Terahertz and Far-Infrared Windows Opened at Dome A in Antarctica

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Astronomers are seeking for higher and dryer sites on earth for better observing condition especially in infrared to terahertz frequency region, where absorption by water vapor dominates atmospheric transmission. Here, we show the measurement of atmospheric transmission from Dome A, Antarctica, using Fourier transform spectrometer in infrared to terahertz frequency region [1]. Because of the low temperature of antarctic plateau, as low as −80 °C in winter time, atmospheric water vapor is scarce and the Dome A can be the best observing site on earth.

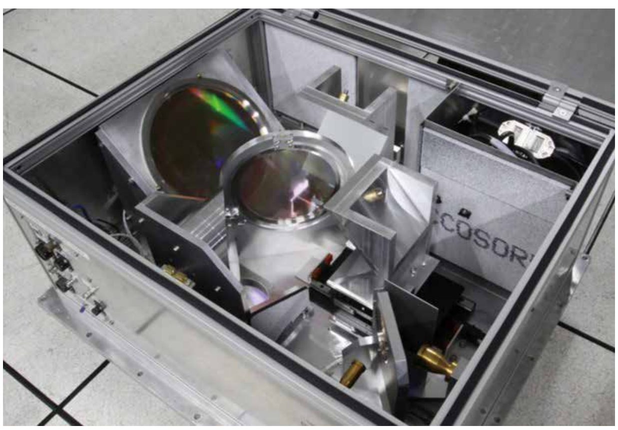

Figure 1: Picture of Fourier transform spectrometer for Dome A atmospheric measurement.

Figure 1 shows the Fourier transform spectrometer used for the atmospheric measurements [2]. Room temperature thermal detectors are used and the spectrometer was calibrated according to two temperature blackbody sources; one at room temperature in the spectrometer and another at outside in cold. Figure 2 shows the measured atmospheric transmittance in the site testing campaign at Dome A during 2010–2011. The transmittance at the supra-terahertz windows reaches as high as 30 %, whereas the best transmittance in ALMA site is as high as 20 % [3]. Furthermore, we observe numerous atmospheric windows all through the terahertz frequencies as shown in figure 1, including 10–20 % transmittance at 2 THz, 3 THz and 5–6 THz windows where astronomical atomic fine structure lines could be observed from ground. The 7 THz window shows median transmittance of about 40 % in winter, which would be important for observing thermal emission from protoplanetary disks and exoplanets. Since variation of atmospheric transmittance is small in Dome A as well as low wind speed, the site is suitable for long baseline terahertz interferometers.

Our atmospheric measurements were used to make detailed comparison to existing atmospheric model and satellite data. We have found the existing model underestimate continuum absorption by water vapor and new constraints on the spectral absorption lead to better understanding of upper troposphere in relation to our climate on the earth.

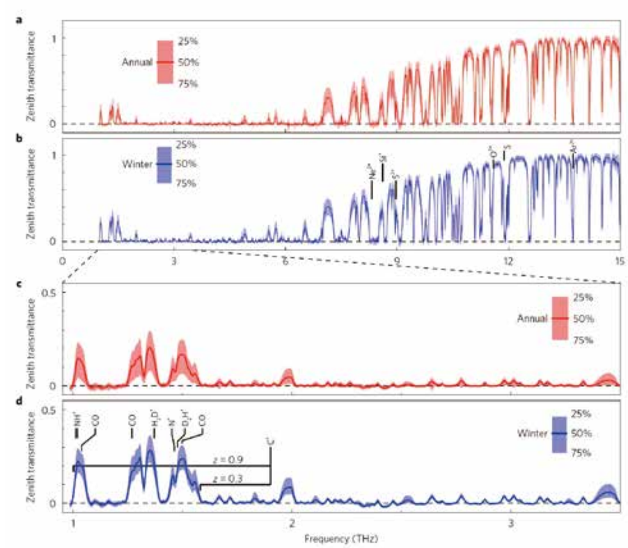

Figure 2: Zenith atmospheric transmittance spectra measured at Dome A. Spectra are shown for the entire year (a,c) and for winter (April-September) only (b,d).

References

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