaked at +/-90° from the direction of the incident photons electric field, thereby imparting information on the linear polarization of the source. The instrument will use a scattering low-Z scintillator core surrounded by secondary high-Z scintillator bars to absorb the scattered photons. Resulting events will be histogrammed into an angular space to measure the cos^2 modulation. A ratio between minimum and maximum values of the distribution will determine the measurement of polarization percentage, as compared to a 100% polarized reference. The detector is designed to utilize a CubeSat satellite bus, which is a small standardized satellite volume, commonly deployed as secondary payloads. The science objectives are to demonstrate the capabilities of small satellite platforms to record long exposure measurements of gamma-ray astrophysical targets; studying black holes and neutron stars. We will present the instrument operation theory, current instrumentation development, and the science potential for an astrophysical CubeSat mission.