Contribution ID: **1153** Type: **Poster**

Instrument Response Functions of the Antarctic Demonstrator for the Advanced Particle-astrophysics Telescope (ADAPT)

The Antarctic Demonstrator for the Advanced Particle-astrophysics Telescope (ADAPT) gamma-ray/cosmic-ray instrument serves as a precursor to the proposed APT mission. This mission is designed to improve sensitivity in the MeV-TeV gamma-ray range by an order of magnitude compared to current missions and is optimized for dark-matter and multimessenger research. The ADAPT instrument uses scintillating fibers for particle tracking and sodium-doped cesium iodide (CsI:Na) tiles read out with wavelength shifting (WLS) fibers for imaging, with solid-state silicon photomultipliers (SiPMs) for calorimetry. It includes four layers of imaging calorimeter detectors and scintillating-fiber trackers, functioning both as a Compton and Pair telescope for gamma-ray measurements from several hundred keV to several GeV. The ADAPT balloon flight aims to advance the technical readiness for the APT gamma-ray mission concept and, during its long duration flight, will provide better sensitivity to 1-100 MeV transients than Fermi or other gamma-ray instruments.
We have optimized event reconstruction models based on simulations incorporating the optical properties of CsI tiles, WLS signal attenuation measurements, and SiPM and preamplifier board characterizations. Atmospheric background has also been modeled, and the instrument's response has been simulated under these conditions. Performance analysis results include the production of full Instrument Response Functions (IRFs), detailing performance based on photon energy, incidence angle, conversion point within the instrument, and other relevant parameters. The IRFs of the ADAPT will be presented along with the updated performance of the full APT detector. The scientific capabilities of the ADAPT instrument in detecting and localizing gamma-ray bursts and other MeV gamma-ray sources will be described. In addition, we will discuss the ability of ADAPT and APT to measure gamma-ray burst polarization.

Collaboration(s)

The Advanced Particle-astrophysics Telescope (APT) Collaboration

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Session Classification: PO-1

Track Classification: Gamma-Ray Astrophysics