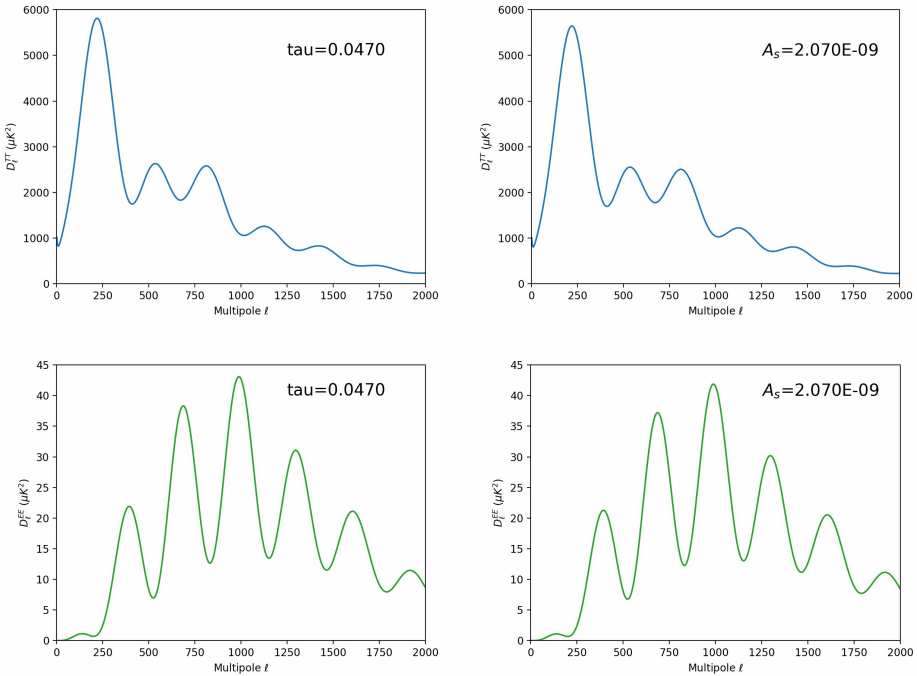
Talking Taurus

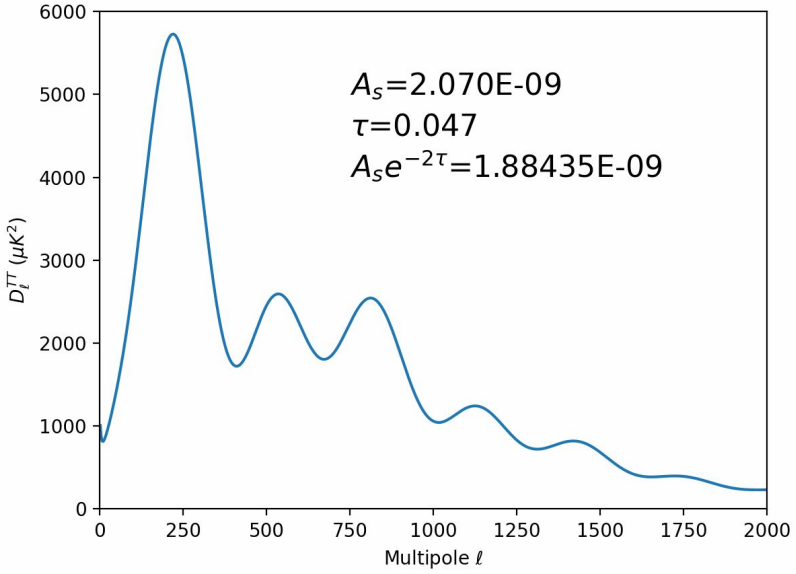
Alexandre Adler

τ Trouble

The amplitude of fluctuations scales with A_s and τ

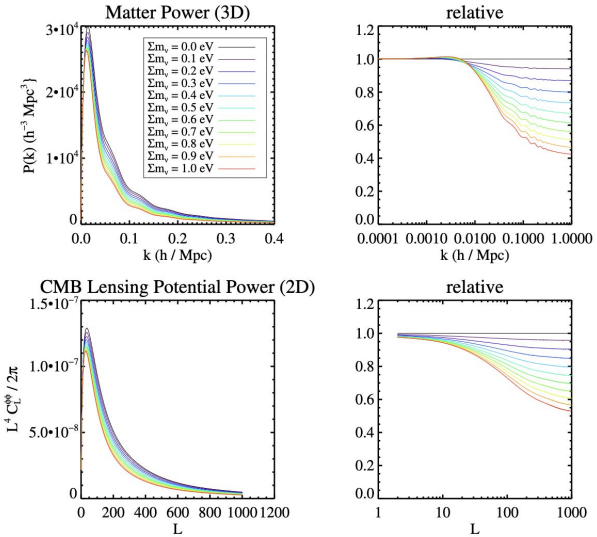


They are almost degenerate

