Latest Results from SPTpol

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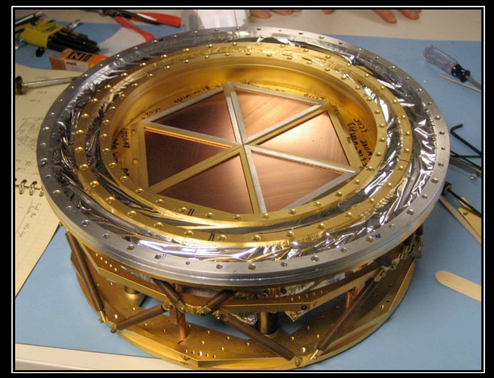
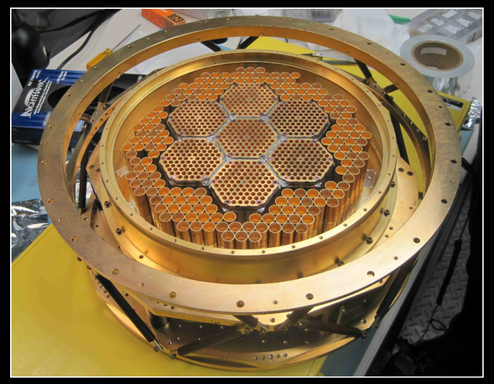
The South Pole Telescope (SPT)

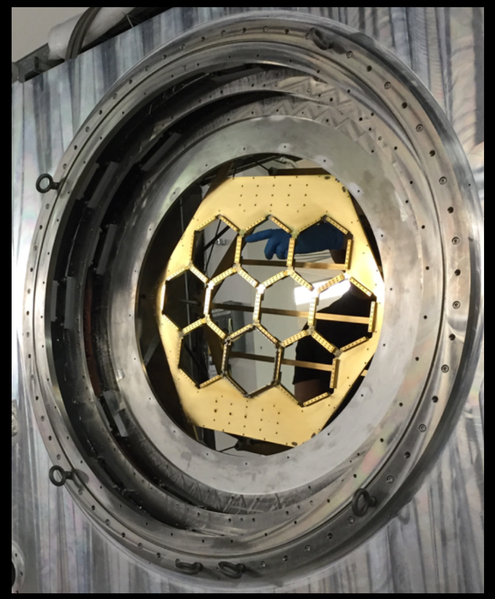
10-meter sub-mm quality wavelength telescope

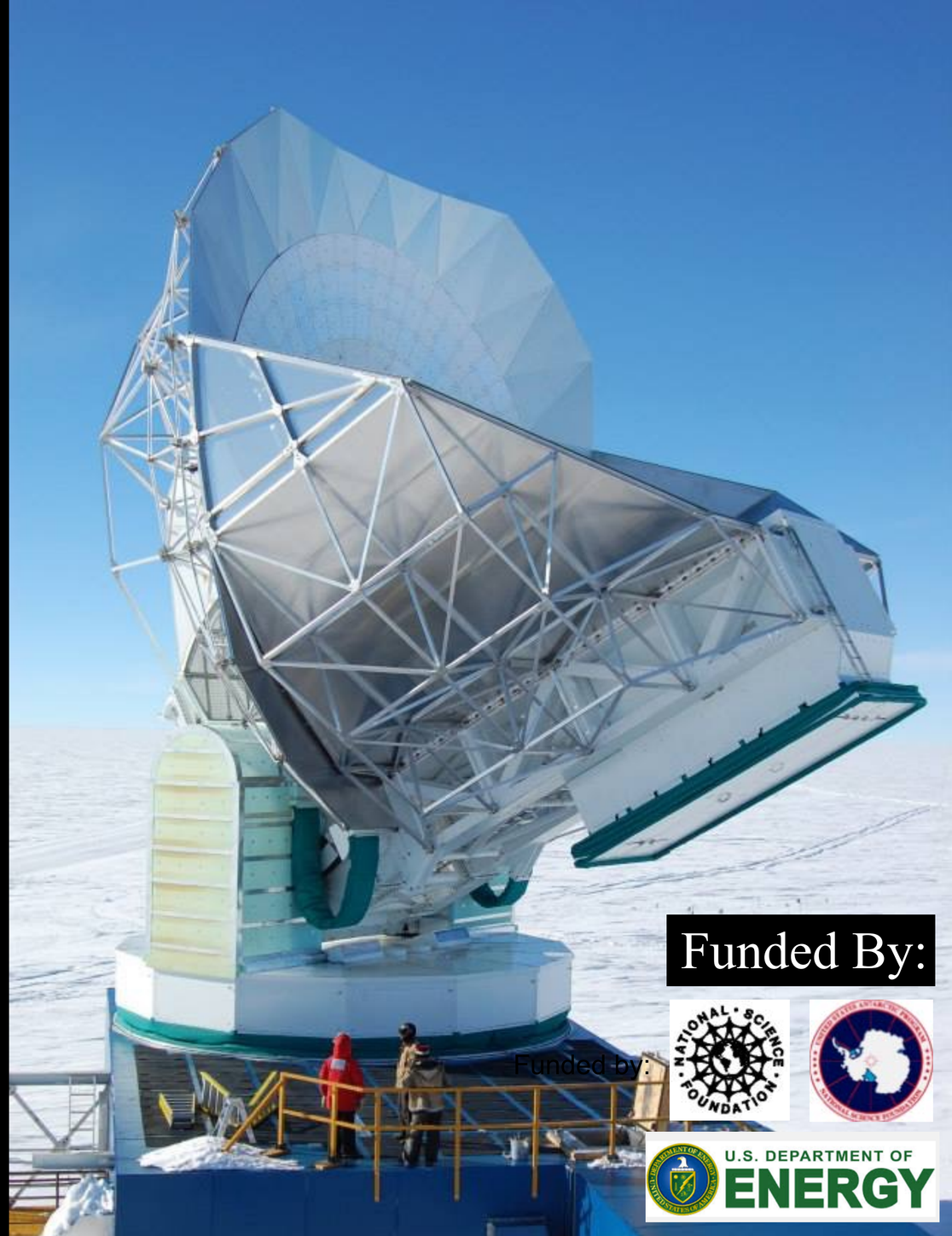
95, **150**, **220** GHz and
1.6, **1.2**, **1.0** arcmin resolution

2007: SPT-SZ	**2012: SPTpol**	**2017: SPT-3G**
960 detectors	1500 detectors	16,200 detectors
95,150,220 GHz	95,150 GHz	95,150,220 GHz
	+Polarization	***+Polarization***









Funded By:

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SPT(pol) Surveys

SPTpol Summer - 2000 deg^2

~ 30 μK-arcmin map depth (T)

SPTpol Survey - 500 deg^2

~ 7 μK-arcmin map depth (T)

SPTpol Deep - 100 deg^2

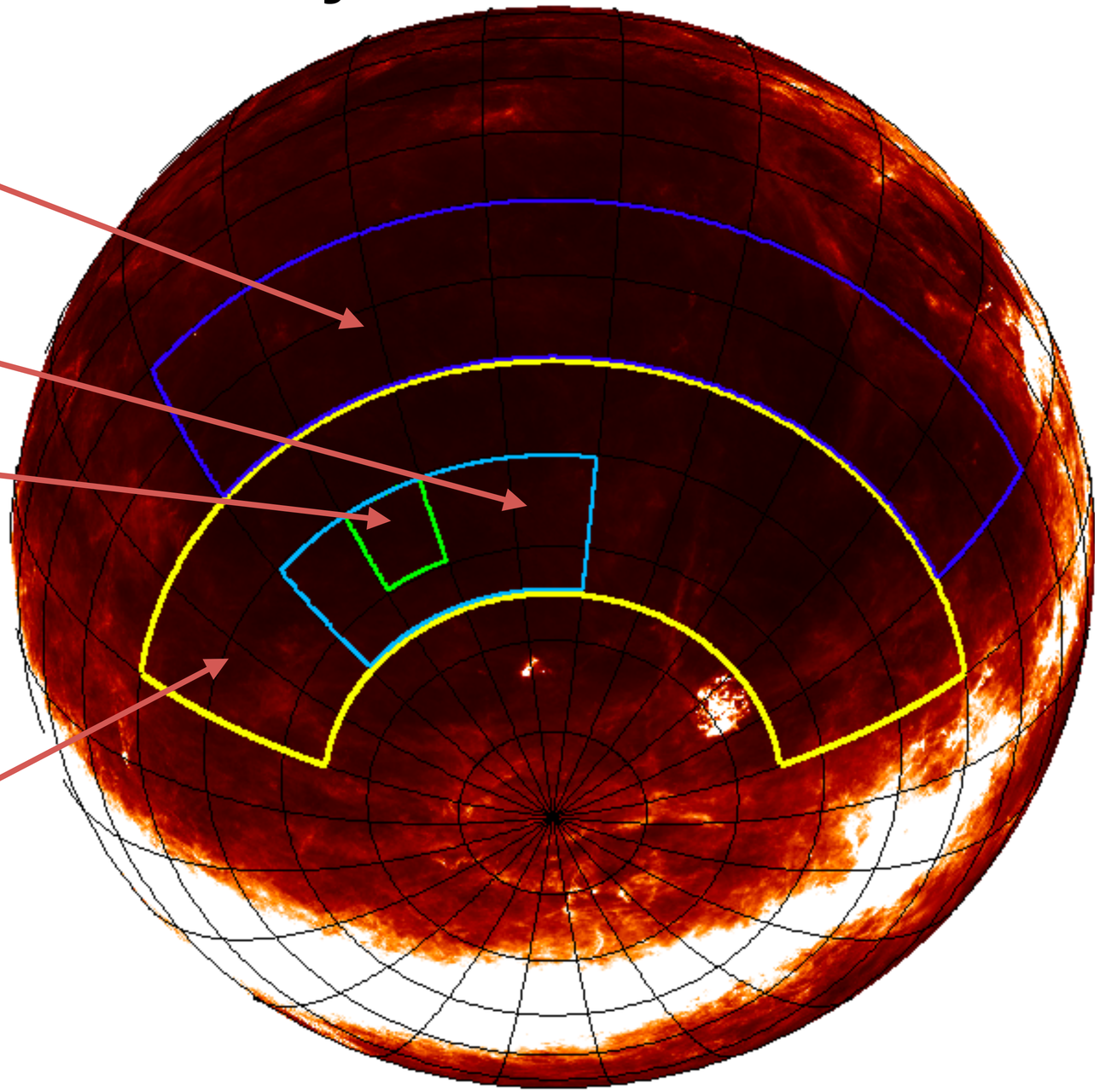
~ 7 μK-arcmin map depth (T)

(from 2012 + early 2013 only)

