

ATMOSPHERIC NOISE REMOVAL FOR BOLOCAM

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Bolocam is a millimeter-wave (1.1 and 2.1 mm) camera with an array of 115 working bolometers. The instrument has been commissioned at the Caltech Submillimeter Observatory in Hawaii, and is now in routine operation. Mapping blank fields ($\simeq 1 \text{ deg}^2$) is the primary use of Bolocam, but it has also been utilized to observe galactic objects. Atmospheric emission from water vapor is the dominant source of noise in Bolocam data, producing a signal 1-2 orders of magnitude larger than the irreducible photon and detector noise.

The beams of individual bolometers coincide at the primary mirror of the telescope, and overlap through the majority of the atmosphere; so most of the sky noise is common to all bolometers. Removal of this common mode signal can then be accomplished by subtracting the average bolometer signal from each bolometer's data. Alternatively, a more advanced common mode subtraction algorithm, Principal Component Analysis (PCA), can be used to subtract the sky noise (see e.g. R. C. Gonzalez, R. E. Woods, *Digital Image Processing*, Addison Wesley, US, 1992). It should be noted that the sky noise remaining in the data after either common mode subtraction is still comparable to the photon and detector noise, even in the best weather.

Attempts are now being made to use the atmospheric model described by Lay and Halverson (*The Astrophysical Journal*, **543**, 787, 2000) to remove more sky noise from the Bolocam data. This model assumes that all temporal fluctuations in the atmosphere are due to wind. This assumption, along with the slight separation of the bolocam beams, means that the sky signal seen in any given bolometer will be seen in other bolometers, but at different times (t_i). Determining the t_i , which depend on the wind vector and geometry of the beams, will allow the common mode subtraction to remove more sky noise.

Additionally, we now have access to data from the phase monitor near the James Clerk Maxwell Telescope. This phase monitor measures the difference in water vapor for two columns through the atmosphere, separated by 100 m. Correlations between Bolocam data and the phase monitor data will help us determine some of the spatial characteristics of the atmosphere.

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