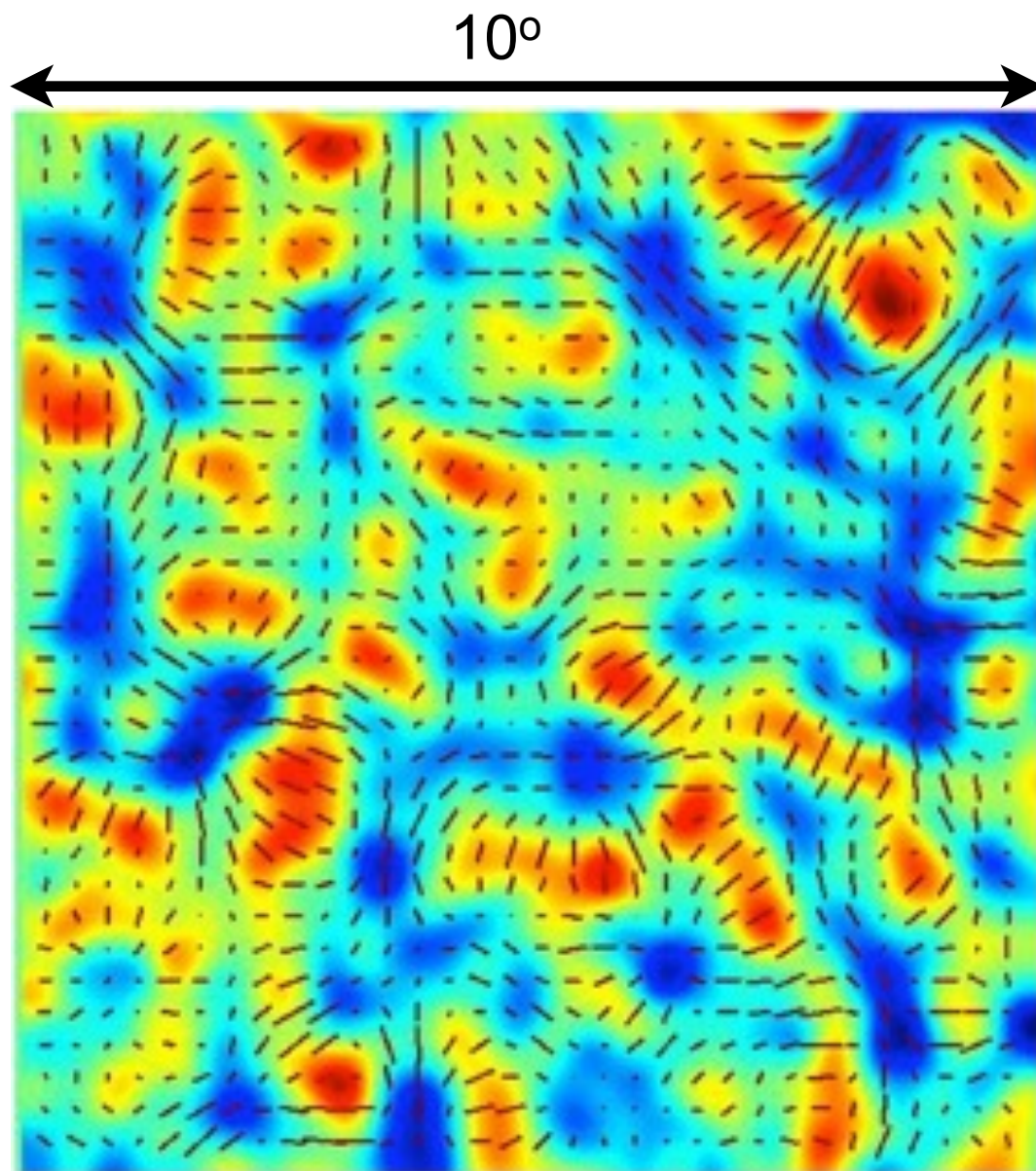


A close-up photograph of a scientific instrument, likely a radio telescope receiver. It features a dark, metallic structure with a grid of circular apertures. A central probe or antenna is visible, surrounded by a circular array of smaller apertures. The background is dark and out of focus.

New Measurements of CMB Polarisation from SPTpol

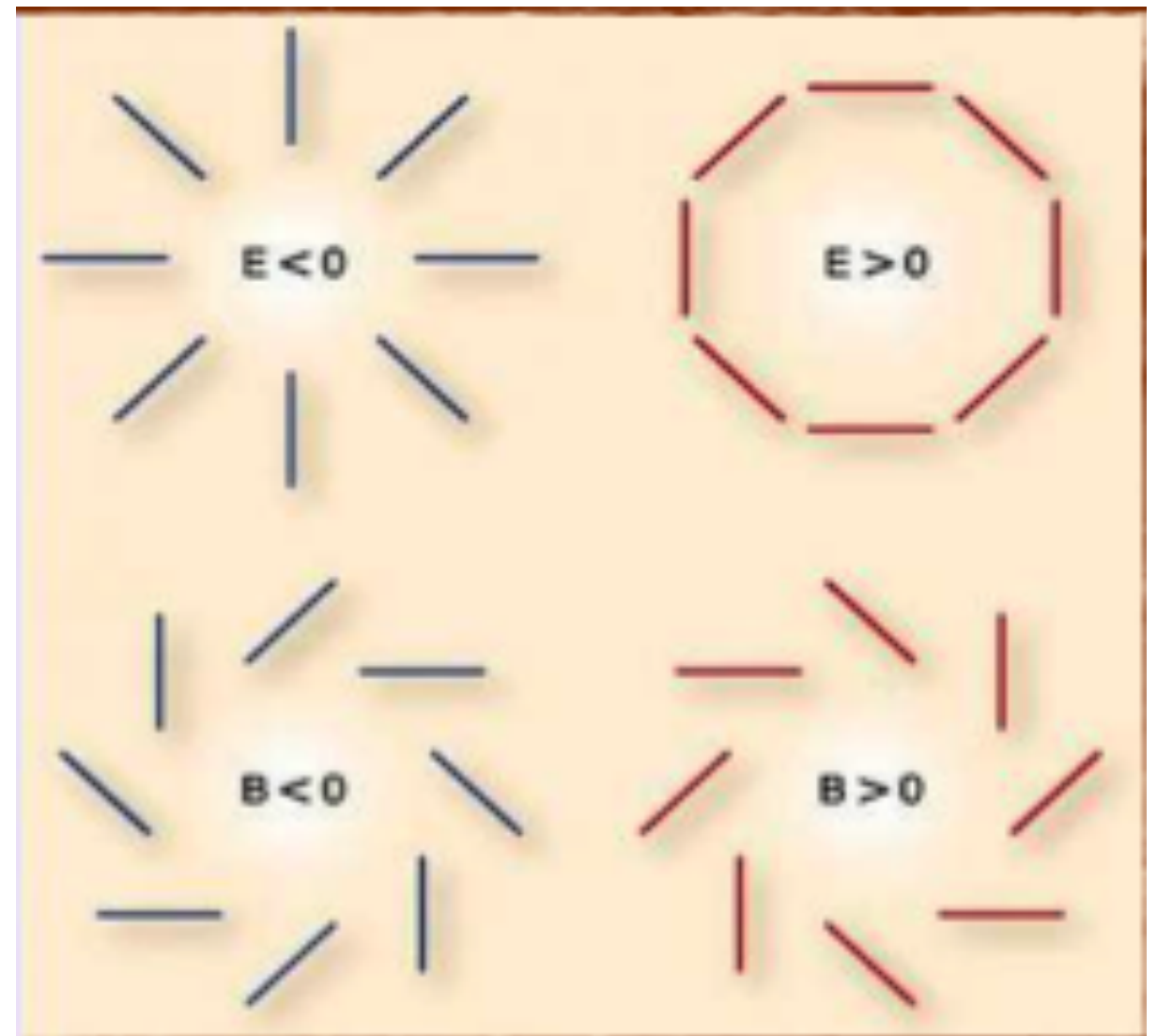
Christian Reichardt
Future Fellow @ University of Melbourne

The CMB is polarised (~10%)



Smith et al 2008

- Any polarisation pattern can be decomposed into “E” (grad) and “B” (curl) modes



- Density fluctuations at LSS do not produce “B” modes!

