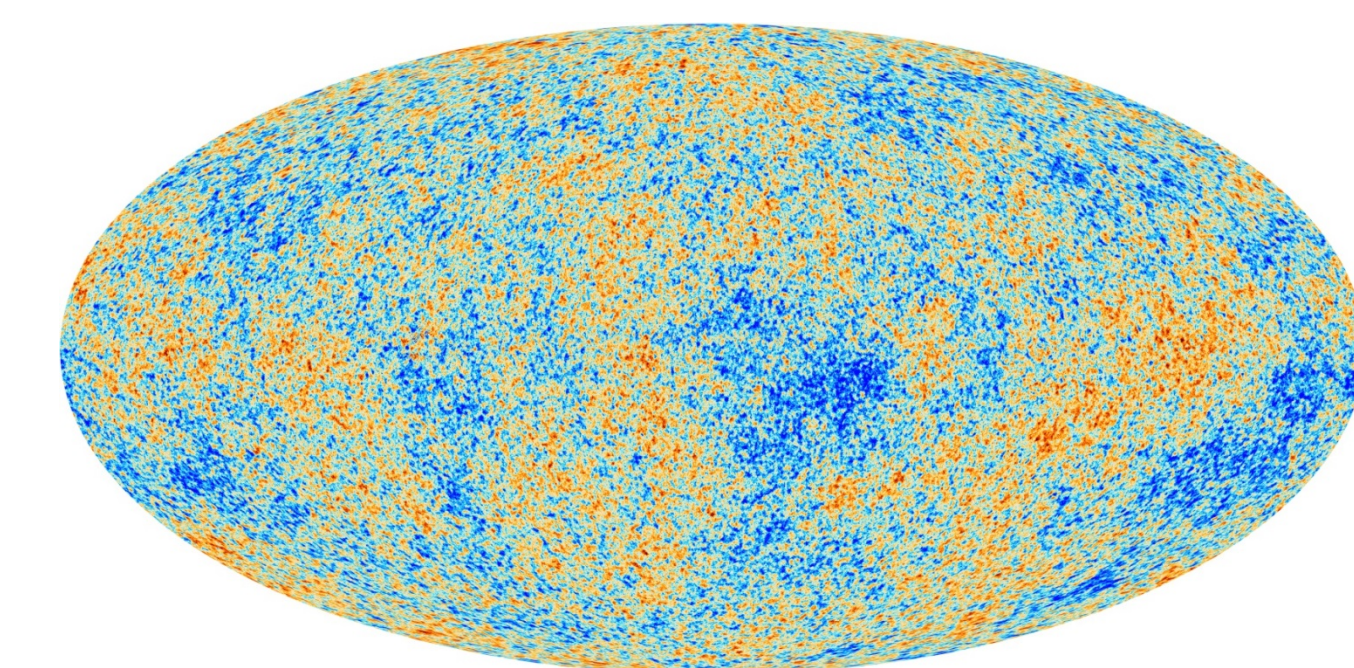


Probe of Inflation and Cosmic Origins (PICO): Optical Design and Sensitivity



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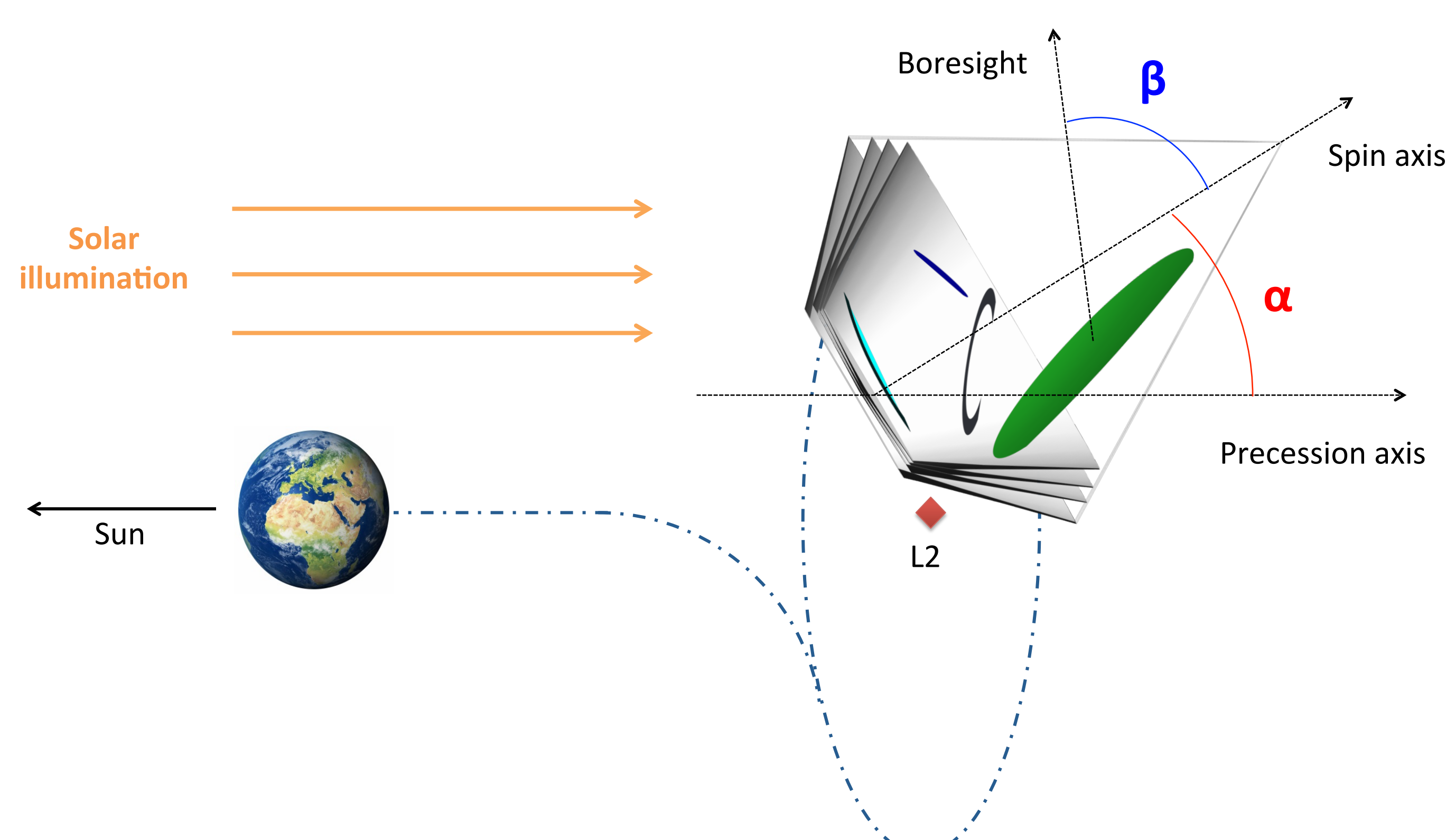
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Scientific Observations

- Improve upper limits on primordial B-modes by 700x, or measure r with $\sigma(r) = 5 \times 10^{-5}$
- Determine the number of light relic particles, N_{eff} , to $\sigma(N_{\text{eff}}) = 0.03$
- Measure τ , the optical depth to reionization to cosmic variance limits, $\sigma(\tau) = 0.002$
 - Along with DESI-BAO observations, measures Σm_ν , the sum of neutrino masses with $\sigma(\Sigma m_\nu) = 14 \text{ meV}$, at least a 3σ detection
- Map Galactic magnetic fields from large scales to 0.05 pc in nearby molecular clouds
- Discover 1,000s of protoclusters and clusters via the SZ effect
- Map the CIB and dusty infrared galaxies across the full sky

