CMB@60
Panel 7 - Space and Ground complementarity

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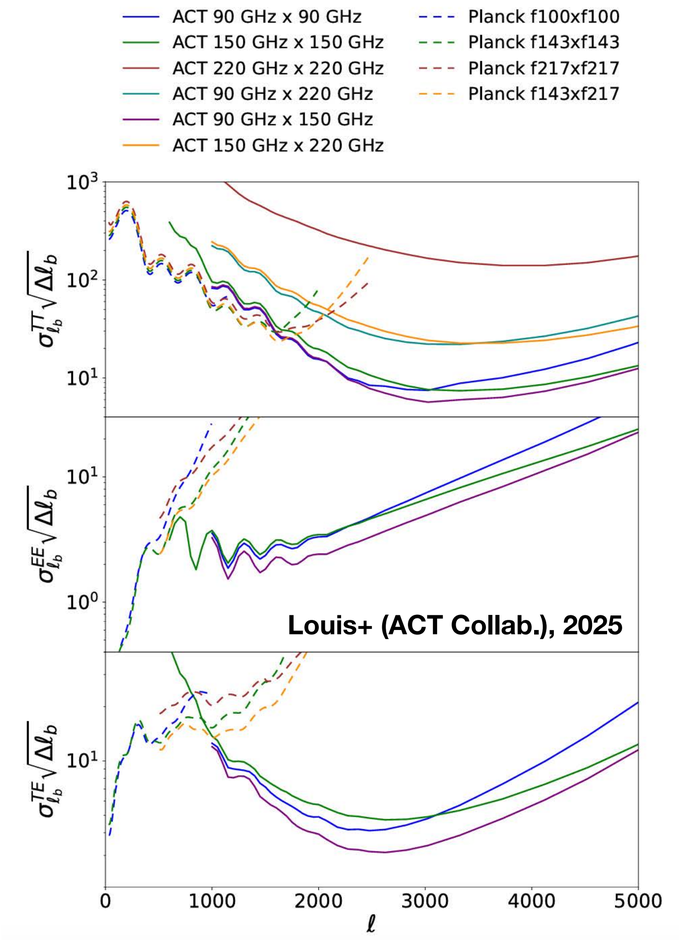
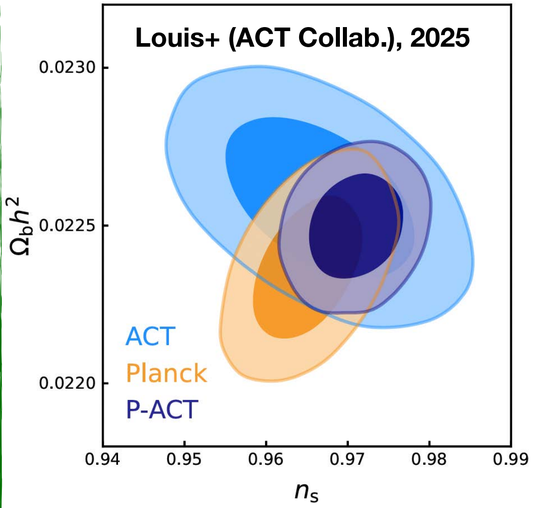
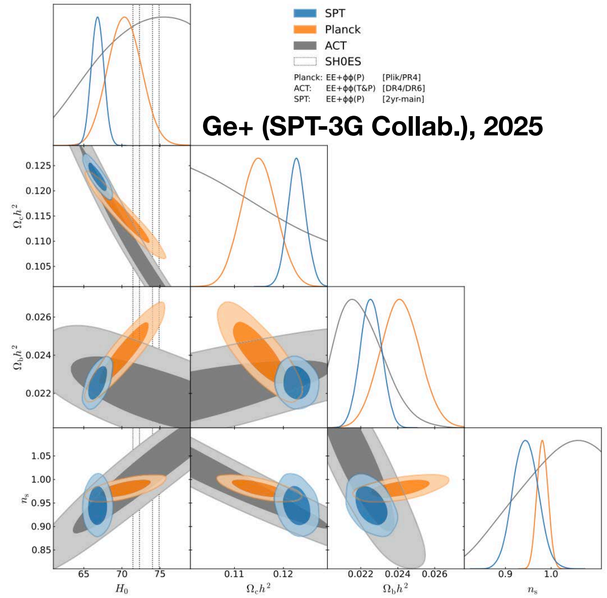
Funded by the European Union
European Research Council
Established by the European Commission

