Kilopixel Superconducting Bolometer Arrays for Near-Space Astrophysics Applications

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***Abstract*— We are producing a matured 1,280 pixel, high-filling-factor backshort-under-grid bolometer arrays for efficient operation at the wavelengths between 30μm and 2mm. The arrays employ leg-isolated superconducting transition edge sensor bolometers operated at 128 mK; tuned resonant backshorts for efficient optical coupling; and a second-generation superconducting quantum interference device (SQUID) multiplexer readout. We describe the design, development, and performance of this bolometer array technology to achieve background-limited sensitivity for cryogenic balloon-borne telescopes and for airborne imagers and spectrometers. The first flight use of these detector arrays will be in the Primordial Inflation Polarization Explorer (PIPER), a balloon-borne experiment to measure the polarization of the cosmic microwave background (CMB) and search for the imprint of gravity waves produced during an inflationary epoch in the early universe. PIPER will fly four times in 2013 to observe at wavelengths of 1500, 1100, 850, and 500 μm in order to separate CMB from foreground emission. Similar (although smaller) arrays will be operated on BETTII, the Balloon-borne Experimental Twin Telescope Infrared Interferometer, operating at a wavelength of 30μm-90μm, shortly thereafter. These arrays were also developed with the intent of operating them on the SOFIA airborne observatory, where the large format can increase the facility's scientific return from imagers and spectrometers.**