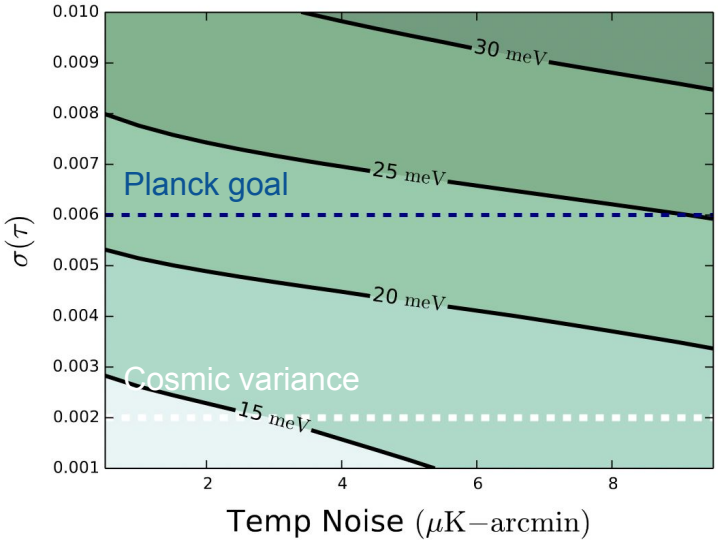


Neutrino Nuisance

Main obstacle to measuring sum of neutrino masses through their suppression of structure growth!

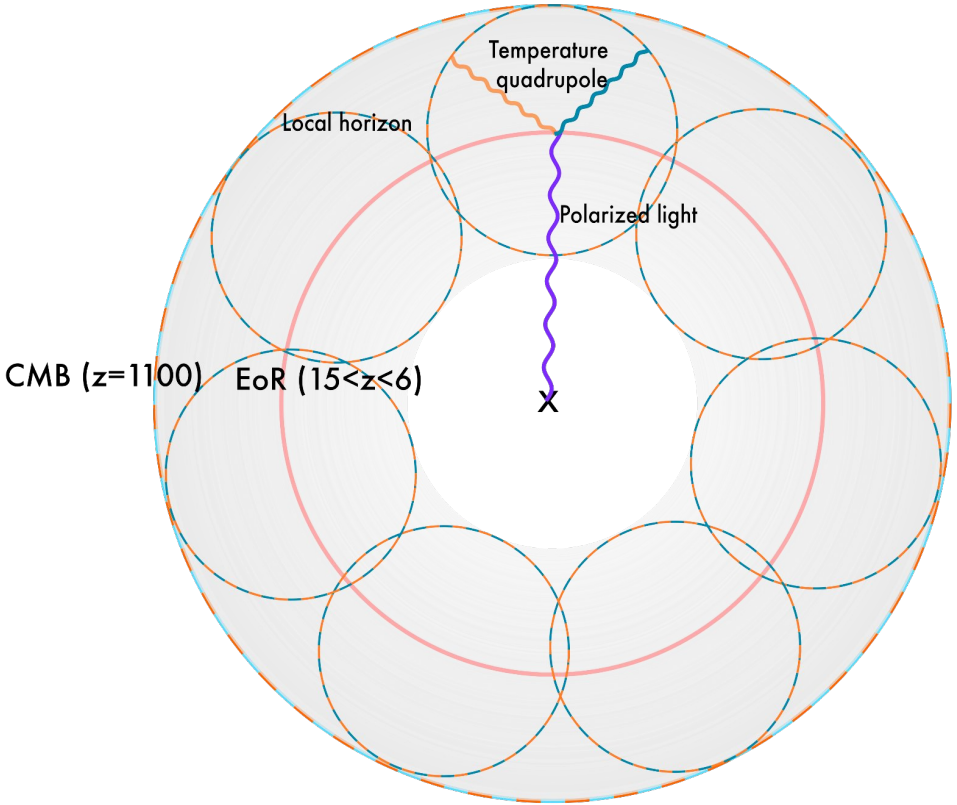


(CMB-S4 Science Book, 2016)

