

Conference: Astronomical Optics and Instrumentation

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Title: The Primordial Inflation Explorer (PIXIE)

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Abstract:

The Primordial Inflation Explorer is an Explorer-class mission to measure the gravity-wave signature of primordial inflation through its distinctive imprint on the linear polarization of the cosmic microwave background. PIXIE uses an innovative optical design to achieve background-limited sensitivity in 400 spectral channels spanning 2.5 decades in frequency from 30 GHz to 6 THz (1 cm to 50 micron wavelength). Multi-moded non-imaging optics feed a polarizing Fourier Transform Spectrometer to produce a set of interference fringes, proportional to the difference spectrum between orthogonal linear polarizations from the two input beams. The differential design and multiple signal modulations spanning 11 orders of magnitude in time combine to reduce the instrumental signature and confusion from unpolarized sources to negligible levels. PIXIE will map the full sky in Stokes I, Q, and U parameters with angular resolution 2.6 deg and sensitivity 0.2 uK per 1 deg square pixel. The principal science goal is the detection and characterization of linear polarization from an inflationary epoch in the early universe, with tensor-to-scalar ratio $r < 10^{-3}$ at 5 standard deviations. In addition, the rich PIXIE data will constrain physical processes ranging from Big Bang cosmology to the nature of the first stars to the physical conditions within the interstellar medium of the Galaxy. We describe the PIXIE instrument and mission architecture needed to detect the signature of an inflationary epoch in the early universe using only 4 semiconductor bolometers.