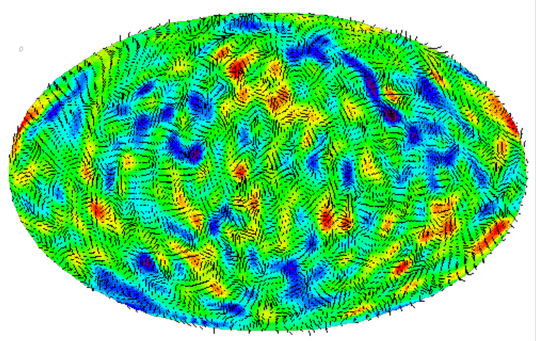

Scientific Goals and Objectives of PICO - Probe of Inflation and Cosmic Origins

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Mission In Brief

- The Probe of Inflation and Cosmic Origins (PICO) is a space mission concept that is being studied in preparation for the 2020 Astronomy and Astrophysics Decadal Survey
- 1.4 meter aperture 2-mirror telescope
- 21 frequency bands between 21 and 799 GHz
- 12,356 polarization sensitive TES bolometers
- Full Sky Survey from L2
- 4 year mission
- Noise: 0.63 uK*arcmin
- 70 times the sensitivity of Planck

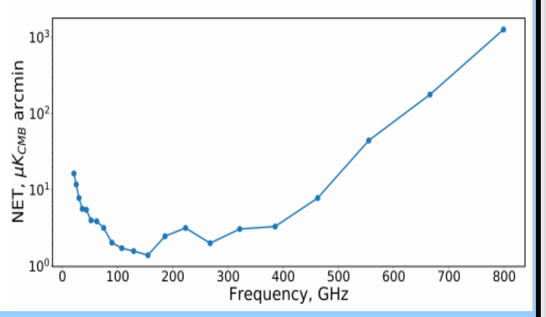

Fig. Sensitivity of PICO over 21 bands.

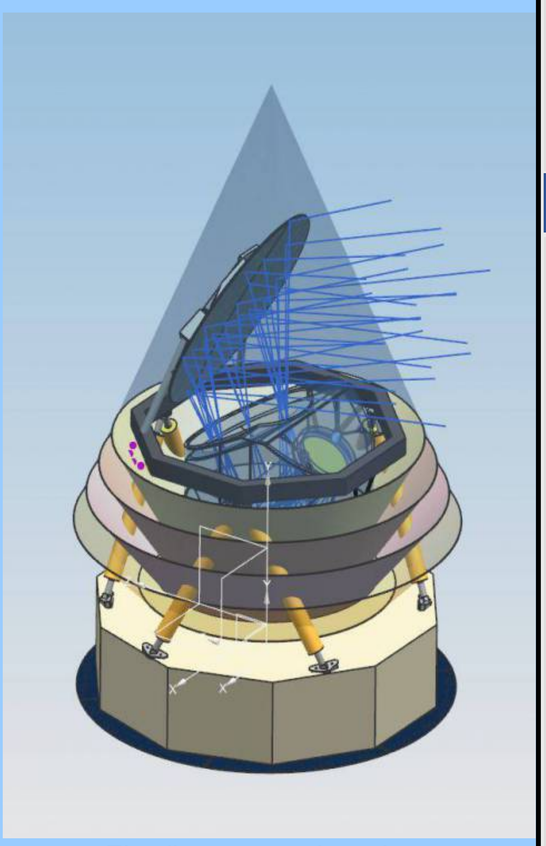

Fig. Current engineering design of PICO satellite.

Fundamental Physics

- ***Cosmic Inflation***
  - Probe energy scale at which inflation occurred and exclude classes of inflationary models

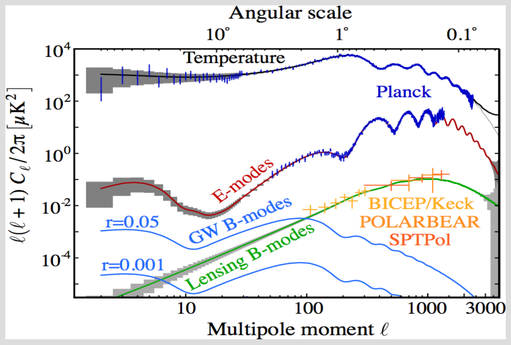

Fig. CMB power spectrum. (new one?)

