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The Advanced Particle-astrophysics Telescope: Simulation of the Instrument Performance

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We will present simulations of the instrument performance of the Advanced Particle-astrophysics Telescope (APT), a mission concept of a γ-ray and cosmic-ray observatory in a sun-Earth Lagrange orbit. The key concepts of the APT detector include a multiple-layer tracker composed of scintillating fibers and an imaging calorimeter composed of thin layers of CsI:Na scintillators and wavelength-shifting fibers. The design is aimed at maximizing effective area and field of view for γ-ray and cosmic-ray measurements and subject to constraints on instrument cost and total payload mass. We simulate a detector design based on $3m$ scintillating fibers and develop reconstruction algorithms for γ-rays from a few hundreds of keV up to a few TeV energies. At the photon energy above $30MeV$, a pair-production reconstruction is applied and the result shows that the APT could provide an order of magnitude improvement in effective area and sensitivity for γ-ray detections compared with Fermi-LAT. A multiple-Compton-scattering reconstruction at photon energies below $10MeV$ achieves sensitive detections of faint γ-ray bursts (GRBs) and other γ-ray transients down to $\sim$ $0.01MeV/cm^2$ with a sub-degree level of localization error. The sensitivity of the polarization measurement in terms of degree of polarization for $\sim$ $1MeV/cm^2$ GRBs is below 20%. The multiple ionization-energy-loss measurements with the imaging calorimeter of the APT also makes it a capable detector for ultra-heavy cosmic-ray composition measurements. In addition, we will present the simulation of the instrument performance of the Antarctic Demonstrator for APT, a balloon experiment using a small portion $< 1\%$ of the APT detector.

Keywords

Gamma-ray detection; Multi-messenger astronomy; Gamma-ray burst

Collaboration

other (fill field below)

other Collaboration

APT (the Advanced Particle-astrophysics Telescope)

Subcategory

Experimental Methods & Instrumentation

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