The South Pole Telescope (SPT)

10 m telescope

Sub-millimeter Wavelength Telescope:

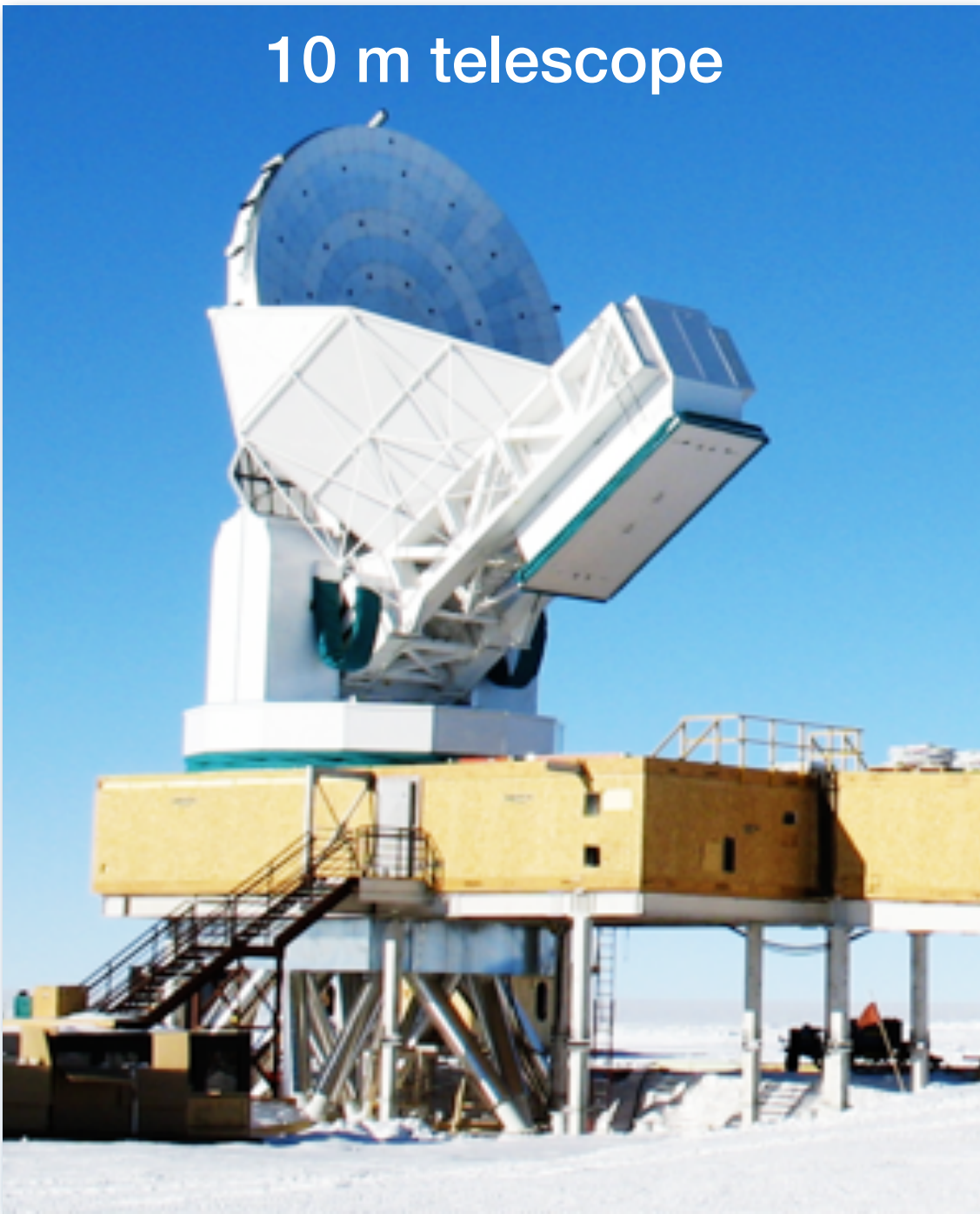
- 10 meter telescope (1.1' FWHM beam)
- Off-axis Gregorian optics design
- Fast scanning (up to 2 deg/sec in azimuth)
- 2" pointing accuracy



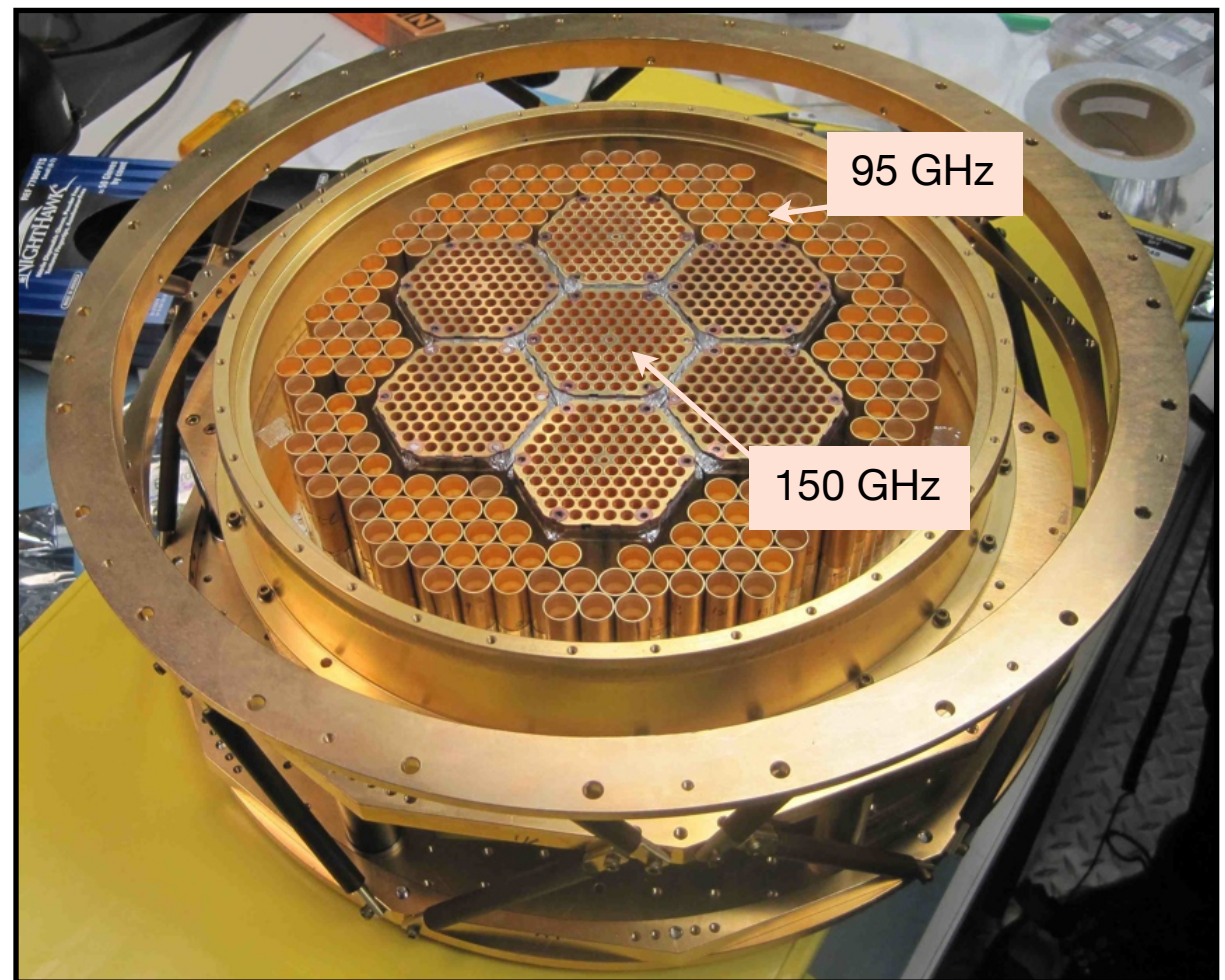
Collaboration

The South Pole Telescope (SPT)

