



UNIVERSITY OF
CAMBRIDGE

IRENE ABRIL-CABEZAS

ACT Collaboration, *incl.* ACT lensing group (Blake Sherwin, Frank Qu, Mathew Madhavacheril, Joshua Kim, Karen Pérez Sarmiento, Anthony Challinor, +++++)

CMB LENSING FROM DAYTIME DATA: A FIRST DEMONSTRATION

New Physics from Galaxy Clustering at GGI, Firenze, Sept 2025



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CMB LENSING FROM DAYTIME DATA: A FIRST DEMONSTRATION



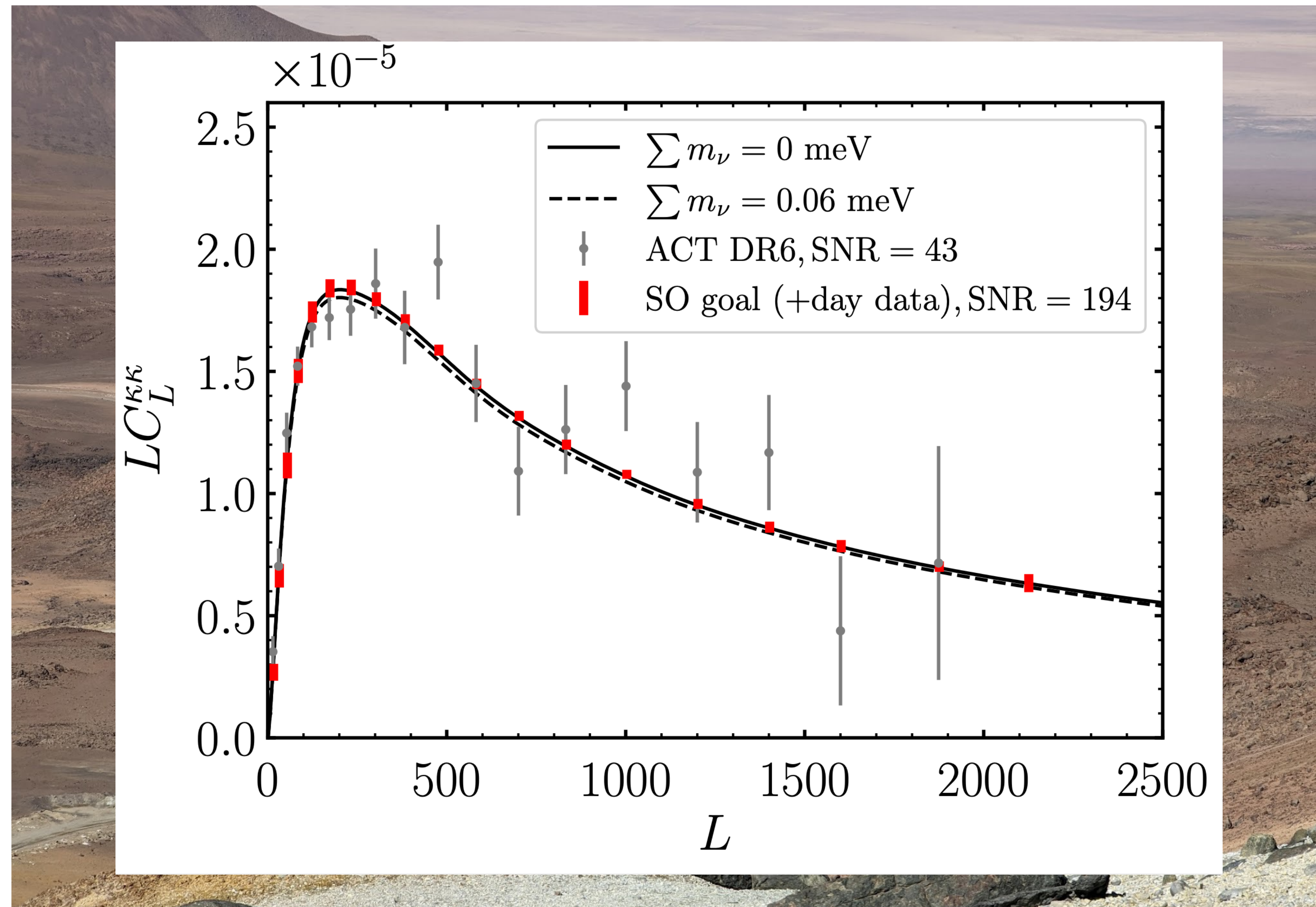
New Physics from Galaxy Clustering at GGI, Firenze, Sept 2025

CERRO TOCO, LLANO CHAJNANTOR, ATACAMA DESERT, CHILE

2



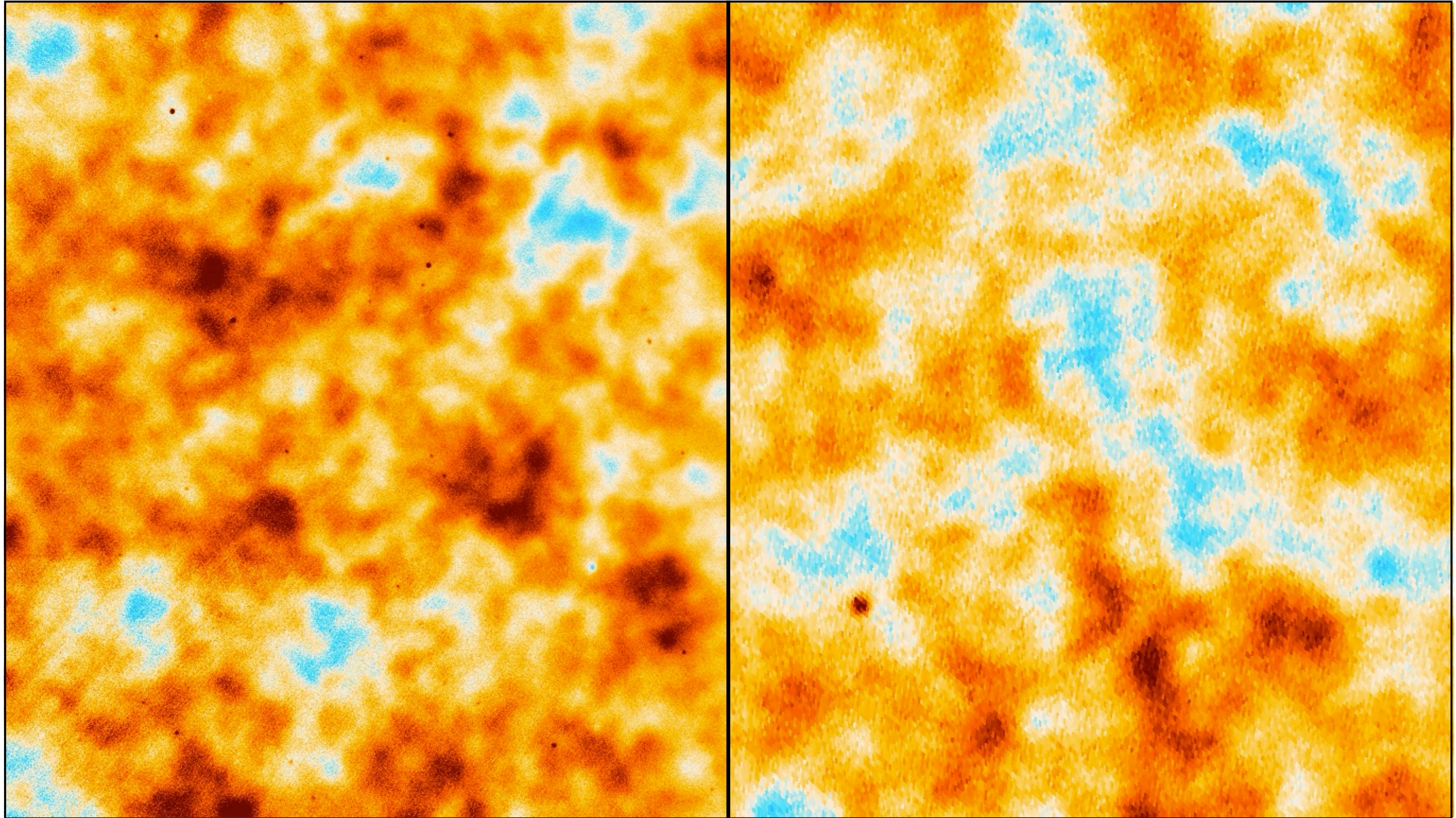
- ✓ 5200m altitude
- ✓ PWV ~1.2mm
- ✓ Low latitude (-23°)
- ✓ Excellent site for CMB observations

