A Few Considerations

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Topics

- F#s and Relay Optics
- Wavefront sensing
- On-axis vs. off-axis telescopes
- Atmospheric transmission

F# and Relay Optics

- Focal plane is large (up to 1.6 m for 100x100 at 1.3 mm)
- Focal plane image size (and dewar and window) scales with F#
  - Drops from 1.6 m for F12 to 0.4 m for F3 (1.3 mm)
  - 0.1 m (350 mu)
- Important to include consideration of desirable detector F#s and strawman methods to provide them
  - E.g., tertiary off-axis ellipse provides smaller F#s and convenient pupil for dewar entry
- Need to consider possible three mirror systems to evaluate resultant system capabilities

Effects of the Secondary

- For "diffraction limited" operation, the secondary needs to be positioned correctly in x,y,z to $\approx 1\lambda$

  $\Rightarrow$ positioning accuracy $\approx \lambda/10$
- For a two-mirror system, the secondary radius gives the focal plane curvature (in paraxial limit):

  $$r_P \approx r_{sec}/2$$
- Depth of focus = few $F^2\lambda \approx 300\lambda \approx 10$ cm @ 300 mu

  $\Rightarrow$ Focal plane curvature not very important

Aberrations

- Large FOV and lambda interval
- If the FOV is independent of λ, aberrations are important at the **shortest wavelengths**
- If the FOV is assumed proportional to λ (fixed number of elements), aberrations are important at the **longest wavelengths**, because the aberration rms grows faster than λ.
  - Field curvature is the obvious example (r^4), but applies to all other aberrations (coma, astigmatism…) as well

Wavefront Sensing

- Large submm arrays open the possibility of using a number of "optical" techniques to determine performance
  - Phase diversity
  - Point diffraction interferometer
  - Etc.
- Should be much quicker than old single-pixel approaches

On-axis vs. off-axis telescopes

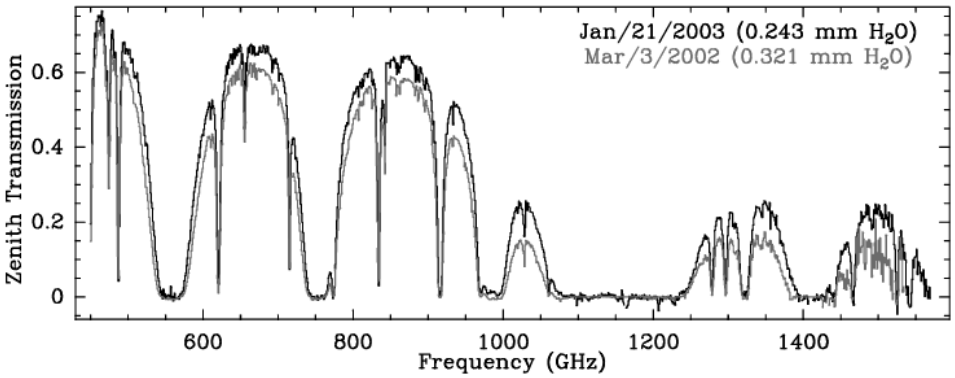
An on-axis telescope can provide an off-axis configuration with a subaperture diameter of about 1/2 the telescope diameter

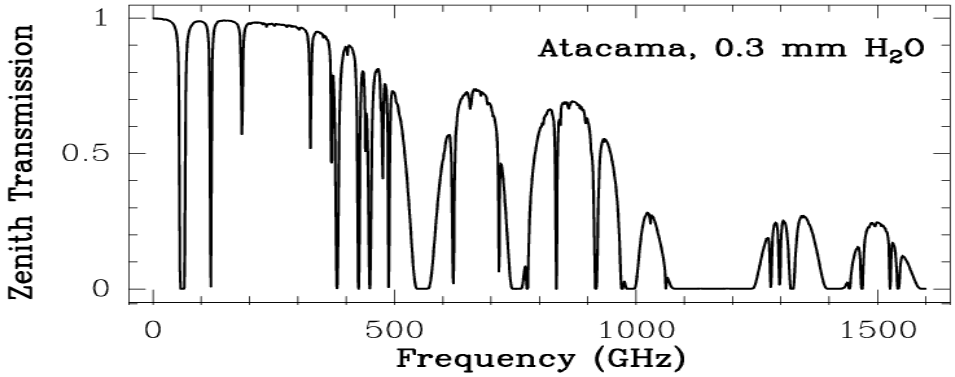
$\Rightarrow$ one can have a sizable off-axis telescope "for free"

Atmospheric Transmission

- Mauna Kea FTS measurements extended to higher frequencies (1.6 THz)
- An accurate submm transmission model is emerging
  - Dry term now well characterized
  - Close to final model for wet term
- The 1.3 and 1.5 THz windows can have "good" transmission (1/4 or so for 300 mu of H_2O)
- With proper calibration a water vapor radiometer is found to agree very well with FTS measurements

Mauna Kea measurements





WVM vs. FTS