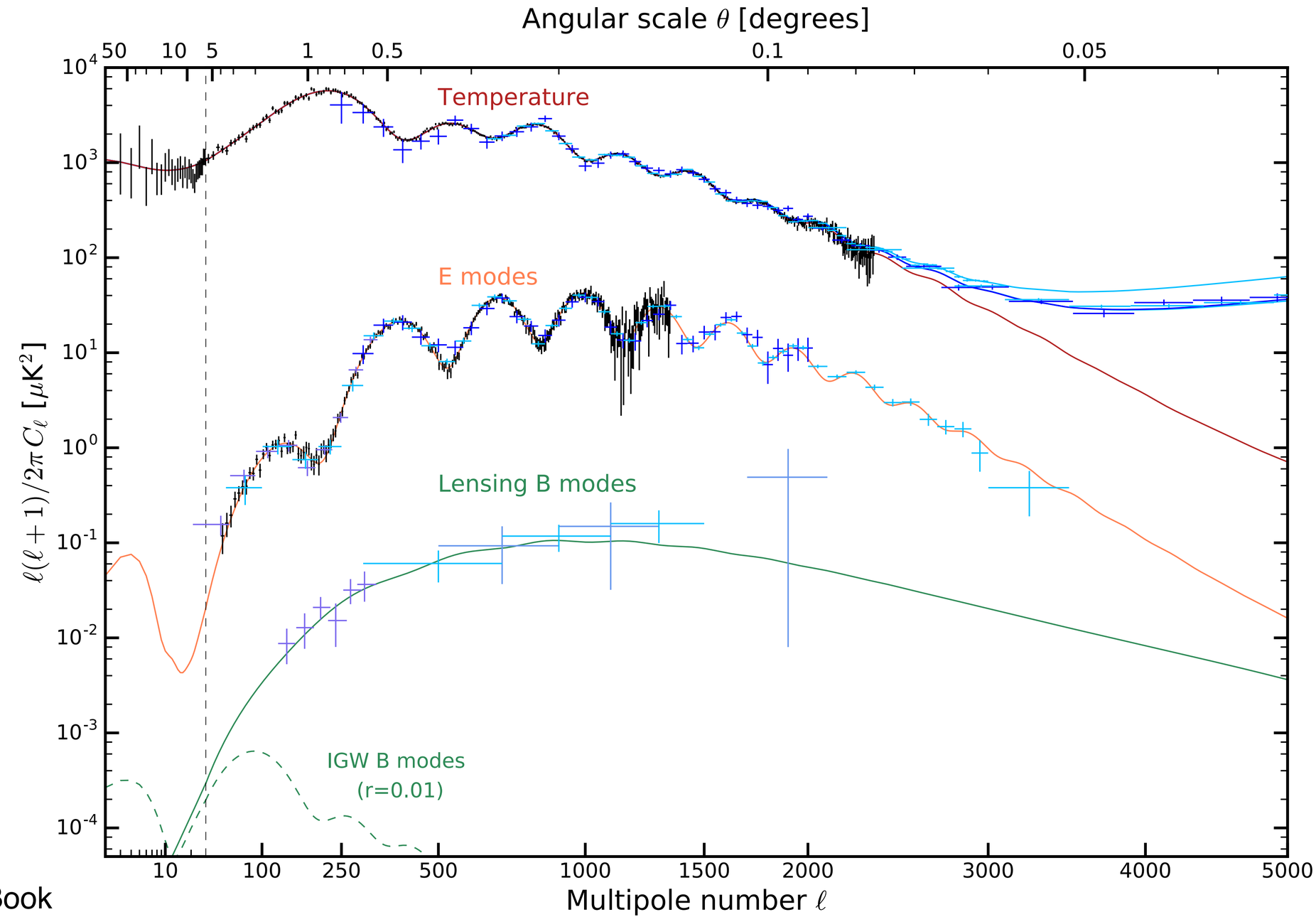
- Hanson, 2013 (BB Cross)
- Crites, 2015 (EE, TE)
- Keisler, 2015 (BB Auto)
- Story, 2015 (ϕϕ)
- Whitehorn, 2016 (Transients)

SPTsz - 2500 deg^2

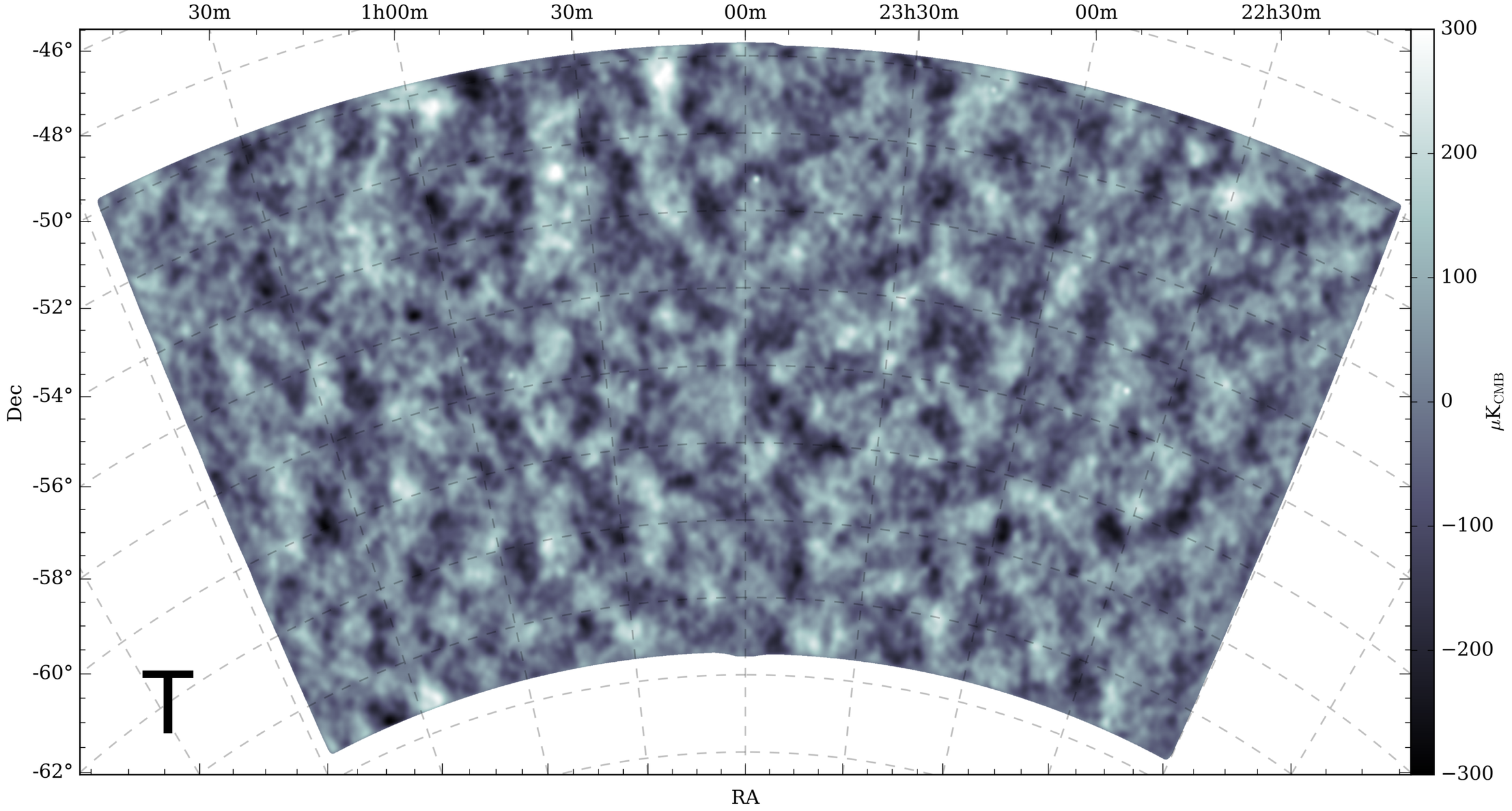
~ 18 μK-arcmin map depth (T)