  - CMB polarization B-mode power spectrum
  - Measure or set upper limit of tensor-to-scalar ratio r with $\sigma(r) < 5\times10^{-5}$ at $r = 0$, $r < 10^{-4}$ at 95% CL after delensing and foreground sub-traction

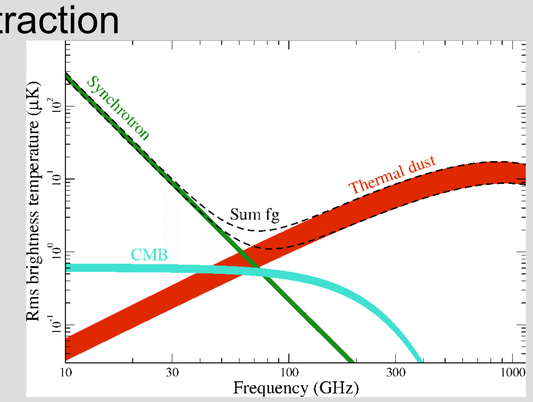

Fig. Brightness temperature RMS as a function of frequency and astrophysical component for polarization from Planck.

- ***Light Relics***
  - Probe effective number of light degrees of freedom N_{eff}
  - Measure the total energy density in radiation excluding photons
  - CMB temperature and E-modes
  - $\sigma(N_{eff}) < 0.03$

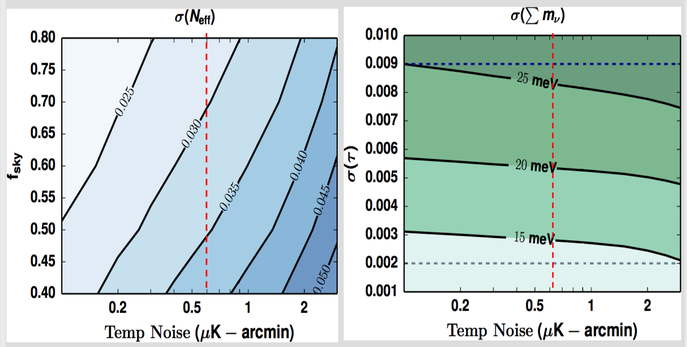

Fig. N_{eff} uncertainty vs noise and sky fraction (left) and sum of neutrino masses uncertainty vs noise and the uncertainty in the measurement of τ, for 0.7 sky fraction (right). Red verticals are the expected performance of baseline mission.

- ***Neutrino Mass***
  - Probe the sum of neutrino mass
  - On small scale, neutrinos free stream out of potential wells and suppress the growth of structure
  - Lensing B-modes
  - $\sigma(\sum m_\nu) < 15$ meV, with BAO data from DESI

Galactic Magnetic Fields

- Star formation and magnetic field strength
  - Magnetohydrodynamic turbulence is a key regulator of the star-formation process
  - Map the magnetic fields of molecular clouds with <1pc resolution (<0.05 pc for the 10 nearest MCs) at 799 GHz for galactic latitudes -20<b<20
- Interstellar medium of our Galaxy vs nearby galaxies
  - Compare the ratio of energy in magnetic field to turbulence
  - Map magnetic fields of nearby external galaxies
- Radiative torque and alignment of dust grains
  - Polarization spectra
  - Map linear polarizations using 10 frequency bands between 150 and 799 GHz for regions with high and low radiative flux

Cosmic Structure Formation

- Star formation history
  - Optical depth to reionization
  - CMB polarization E-mode
  - Sensitive to very large angular scale, thus exclusively available for space mission
  - $\sigma(\tau) < 0.002$
- Determine the role of energy injection due to feedback processes on galaxy formation and evolution
- All sky CMB temperature and Compton Y maps

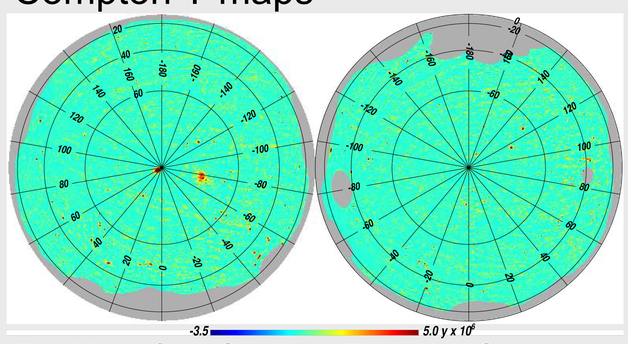

Fig. Map of the Sunyaev-Zeldovich Compton parameter from Planck.

Legacy Science

- Discover thousands of new proto-clusters over the entire sky and in redshift
- 3,000 highly lensing-magnified point sources
- Hundreds of high-z gravitationally stable (virialized) galaxy clusters
- Detection of thousands of radio sources and dusty galaxies in polarization

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Acknowledgement

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