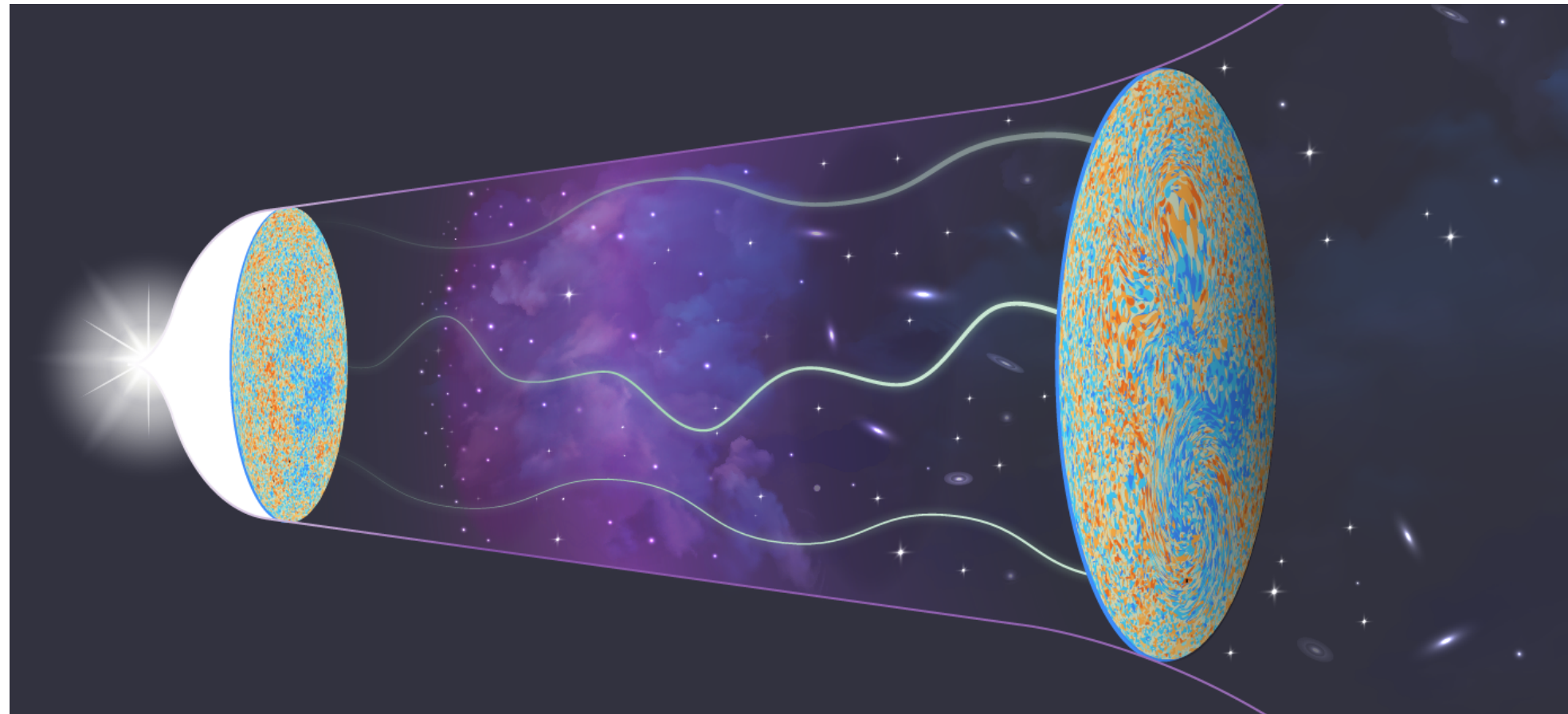


ACT + Planck

Planck

Source: Sigurd Naess and the ACTPol Collaboration

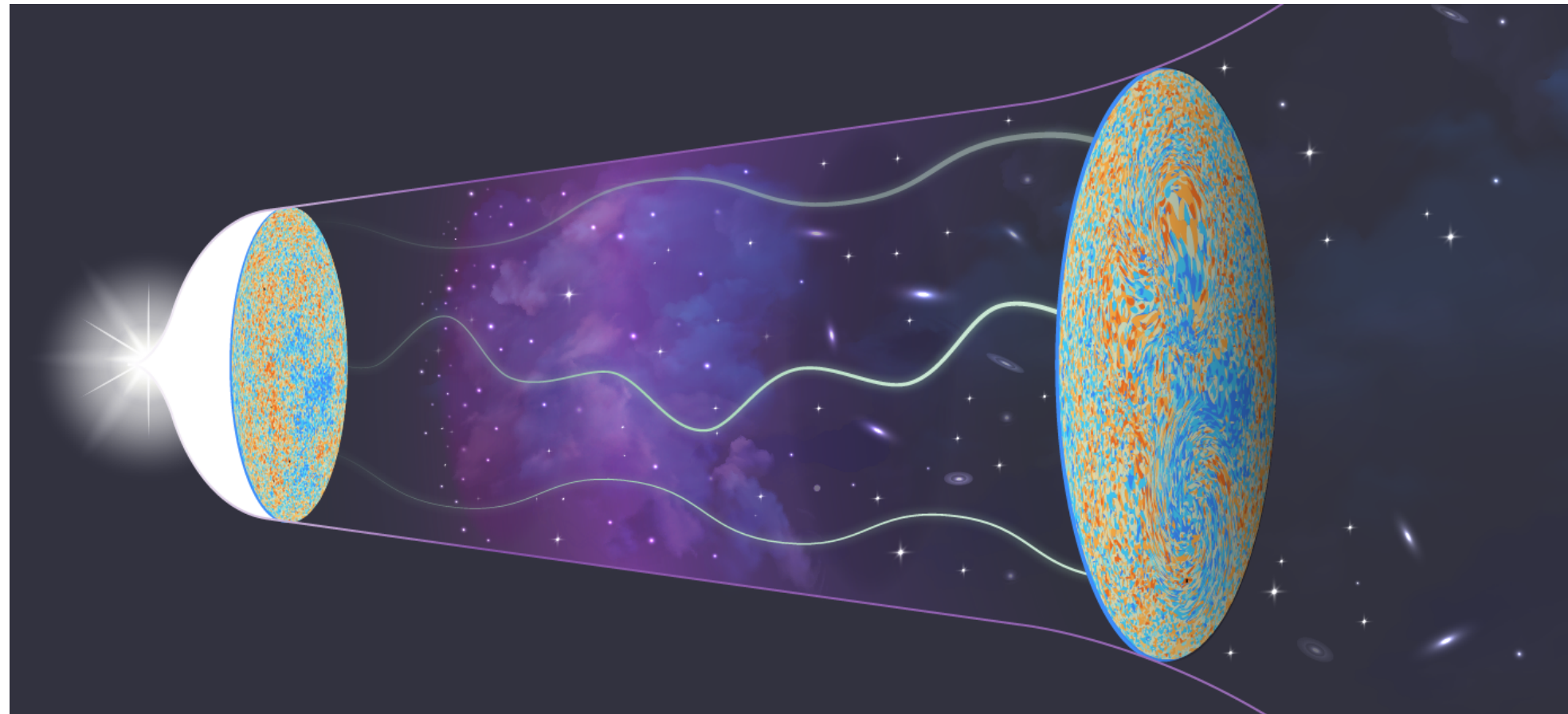




Lucy Reading-Ikkanda / Simons Foundation

Lensing changes the CMB statistics,
correlating formerly independent modes

$$\langle T(\mathbf{l}) T^*(\mathbf{l} - \mathbf{L}) \rangle \propto \phi(\mathbf{L})$$



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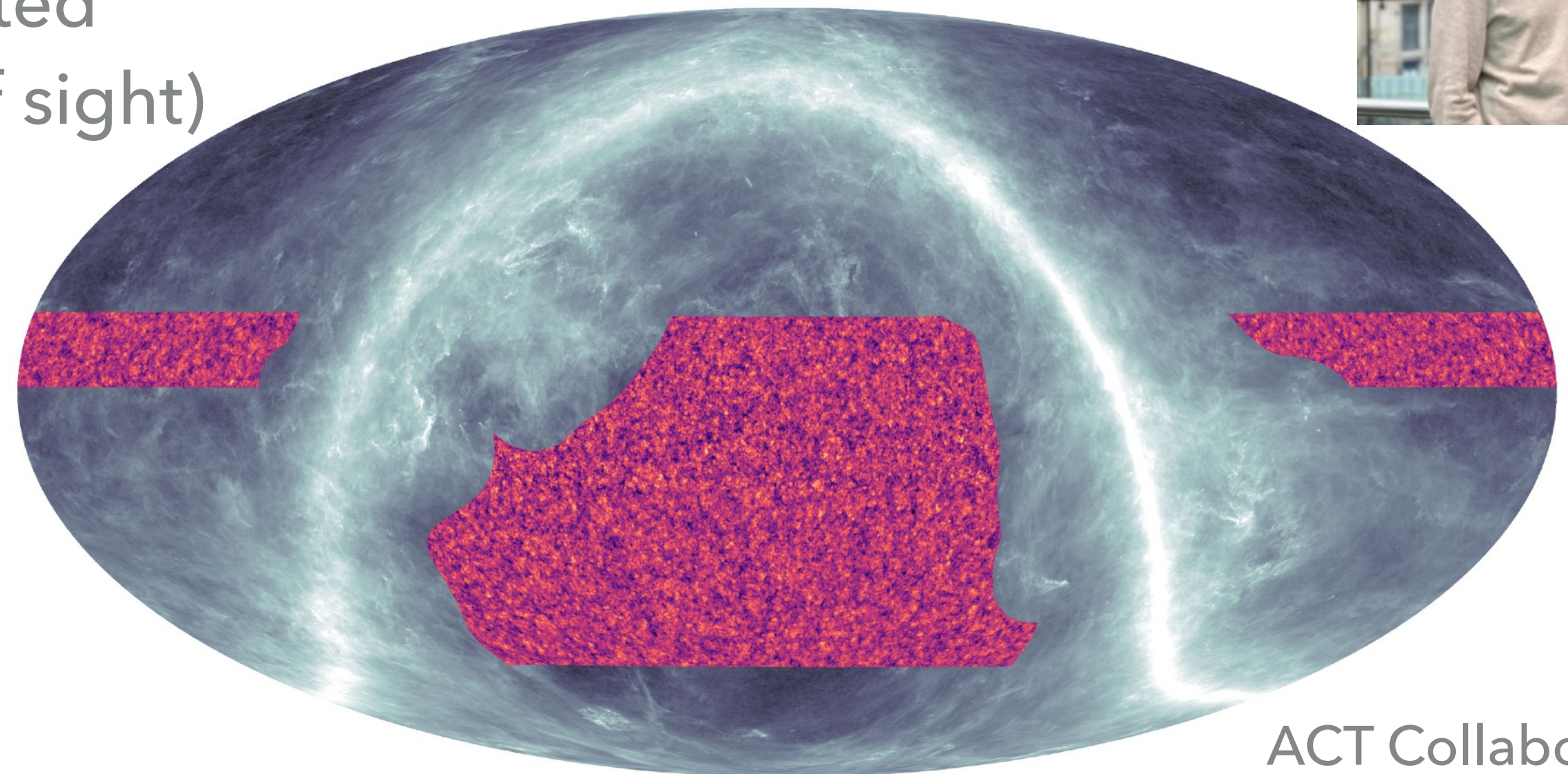
$$\langle T(\mathbf{l}) T^*(\mathbf{l} - \mathbf{L}) \rangle \propto \phi(\mathbf{L})$$