10 m telescope



SPTpol - 2nd camera on SPT



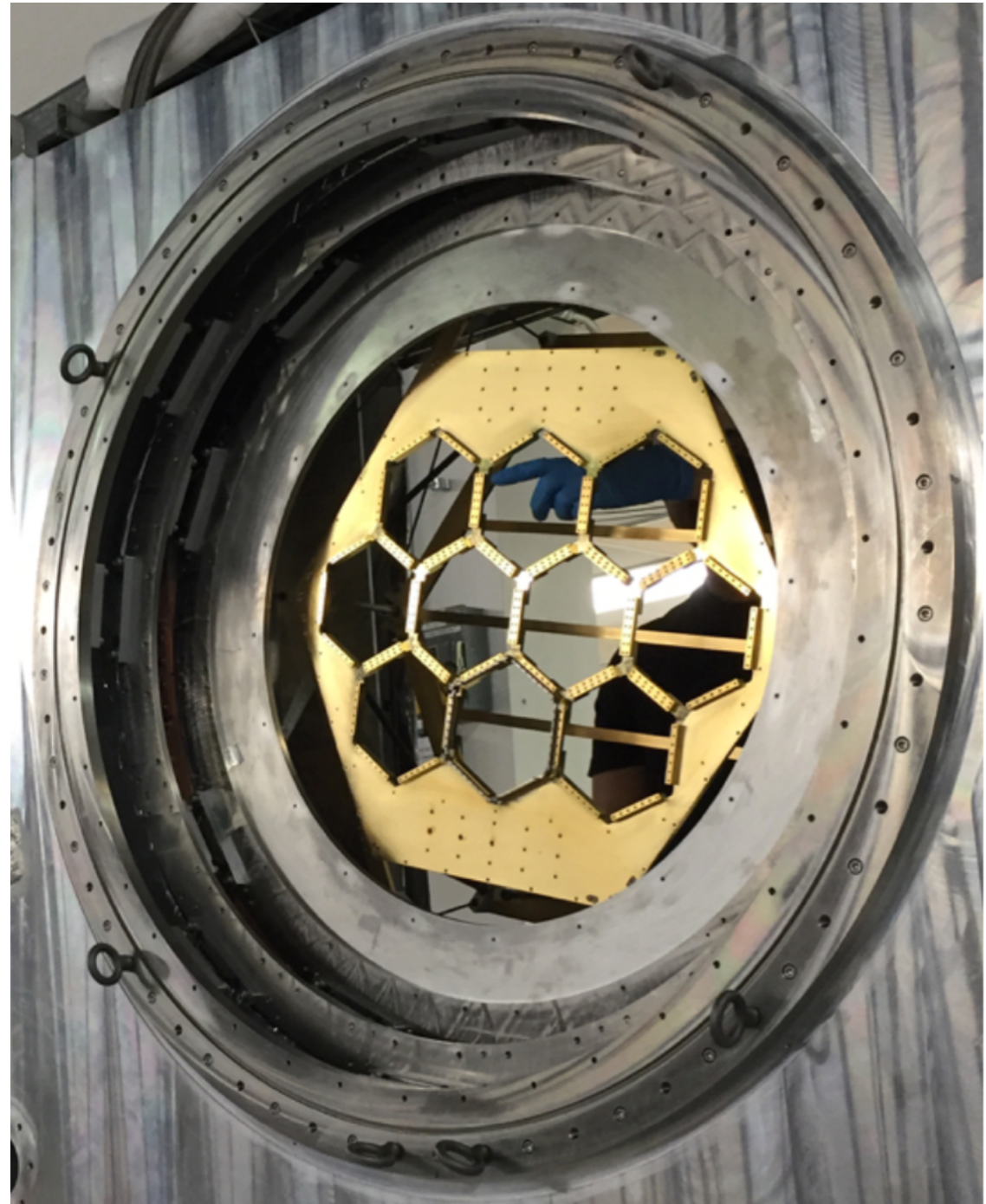
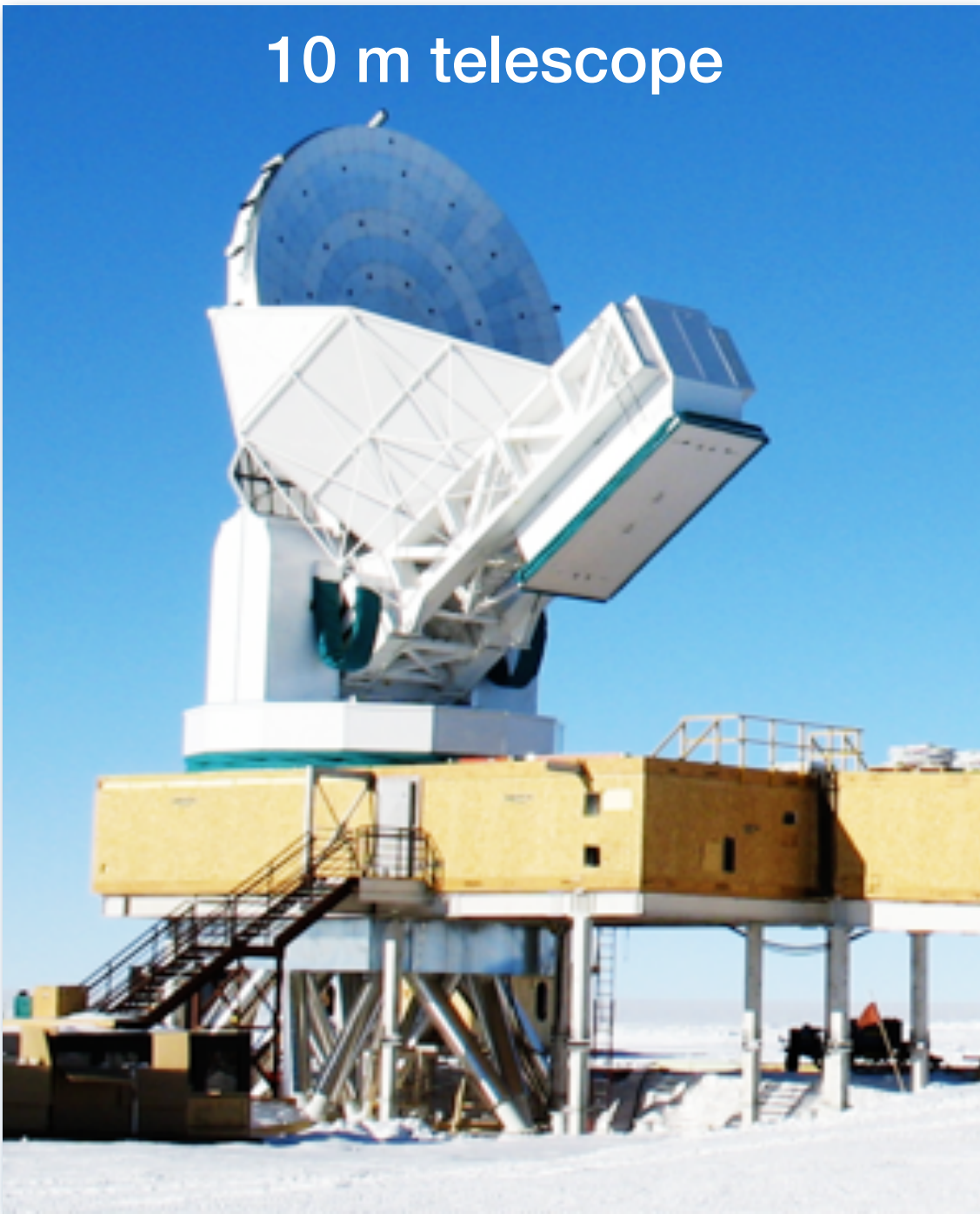
- 1536 *polarization-sensitive* bolometers
- 500 deg² survey
 - 8 μ K-arcmin @ 95 GHz
 - 5 μ K-arcmin @ 150 GHz



The South Pole Telescope (SPT)

SPT-3G - 3rd camera on SPT

10 m telescope



- 10x more bolometers (16,200)
- 2500 deg² survey in 95, 150, 220 GHz
- Being installed now! First light in February!

The South Pole Telescope (SPT)

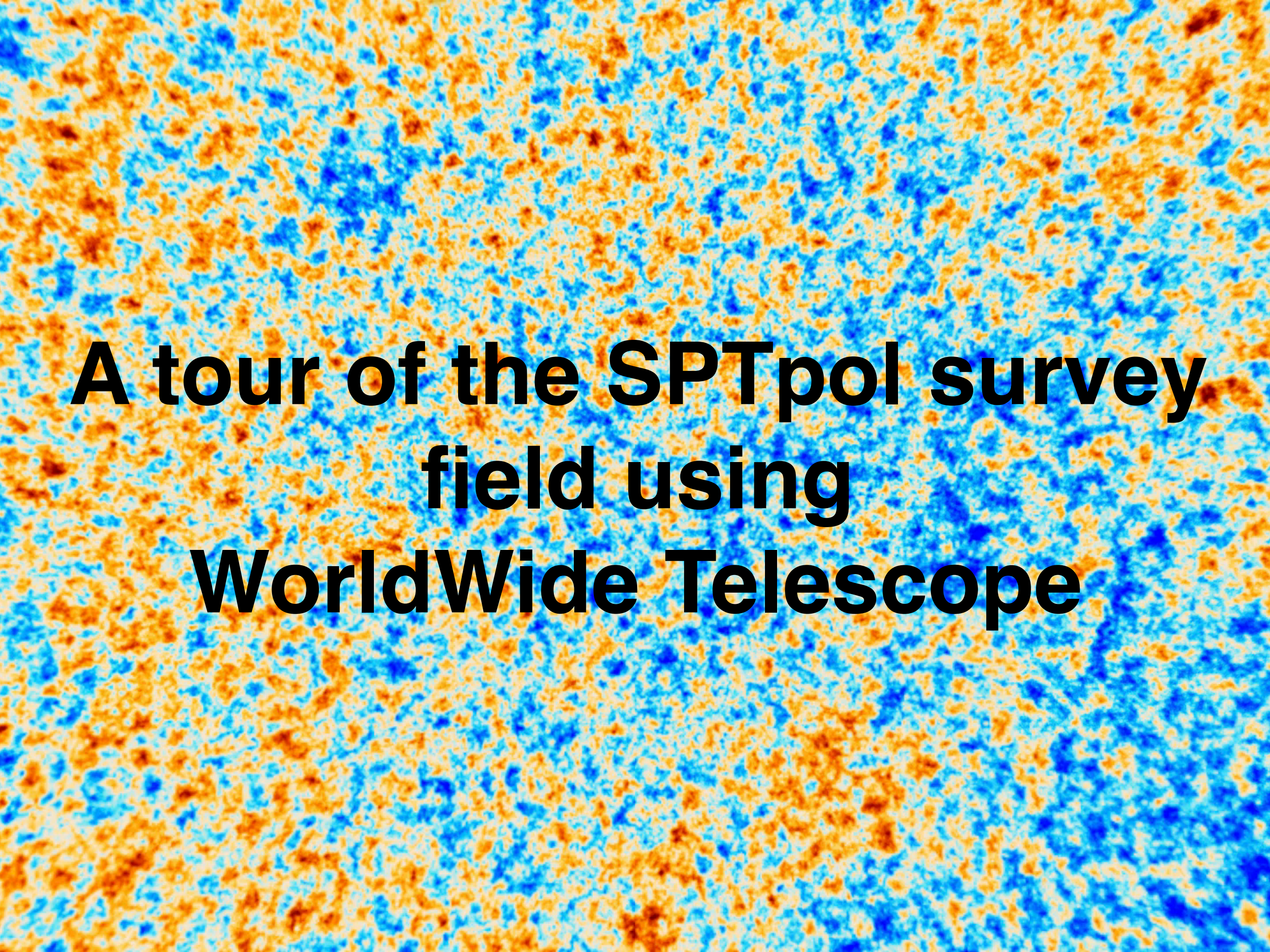
SPT-3G receiver starting trip to Pole:

Left Chicago: Oct 30, 2016

Arr. Christchurch: Nov 2, 2016

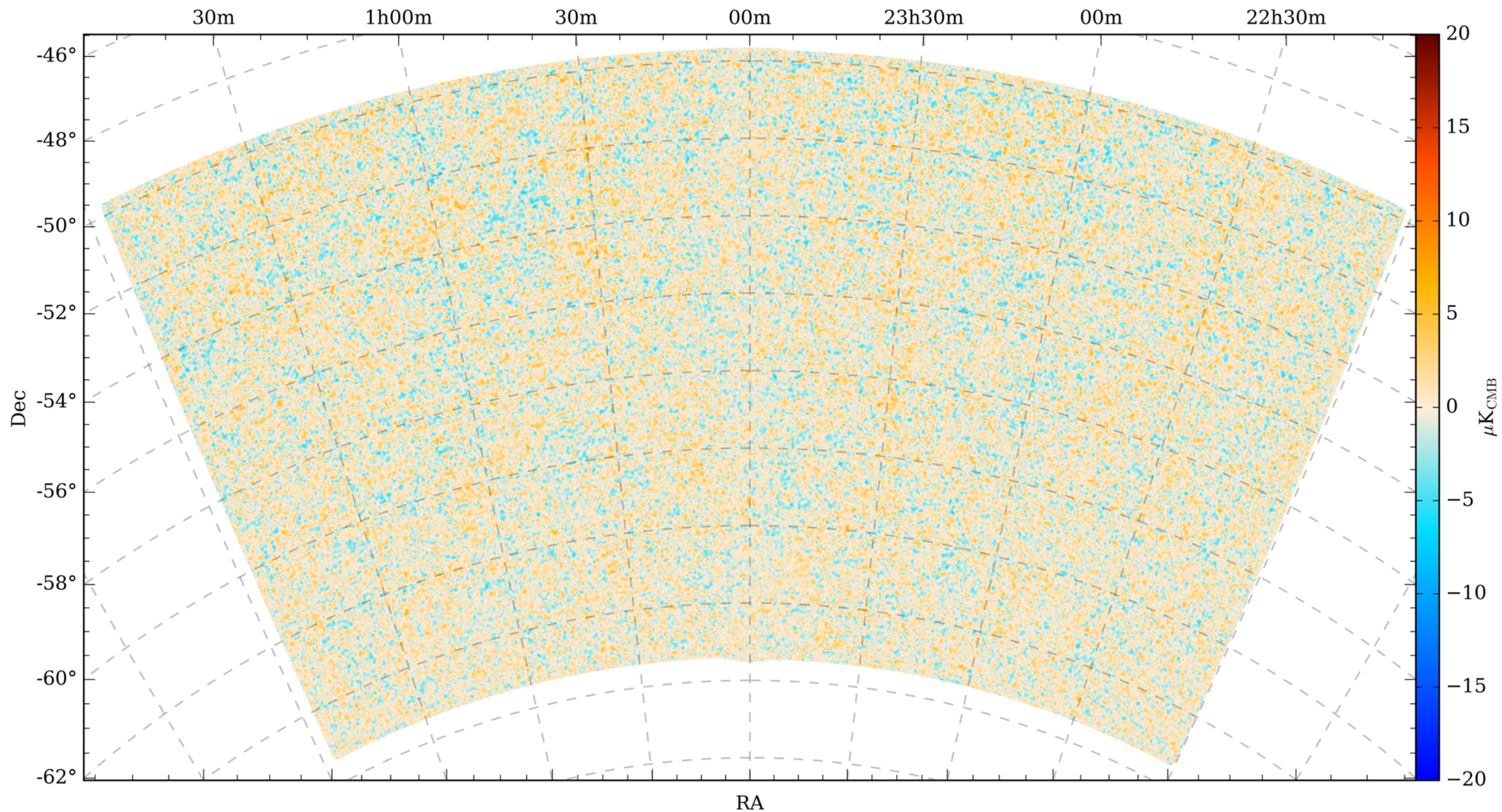


People got to Pole in early November to begin work

The background of the slide is a Cosmic Microwave Background (CMB) fluctuation map. It displays a complex, grainy pattern of orange, yellow, and blue colors, representing the temperature variations in the early universe. The pattern is dense and covers the entire area of the slide.

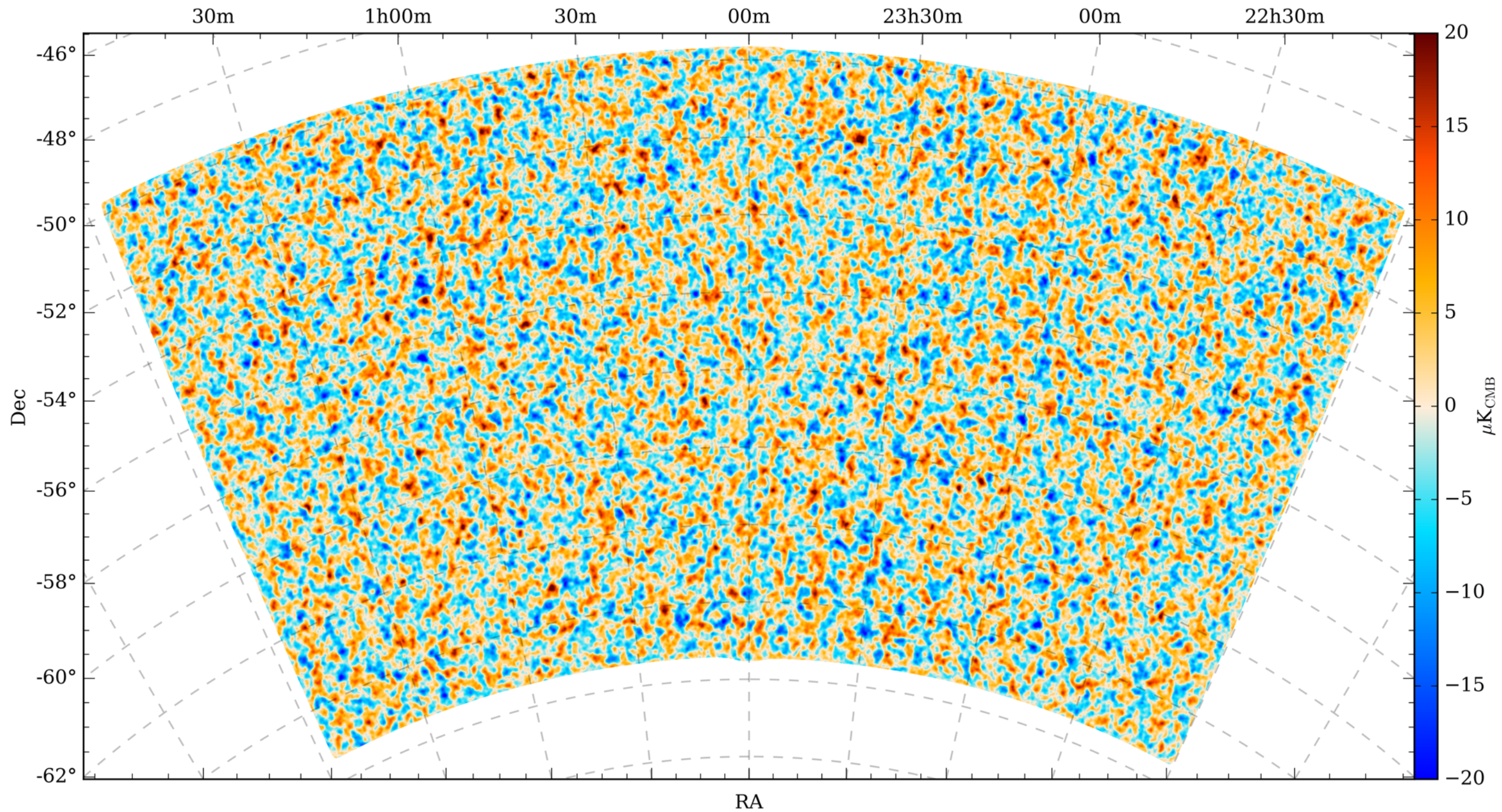
A tour of the SPTpol survey field using WorldWide Telescope

