



Design, deployment, and operation of ACTPol, a millimeter wavelength, polarization sensitive receiver for the Atacama Cosmology Telescope

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We highlight considerations for the design and operation of ACTPol, a new receiver for the Atacama Cosmology Telescope (ACT), capable of making polarization-sensitive, millimeter-wavelength observations of the Cosmic Microwave Background (CMB) at arcminute angular scales. ACT is a six-meter telescope located in northern Chile, dedicated to enhancing our understanding of the structure and evolution of the early Universe by direct measurement of the CMB. We describe the design of the ACTPol focal plane at full-deployment, consisting of dual 150 GHz array package modules and a multichroic array package with simultaneous 90 GHz and 150 GHz sensitivity. Each of these detector array packages resides behind a set of custom-designed, high-purity silicon reimaging optics with a novel anti-reflective coating geometry, the characteristics of which will be detailed. Each array package module consists of ~ 1000 transition-edge sensor (TES) bolometers used to measure the response of ~ 500 feedhorn-coupled polarimeters, enabling characterization of the linear orthogonal polarization of incident CMB radiation. The polarimeters are arranged in three hexagonal and three semi-hexagonal silicon wafer stacks, mechanically coupled to an octakaidecagonal, monolithic corrugated silicon feedhorn array (~ 140 mm diameter). Readout of the TES polarimeters is achieved using time-division SQUID multiplexing. Each array package is cooled using a custom-designed dilution refrigerator providing a sub-100 mK bath temperature to the detectors, which have a target T_c of 150 mK. Given the unique cryomechanical constraints associated with this large-scale monolithic superconducting focal plane, we address the design considerations necessary for integration with the optical and cryogenic elements of the ACTPol receiver. With first light achieved in July 2013, and second season operations completed in late-2014 (with dual 150GHz polarimeter arrays installed), and full deployment recently completed and operations underway, details of the ACTPol receiver deployment and early results will be highlighted.