THE CAPMAP FOCAL PLANE ON THE CRAWFORD HILL 7-M ANTENNA

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CAPMAP is an ongoing experiment to characterize the small scale polarization of the cosmic microwave background radiation (CMB). CAPMAP is comprised of an array of 16 correlation polarimeters with 4 operating at 40GHz and 12 operating at 90GHz. This array is fielded on the Crawford Hill antenna which is an off-axis cassegrain telescope with a 7 meter diameter primary mirror and large focal plane which has Strehl ratios greater than 0.97 over a 1.4° diameter field of view. In this talk I will describe how we designed the CAPMAP focal plane to take advantage of the many attractive features of the Crawford Hill antenna, and also to mitigate aspects of the design which are not optimal for our purposes. The discussion will include measurements of the performance of the CAPMAP system, which is currently acquiring data for its third season.

The CAPMAP focal plane uses individual horn plus lens feed assemblies for each receiver. The 7-meter telescope achieves its large focal plane and excellent optical quality through its long focal ratio f = 5.6. This means the primary mirror is only 10° wide as viewed from the focal plane. Thus the feeds must produce tightly collimated beam patterns. Additionally for CMB observations the side-lobes of the feeds must be minimized since those which fall outside this 10° cone pass beyond the edge of the primary and can hit the ground which could lead to spurious non-cosmological signals. The corrugated feed horn and microwave lens systems are carefully optimized to produce narrow beams with low side-lobes (¡-40dB) and low cross-polarization (¡-35dB).

The fact that each receiver has an independent feed allows for significant freedom in the arrangement of the feeds in the focal plane and equivelently, the pattern of beams on the sky. We exploit this freedom to introduce 4-fold and 8-fold symmetries into the focal plane which when combined with our scan strategy produces a uniform polarization coverage over a 2.2° diameter disk on the sky, with built in systematic checks between different receivers.

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