E-modes - A noise map



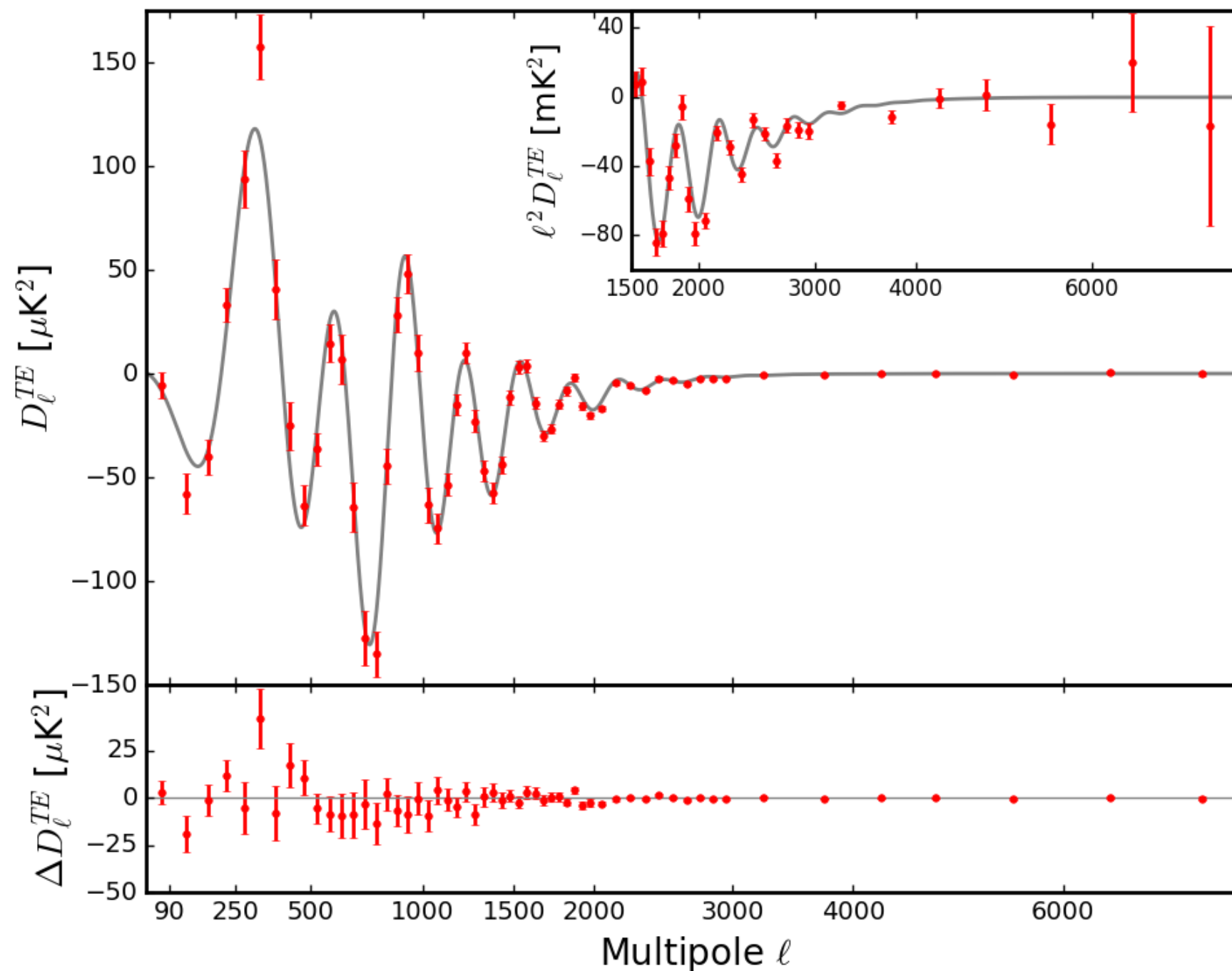
- Map from the first half of the season minus the second half
- Noise: $9.4 \mu\text{K-arcmin}$ between $2000 < \ell < 4000$.

E-modes measured with SPTpol



- High signal-to-noise!

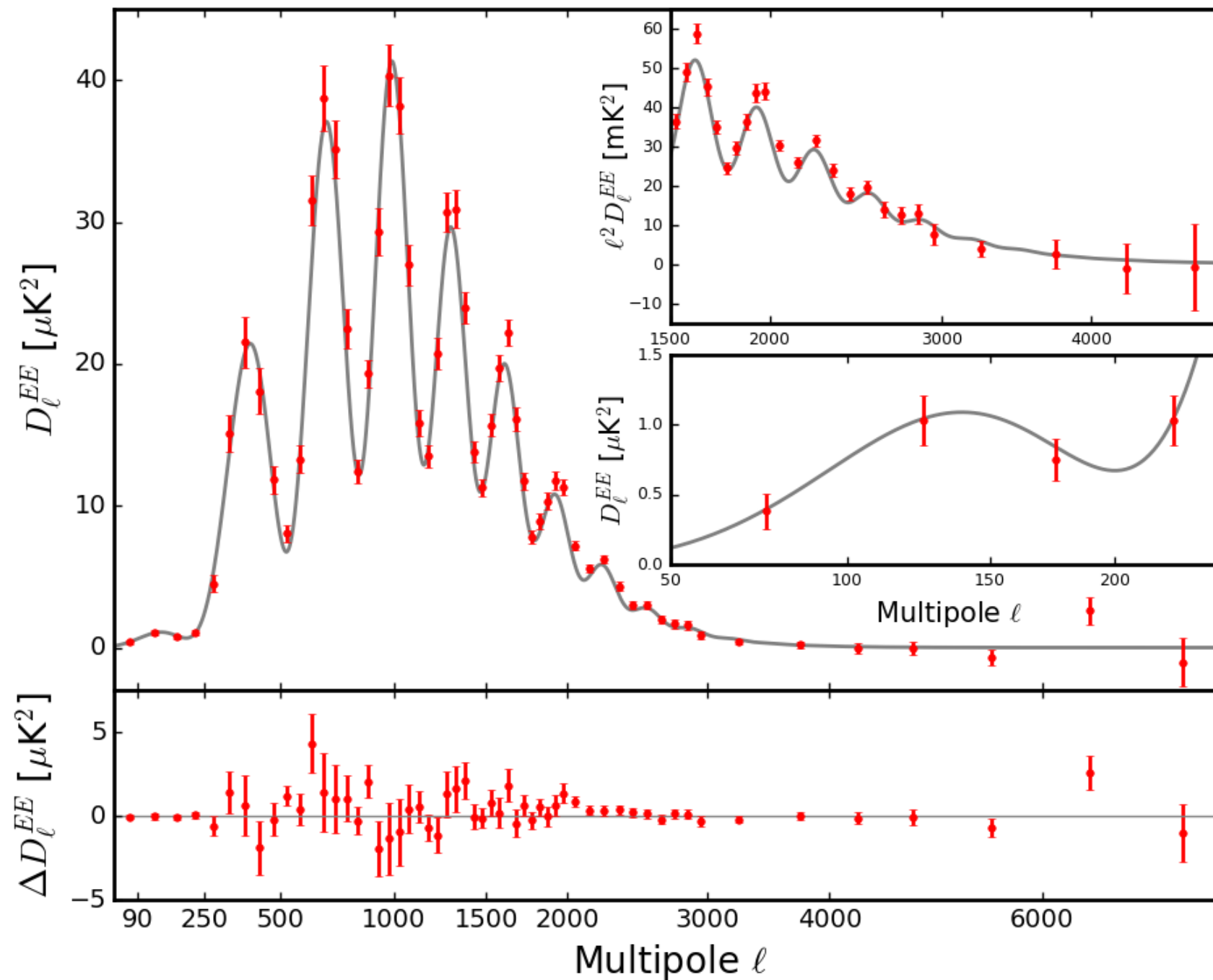
TE Power Spectra



Henning et al.,
In prep

- Model not fit to data! (Planck plikHM_TT_lensing_lowTEB)
- Sample-variance limited at $\ell < 2050$