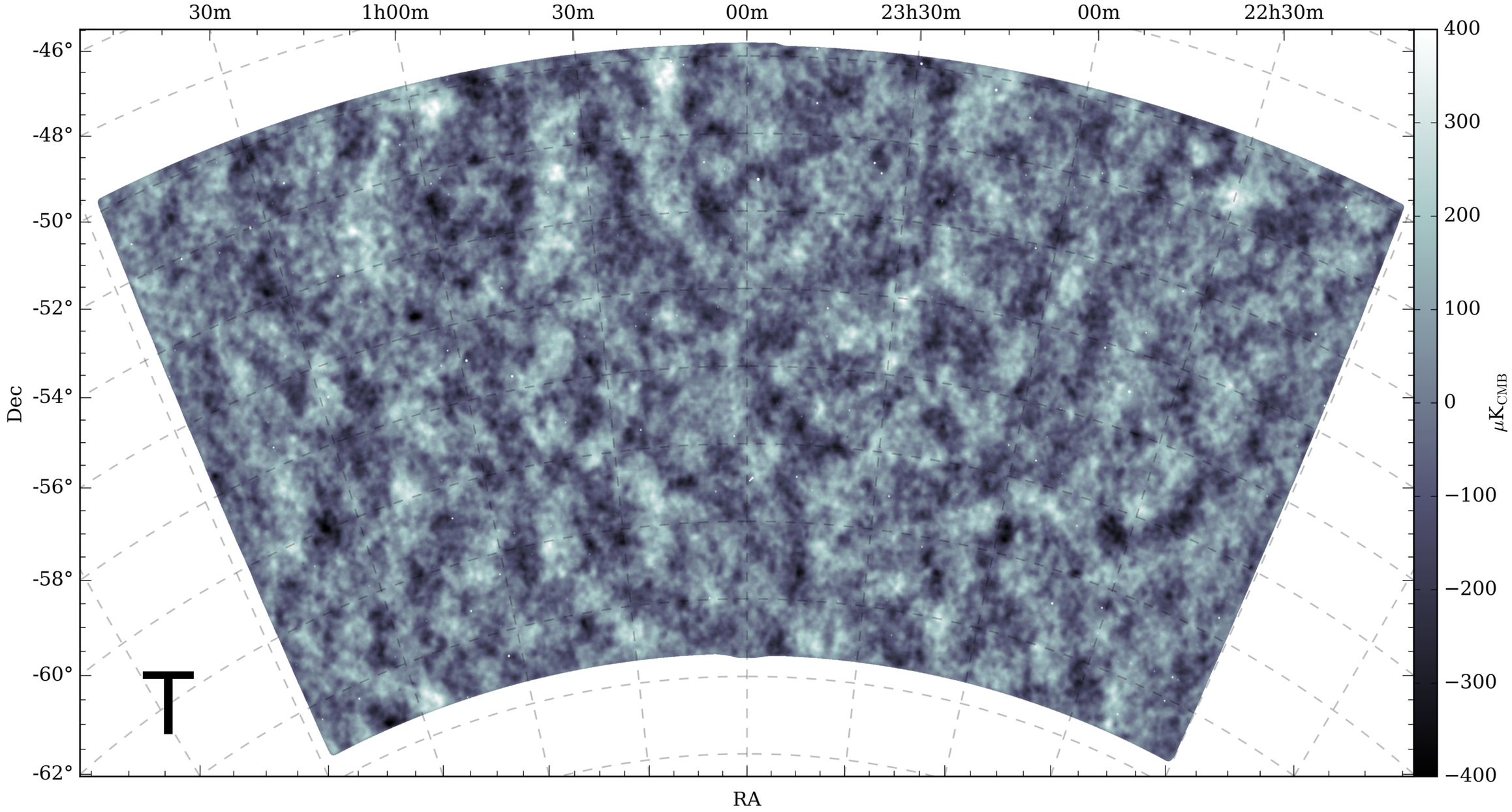
CMB Angular Power Spectra



Modified from
CMB-S4 Science Book

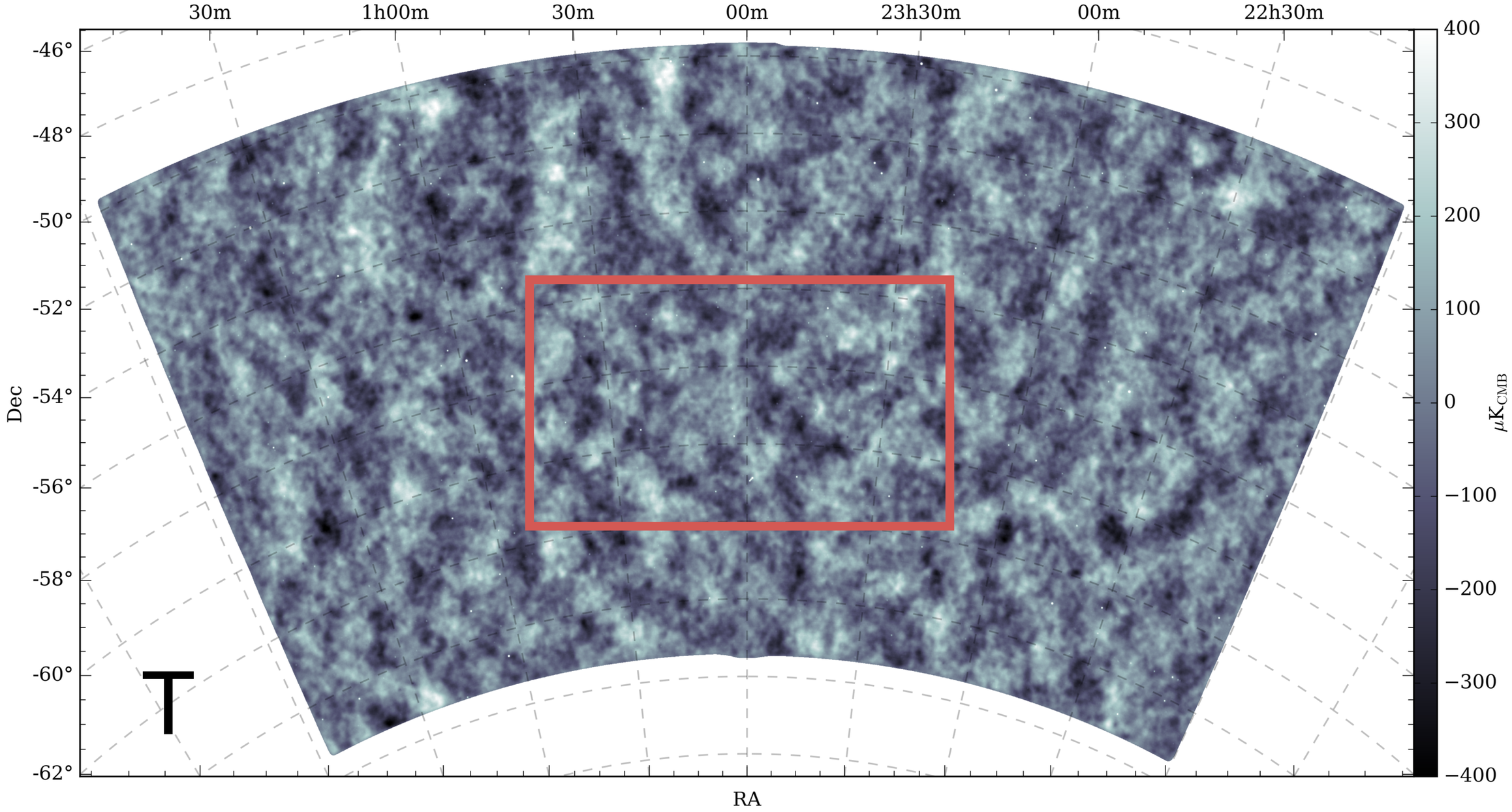


Planck 143 GHz



SPTpol 150 GHz

- White noise floor of ~ 7 μK-arcmin.
- May 2013 - Oct 2015



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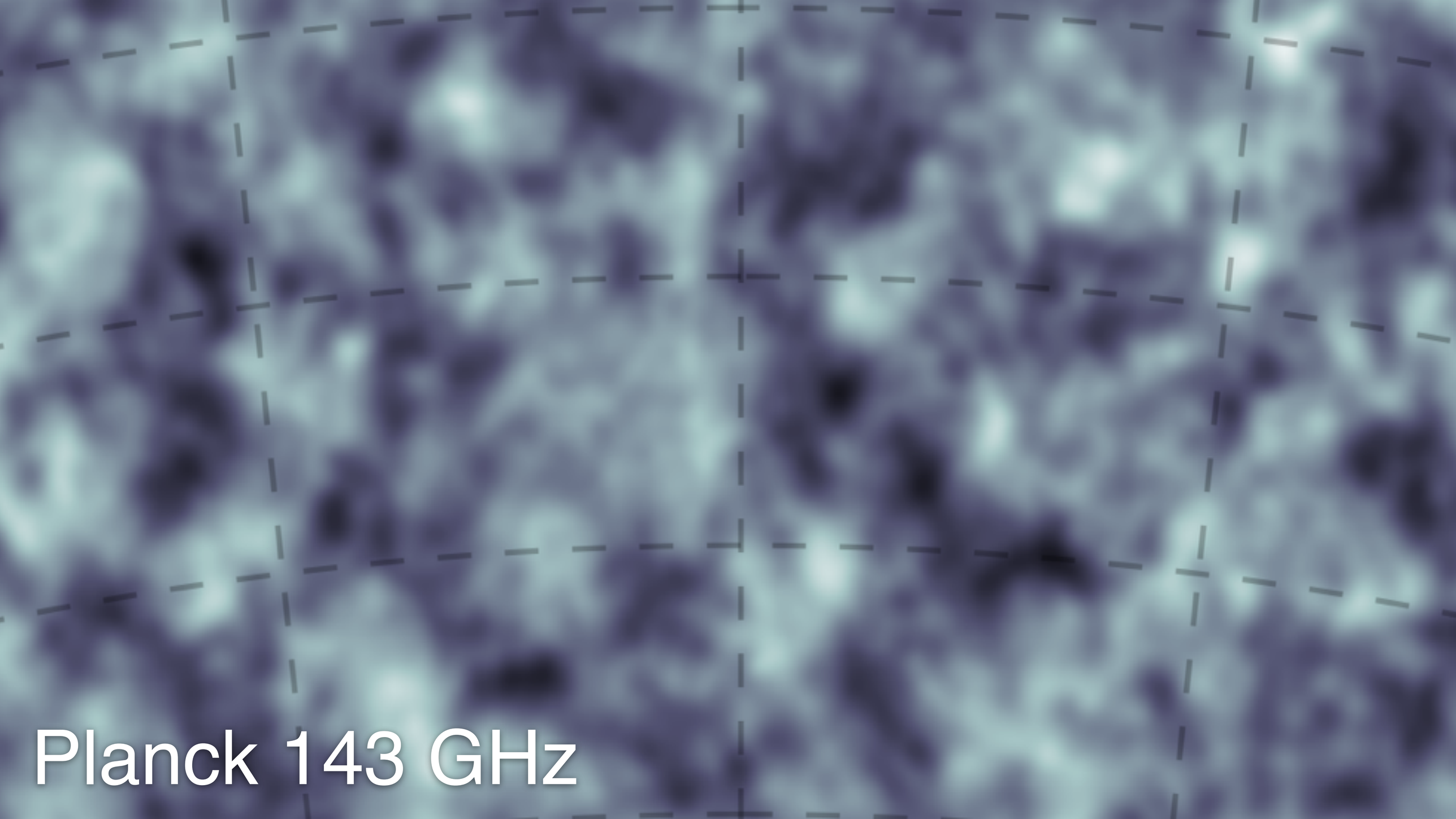
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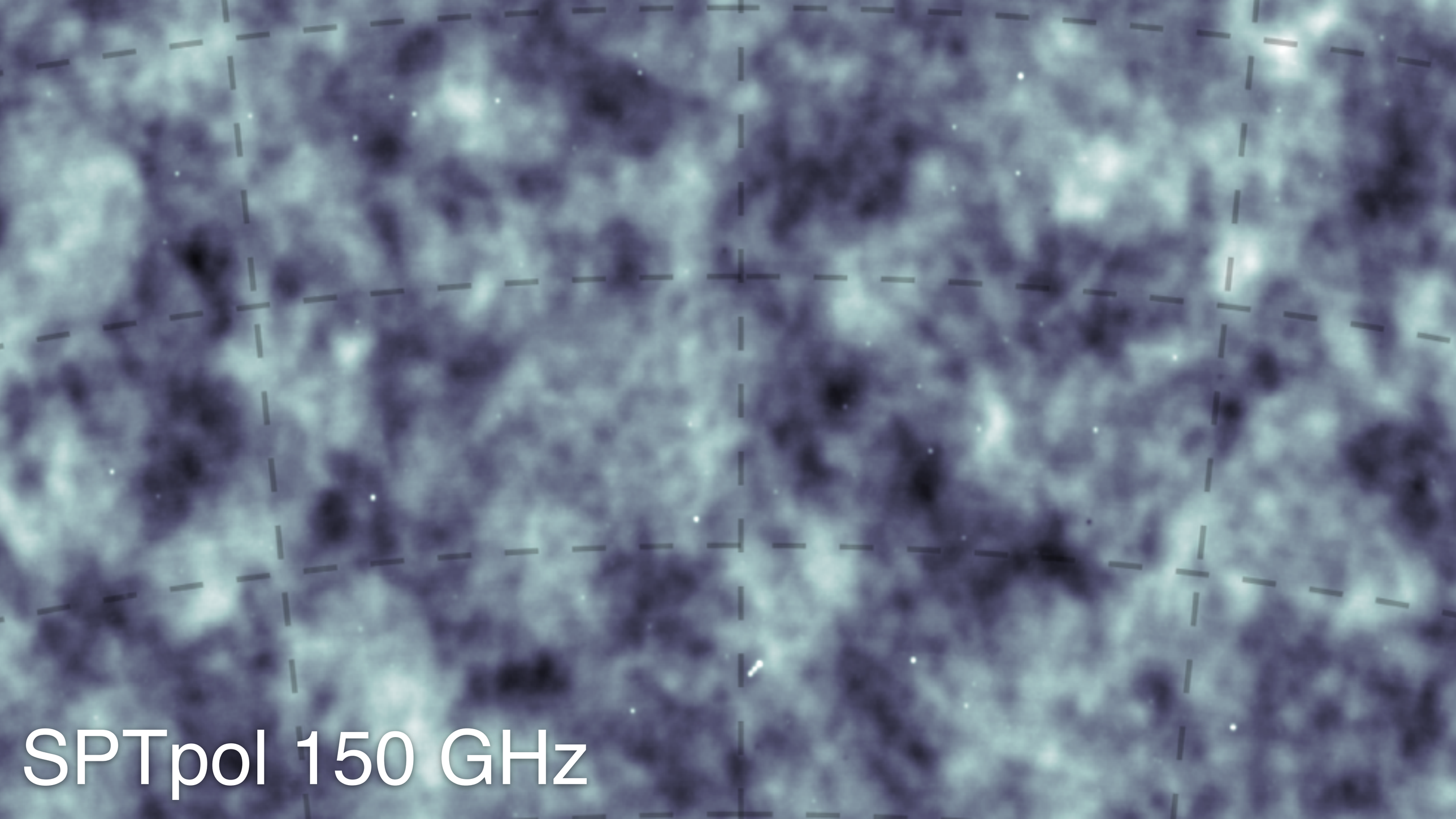
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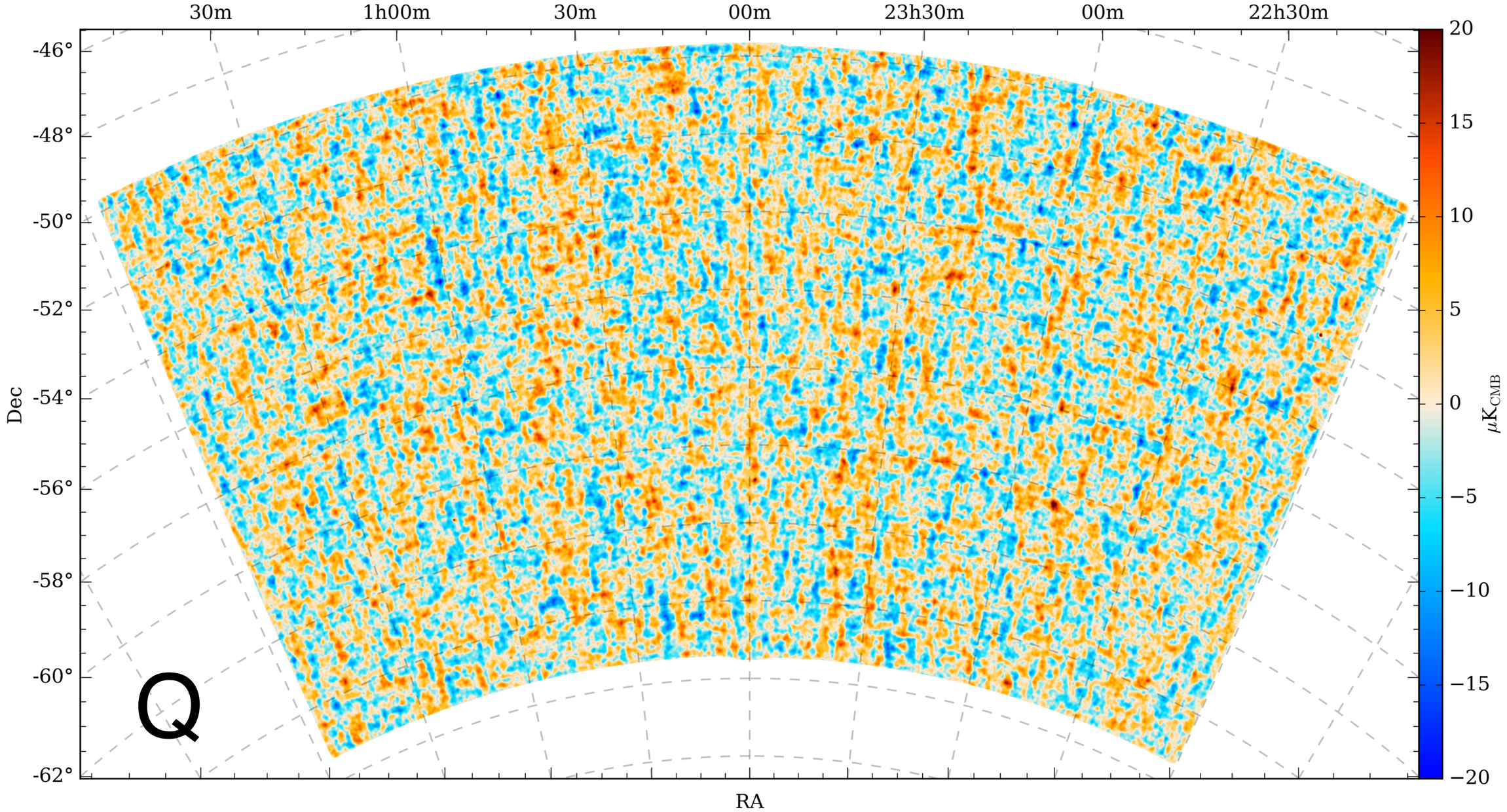
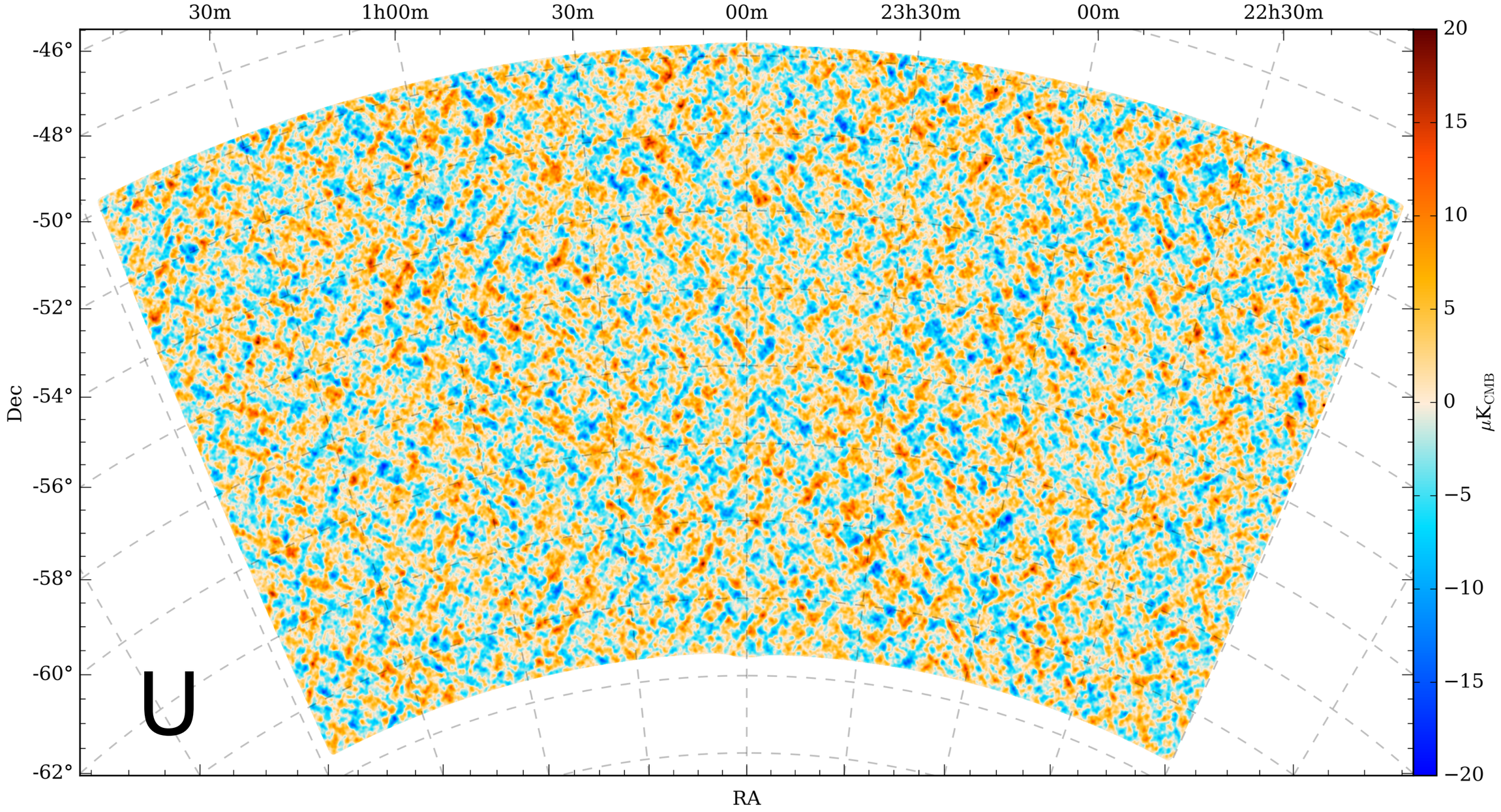


