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The ADAPT Mission: The Antarctic Demonstrator for the Advanced Particle-astrophysics Telescope

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We present the status of the development of the Antarctic Demonstrator for the
Advanced Particle Astrophysics Telescope (ADAPT), a balloon-borne gamma-ray/cosmic-ray detector that will serve as a pathfinder for the APT mission. With a 3 m×3 m area and Lagrange orbit, the APT instrument would achieve a nearly all-sky instantaneous field-of-view, an order of magnitude improvement in sensitivity compared with Fermi at GeV energies, and several orders of magnitude improvement in MeV sensitivity compared with existing experiments. Like the larger APT instrument, ADAPT combines a gamma-ray pair tracker and Compton telescope in a single monolithic design. ADAPT uses scintillating fibers for the tracker and CsI tiles read-out by wavelength-shifting fibers for the imaging calorimeter and Compton detector. ADAPT combines 4 layers of Sodium-doped CsI imaging calorimeter (ICC) detectors with 4 layers of Scintillating fiber tracker followed by an electromagnetic tail calorimeter consisting of 4 additional layers of integrating CsI counters. ADAPT has an active cross-sectional area of 0.45m×0.45m that is partially covered with a single layer of Silicon Strip Detectors (SSDs) to provide cosmic-ray charge measurements. The SSDs combine a wide-dynamic range readout on the Ohmic side for high-Z charge measurements with a a low-noise readout of the 1.5mm strips (based on the NRL3 ASICs) for gamma-ray/X-ray measurements. The instrument makes use of new low-power ASICs to readout Silicon photomultipliers (SiPM) singals: the 16-channel SMART preamplifier ASIC is followed by the 16 channel 100-250 Msps ALPHA ASICs that use a switched capacitor array for waveform capture from the ICC and tracker SiPMs. With 2.2 radiation lengths of CsI:Na (limited by weight), the instrument will provide some sensitivity up to GeV energies for pair-production event reconstruction. While a quarter of the area of the Fermi LAT, the use of all-active converter layers provides higher instantaneous sensitivity at tens of MeV for transients (e.g., low-energy peaked Blazars). The primary objective of the flight is to demonstrate prompt localization of several GRBs during a (nominal) 30 day flight scheduled for 2024/25. A real-time computational pipeline will be used to provide prompt localizations to ground-based telescopes. Measurements could provide importnat new polarization and multiwavelength spectral measurements of the prompt emission of several bright GRBs.