ELECTROMAGNETIC PROPERTIES OF FILLED PIXELATED ARRAYS

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Filled arrays of bolometers are currently being employed for use in astronomy from the far-infrared through millimeter parts of the electromagnetic spectrum. Because of the large range of wavelengths for which this is applicable, the number of modes supported by a bolometric pixel will vary according to specific application. Withington et al. (2003) have built a formalism for treating the electromagnetic properties of such bolometers by propagating the second order statistical properties of the radiation through a canonical optical system. In this work, we use this formalism to construct beam pattern images of square pixels for various ratios of p/λ where p is the pixel size and λ is the wavelength. In the low mode limit, the diffraction effects cause the beam pattern to be circular with a quadrupole dependence of Stokes Q and U. High mode cases approach the geometric limit. The polarization in these cases can be seen to trace the pixel edges. The effective size of the beam has a direct impact on the inter-pixel coupling and sets the number of independent detectors in an astronomical focal plane. This technique illustrates and quantifies the relationship between pixel size and angular resolution limits for a given wavelength and telescope. This is especially true in the limit of low p/λ. In this case, the diffraction due to pixelization is non-negligible for the calculation of the overall angular resolution of the telescope. In addition, for instruments that are polarization sensitive, this method also provides a quantitative method for determining the contribution of the instrument to the measured polarization.

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