Satellite and Instrument

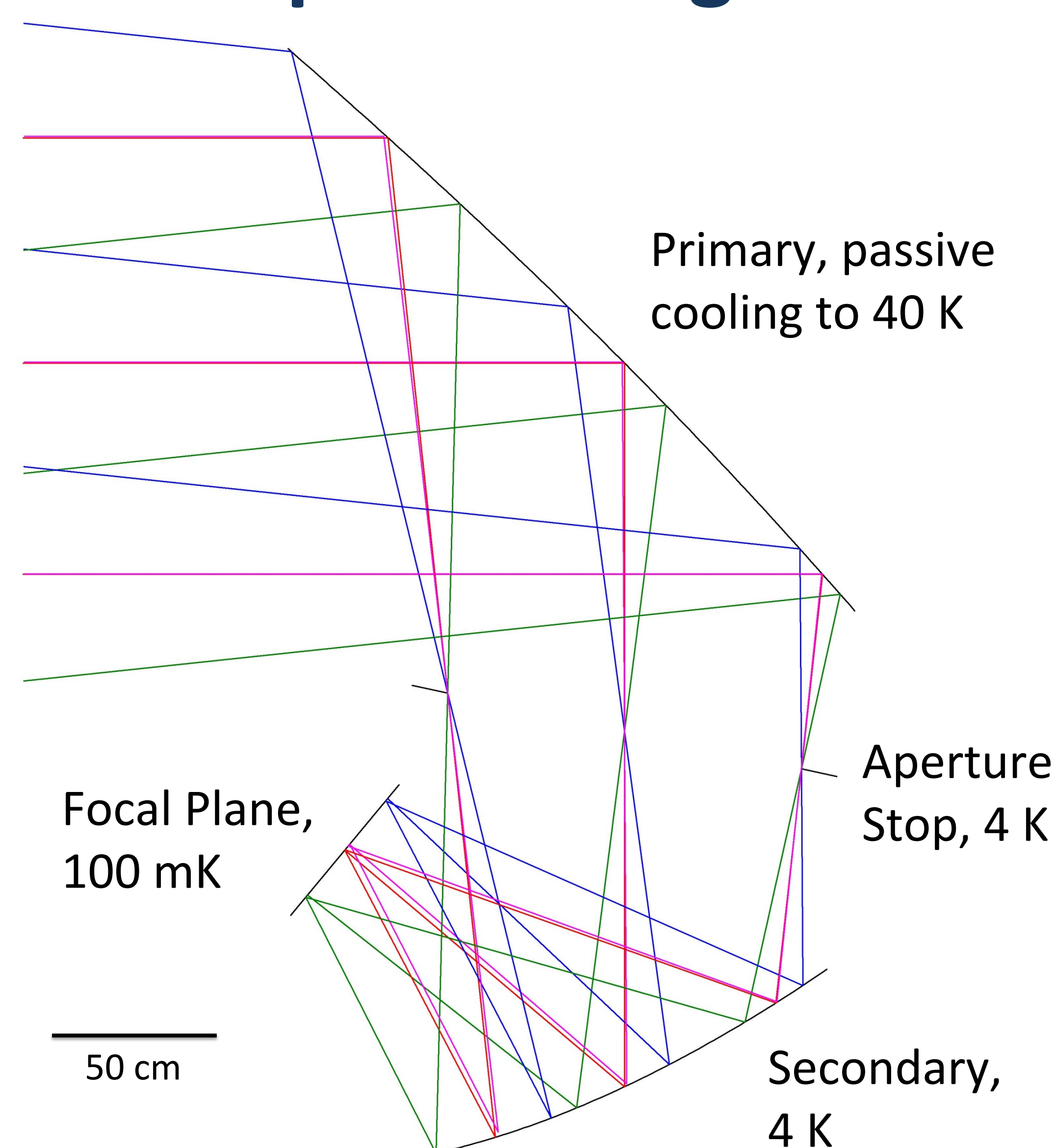
- With 70 times the polarization sensitivity PICO is equivalent to 4,900 *Planck* missions
- 21 bands from 21 GHz to 800 GHz
- 12,400 polarization sensitive TES bolometers
- 1' resolution at 800 GHz, 38' at 20 GHz
- Full-sky coverage
- Multiplexed readout,
 - FDM: x100 per pair of wires
 - TDM: 128 rows, 100 columns
- Precession and spin based scan strategy from L2 with $\alpha = 30^\circ$, $\beta = 65^\circ$