Space vs/+ Ground



- Access to <u>different scales</u> with <u>different sensitivity</u>





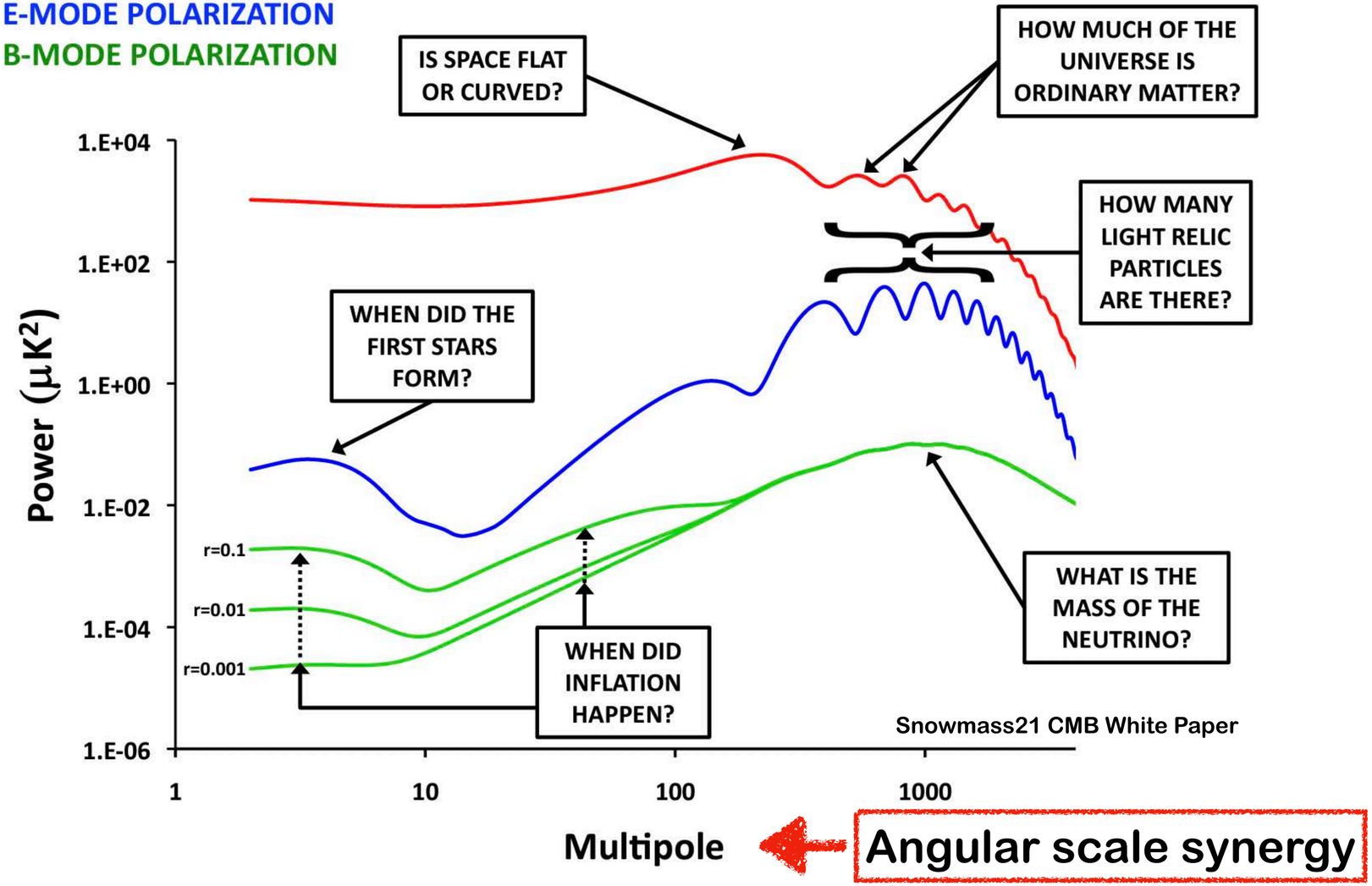
- Constraining power now <u>comparable</u>
- <u>Complementary</u> cosmological information