Matter density
field (projected
along line of sight)

Use this to reconstruct $\phi(\mathbf{L})$:

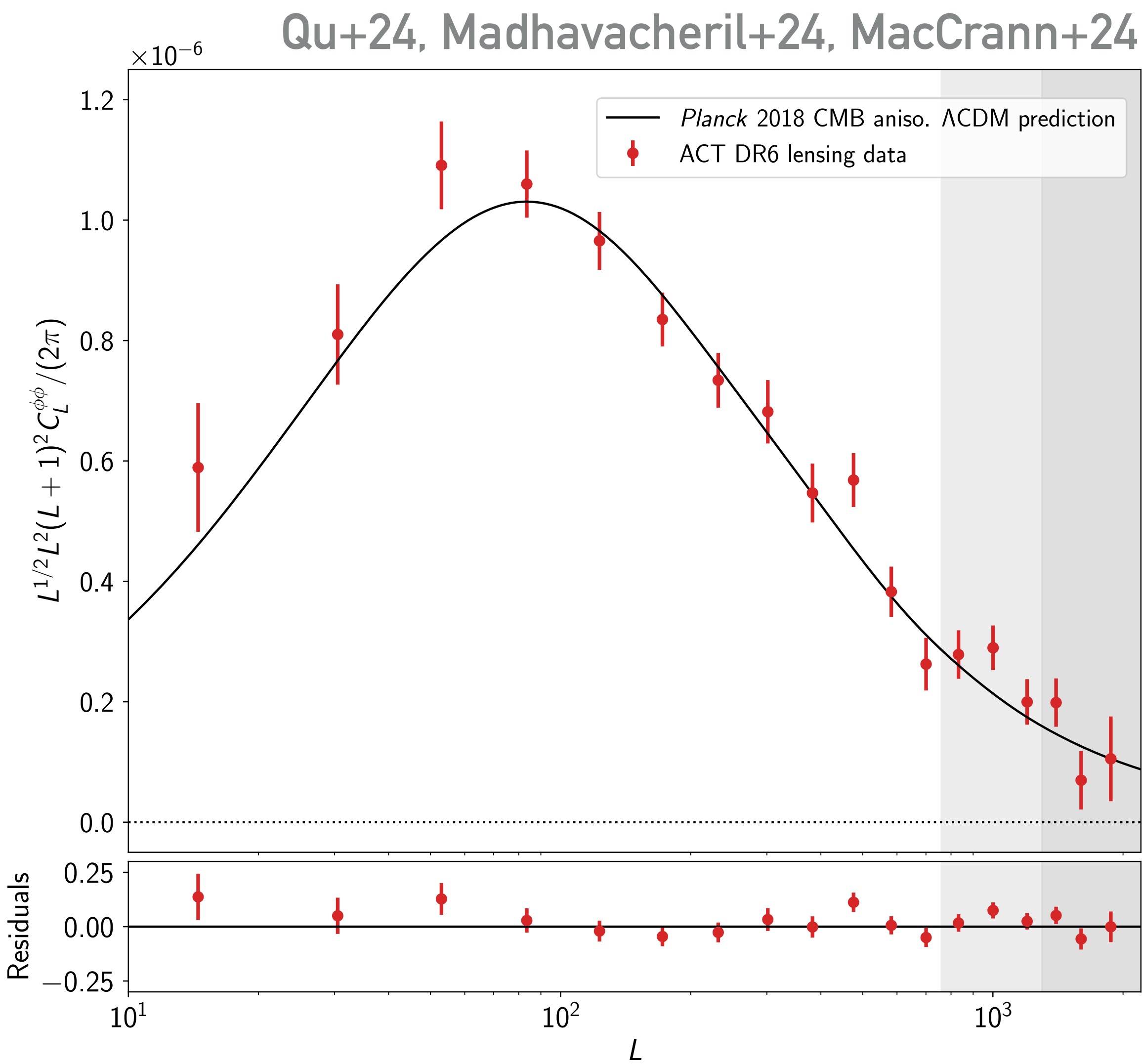
$$\hat{\phi}(\mathbf{L}) \sim \int d^2\mathbf{l} T(\mathbf{l}) T^*(\mathbf{l} - \mathbf{L})$$

Frank Qu
Cambridge
→ Stanford

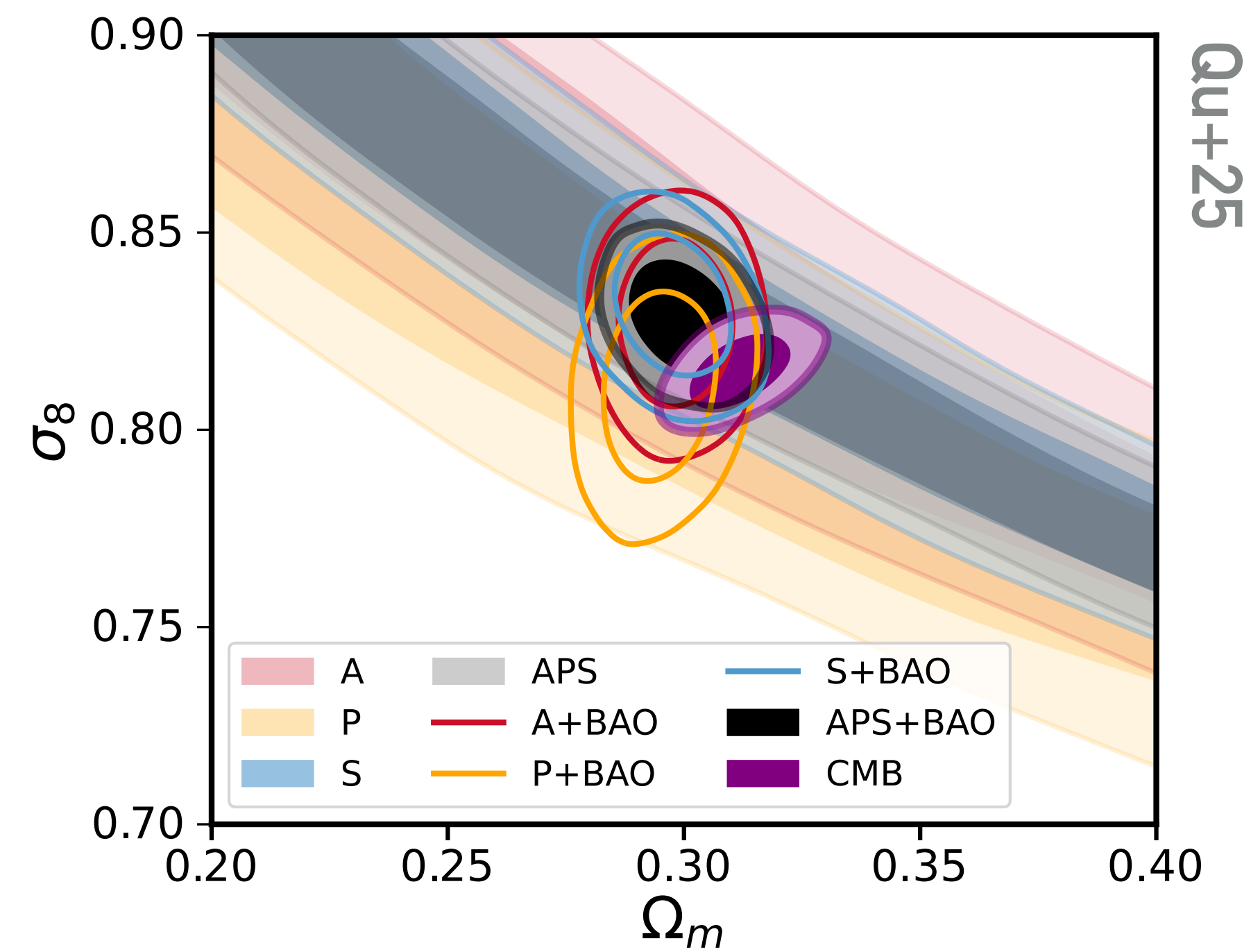
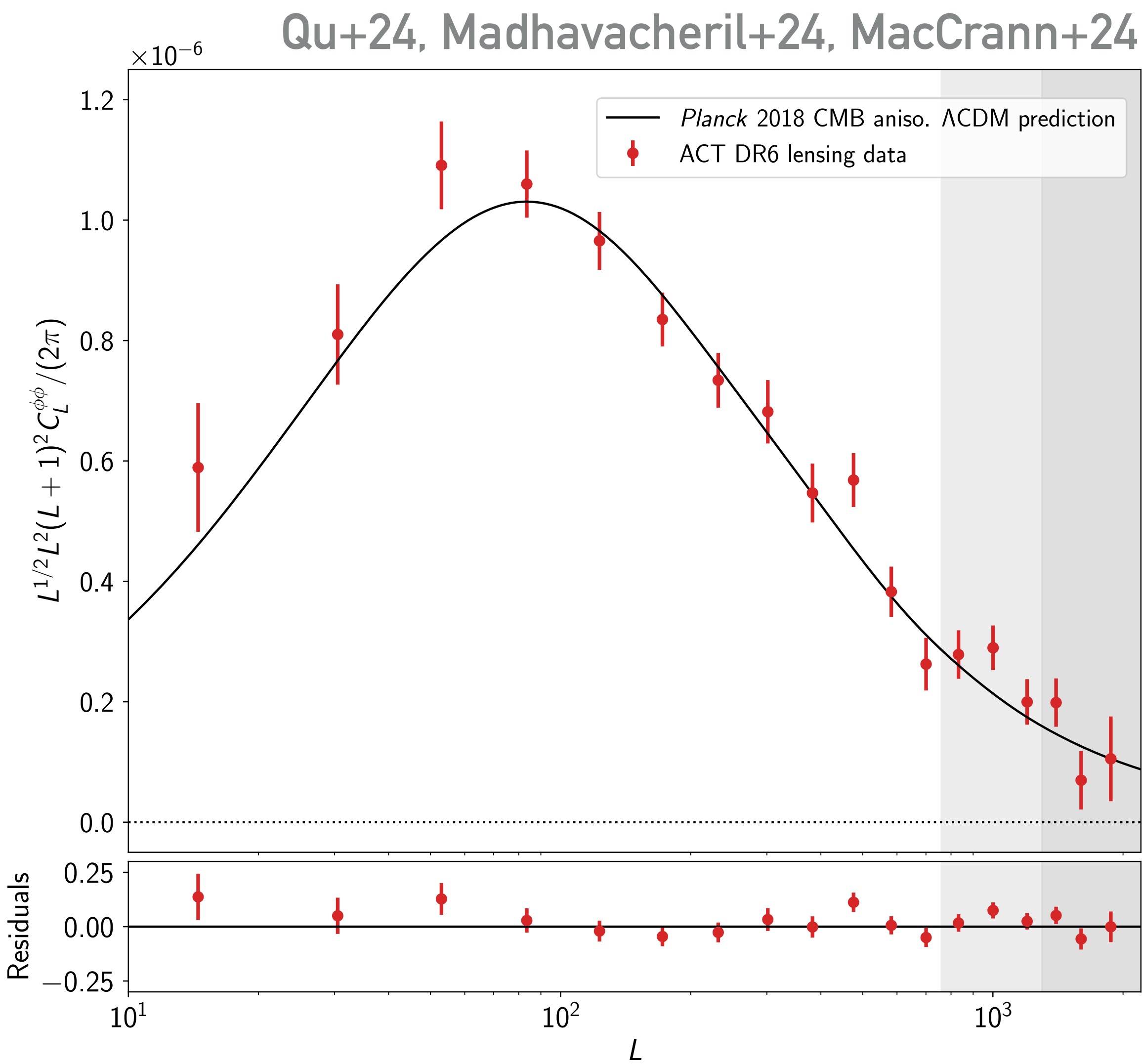


