JF: Tropospheric Path Delay Correction

Phase Correction Experiments at Chajnantor and Mauna Kea

Guillermo Delgado
European Southern Observatory

Martina Wiedner
Harvard-Smithonian Center for Astrophysics

Simon Radford
National Radio Astronomy Observatory

Angel Otárola
European Southern Observatory

Victor Belitsky
Onsala Space Observatory

Denis Urbain
Onsala Space Observatory

European Southern Observatory,
Alonso de Córdova 3107, Vitacura, P.O. Box 19001, Santiago 19, Chile
Tel: +56 (2) 2285006, Fax: +56 (2) 2285132, e-mail: gdelgado@eso.org

Background

Overcoming the image degradation caused by fluctuations in atmospheric water vapour, presents a major challenge for the next generation of millimeter and submillimeter interferometer arrays. Water line radiometry is a promising technique that allows continuos correction of atmospheric phase fluctuations.

Instrumentation

To test the water line radiometry technique, we have built two pairs of water line radiometers (WLRs) operating in the strong water vapour transition at 183 GHz. One set of instruments is used for phase correction for the JCMT-CSO interferometry on Mauna Kea, Hawaii. Thus, these water line radiometers view the same path through the atmosphere as the interferometer. The varying depth of the water vapour column is determined by monitoring the intensity and shape of the 183 GHz water vapour emission line. Changes in the atmospheric path delay are determined from the difference in the water vapour column measured with the two radiometers. With these predicted path variations we are able to reduce the interferometer's rms phase fluctuations from 60° (143 µm) to 28° (67 µm) at 350 GHz in good weather (1.5 mm of PWV) and from random phase to 48 deg (114 µm) in bad weather (3.5 mm of PWV).

To further test this phase correction method, in particular with respect to the LSA/MMA, two 183 GHz WLRs have been deployed at the ends of a 300 m baseline, 12 GHz test interferometer on the LSA/MMA site at Chajnantor, Chile. This second test has two advantages. First, it is conducted under the same conditions expected for the LSA/MMA. Second, in contrast to the JCMT-CSO interferometer, the phase noise of the 12 GHz interferometer is known. This allow us to discriminate between phase fluctuations due to instrumental effects in the interferometer and imperfect phase corrections due to the WLRs.

Results

Results from Mauna Kea and initial results from Chajnantor for 1999 will be presented. The technique's effectiveness for the LSA/MMA at Chajnantor will be discussed, including any changes caused by varying weather conditions or diurnal and seasonal cycles.

Reference

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