- Space vs ground = strong cross-check
- Space + ground = improved sensitivity

What from where

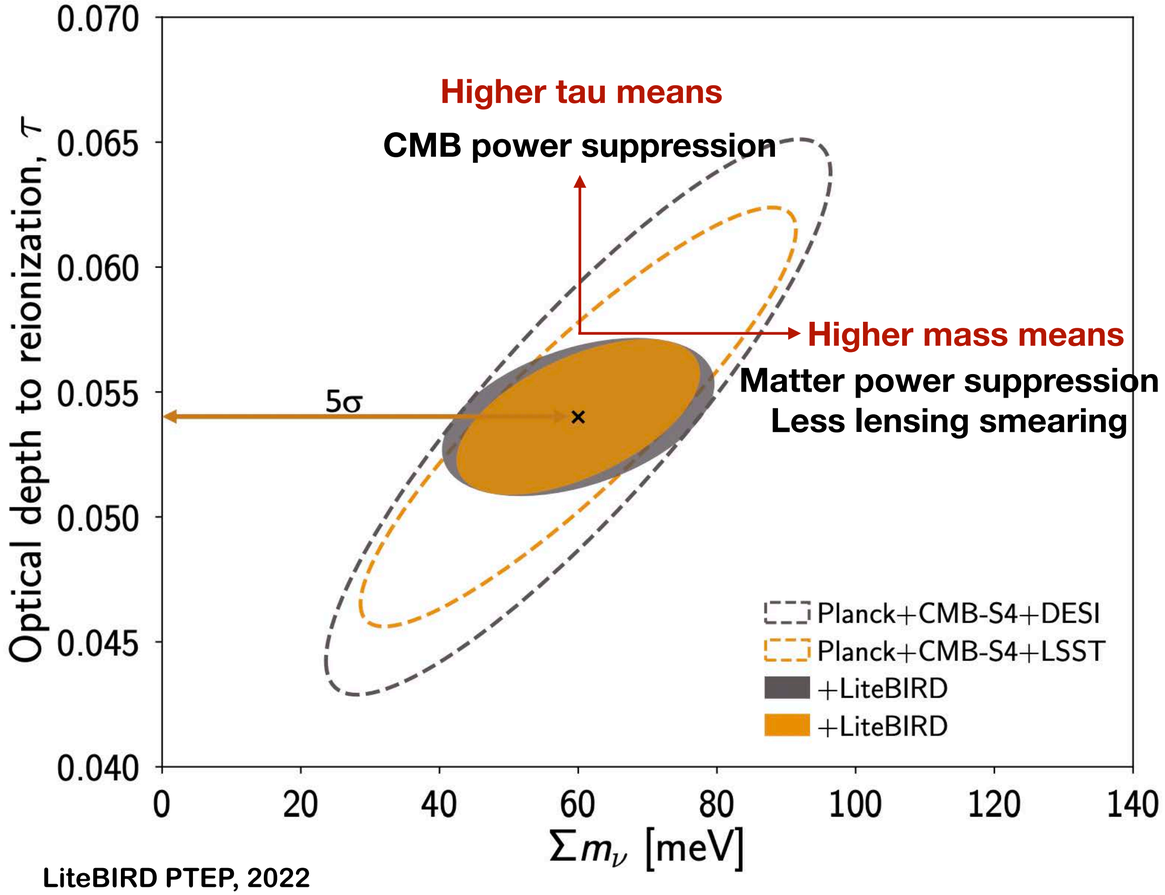
TEMPERATURE
E-MODE POLARIZATION
B-MODE POLARIZATION

Field synergy



Angular scale synergy

Particle cosmology



LiteBIRD PTEP, 2022

See also M. Lattanzi slides and Panel 4

Measurement of neutrino masses requires comparison between high-z and low-z amplitude from high-res experiments