ACT Collaboration
Qu+24, Madhavacheril+24, MacCrann+24

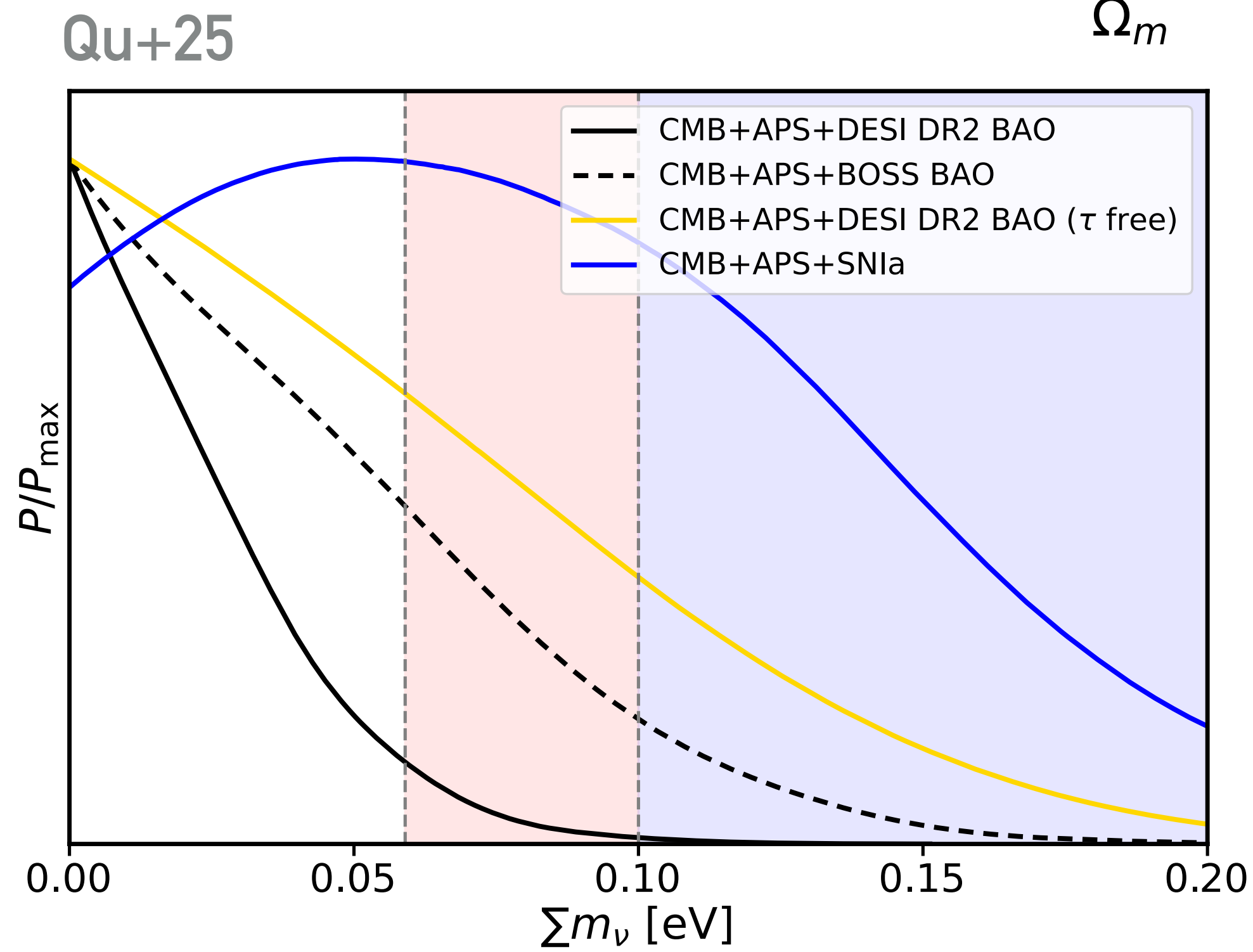
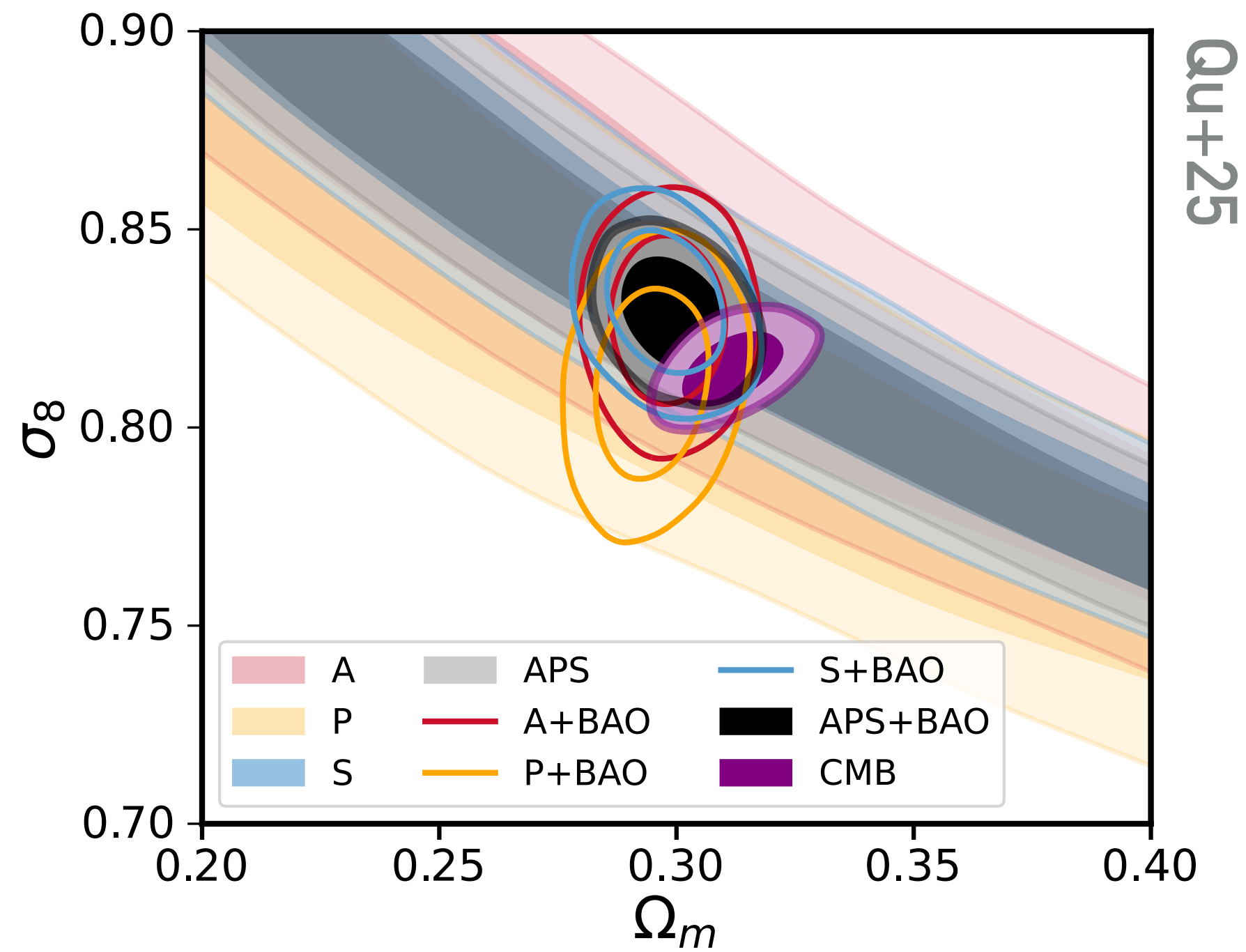
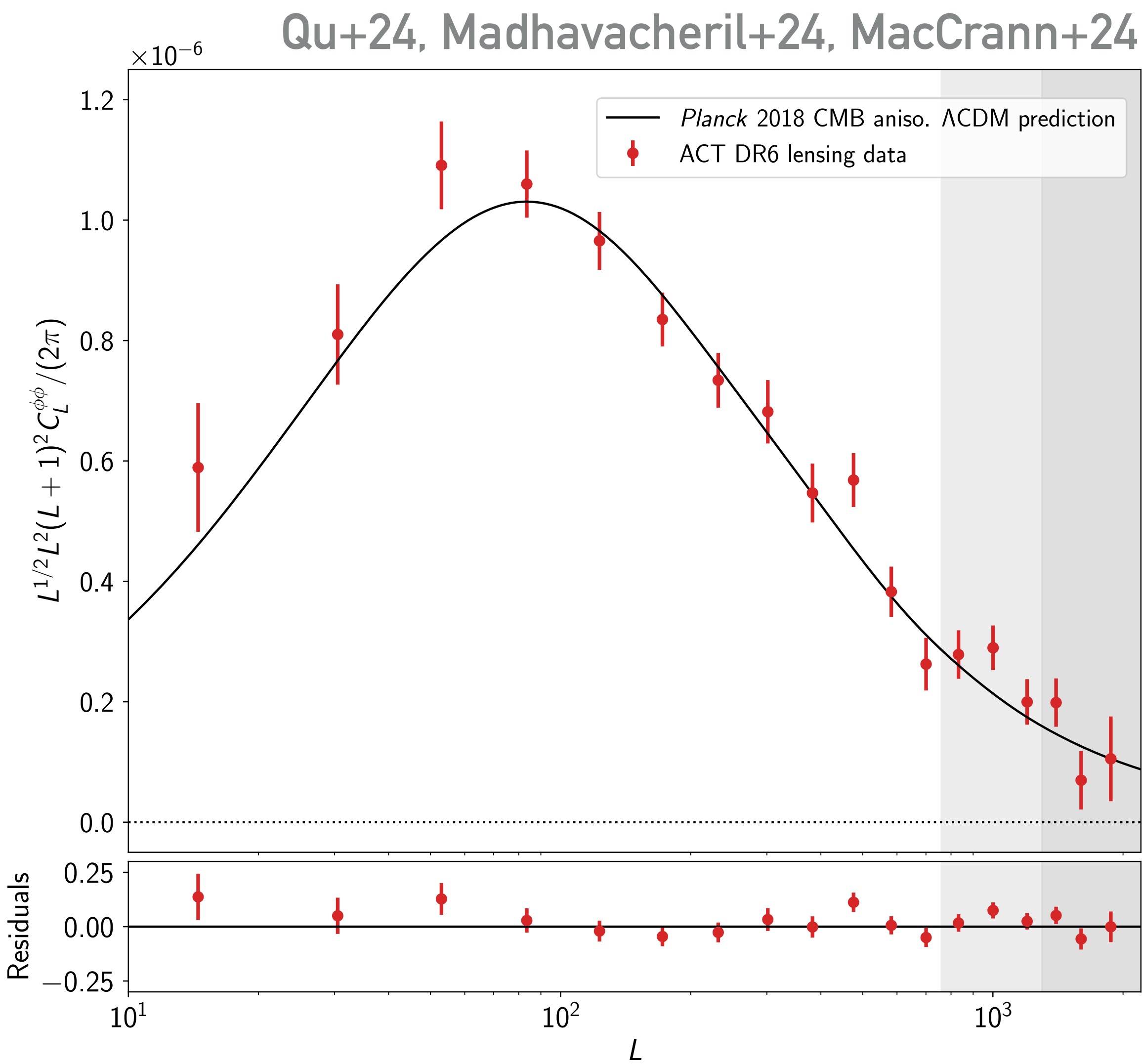