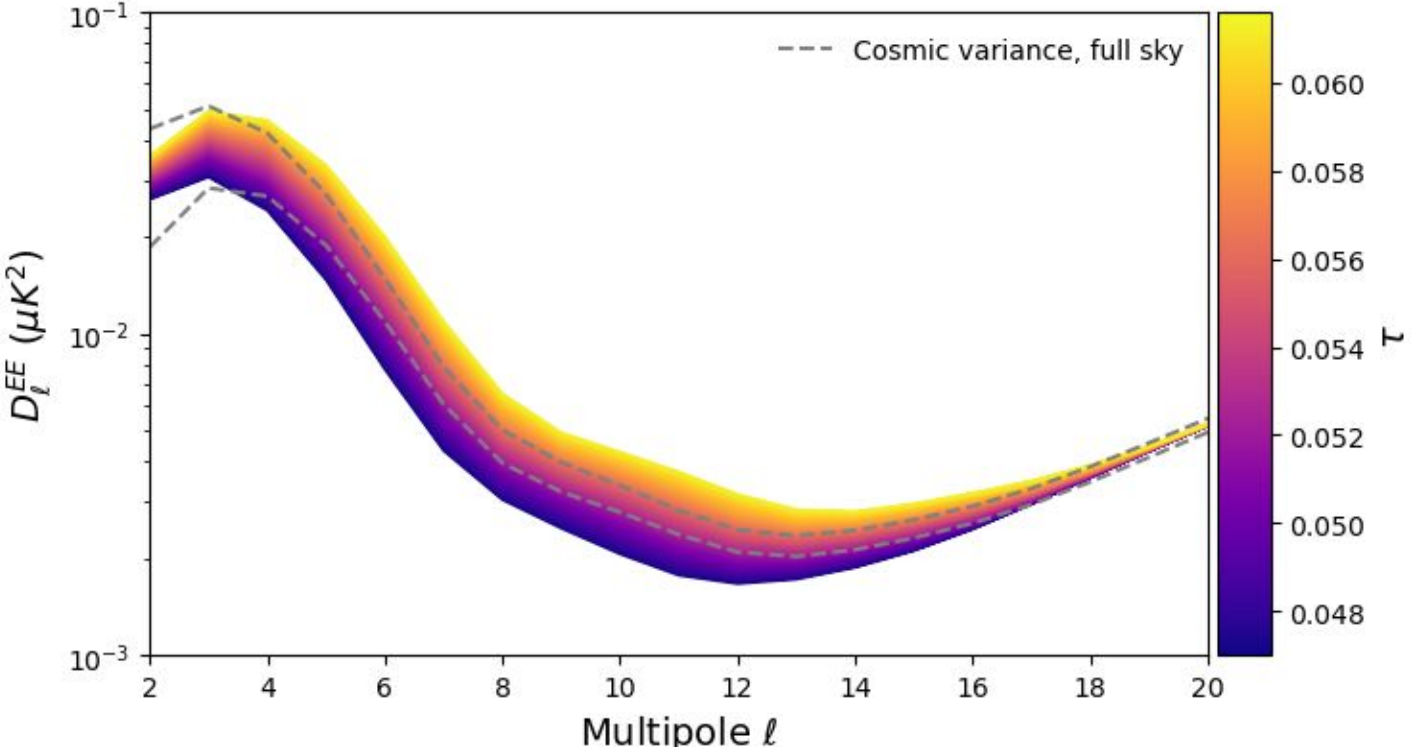


ibid.