SPTpol 150 GHz

- 9.4 μK-arcmin between $2000 < \ell < 4000$.
- Smoothed by 4 arcmin FWHM Gaussian.



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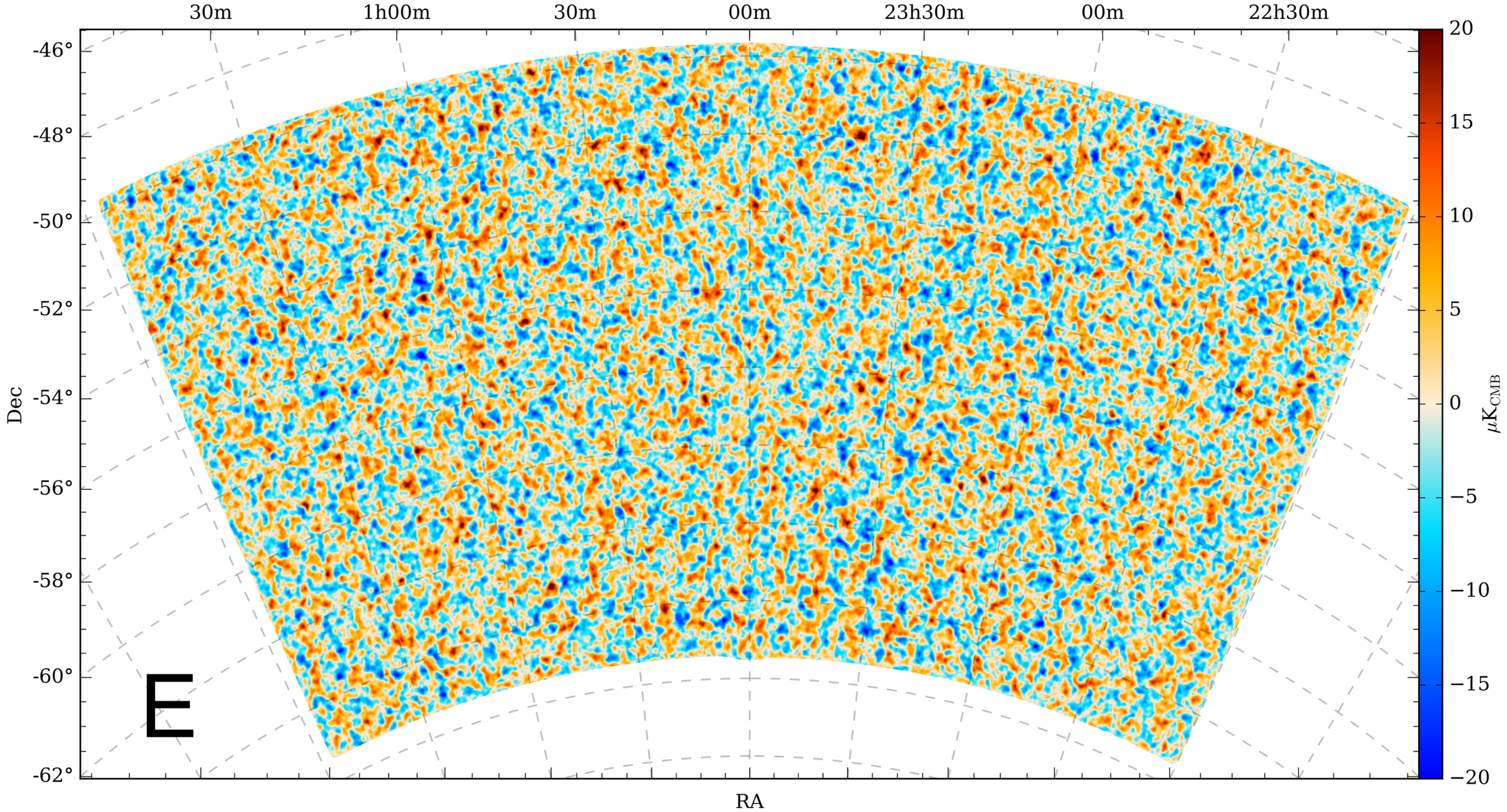