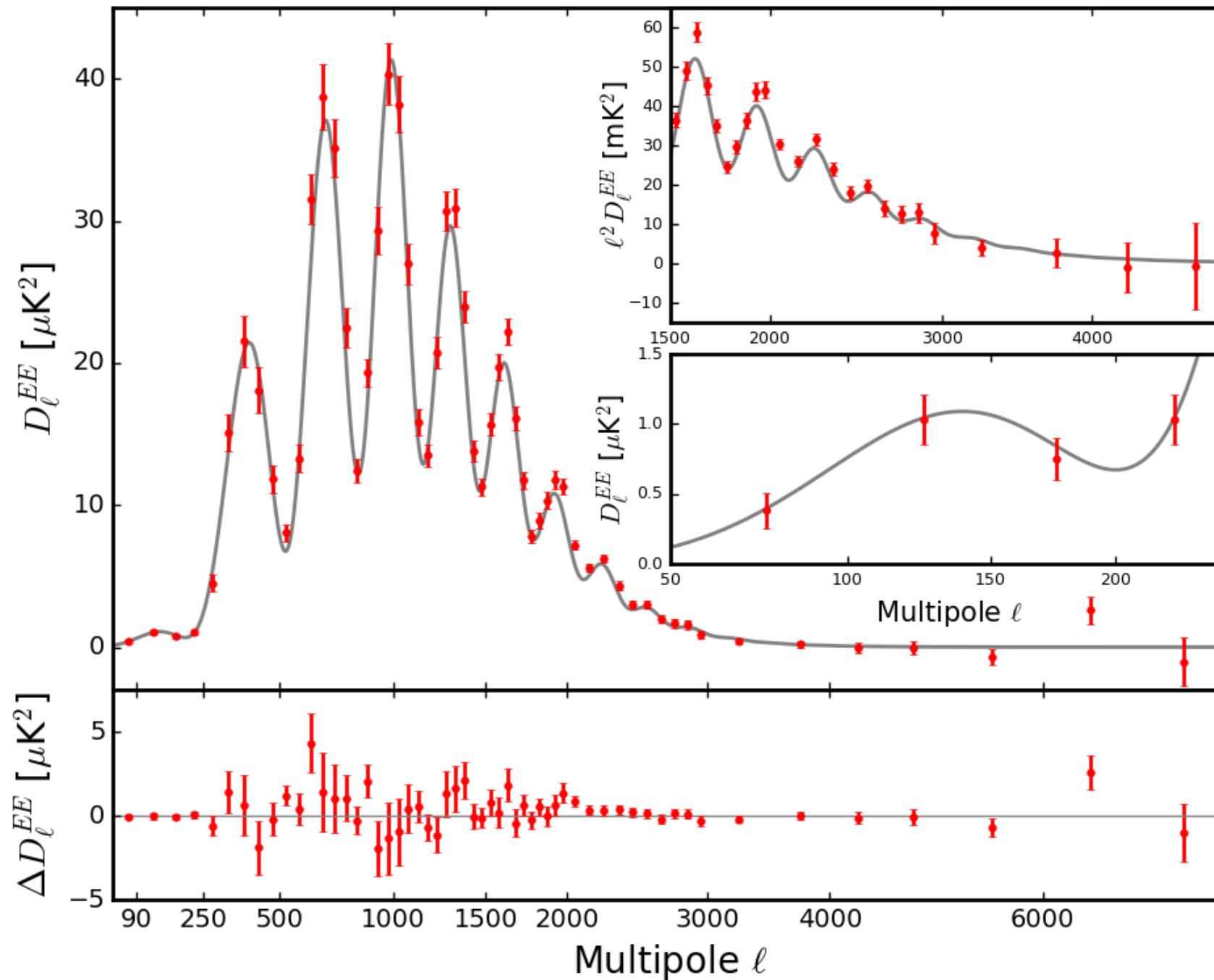
EE Power Spectrum



Henning et al.,
In prep

- Sample-variance limited at $\ell < 1750$
- 9(?) acoustic peaks — as many as in Temperature!

EE Power Spectrum



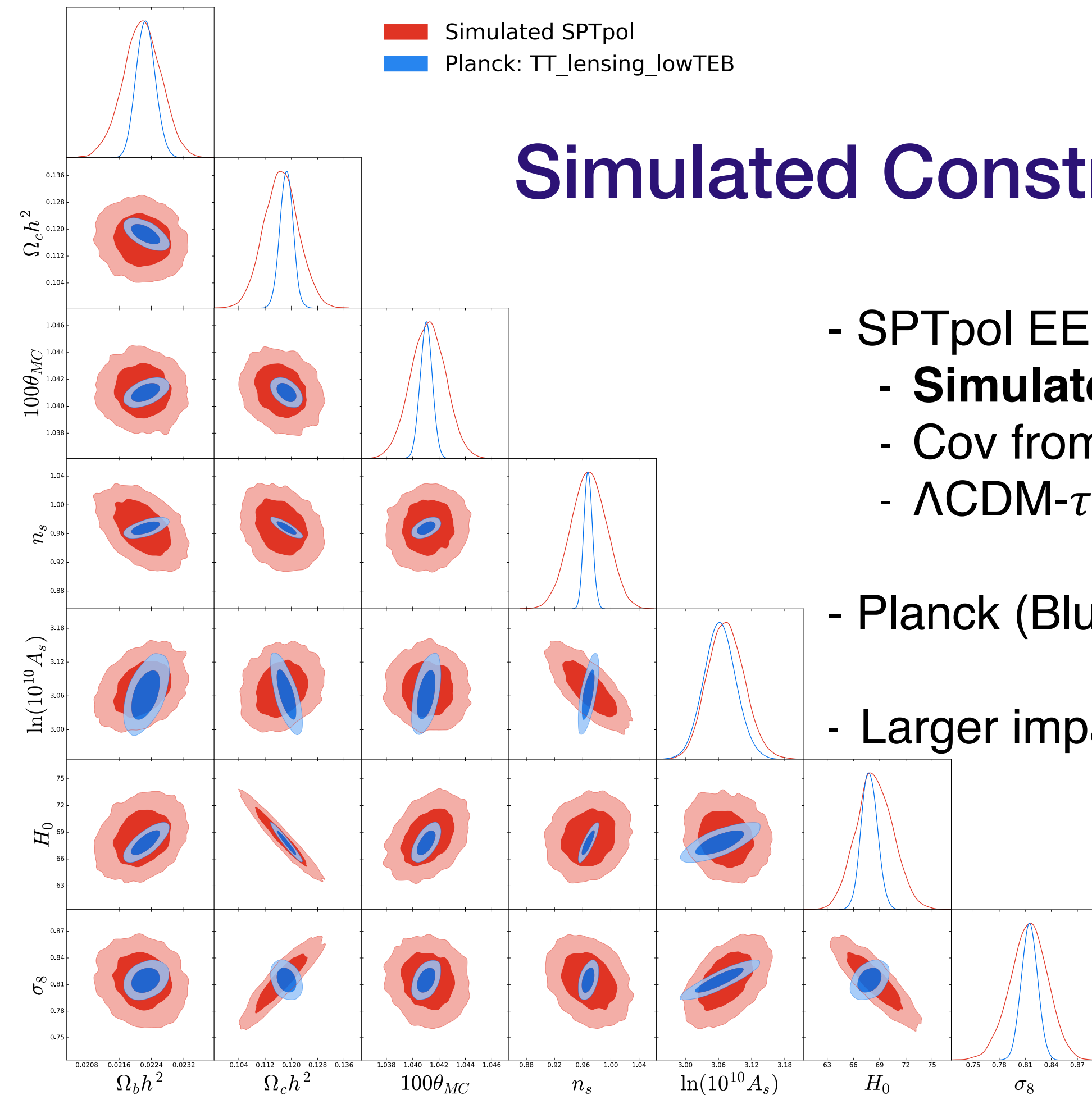
Henning et al.,
In prep

- **$D_\ell^{\text{PS}} < 0.1 \mu\text{K}^2$ at 95% confidence.**
 - Poisson power crosses EE at $\ell \sim 3800$.
 - Source mask: $> 50 \text{ mJy}$ (in T)

