Optics Updates

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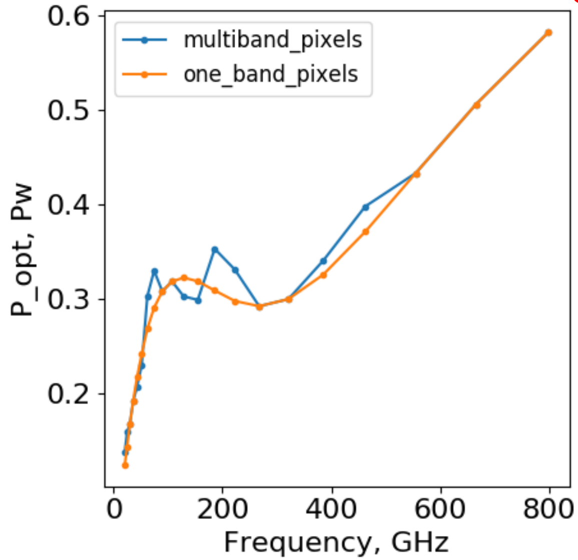
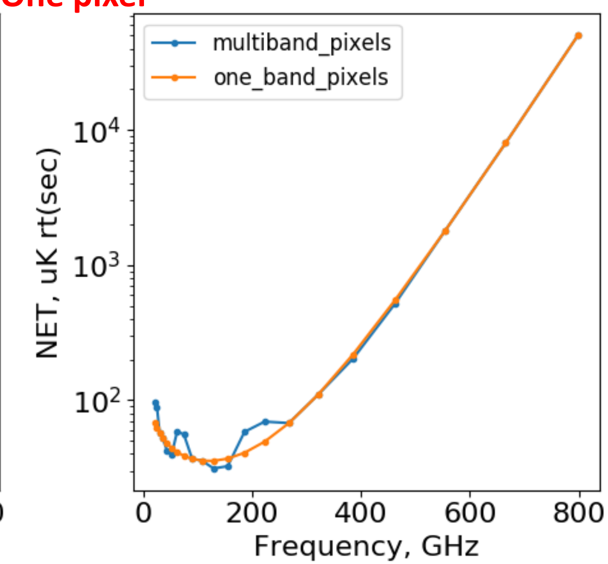
Single band pixels

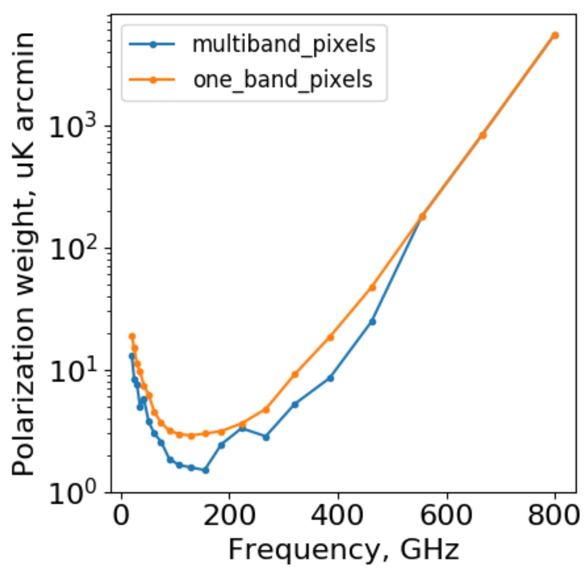
- 21 single band pixles compared to 21 bands in 6 trichroics and 3 single frequency pixels
- Smoother NET per pixel, illumination is 10 dB edge taper for all bands
- Worse total sensitivity because fewer detectors
- No change to 565, 665, 800 GHz since already single band
- Total CMB weight is
  - 0.67 uK arcmin, multiband
  - 1.08 uK arcmin, singleband