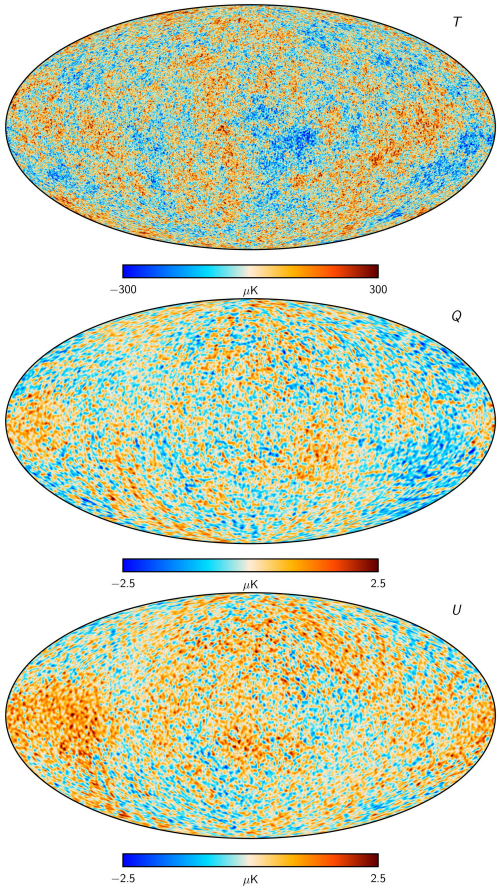
Producing Polarisation

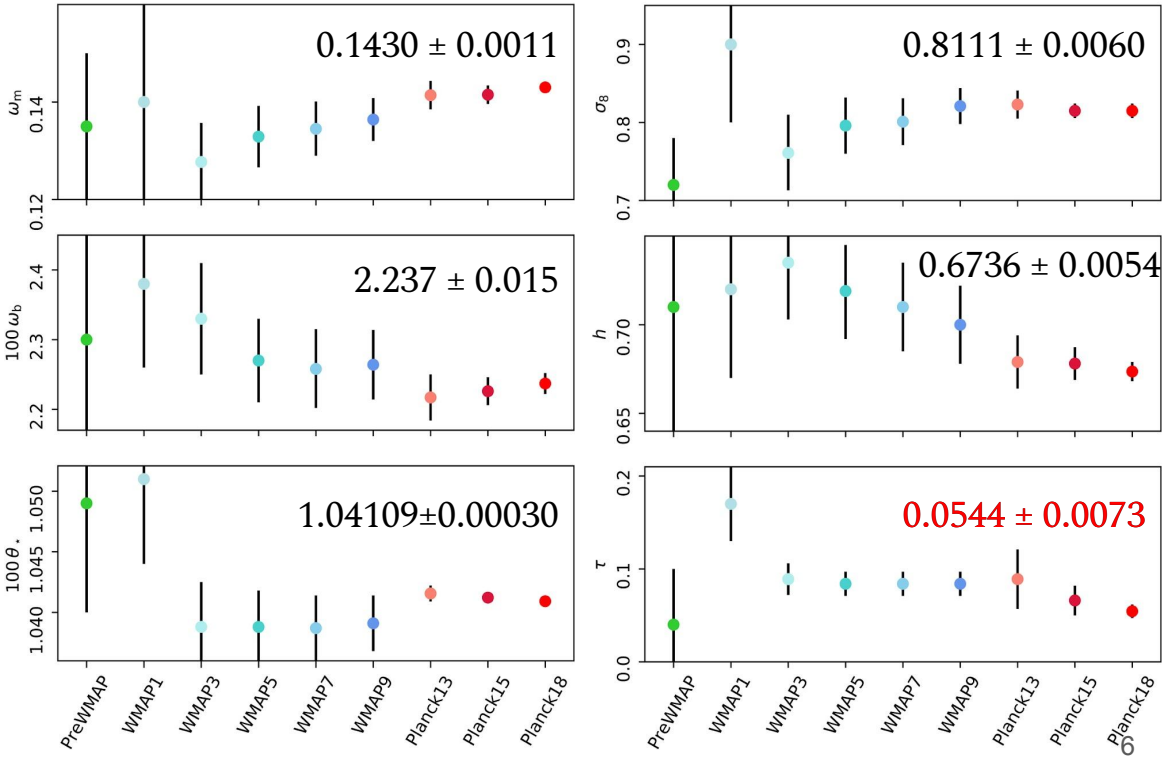


EE Excitement



Planck's Precision

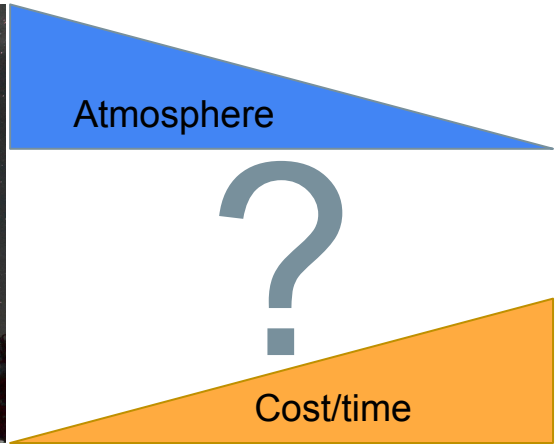


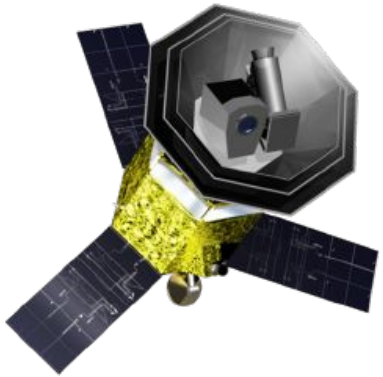


Nominal Needs

An experiment with:

- Excellent sensitivity: many detectors that integrate for a long time
- Multiple frequency channels to disentangle foreground emission
- As large a sky coverage as possible

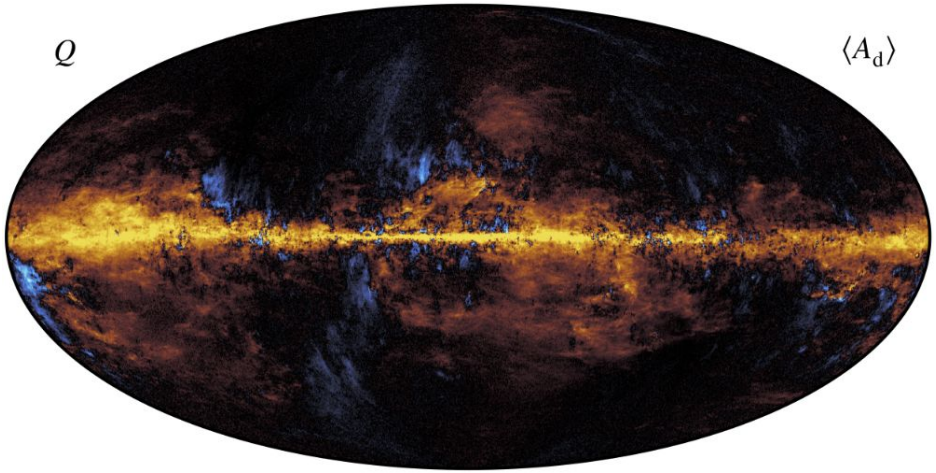




Dust Disruption

Foregrounds are very bright, polarized, and have structure on large scales.

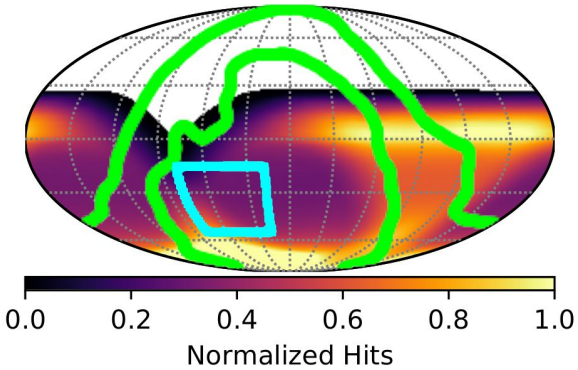
Cosmic variance scales as $1/f_{sky}$ so we can't just mask 90% of the sky.

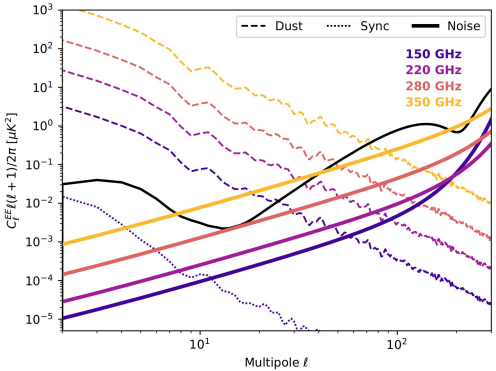


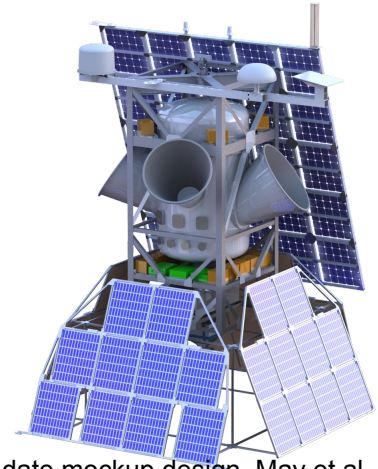
Map of polarized thermal dust emission,
Beyond Planck XV, T. L. Svalheim et al. (2022)

Taurus Time!