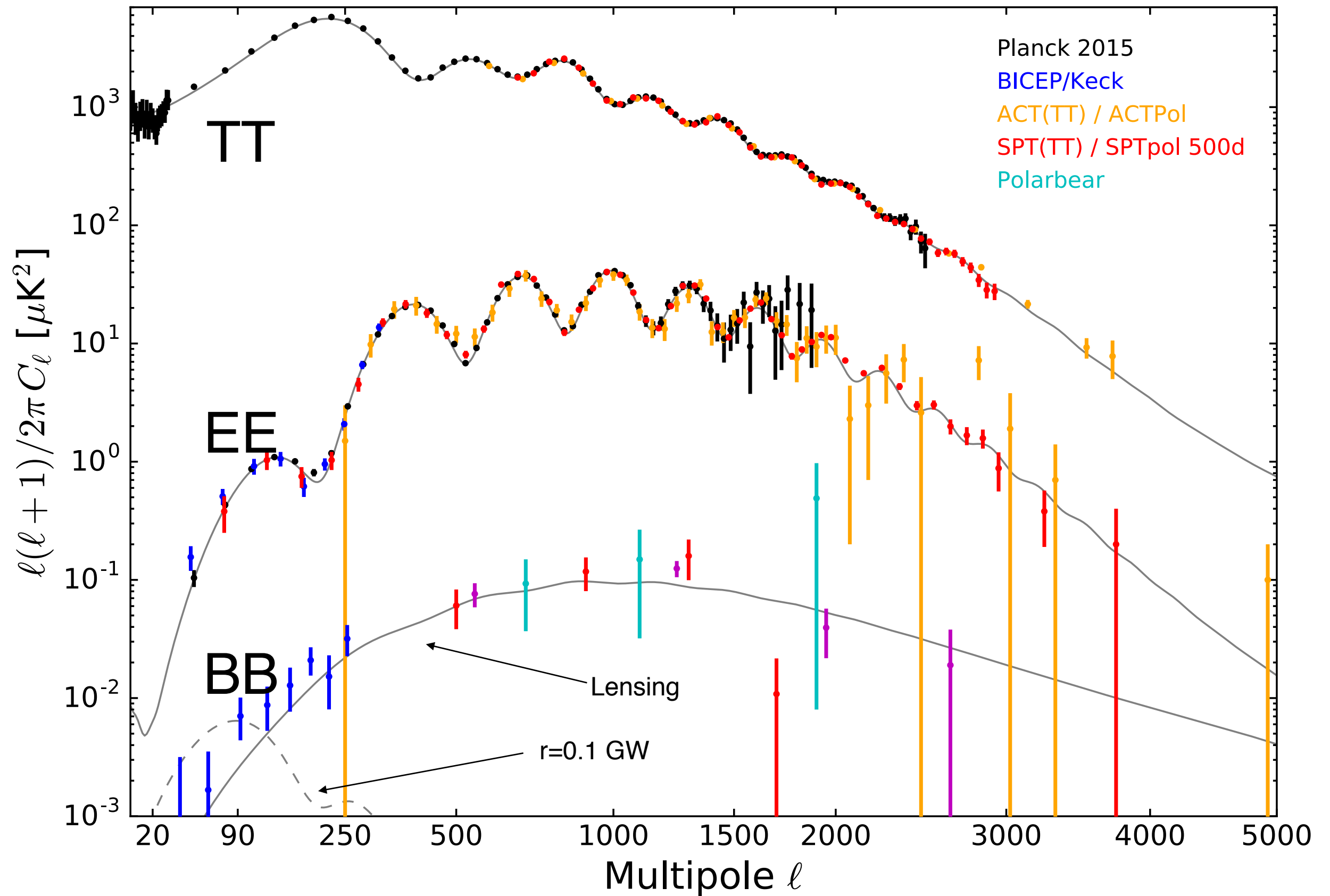
■ Simulated SPTpol
■ Planck: TT_lensing_lowTEB

Simulated Constraints

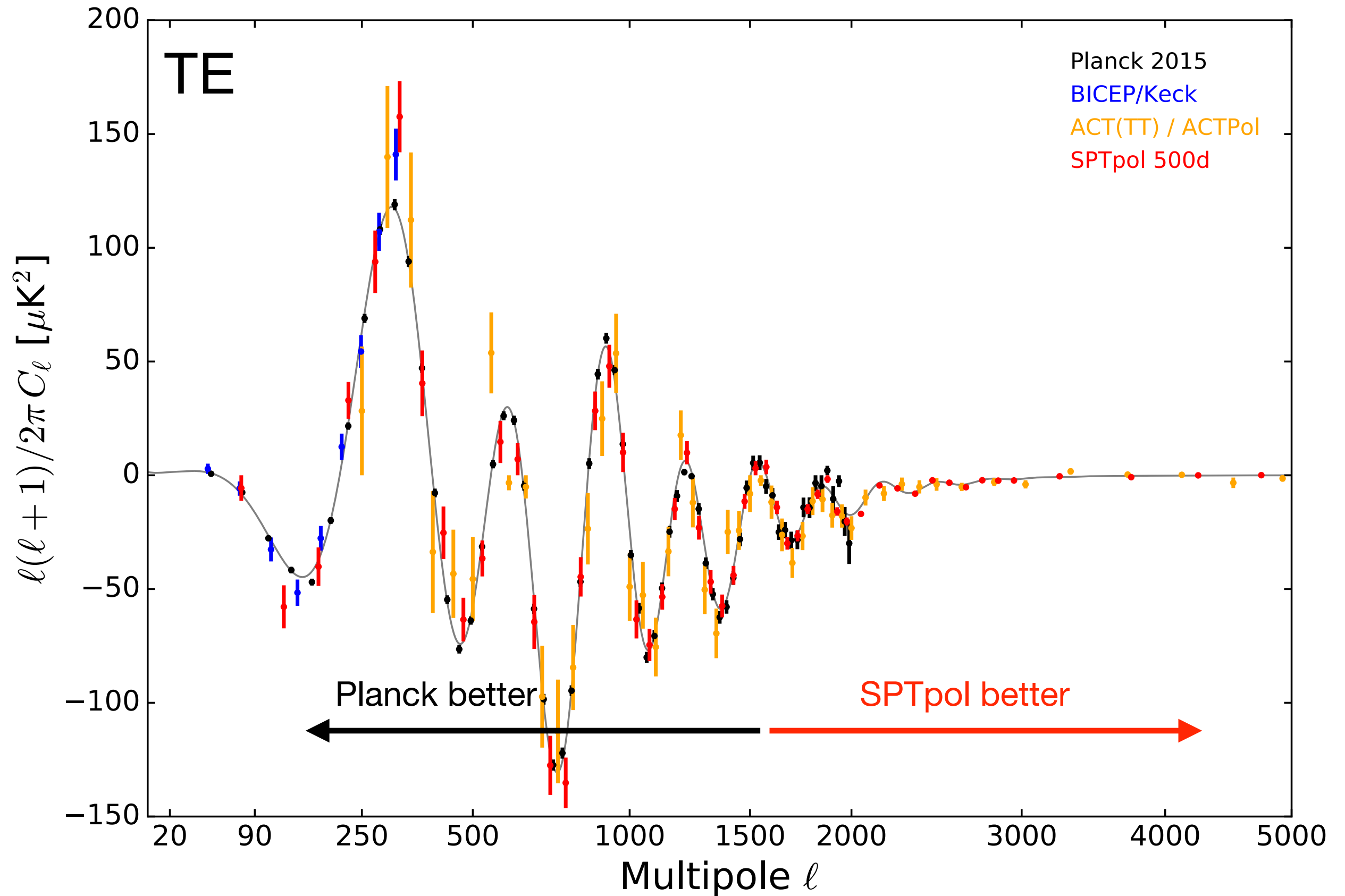
- SPTpol EE+TE(Red)
 - **Simulated bandpowers**
 - Cov from real data
 - Λ CDM- τ
- Planck (Blue)
- Larger impact beyond LCDM