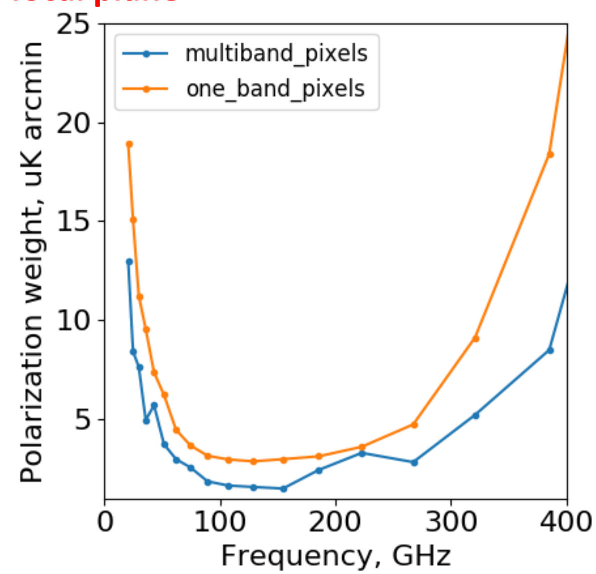
One pixel





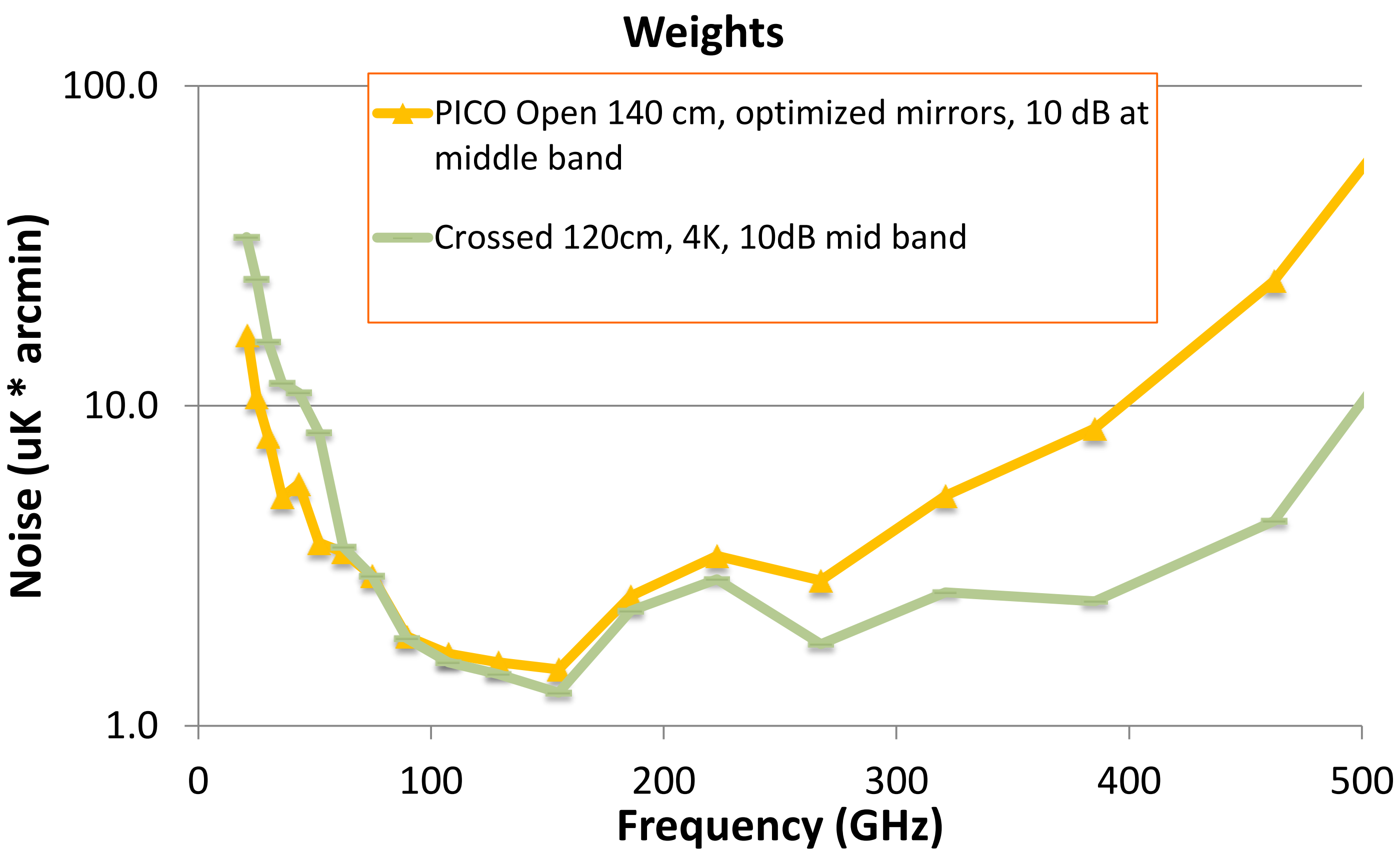
Full focal plane





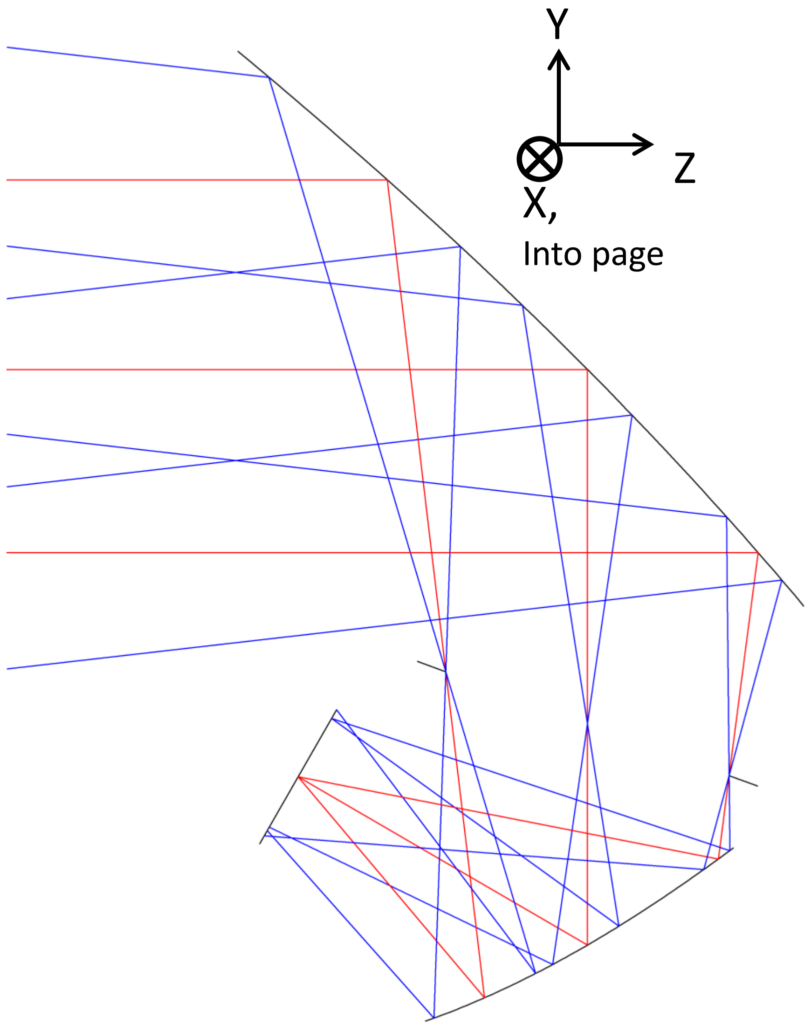
4 K, 120 cm crossed Dragone

- Assuming all mirrors and stop are 4 K
- Comparing to 15,000 detector 140 cm open
- Both have pixel size set by middle band of pixel
- 140 cm: 15,030 detectors
- 120 cm: 12,840 detectors



Alignment sensitivity

- Rough spot check using CodeV at 900 GHz
- Mirror offsets parallel to chief ray of 100 um give < 1% change in Strehl
  - Offsets of 1 mm give 3% change in strehl
- Alpha is rotation around X axis
- Beta is rotation around Y axis
- Mirror tilts, primary
  - Alpha tilts of 0.01 deg gives 3% change in strehl
    - 0.01 deg is 200 um shift at mirror edge
  - Beta tilts of 0.5 deg gives 3% change
- Mirror tilts, secondary
  - Alpha tilts of 0.01 deg gives 3% change
  - Beta tilts of 0.05 deg gives 3% change
- Focal plane tilts
  - Alpha or beta 0.5 gives 7% change in strehl



Mirror Emissivity

- Measurements of Planck (Tauber 2010) mirrors give 0.1 % at 150 GHz, we've used 1%
  - Scales with sqrt(frequency). This scaling has always been assumed.
  - Scales with temperature
  - Suggests up to 0.5% emissivity at highest frequencies possible due to dust contamination on mirrors