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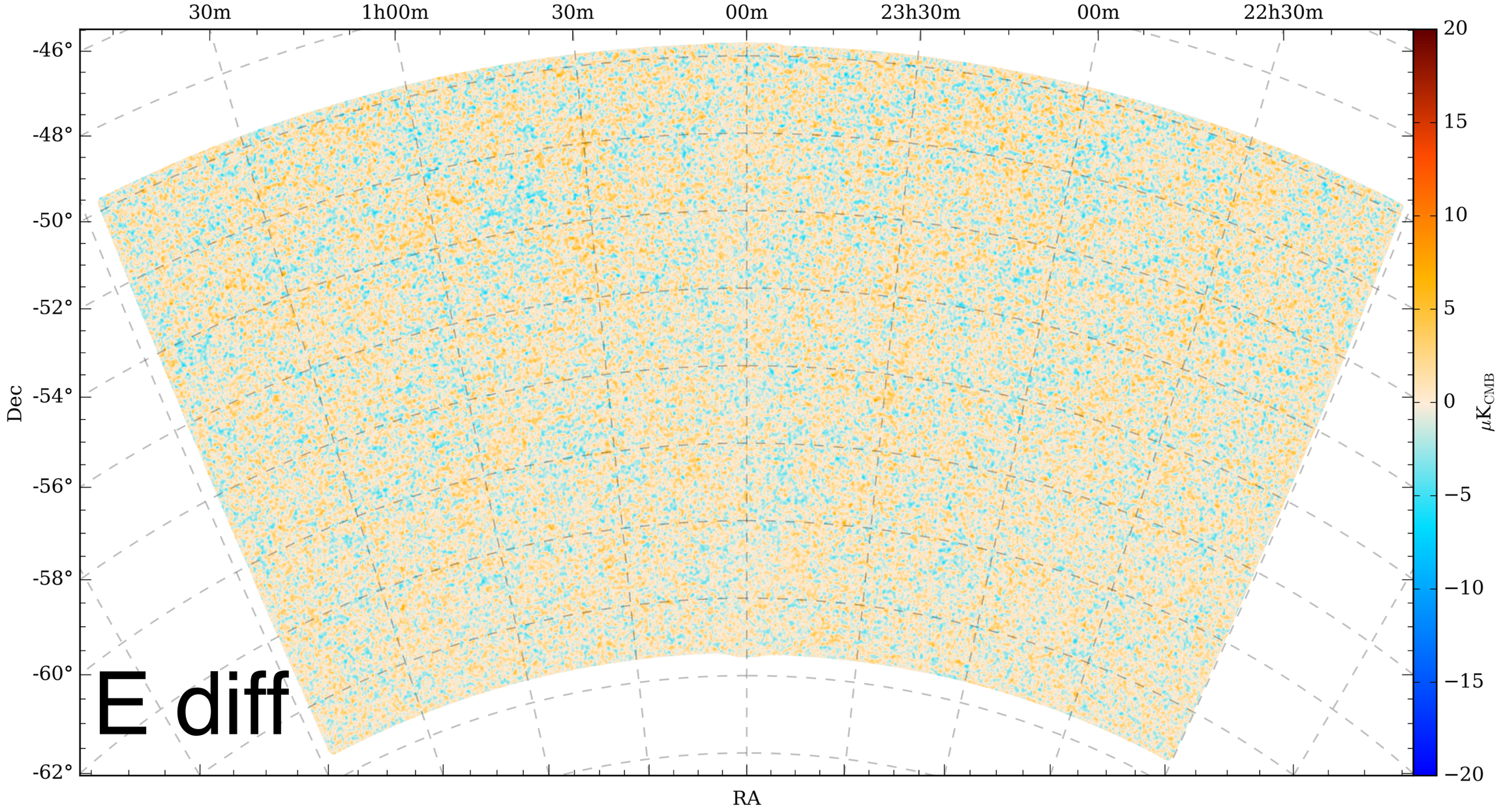
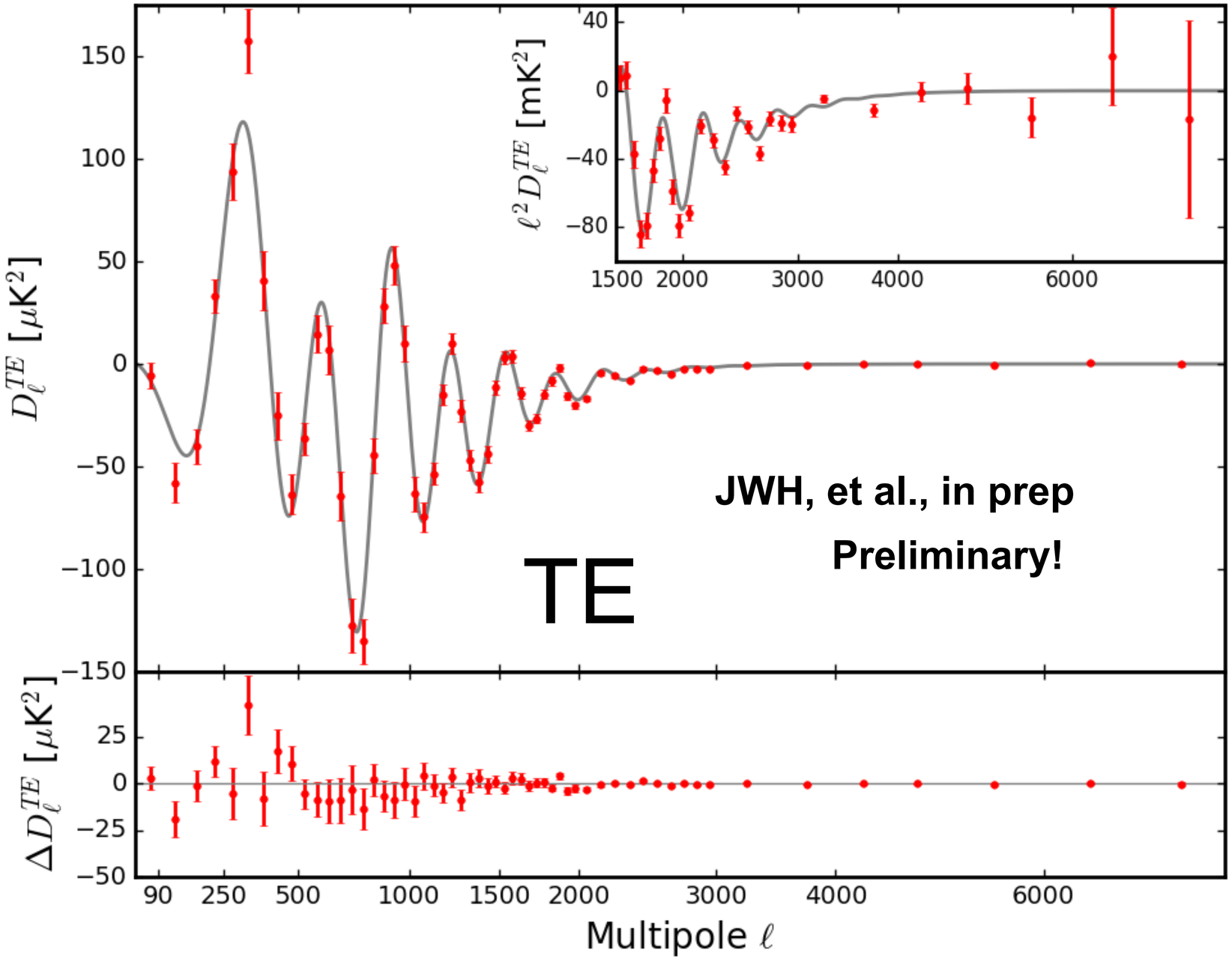


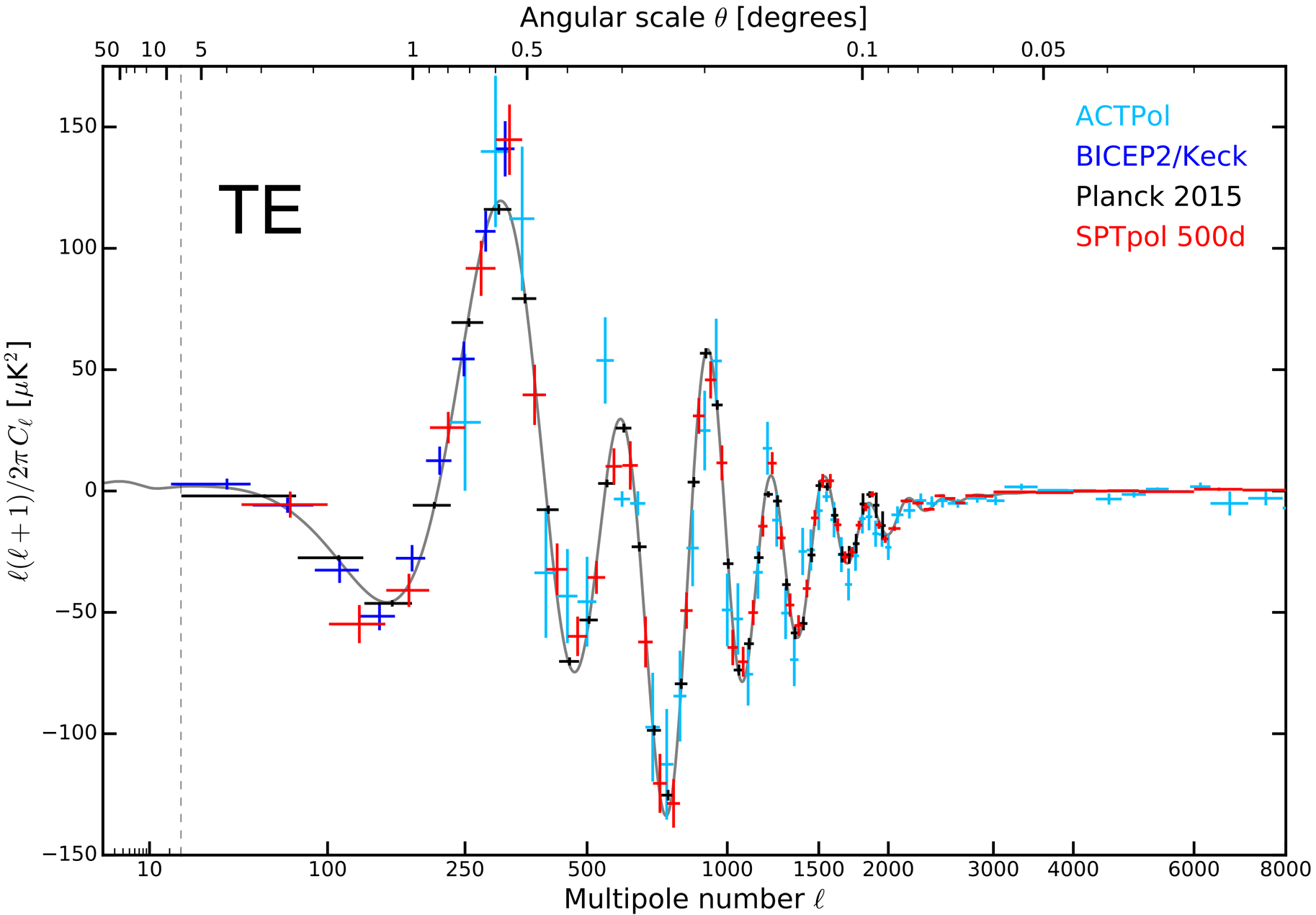
SPTpol 150 GHz - First-half map minus second-half map.

Survey Field Power Spectra

- Theory is Planck plikHM_TT_lensing_lowTEB
- Only sample and noise variance
- **182**σ rejection of no-TE hypothesis.
- Sample-variance limited at $\ell < 2050$