High-z amplitude convolved with tau

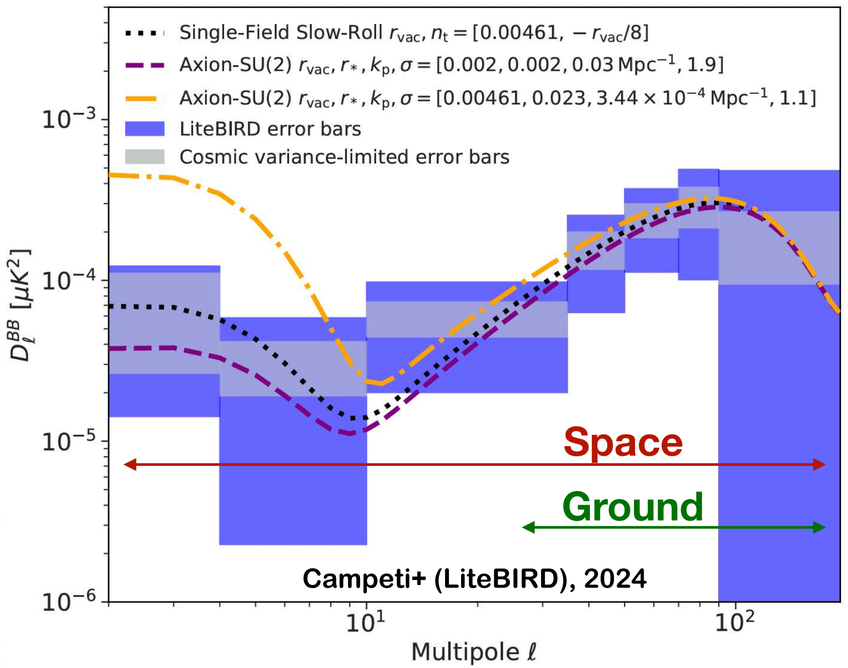
Need for CVL measurement of tau from large-scale polarisation

Combine the power of large-angle high-sensitivity CMB polarisation with arcmin maps from ground

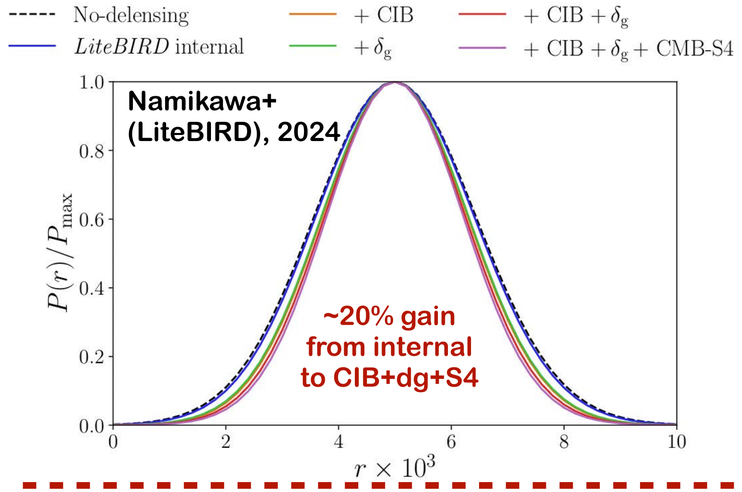
See recent works claiming for a higher tau to "solve" the negative neutrino mass DESI preference

Early Universe

See also Panels 5,6&9



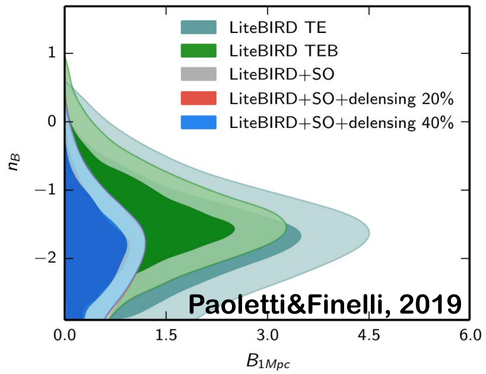
Tensor modes visible in both reionisation and recombination bumps
If both detected:
- **Stronger significance**
- **Cleaner model characterisation**



ψ experiments	σ_r
S4-Wide + SO-SAT + ASO-SAT	0.0110
S4-Wide + LiteBIRD	0.0077
S4-Deep + S4D-SAT	0.0064
Combined	0.0047