Reference

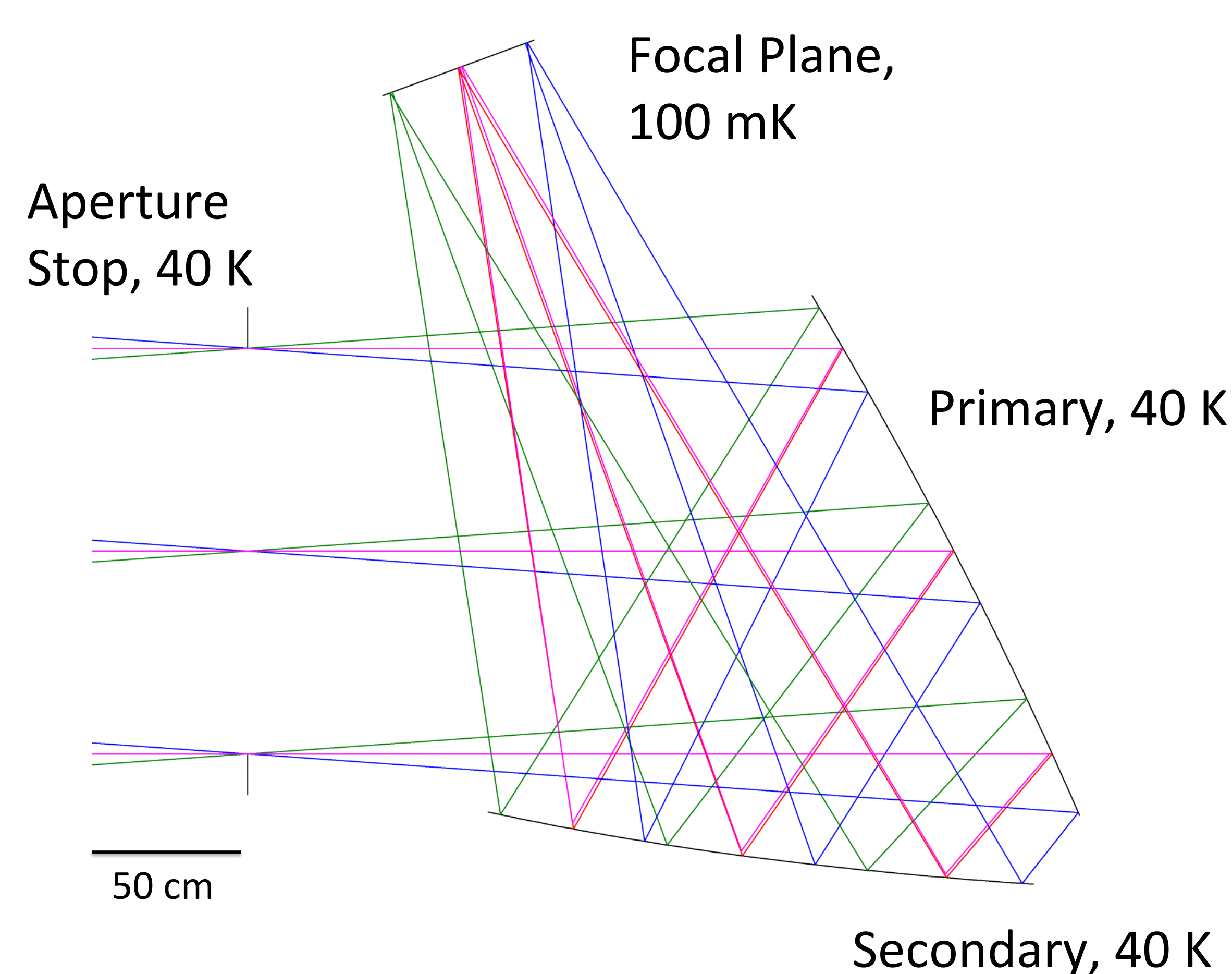
[1] C. Dragone, "First-order correction of aberrations in Cassegrainian and Gregorian antennas," in IEEE Transactions on Antennas and Propagation, vol. 31, September 1983.