CMB Polarisation

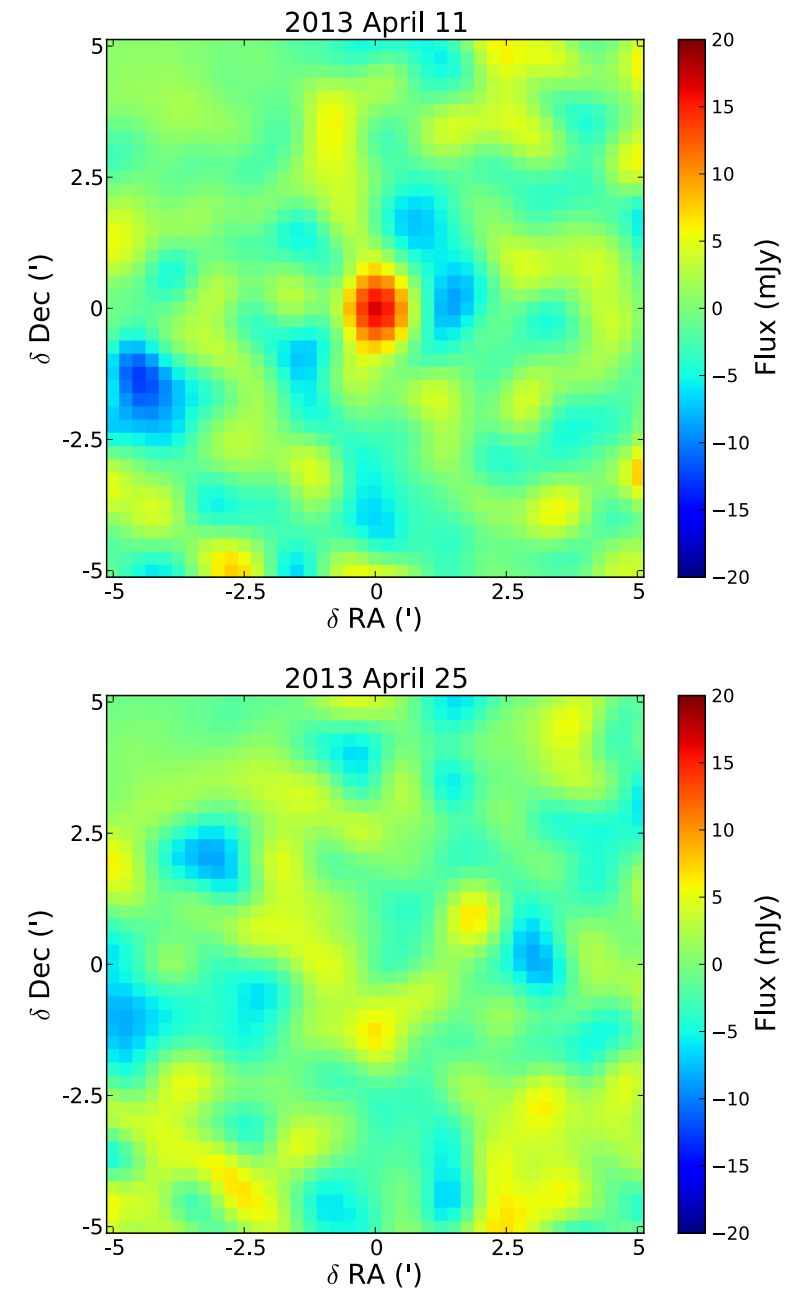
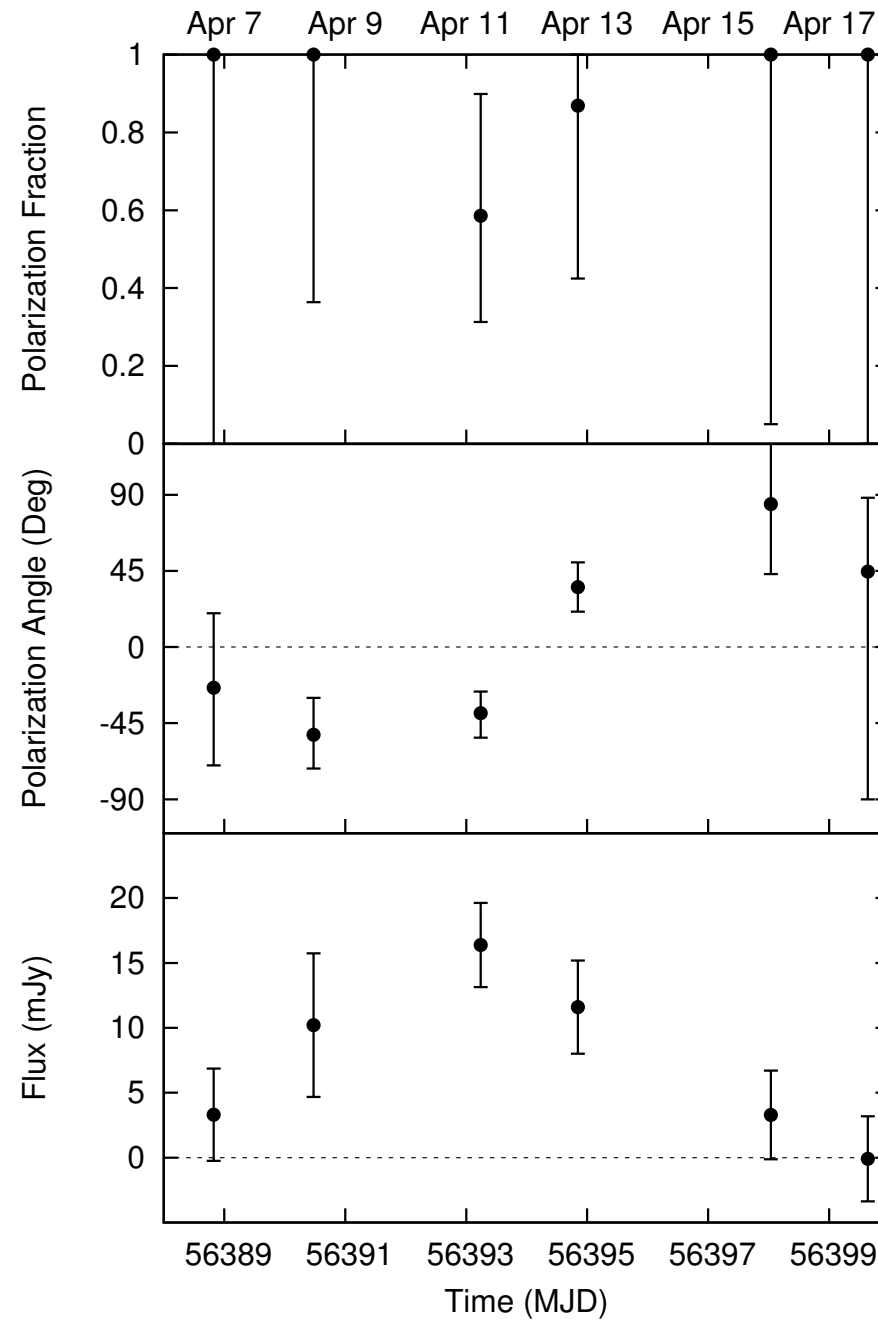
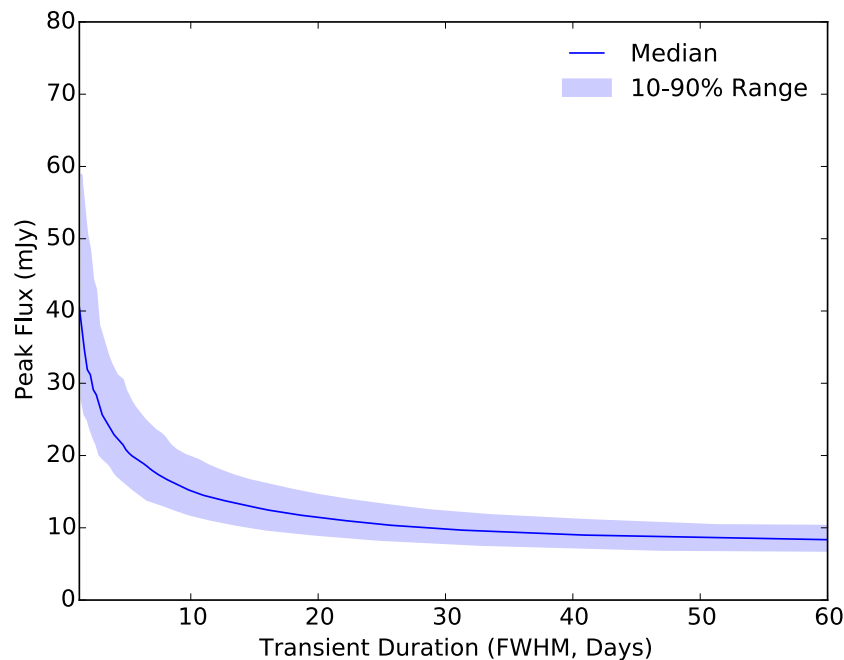


CMB Polarisation



Transient Search

- Searches observations of 100 deg² field (2012-early 2013).
- SPTpol sensitive to $\sim > 10$ mJ transients over range of durations.
- Low significance candidate (PTE = 0.01)
 - broadly consistent with gamma-ray burst afterglow.



In conclusion

- The SPTpol 500d survey:
 - Detect 9 acoustic peaks in EE (as many as TT!)
 - Best measurements of polarised damping tail
- SPT-3G being commissioned as we speak
 - **10x more detectors** (95, 150, 220 GHz)
 - **18x lower noise than Planck** 143 GHz channel across 2500 deg²
- Planning underway for stage IV experiment with ~2 million detector-year survey