UNIFIED AND CONSISTENT STRUCTURE GROWTH MEASUREMENTS



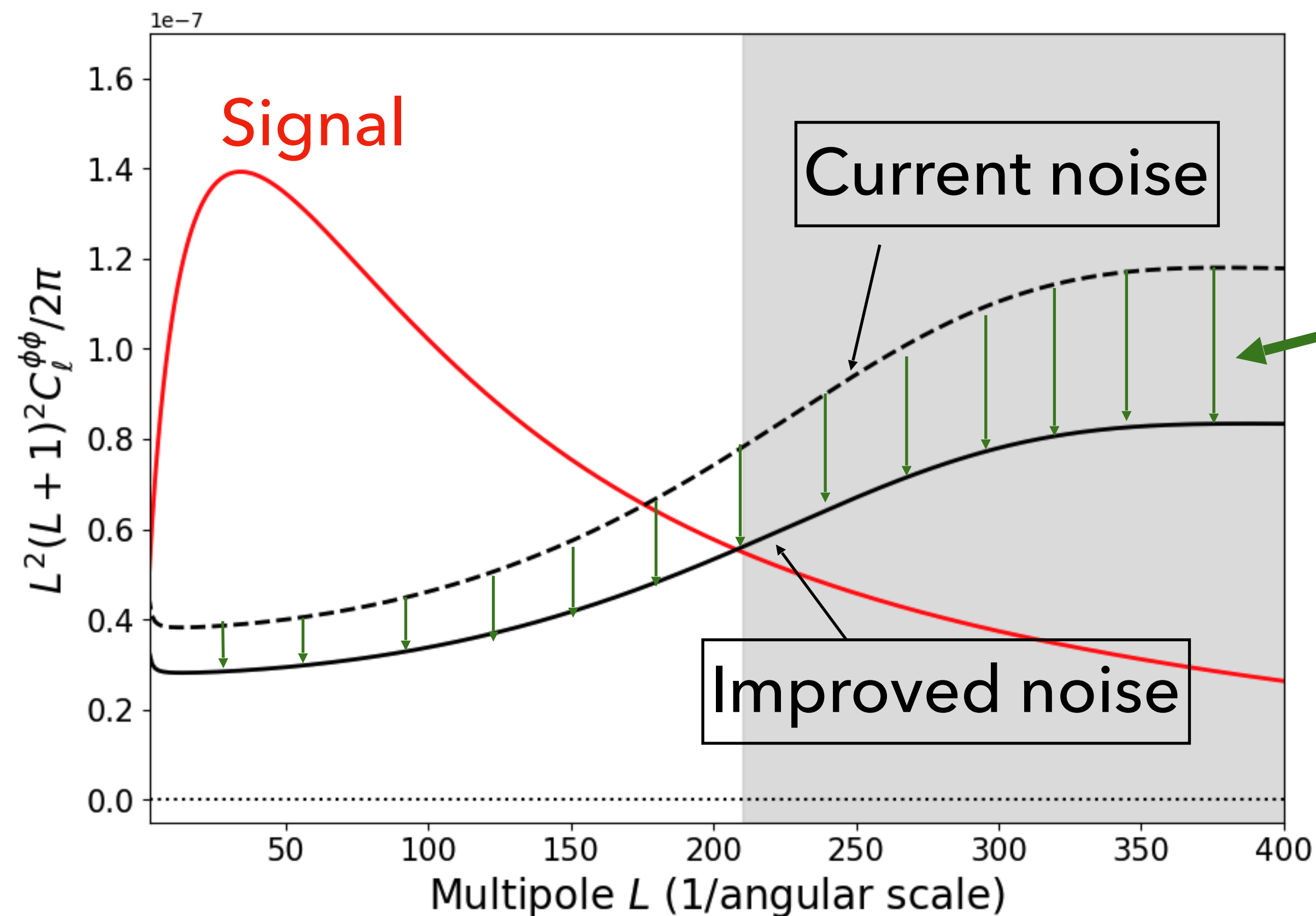
UNIFIED AND CONSISTENT STRUCTURE GROWTH MEASUREMENTS