Namikawa+, 2025

Lensing potential as a matter tracer from small-scale CMB improve r constraints:
- **With efficient delensing**
- **By allowing alternative analysis methods**
  (e.g., Namikawa&Sherwin, 2023)

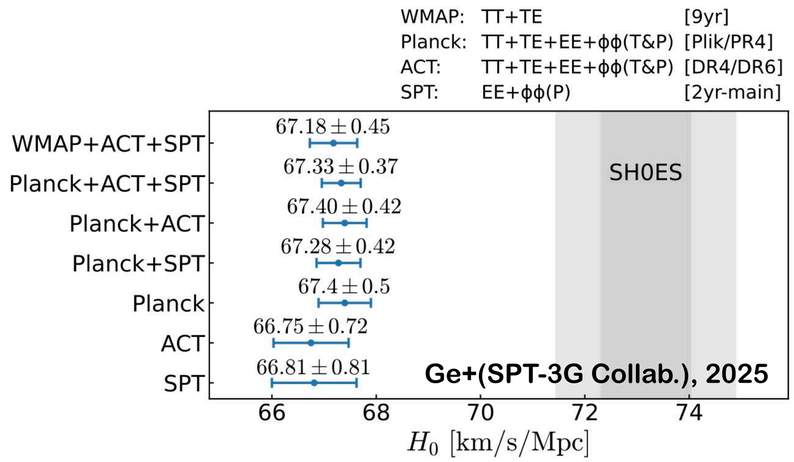


Dataset ($A_L = 1$)	Fields	τ	$\beta_E^2\ [10^{-2}]$	$\beta_V^2\ [10^{-3}]$	$r\ [10^{-3}]$
LB w/o small scale	TEB	$0.0543^{+0.0019}_{-0.0021}$	< 9.7	< 1.1	< 0.4
	TEBV	0.0544 ± 0.0020	< 0.5	< 1.1	< 0.4
LB + CMB-S4	TEB	$0.0544^{+0.0017}_{-0.0020}$	< 5.1	< 0.9	< 0.4
	TEBV	0.0544 ± 0.0019	< 0.5	< 0.8	< 0.4

Raffuzzi+, 2024

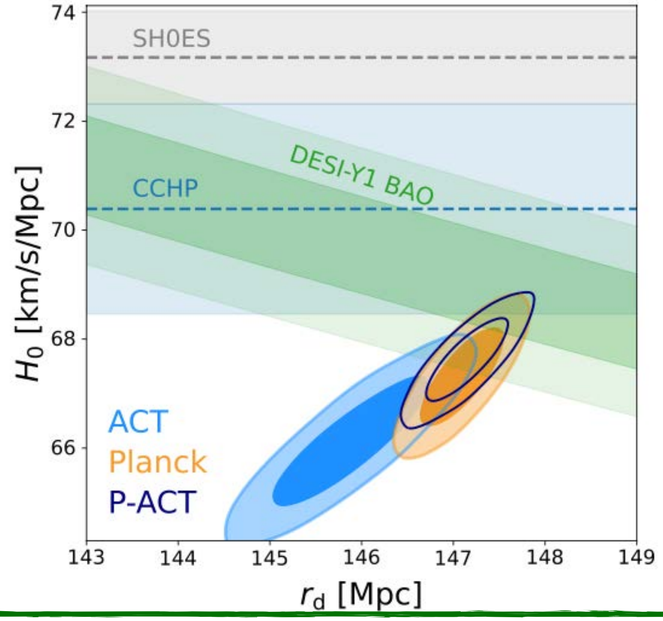
Combination of different imprints on different scales and fields improves constraints on physical model parameters
(e.g., Paoletti&Finelli, 2019 on Primordial Magnetic Fields; Raffuzzi+, 2024 on Generalised Faraday Effect)