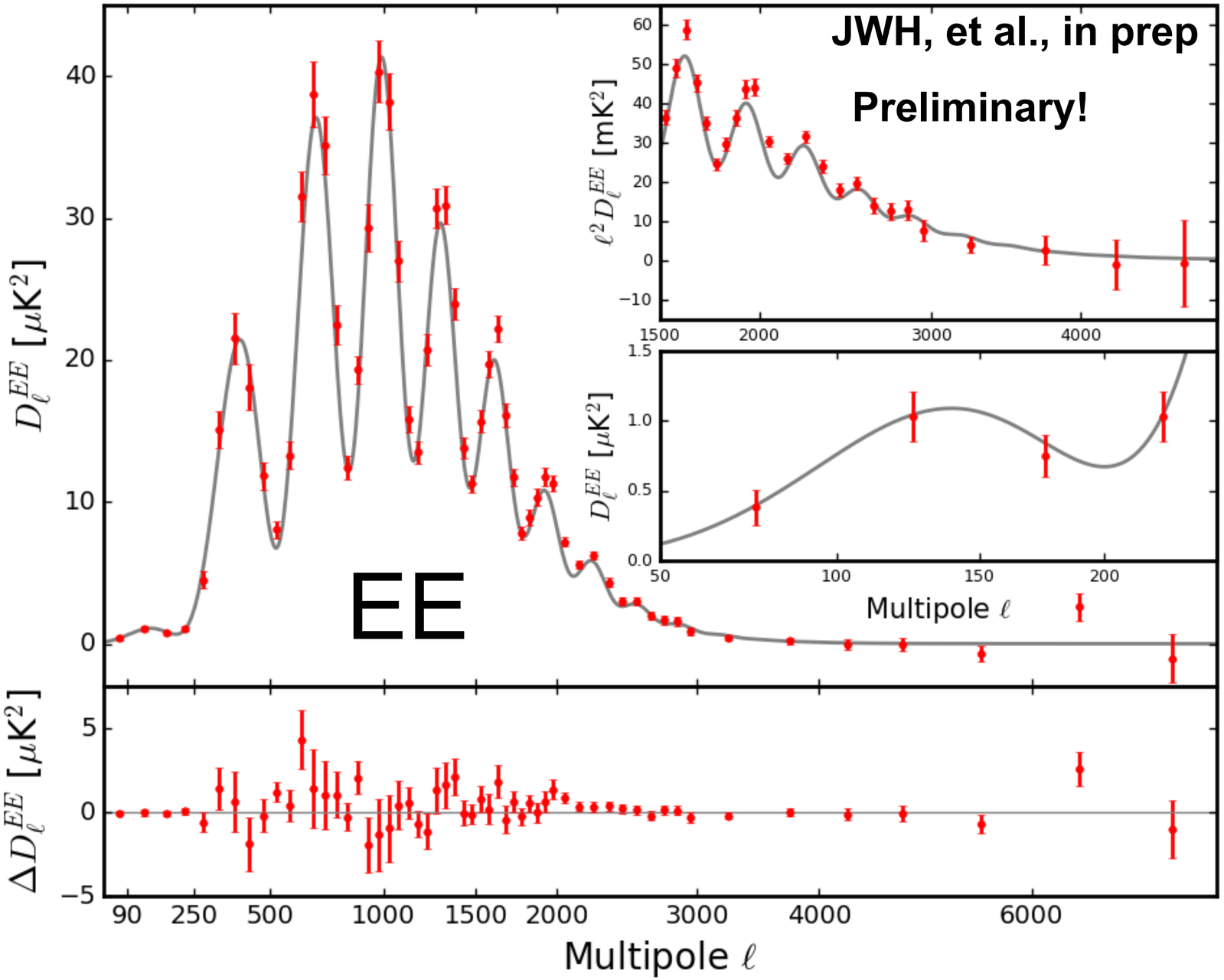


Compilation of TE Measurements

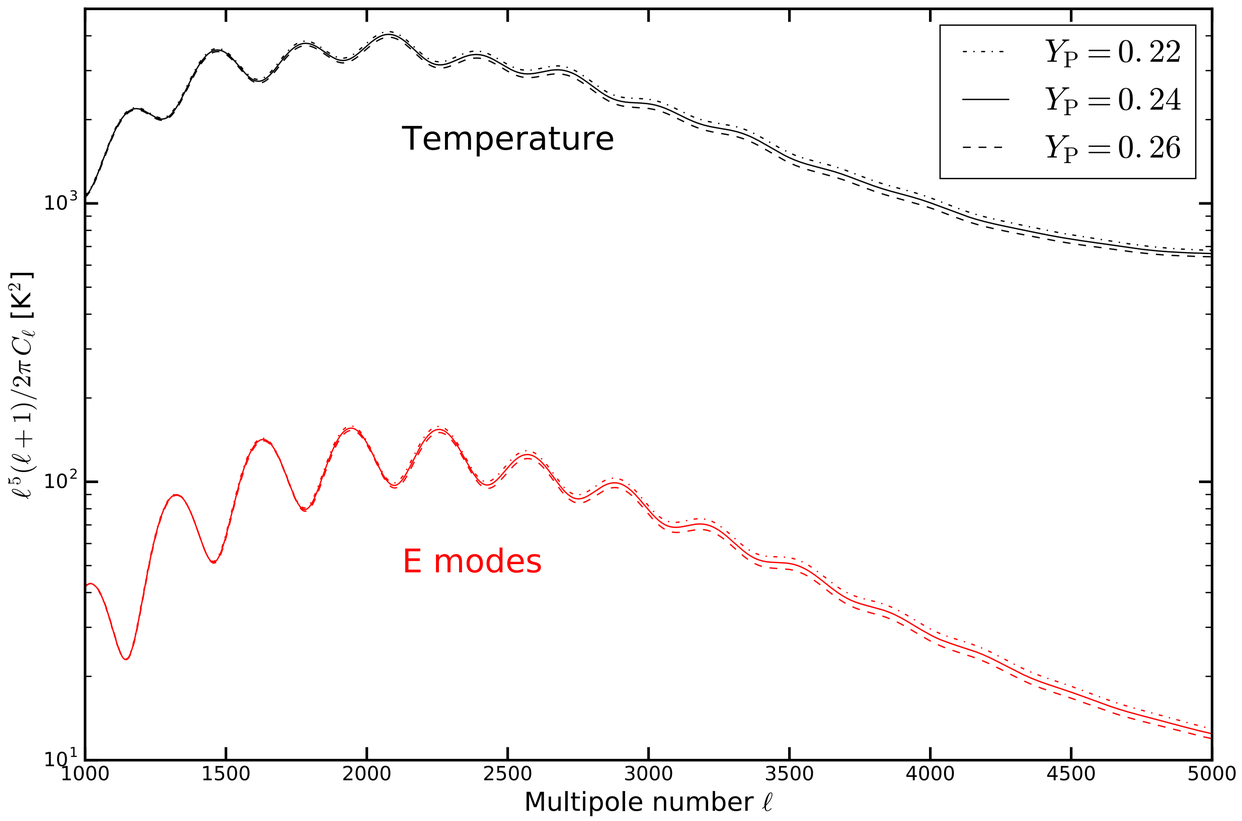


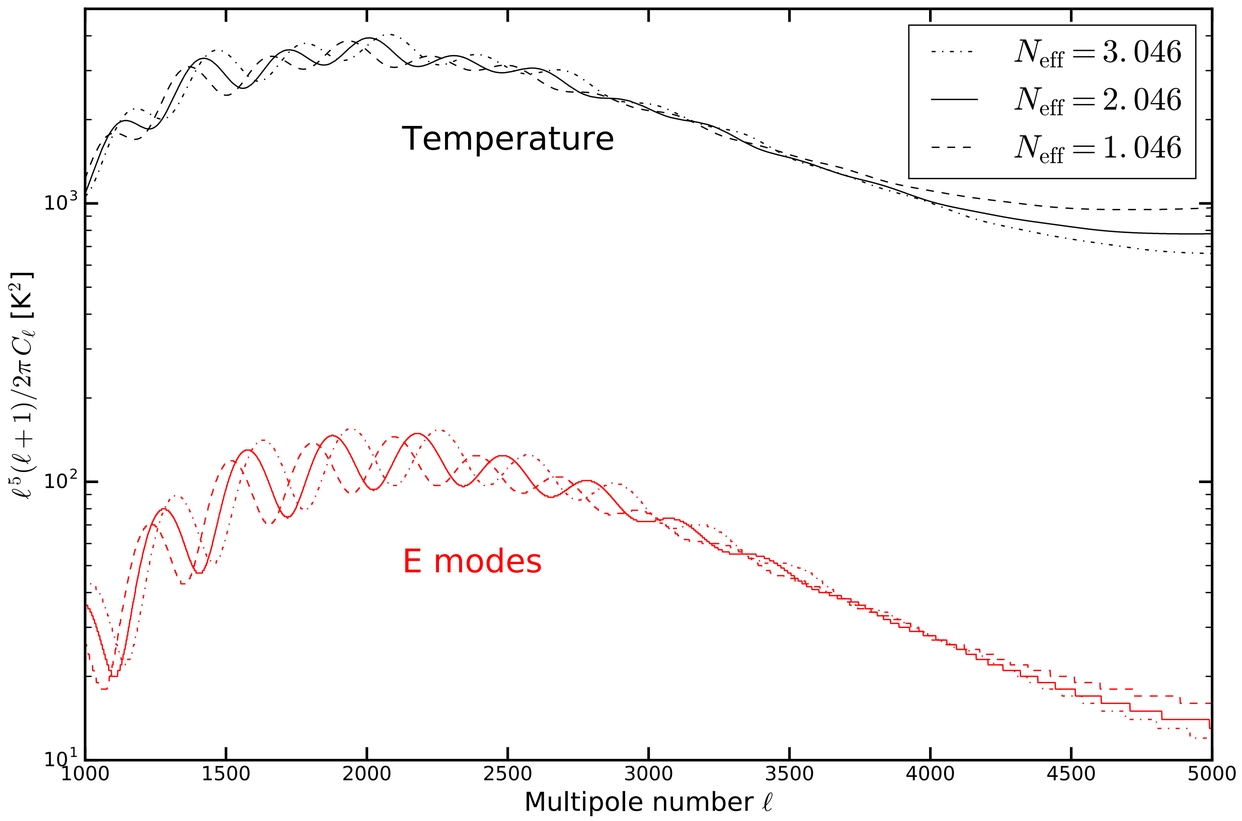
Survey Field Power Spectra

- **320σ** rejection of no-EE hypothesis.
- Sample-variance limited at $\ell < 1750$
- 9 acoustic peaks between $50 < \ell < 3000$
- **$D_\ell^{PS} < 0.1$ μK2 at 95% confidence**
  - **(Contributes < 1 μK-arcmin to rms map noise).**
  - Weak source cut at > 50 mJy in T.
  - Poisson power crosses EE at $\ell \sim 3800$.
  - Minimal foregrounds!