UNIFIED AND CONSISTENT STRUCTURE GROWTH MEASUREMENTS



I am leading inclusion of daytime data (in prep.) & cosmological analysis (in prep.)
for final ACT lensing release

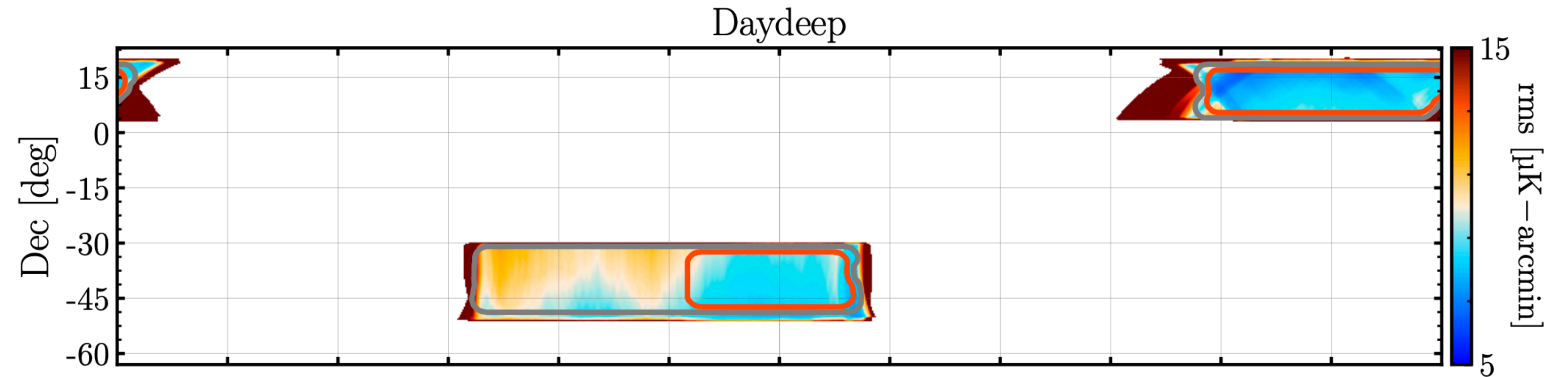


Expected improvements for the final
ACT lensing analysis (part I):

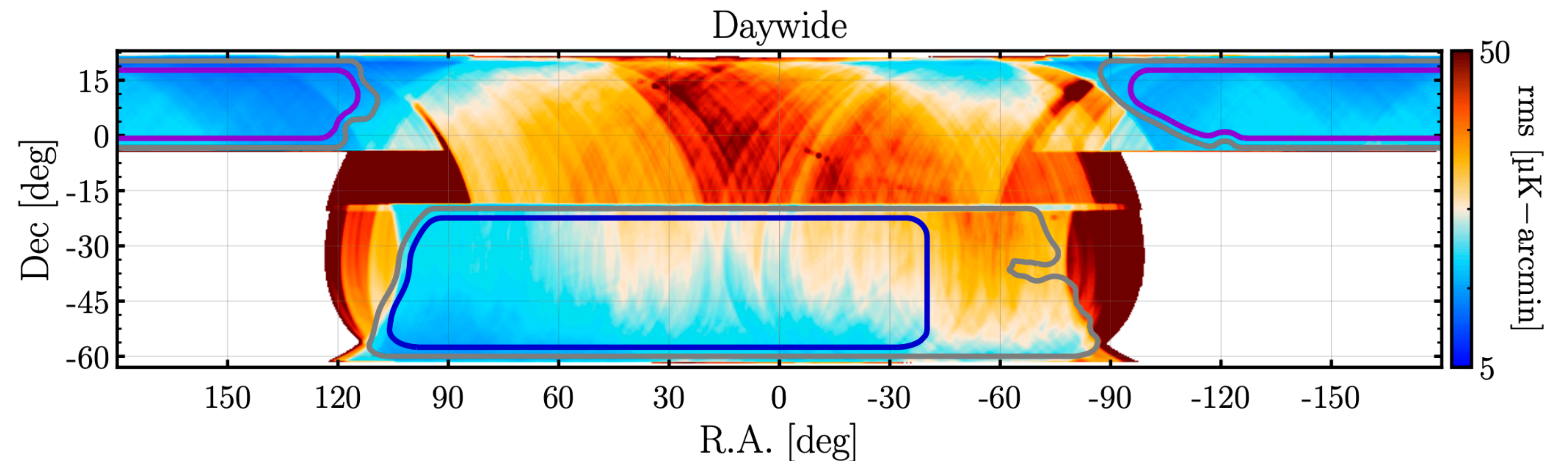
- Additional seasons
- Inclusion of daytime data

- ▶ Data taken during the day (11:00 - 23:00 UTC)

2017–2019:
“DAYDEEP”

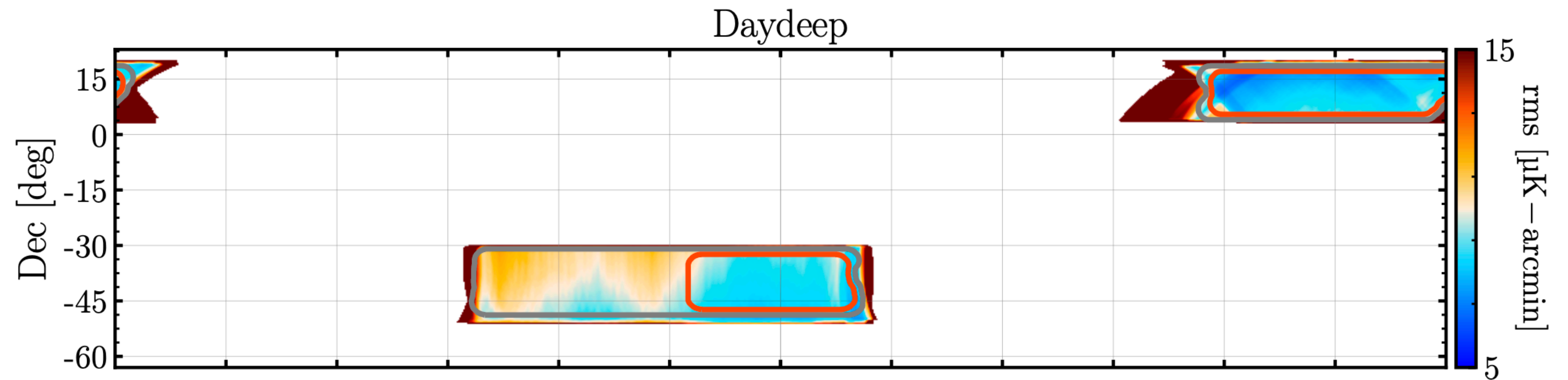


2020–2022:
“DAYWIDE”

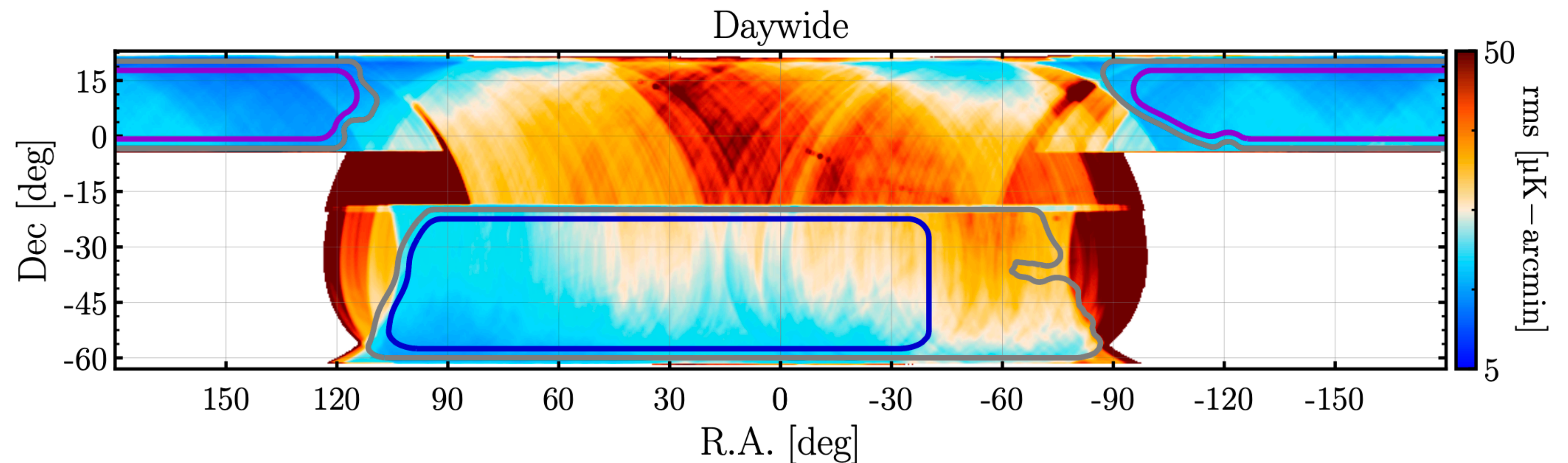


- ▶ Data taken during the day (11:00 - 23:00 UTC)
- ▶ Challenging: Sun's heat distorts the telescope mirror, causing pointing offsets and beam deformations