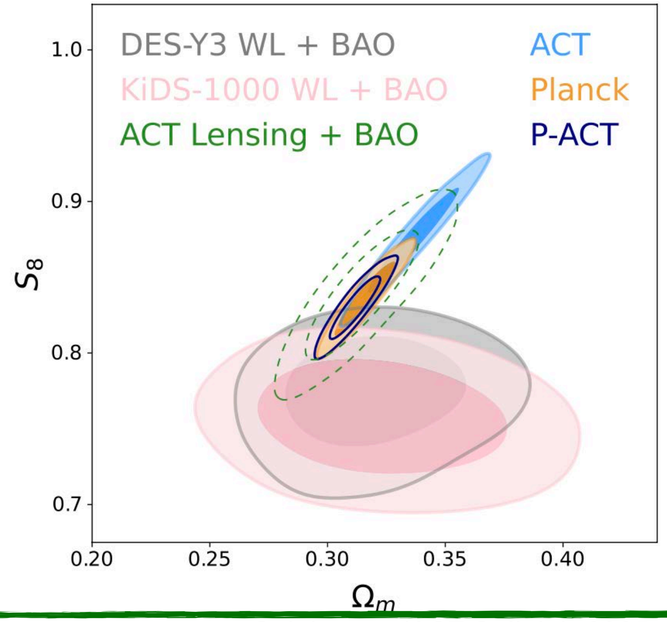
Cosmic concordance



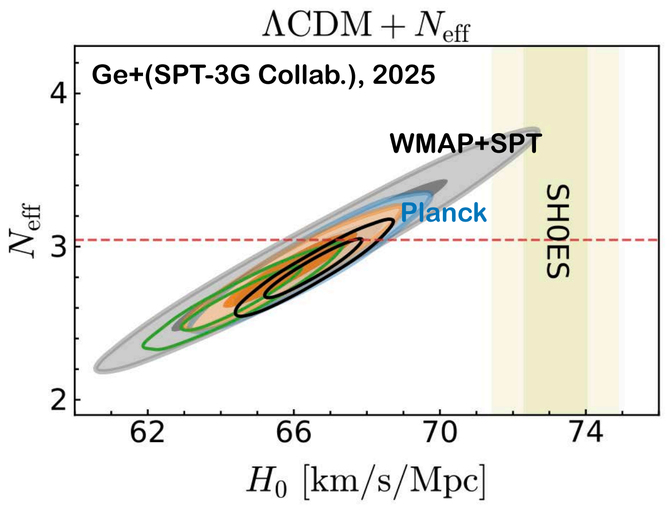
Independent and comparable estimates are key in understanding tensions

Louis+(ACT Collab.), 2025

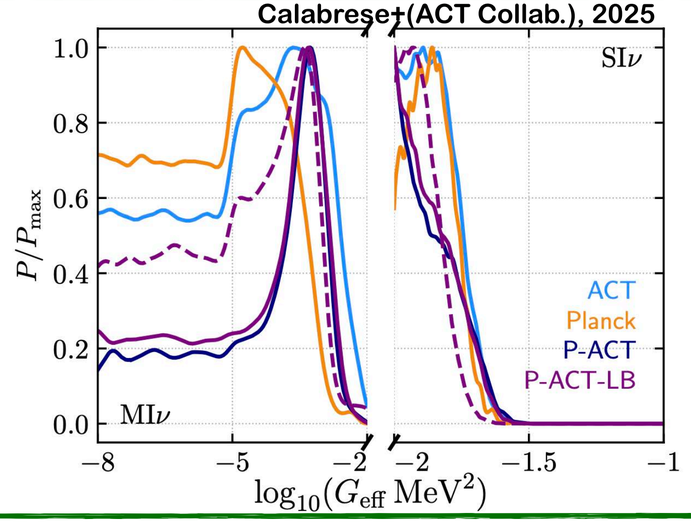




Independent and comparable estimates are key in strengthening confidence in model constraints