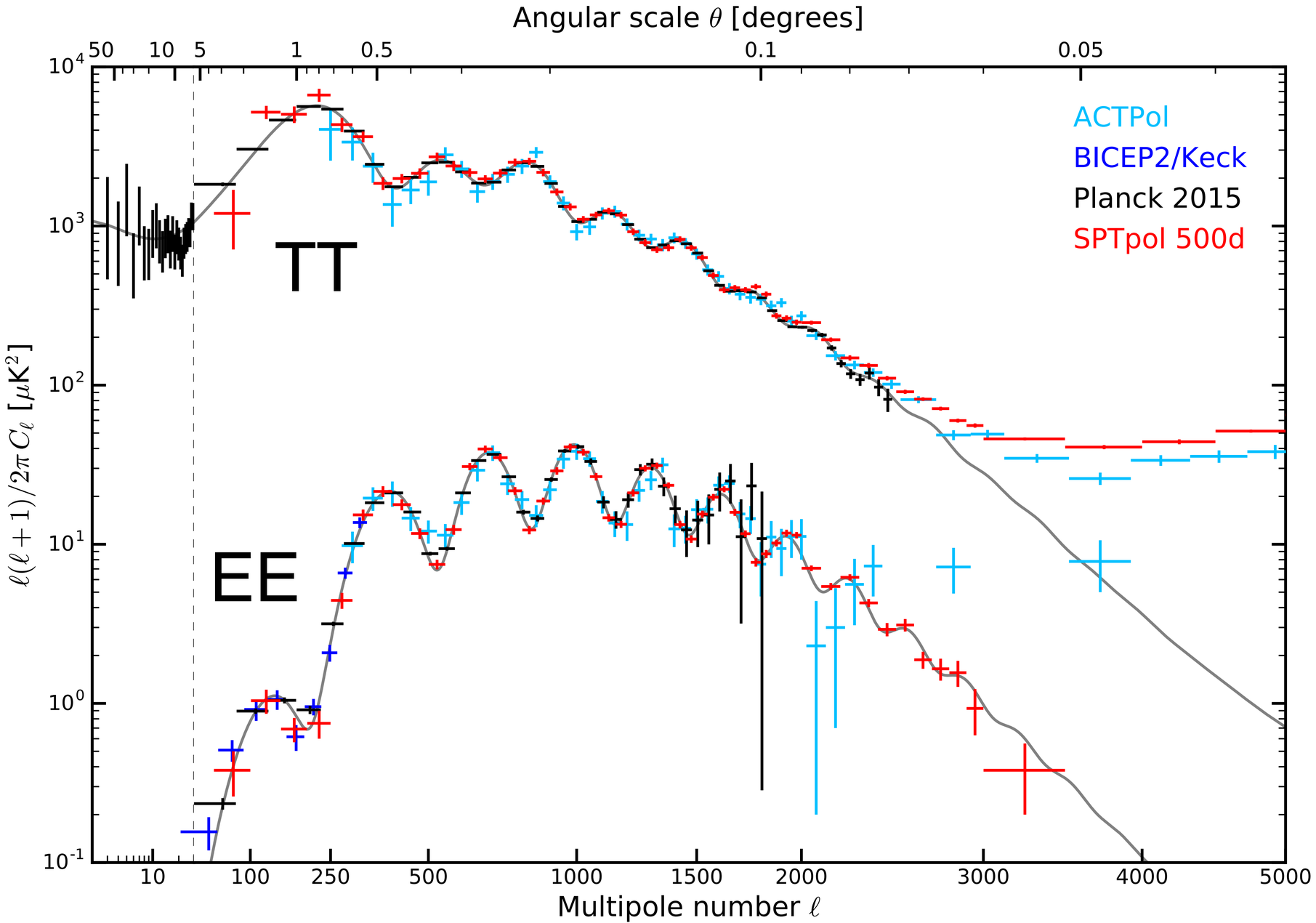
Uncovering the Damping Tail

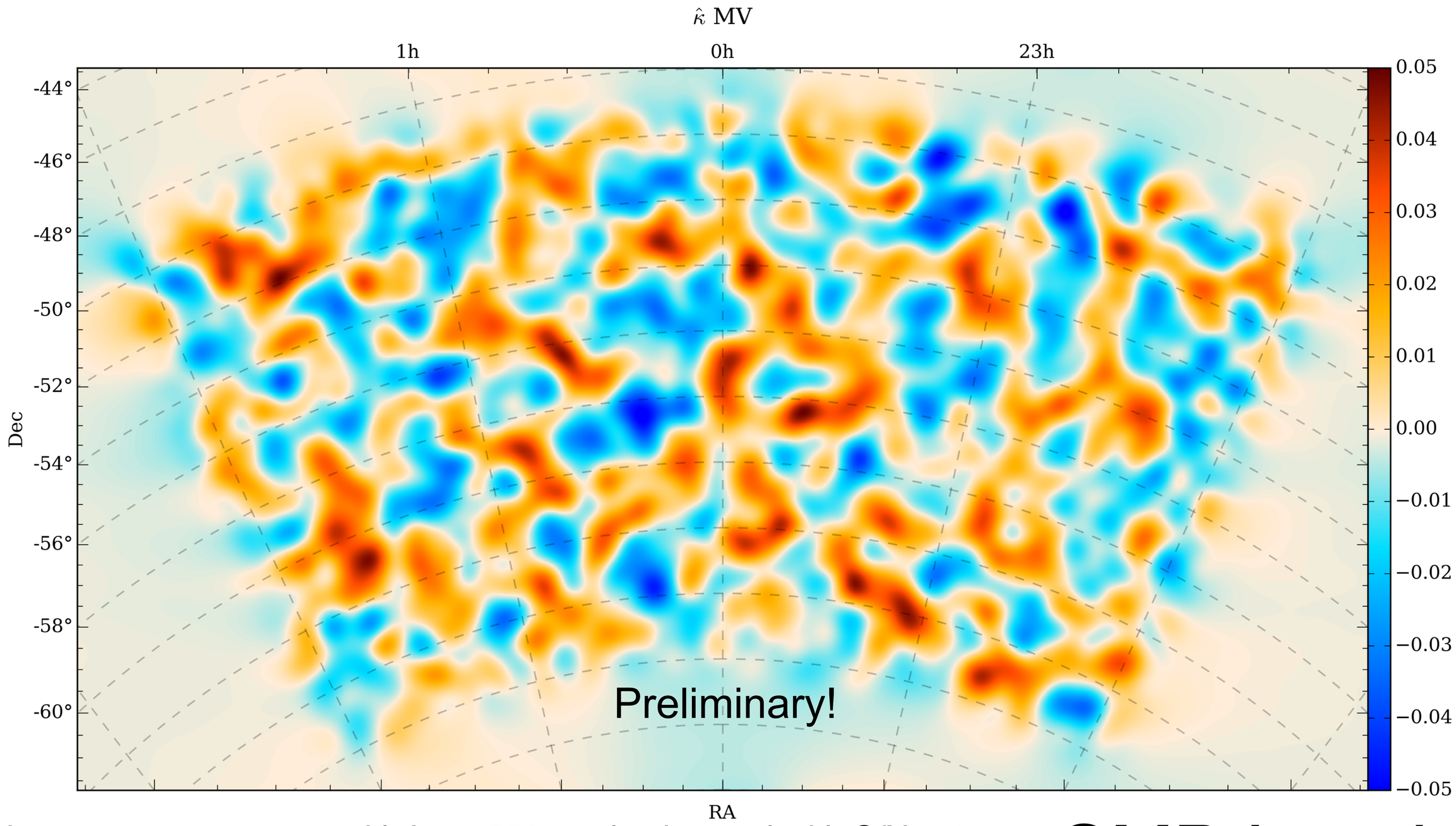




- Measurements at intermediate angular scales inform us about neutrino and helium content.

Compilation of TT and EE Measurements

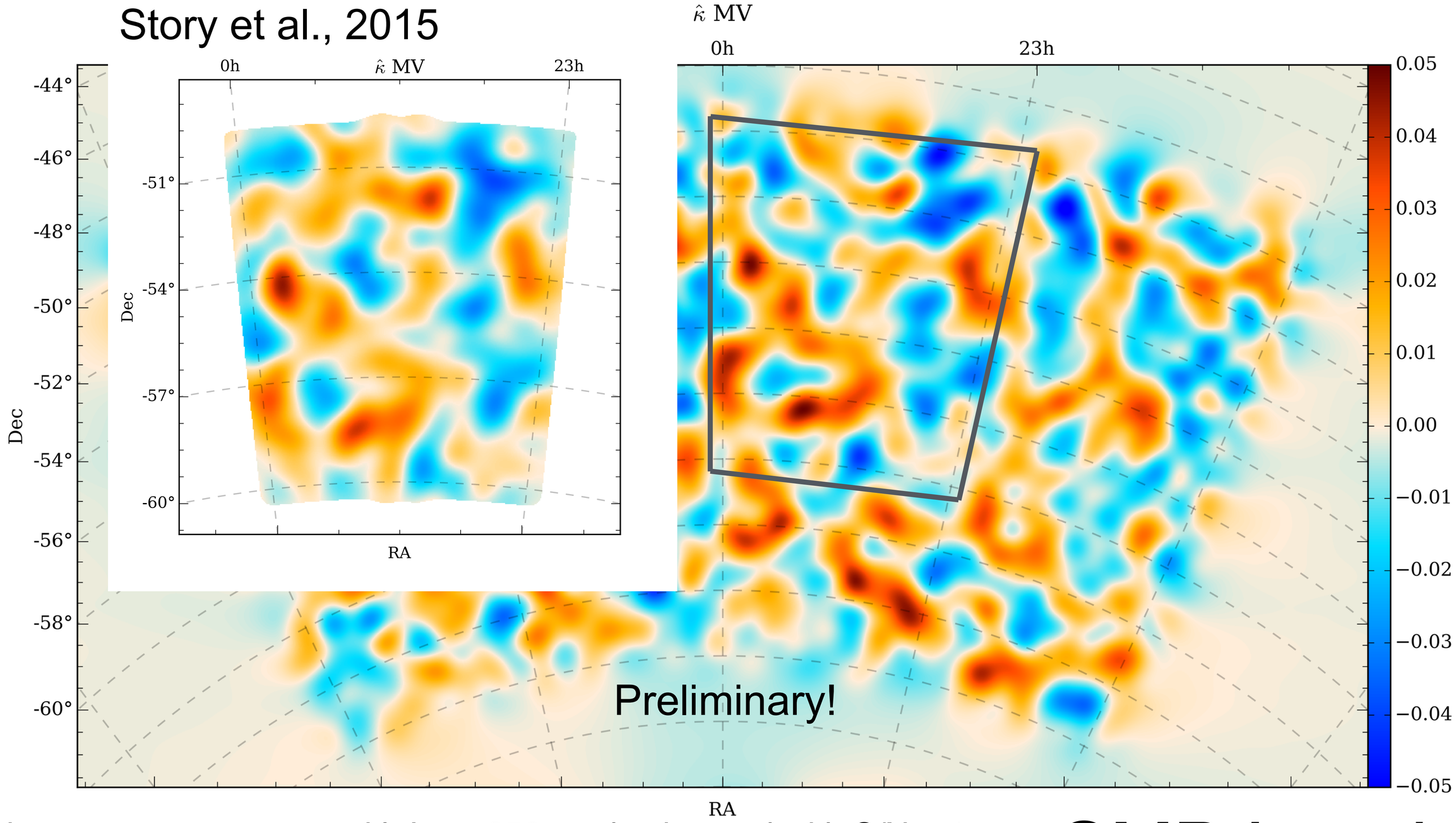




CMB Lensing

- Lensing convergence map with L ~< 250 modes imaged with S/N > 1.
- **Monica Mocanu (U. Chicago)**

