

Observational Consequences of Millimeter and Submillimeter Opacity

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We are most interested in the question of atmospheric opacity because we would like to know just how much cosmic radiation gets through to our site as a function of wavelength. However, understanding the optical depth of the atmosphere helps us to address more subtle issues which a millimeter or submillimeter astronomical telescope faces:

- What is the sensitivity of the instrument at the various observational bands?
- How does the sensitivity vary with zenith angle? How does this impact the way the telescope will be used, and how should it impact the design of the telescope?
- How severe are the continuum atmospheric total power fluctuations, and how can we make total power continuum observations which are not limited by these fluctuations?
- Inhomogeneously distributed water vapor causes both phase errors and short time scale refractive pointing errors. In the millimeter, the water vapor is nondispersive, so the rms phase errors increase linearly with frequency and the refractive pointing errors do not vary with frequency. However, the water vapor becomes dispersive in the submillimeter, and the phase errors and refractive pointing do not follow their simple scaling. The degree of dispersion seen in the water vapor can be estimated by the same transmission models which predict the opacity. If these models can reproduce the measured submillimeter opacity, that will give us more confidence that their dispersion predictions are accurate.
- High frequency observations will be very demanding of the MMA and the conditions on the site, requiring excellent pointing (ie, low winds and small thermal gradients), low atmospheric opacity, and good phase stability. What fraction of the time will all of these quantities be good enough to permit submillimeter observations?

The new data on submillimeter opacity from the current generation of site testing equipment is helping to answer these questions.

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3. (a) Atmospheric transmission
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