Optical Design



- 1.4 m Open Dragone, corrected to reduce coma [1]
- 18 x 12 degree field of view
- f/1.42 system gives compact focal plane

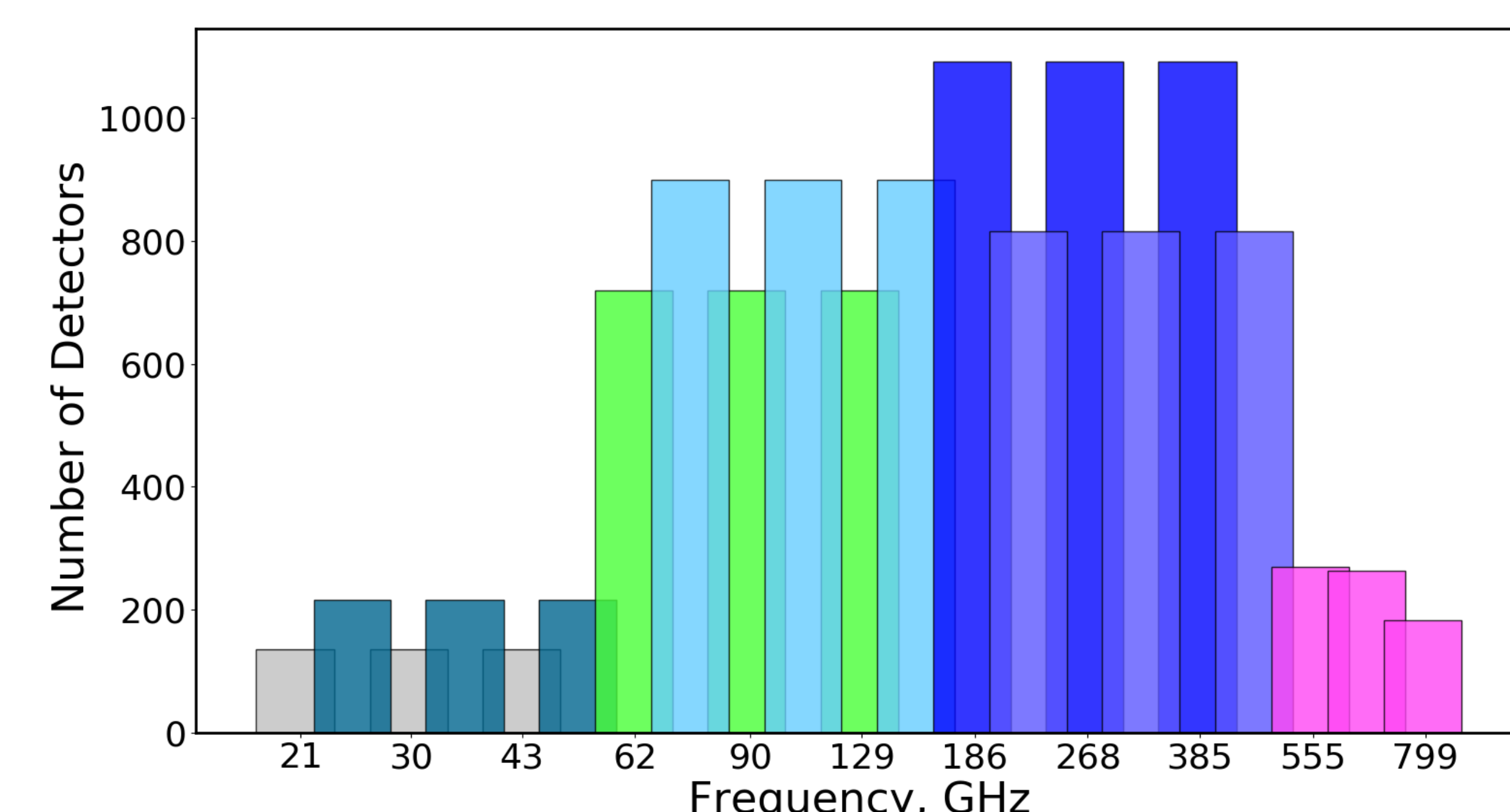
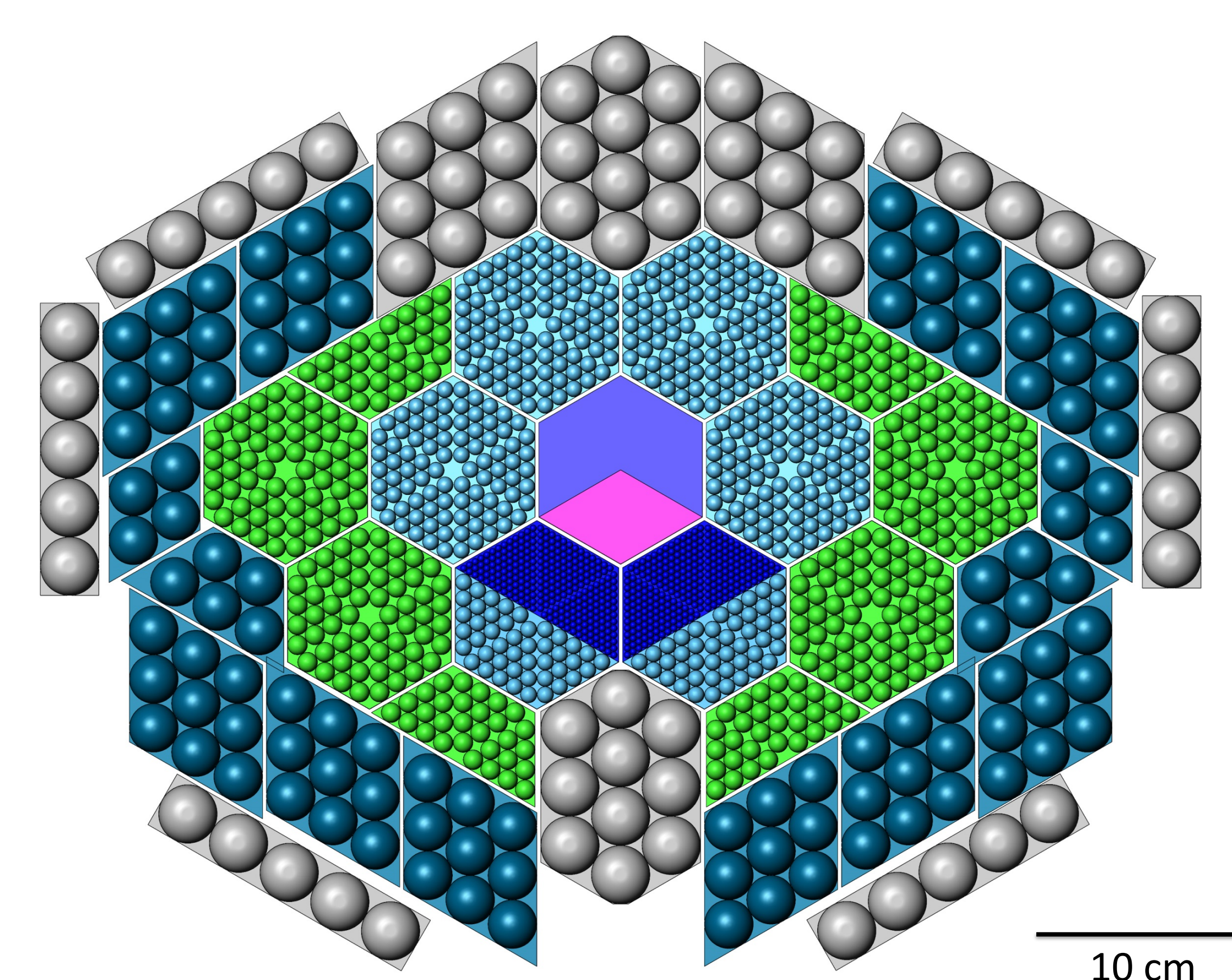
Alternative Design Considered