Story et al., 2015



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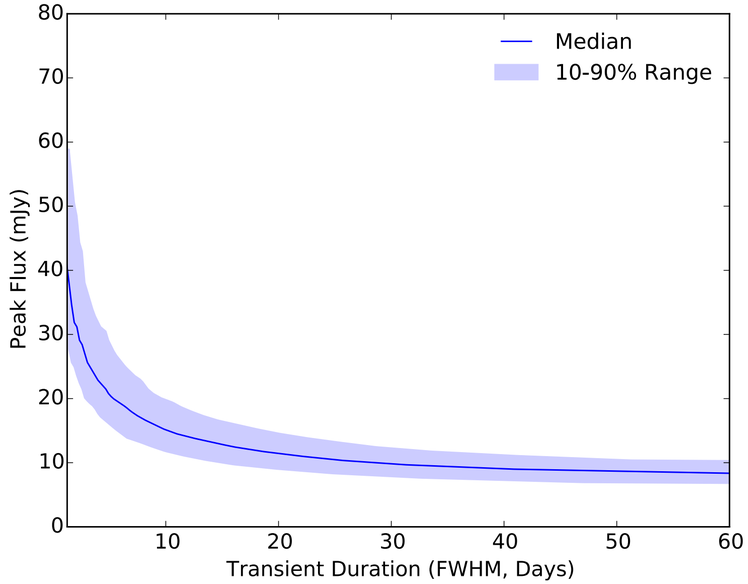
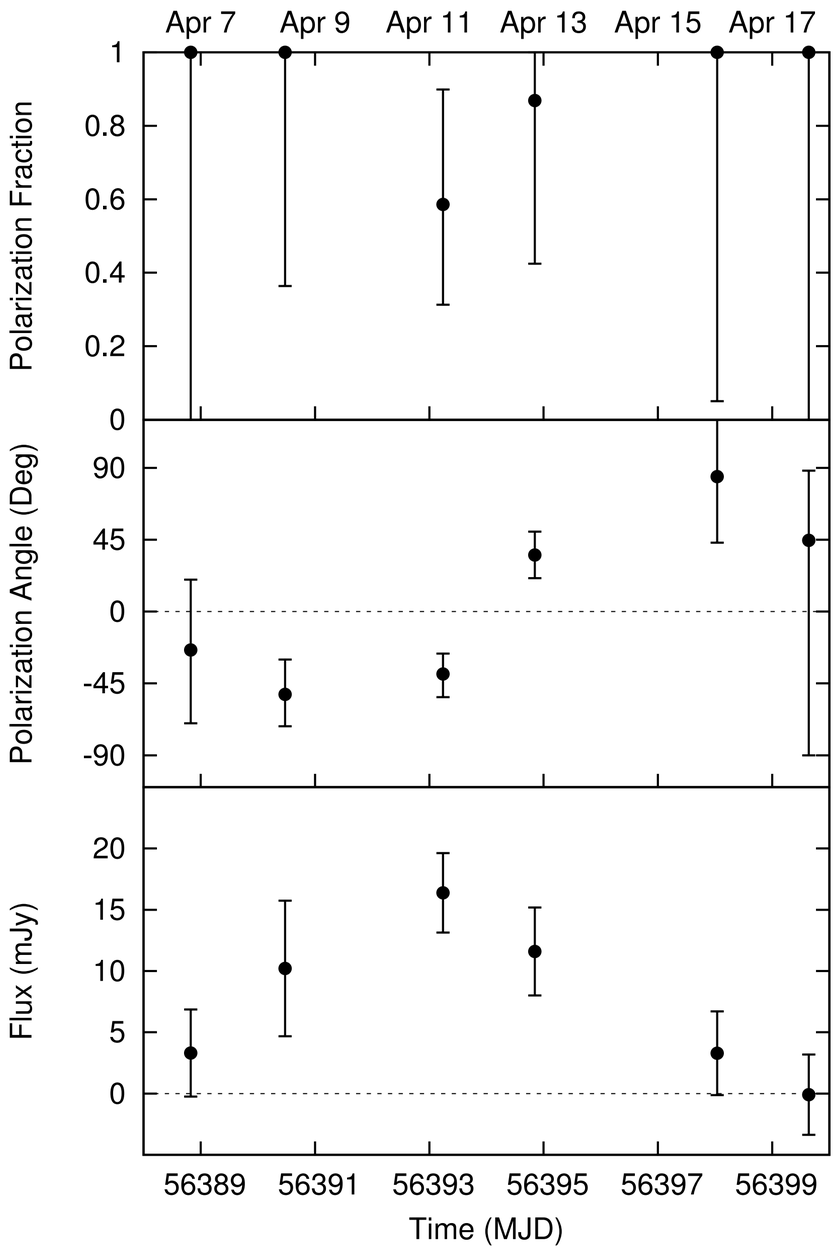
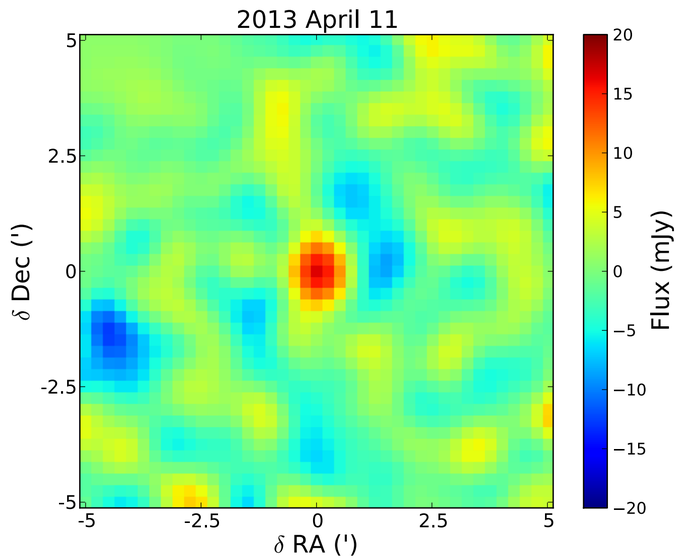
CMB Lensing

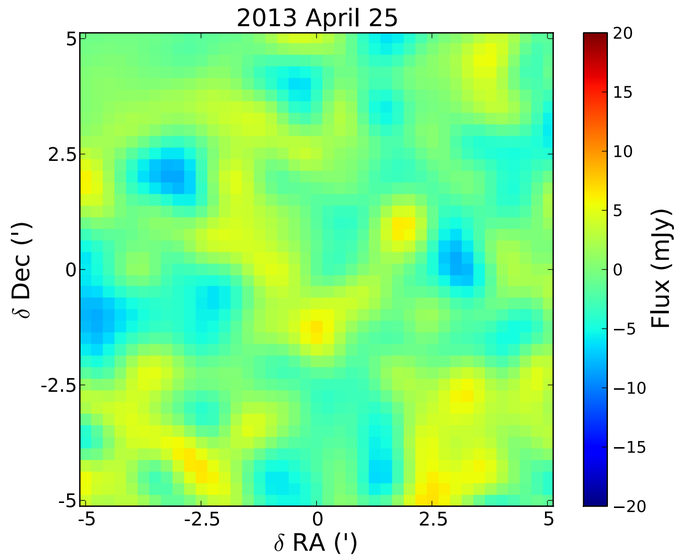
Transient Search

- **Whitehorn, Natoli, et al. accepted**
- Searches observations of 100 deg^2 field (2012-early 2013).
- SPTpol sensitive to ~ > 10 mJ transients over range of durations.
- Low significance candidate (PTE = 0.01) but broadly consistent with gamma-ray burst afterglow.

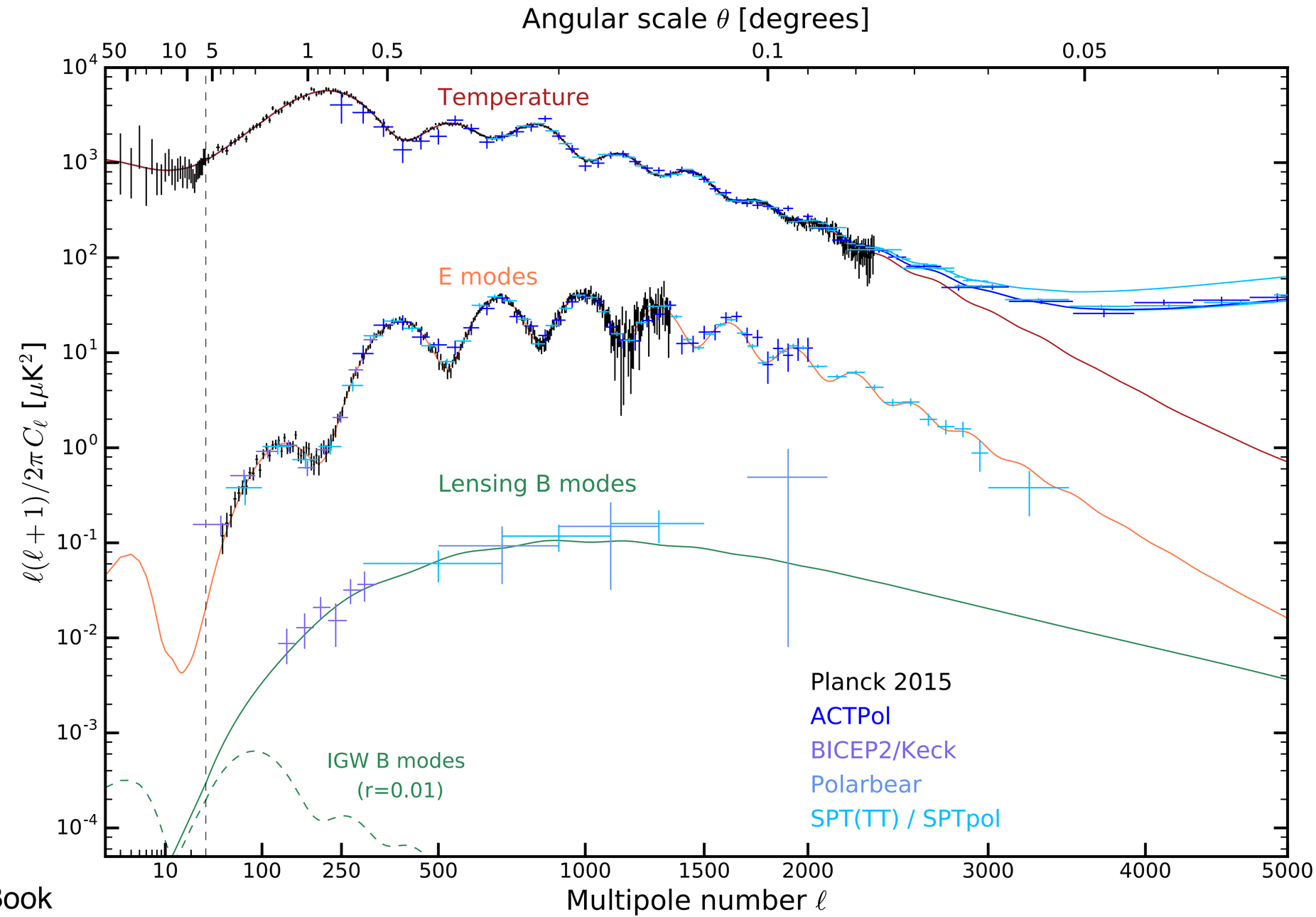








… Plus Much More



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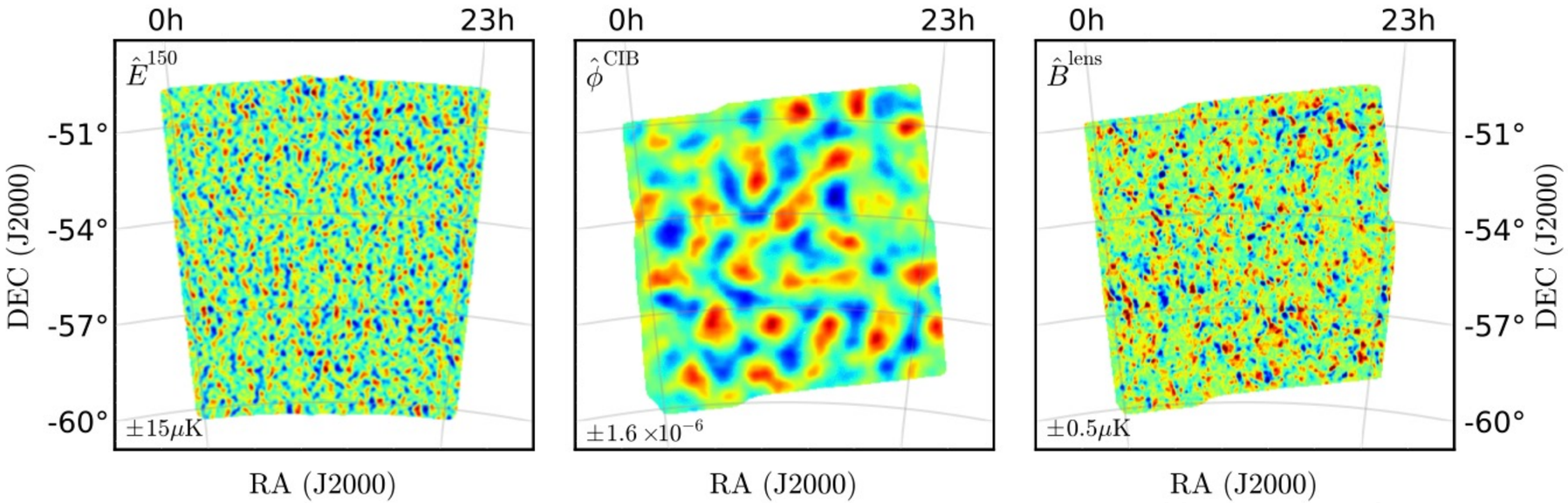
… Plus Much More

- Delensing of SPTpol 100d BB **(Manzotti, Story, Wu)**



Hanson, et al., 2013

- BB Auto from 500d **(Sayre)**
  - Extending Keisler et al. 2015 analysis to lower ℓ.
  - ~ Same depth, but five times the area.

- Delensing BICEP/Keck (SPTpol E modes, $\phi\phi$)

Summary

- Maps and power spectra from ~ 3 seasons of observing 500 deg^2 with SPTpol.
- Detect 9 acoustic peaks in EE between $50 < \ell < 3000$.
  - Probing deep into polarization damping tail for first time.
- Sample variance limited at $\ell < 1750$ (2050) in EE (TE) and become more sensitive than Planck at $\ell > 1100$ (1500) in EE (TE).
- $D_\ell^{PS} < 0.1$ μK2 at 95% confidence with weak source cut.
- Lensing spectrum and BB auto from 500 deg^2.
- Millimeter transient searches.
- SPT-3G deploys this fall: order of magnitude more detectors!