Noise and focal plane model, Open vs Crossed Dragone

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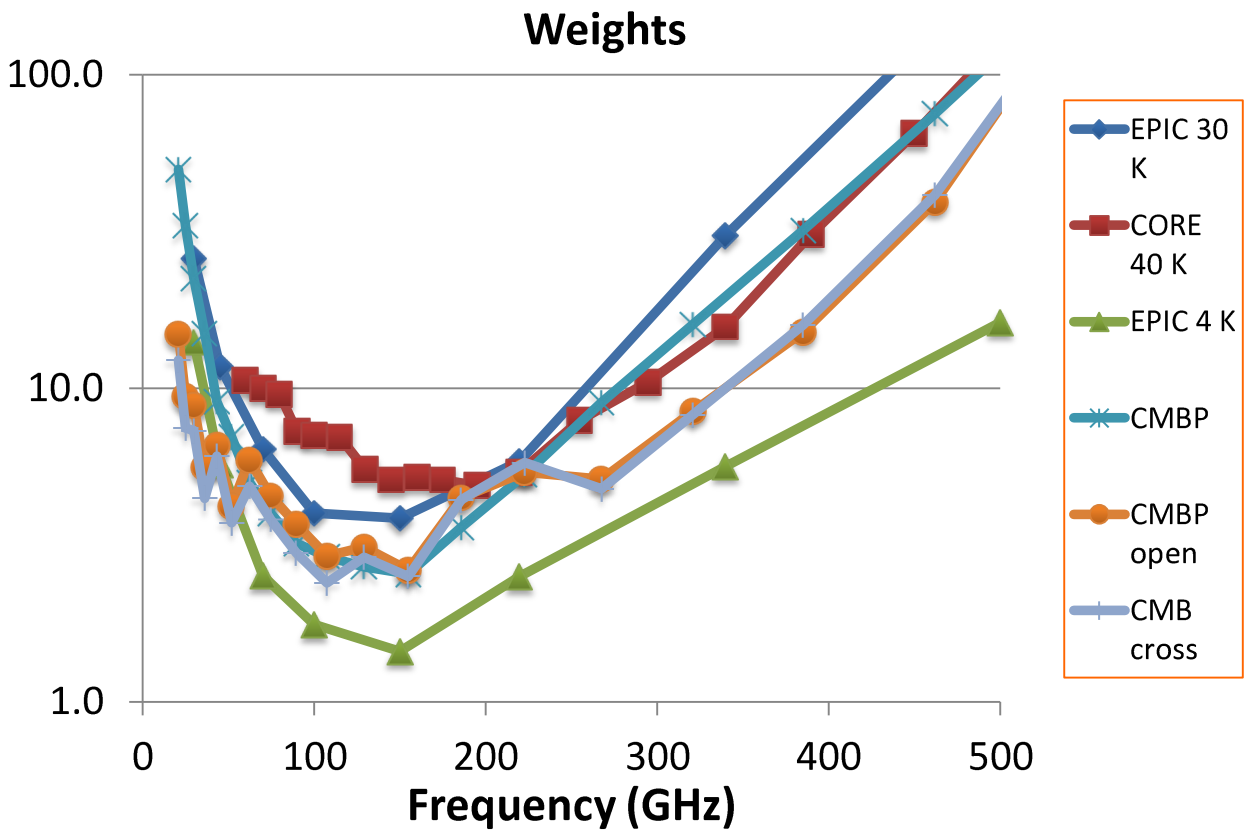
Status

- Baseline polarization weight by band.
- Edge taper set by lowest band of multichroic pixels.
- Comparison between FDM (Karl) and TDM (Roger) numbers.

- Next steps:
  - Sensitivity of 4K crossed dragone
    - Sensitivity loss going to 10, 20, 30 K.
  - Update readout noise to reflect space optimization
  - Optimize pixel size
  - Add thermal filters to light path
  - Compare with O'Brient's TDM model

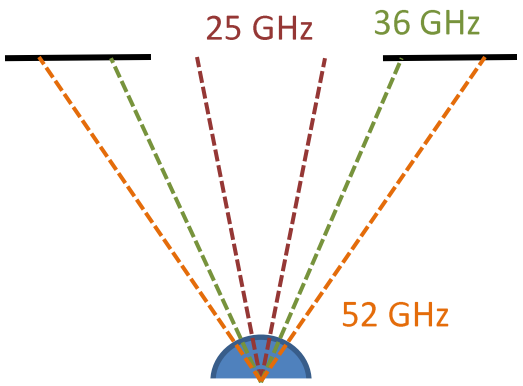
Polarization weight, last week

- Edge tapers:
  - 4.8, 10, 20.7 dB
  - 12, 25, 52 dB
- Number of pixels calculated from:
  - Available DLFOV area
  - Pixel size
  - Hex packing factor of 0.9069
- Physical focal plane NOT laid out.
- Full sky and 4 yr mission at 100% observing.
- Crossed: 10.5k detectors
- Open: 6k detectors



Edge taper set by lowest multichroic pixel band

- Design edge taper (10 dB, 25 dB) set by lowest band
- Pixel diameter larger by a factor of 1.4
- Number of pixels reduced by factor of 2
  - Px_area = (1.4)^2 = 2
- Edge tapers are now:
  - 10, 21, 43
  - 25, 52, 108
- FWHM is roughly constant across 3 bands in one pixel.
  - This results in a penalty in resolutions at bands 2 and 3 of each MCP.
  - Example for crossed Dragone case:

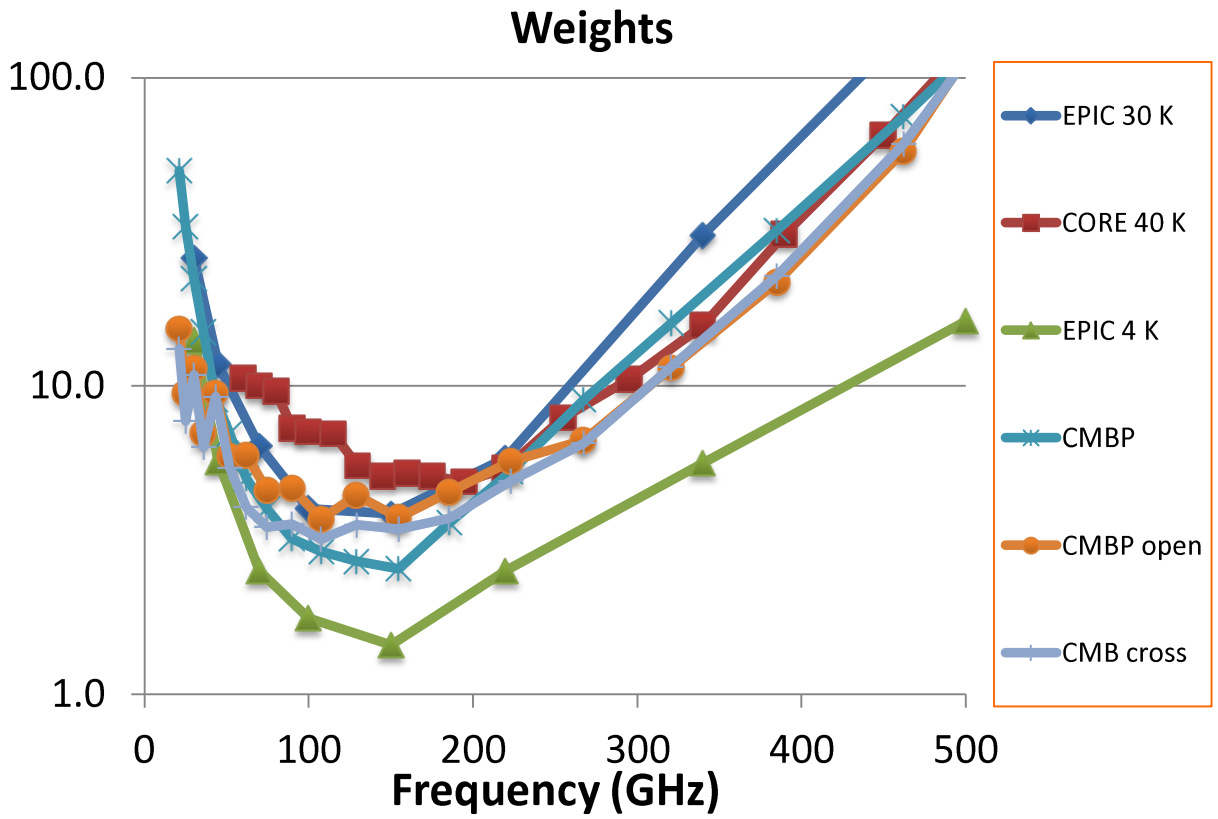


Band (GHz)	Pixel Type	Taper (dB)	FWHM (')
20.8	A	25	48
30	A	52	42
43.2	A	108	42
25	B	25	40
36	B	52	35
51.8	B	108	35

- Edge taper sets first sidelobe.
  - What sidelobe level is acceptable?
  - -20 dB? -40 dB?

Polarization weight, new edge taper

- Edge tapers:
  - 10, 21, 43 dB
  - 25, 52, 108 dB
- Number of pixels calculated from:
  - Available DLFOV area
  - Pixel size
  - Hex packing factor of 0.9069
- Physical focal plane NOT laid out.
- Full sky and 4 yr mission at 100% observing.
- Crossed: 5.2k detectors
- Open: 3k detectors



Comparison to Roger's TDM Noise

- Optical powers agree within 3 %
- Photon noise, I am 17 % lower at low frequency. Likely a difference in how we treat bunching noise.

Roger: $NEP^2_{bunch} = 2\nu P^2_{tot}/\sqrt{\Delta\nu}$

Karl: $NEP^2_{bunch} = \int \xi p^2_{tot} d\nu, \quad \xi = 1$

- Phonon noise, I am 30 % higher at all frequencies.
  - Different G and/or Tc?
  - Equations for G agree, $G_c = G_{dyn}$:

Roger: $$P_{sat} = G_c T_c \frac{1-(T_o/T_c)^{n+1}}{n+1}$$

Karl: $$P_{sat} = \overline{G}(T_c - T_o),$$
$$\frac{G_{dyn}}{\overline{G}} = (n+1)\frac{1-T_o/T_c}{1-(T_o/T_c)^{n+1}},$$
$$P_{sat} = G_{dyn}\frac{1}{n+1}(T_c - T_o)\frac{1-(T_o/T_c)^{n+1}}{1-T_o/T_c}$$

- I have 'readout' which Roger doesn't. He has 'shunt' which I don't.
- Final NEP comparison, mostly phonon noise difference.