2017–2019:
“DAYDEEP”

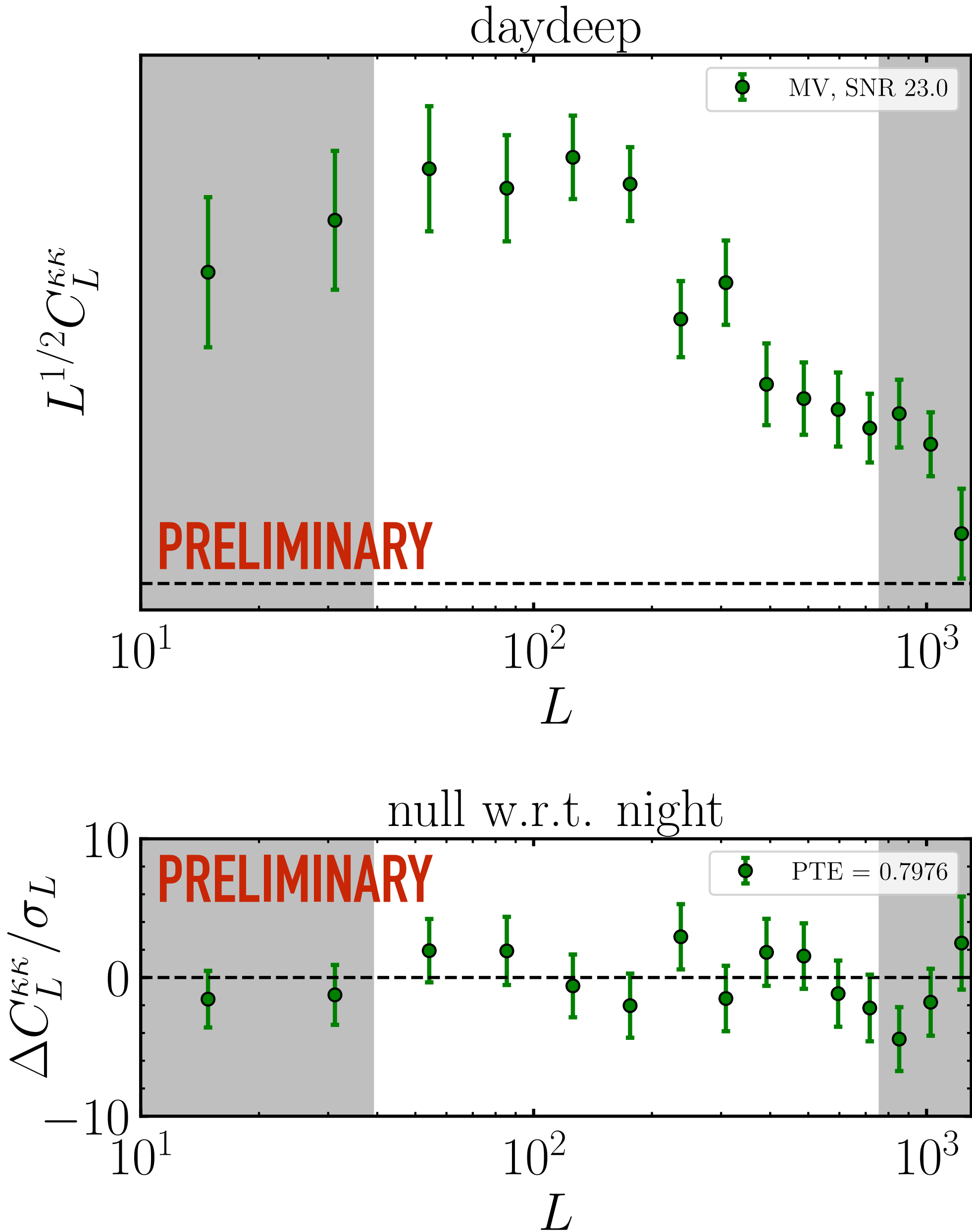
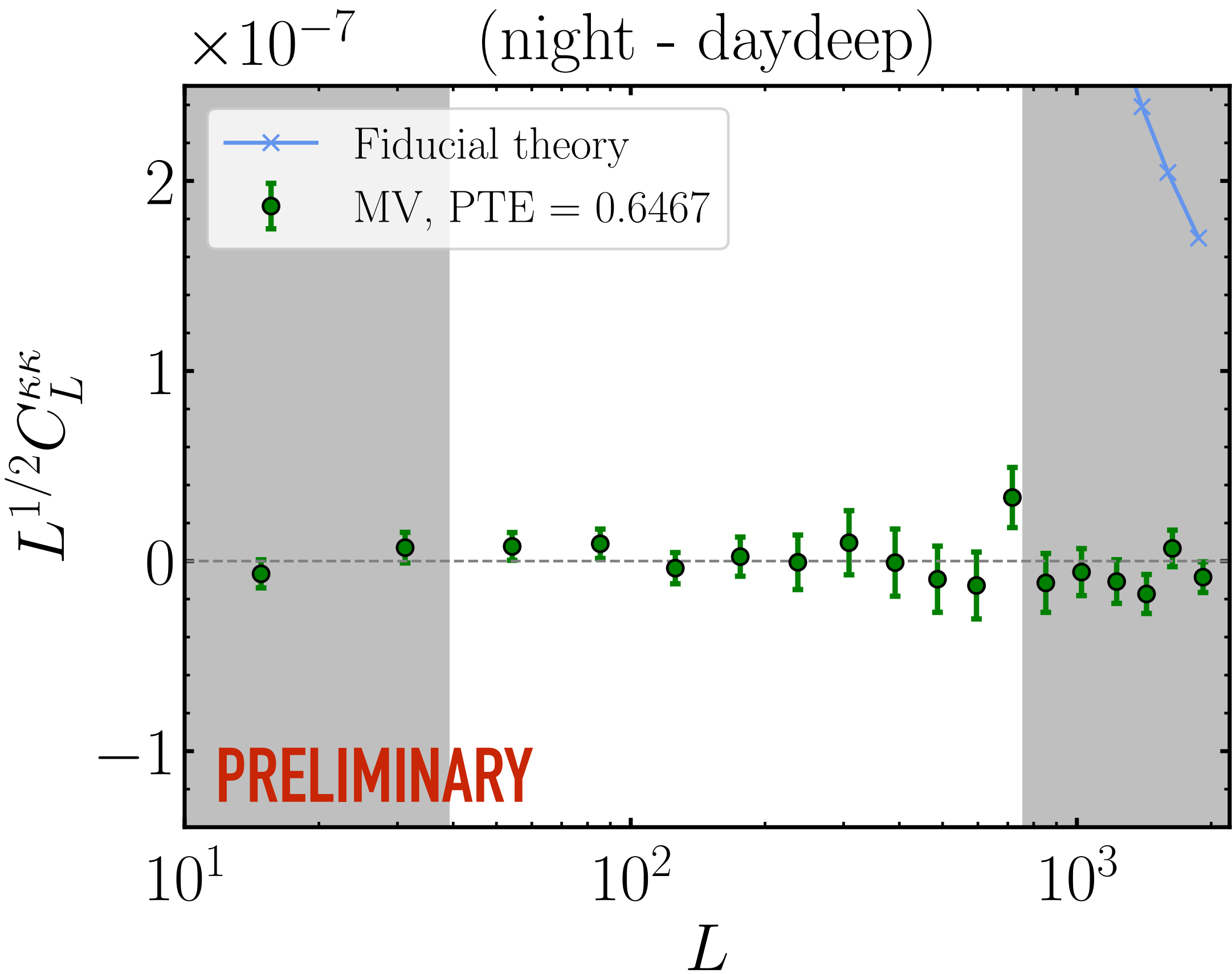


2020–2022:
“DAYWIDE”

