

HIGH DIRECTIVITY PLANAR SLOT ANTENNA ARRAYS
FOR MILLIMETER AND SUB-MILLIMETER IMAGING

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We are developing a new family of planar antennas which are of great interest for use in future millimeter and submillimeter direct-detection focal-plane architectures, such as CMB polarimetry using antenna-coupled bolometer arrays. Such architecture promises a lot of advantages compared to existing systems. Compared to bolometers with extended area radiation absorbers, antenna-coupled bolometers provide greatly reduced thermally active area, allowing for gains in sensitivity and response speed. Furthermore, the large sub-K feedhorn optics currently required by missions such as Herschel and Planck which comprise more than 95% of the sub-K focal plane mass and volume, would be eliminated. Such highly integrated architectures would allow for a very large number of pixels.

Each antenna consists of an array of N long slot antennas which are fed along their length at M points. The resulting N*M feed points are combined using a binary summing tree made of low-loss superconducting microstrip lines. The amplitude and phase of the electric field at each element of the array control the pointing and far-field beam pattern. By passively adding the electric fields of each antenna in a phase-coherent manner, we can synthesize the diffraction-limited beam. Due to its large size, the resulting array antenna produces a narrow beam pattern, around 15 degrees FWHM for the device demonstrated here, and can therefore be used without additional coupling elements such as hyperhemispherical lenses or feedhorns. The radiation and impedance characteristics of the antenna were obtained from a momentmethod calculation. We have measured the beam pattern of a singlepixel 110 GHz device coupled to an SIS detector, and find good agreement with the calculated response.

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