Water Vapor Phase Correction at OVRO

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Correction of tropospheric phase errors is a major challenge for the next generation of millimeter and sub-millimeter interferometers. While the longest baselines at millimeter wavelengths have a nominal resolution of 0.01 arcsec, the fluctuations in water vapor in the atmosphere often limits the seeing to 0.1 arcsec or worse at even the best sites. It is important to remove the effect of these fluctuations if these instruments are to reach their full potential.

OVRO has had an ongoing program to use three channel radiometers observing the 22 GHz water vapor line to measure and correct the wet component of the tropospheric phase fluctuations. Each of the six 10 m diameter antennas in the millimeter interferometer array has cooled Water Line Monitor (WLM) which uses the full 10 m aperture to produce a pencil beam that is closely aligned with the millimeter astronomy beam.

The initial studies show that a large fraction of the water vapor induced phase fluctuations can be corrected and improved images obtained. The correction of the decorrelation on the five minute time scale is straightforward. It has also been demonstrated that linking the phase of the calibrator to the target source along with differential WLM phase correction can dramatically improve the astronomical images in bad seeing conditions. The challenge has been to develop robust imaging algorithms that can cope with the varying weather conditions and imperfections in the radiometers. The instabilities of the radiometers on the time scale from a few minutes to a few hours has been the most challenging aspect of the system.

This paper will report on the algorithms developed for processing the WLM and astronomy data and the degree to which they can correct for the tropospheric phase fluctuations.

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