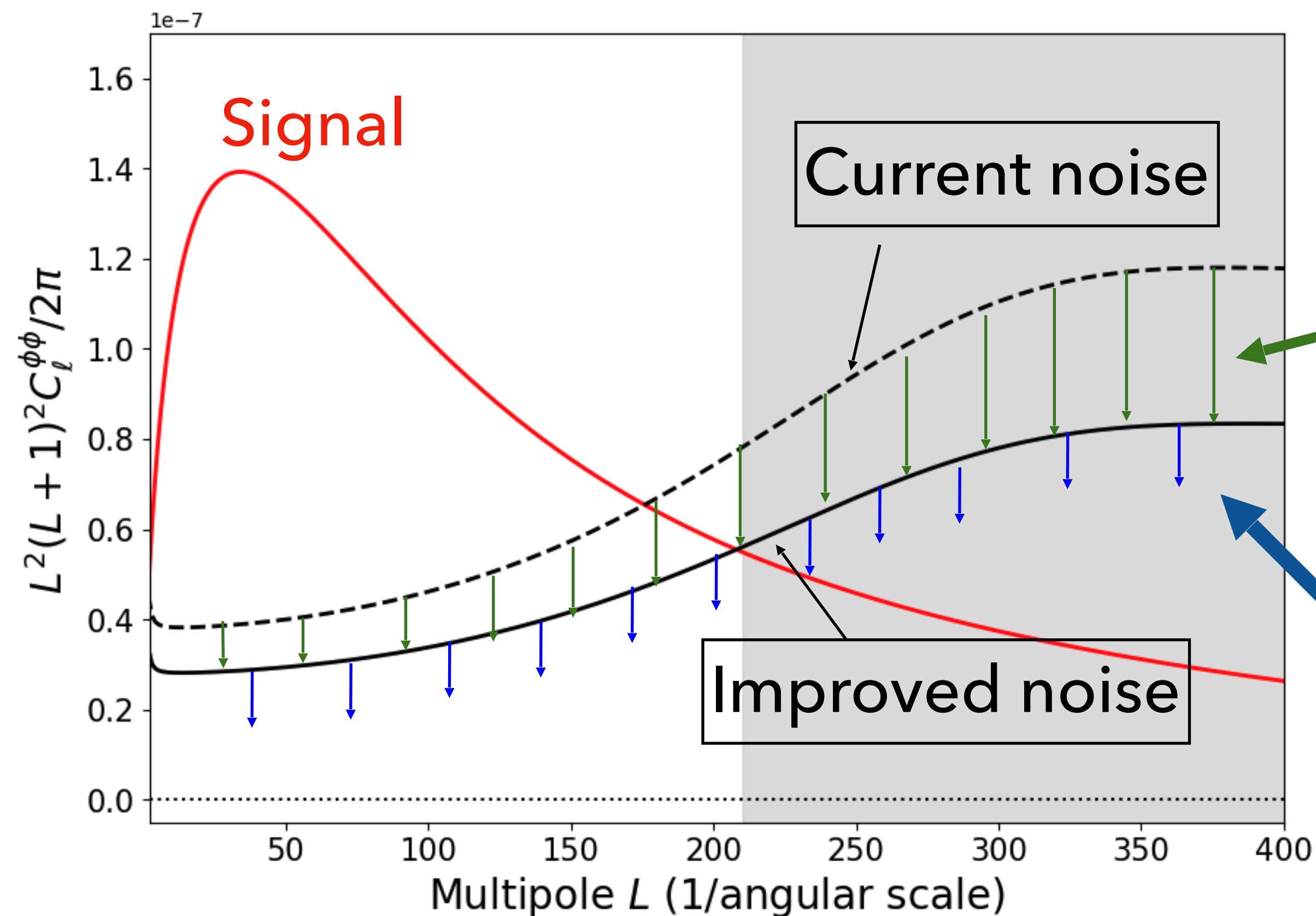


More than 100 map-level and band power-level null tests passing

Signal SNR ~30 from daytime-only data

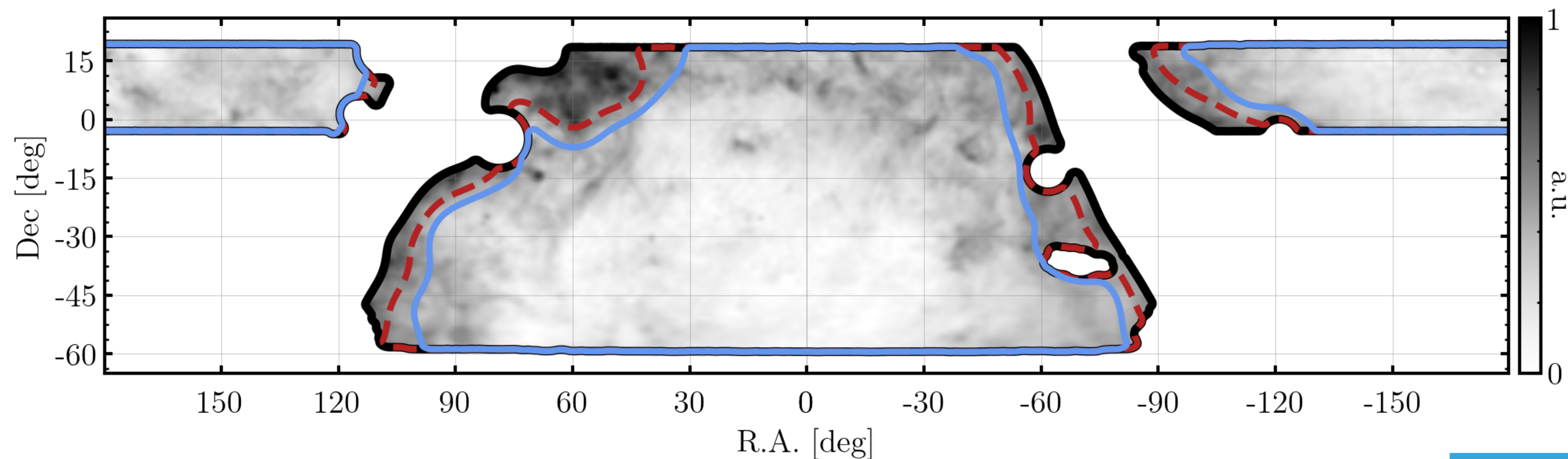


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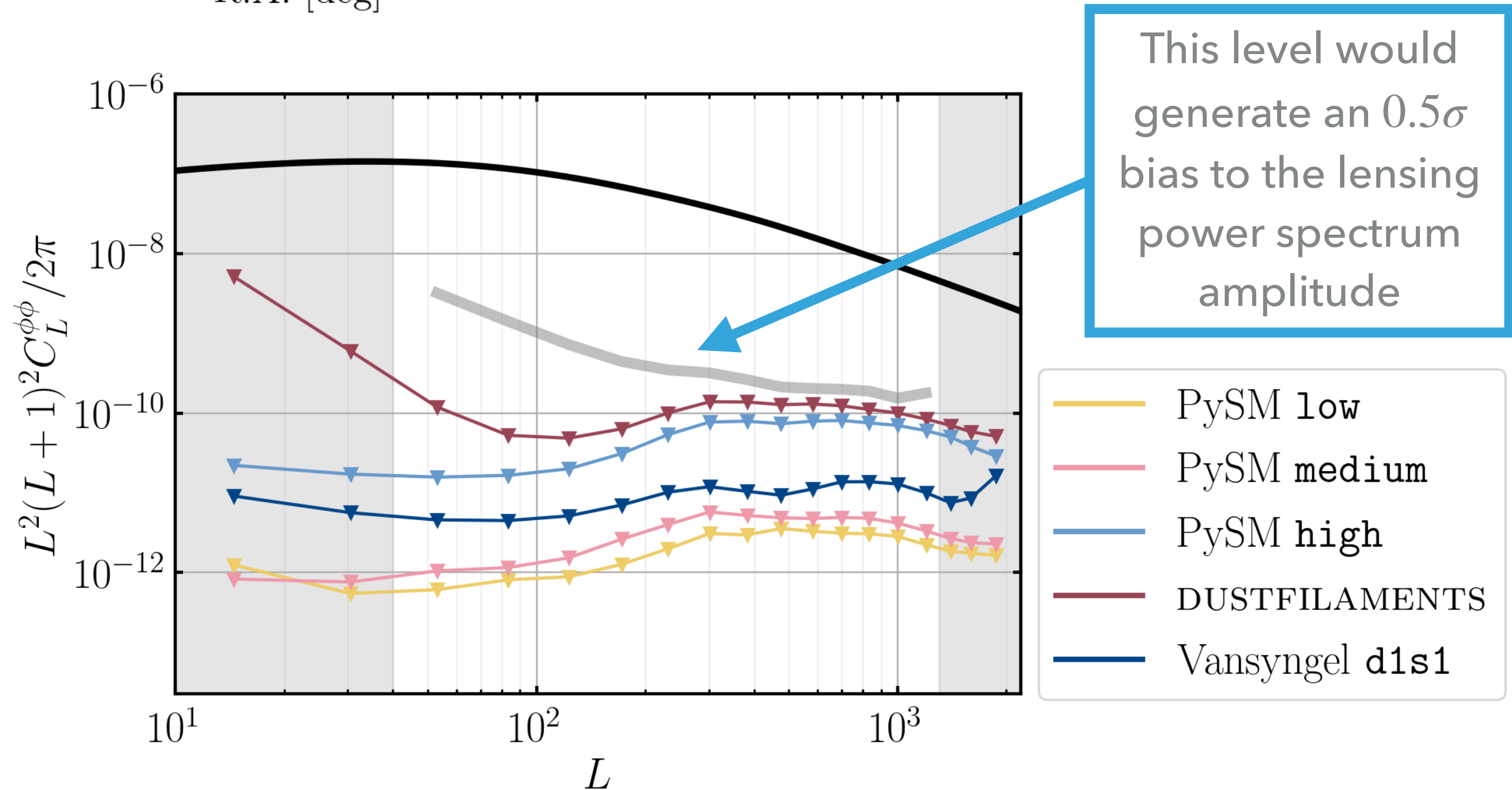


Expected improvements for the final
ACT lensing analysis

- Additional seasons
- Inclusion of daytime data
- * Optimal filtering
- * Improved sky-cuts
- * Map-level combination with Planck



Obtained upper limits for the bias to the CMB lensing power spectrum amplitude from a whole suite of Galactic dust foreground models



- ▶ Atacama Cosmology Telescope. CMB lensing with daytime data:
pathfinder for the Simons Observatory

Forecast total signal SNR above 60

First demonstration of cosmology with daytime data
- ▶ Additional improvements from Galactic foreground mitigation strategies
- ▶ *Where are the neutrinos?*