1.2 m Cross Dragone

- Larger, difficult to baffle sidelobes
- f/2.5 or greater increases focal plane size and mass
- Large secondary difficult to actively cool
- Lower optical aberrations

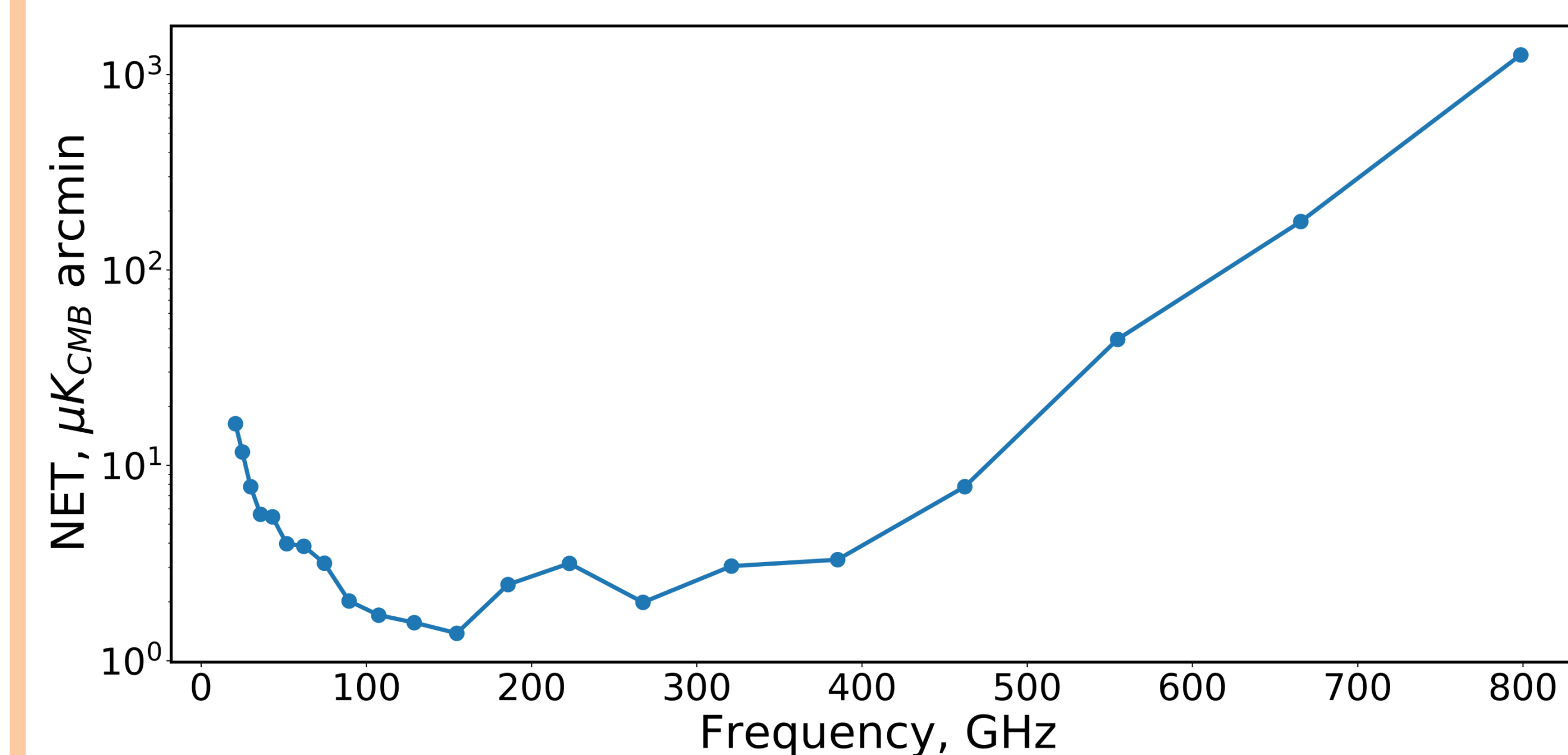
Focal Plane



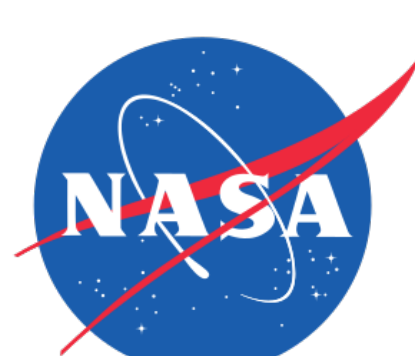
- Three color pixels, six polarization sensitive detectors per pixel

Sensitivity

- White noise only
- Includes photon (dominates), phonon, readout, and Johnson noise terms
- 4 year mission at 95% observing efficiency



- Total integrated polarization map depth of 0.63 $\mu\text{K}_{\text{CMB}} \text{ arcmin}$



The PICO collaboration thanks NASA for supporting this study.