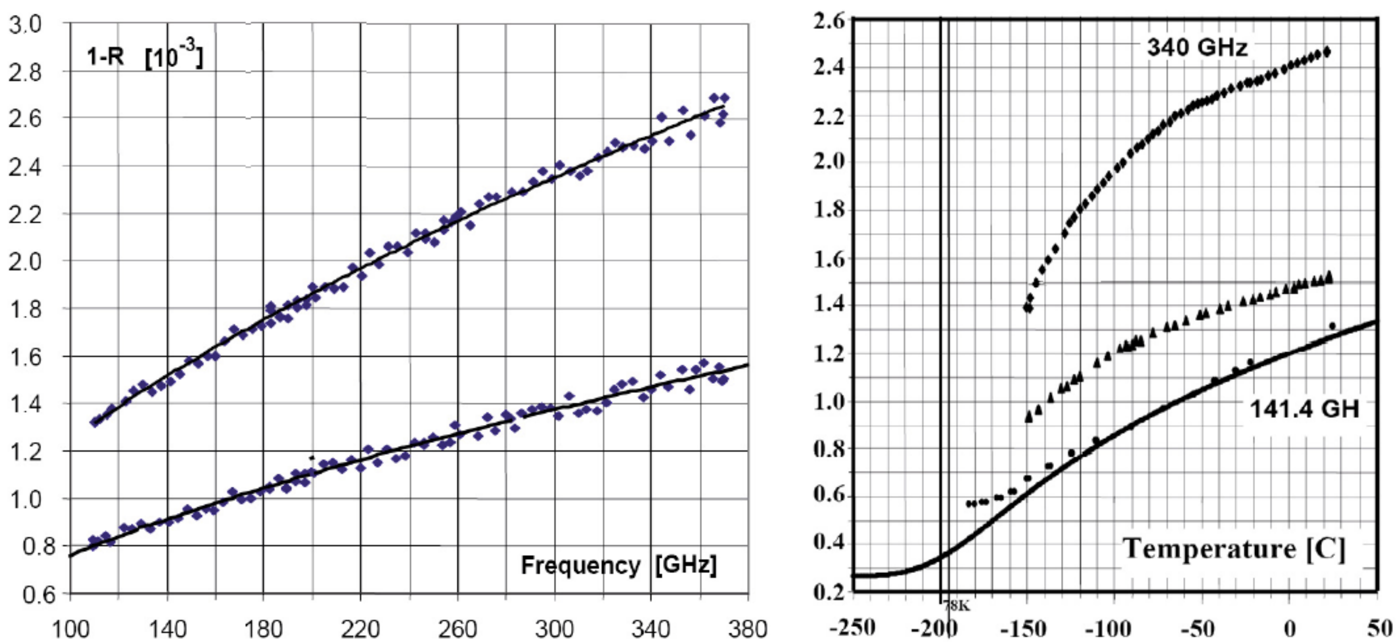
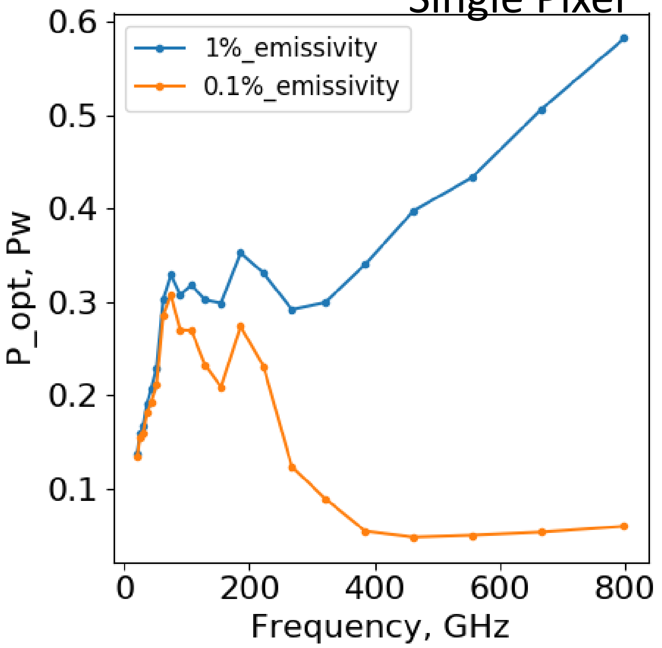


Fig. B.1. (*Left*) Measured dependence of the reflection loss (1 – *R*) of a sample of *Planck* reflector material as a function of frequency, when the sample is at room temperature (296 K, upper curve), and at ~110 K (lower curve). The solid lines are fits to the expected root-square dependence on frequency and (temperature-dependent) resistivity. (*Right*) Dependence of the reflection loss of the same sample as a function of temperature, for two frequencies: 340 GHz (diamonds) and 141 GHz (triangles). The solid line is a theoretical calculation of the reflectivity of pure aluminium, including the abnormal skin effect, which sets in at a temperature below ~60 K. The dots are measurements of a 0.3 mm thick sheet of pure aluminium.

Mirror Emissivity

- Calculated 140 cm Open case with 0.1% mirrors
  - 3x improvement at highest bands
- Still to do:
  - Include 0.5% emissivity at high frequency from contamination on mirrors
  - Account for scaling with temperature
  - Double check that thermal dust emission at 800 GHz is negligible fraction of loading
  - Calculate for 120 cm crossed case at 30 K.

Single Pixel



Full focal plane