COMPARATIVE MEASUREMENTS OF TROPOSPHERIC PHASE STABILITY

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Variations in the electrical path length caused by inhomogeneously distributed tropospheric water vapor present natural limits to the sensitivity and resolution of astronomical observations, particularly at millimeter and submillimeter wavelengths. Although active techniques can correct these phase errors to some degree, it behooves planners of a new instrument to choose a site with the best possible limits.

To evaluate possible sites for NRAO's proposed Millimeter Array, we constructed small aperture interferometers to directly measure the tropospheric phase stability. Similar to earlier designs (Ishiguro et al., 1990, in *Radio Astronomical Seeing*, ed. Baldwin & Wang, p. 60; Masson, 1994, in *Astronomy with Millimeter and Submillimeter Interferometry*, ed. Ishiguro & Welch, p. 87), these instruments observe an unmodulated beacon broadcast from a geostationary satellite and measure the phase difference between the signals received by two antennas 300 m apart. Although the beacon frequency is around 11.5 GHz, the results can be scaled to millimeter and submillimeter wavelengths because the atmosphere is non-dispersive away from line centers. Novel design features include a local oscillator phase locked to the received signal and digital correlation of the downconverted signals with a personal computer.

Two instruments have been deployed, one in 1994 September at 3720 m near the VLBA antenna on Mauna Kea, Hawaii, and the other in 1995 May at 5000 m near Cerro Chajnantor in northern Chile. This site is near the village of San Pedro de Atacama, about 275 km ENE of Antofagasta. Both instruments are operated in conjunction with adjacent 225 GHz tipping radiometers. With identical instruments operating simultaneously, we can directly compare the phase stability at the two sites. We have also compared our data with archival data for other sites, notably "millimeter valley" near the summit of Mauna Kea (Masson 1994).

Initial results for Mauna Kea indicate the phase stability distributions are similar at the VLBA site and at millimeter valley, but the best conditions occur at different times at these two locations. We confirm the pronounced diurnal variation in the phase stability on Mauna Kea. At Cerro Chajnantor, the phase stability is substantially better than on Mauna Kea. The diurnal variation is less pronounced and conditions of good phase stability occur two to three times more often.

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3. (a) Tropospheric phase calibration for interferometers

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