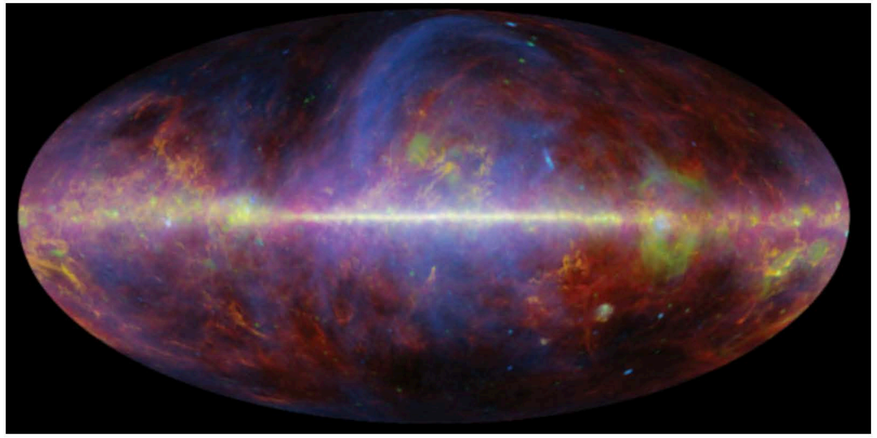
Calabrese+(ACT Collab.), 2025



See also Panel 5

Cosmo+astrophysics

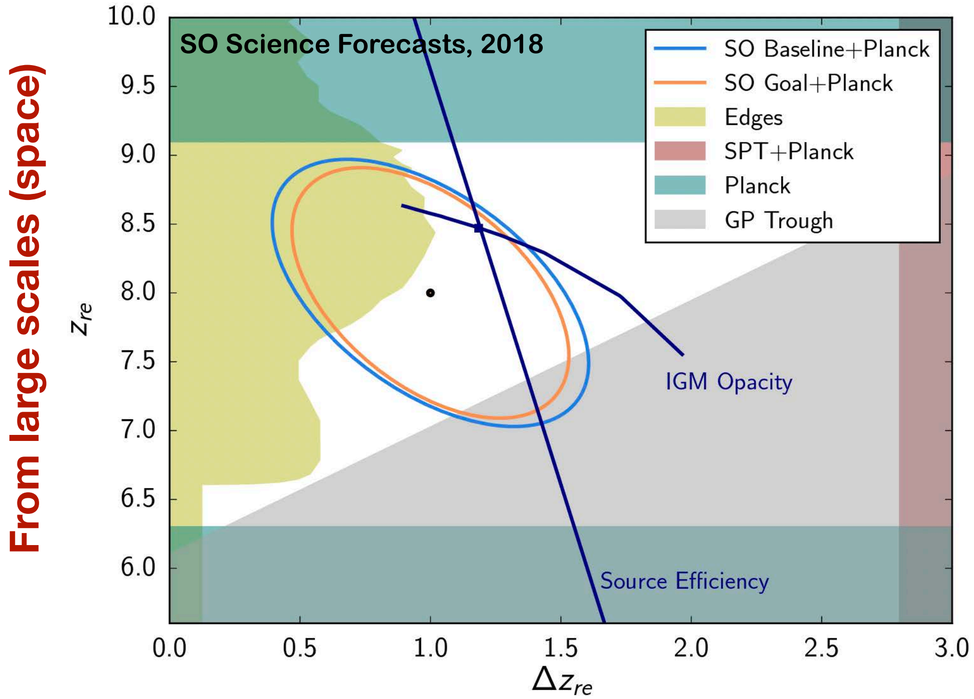
Panexperiment Galactic Science Group



Composite image of Galactic emission as measured by the Planck satellite. Different colors represent dust, synchrotron, free-free, and carbon monoxide line emission. Credit: ESA/NASA/JPL-Caltech.

Our mission

The purpose of the Pan-Experiment Galactic Science Group is to pool expertise from researchers interested in using cosmic microwave background experiments to study the Milky Way. The group operates as a virtual meeting space for scientists that work across various



From small scales (ground)

"Deep and increasing connection between cosmology and the rest of astrophysics. Cosmological probes are invariably intertwined with their astrophysical context. These connections are often couched as "systematic uncertainties," which ignores the synergistic opportunities that come with the co-development of different areas of the field"

https://doi.org/10.17226/26141.

Some discussion points

- Are there any science targets not yet identified which could benefit from space/ground complementarity?
- Overlapping communities: how to make sure analyses and results are “uncorrelated”?
- Shall we identify new (governance/computational/infrastructural/funding) tools and platforms to boost collaborative efforts?
- Public products: enough to guarantee reproducibility, cross-checks, info sharing?
- Data format/simulations/analysis tools: do we need coordinated efforts?

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