- Superpressure balloon flight: 30 days 32 km up
- Four frequency bands centred on 150, 220, 280 and 350 GHz to probe dust
- ~5000 detectors at 100 mK, each sensitive to two frequency bands
- Split between three refractors
- Scan at night, recharge during the day







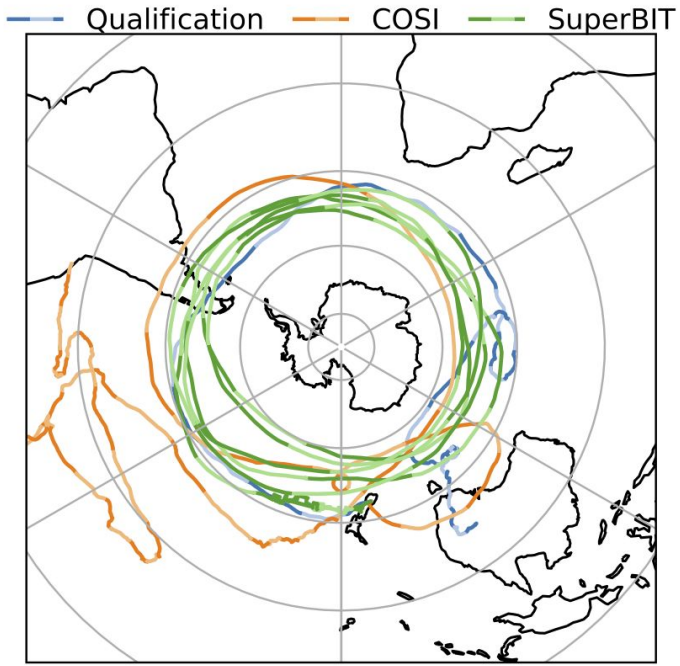
Up-to-date mockup design, May et al. (2024) 2407.01438

Blowing Balloons

Advantage over ground-based experiments: Very little atmosphere

Advantage over satellites: Much lower cost, newer tech

Inconvenients: Flying risk, limited mass, limited flight time, data recovery

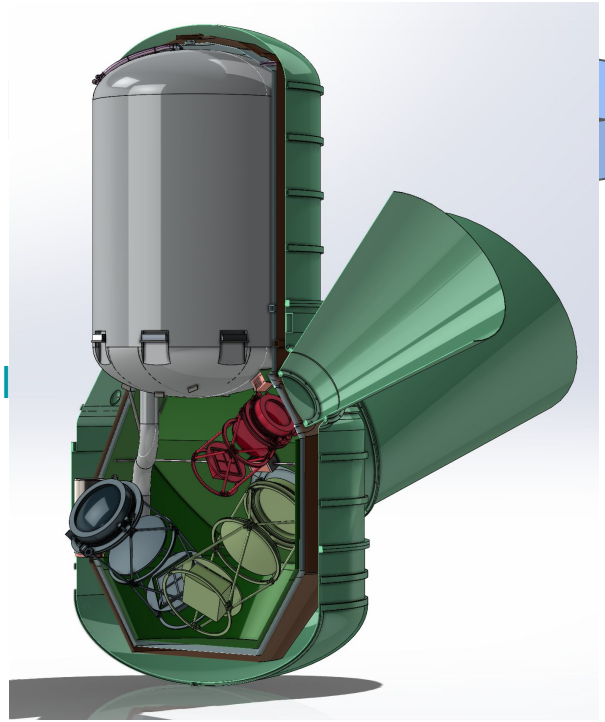


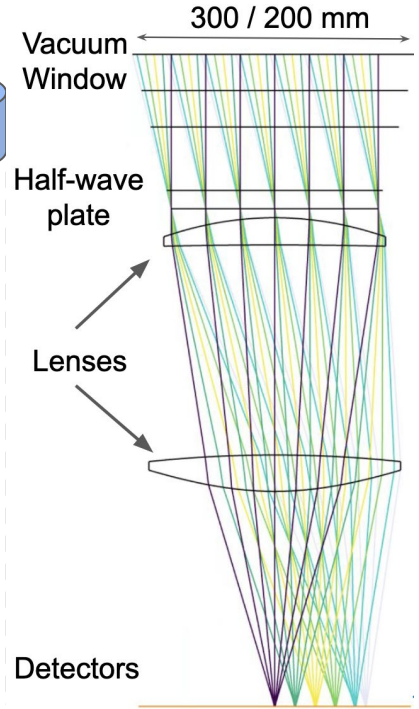
Instrument Inspection

Depointed receivers to deal with SSN

Two 150/220GHz refractors, the third 280/350GHz

Stepped HWPs, filters, baffles for sidelobe rejection





Cryogenic contraptions

Main tank contains ~660L of liquid He

Cold stage: a Mini-DR that provides 3 μW at 100 mK

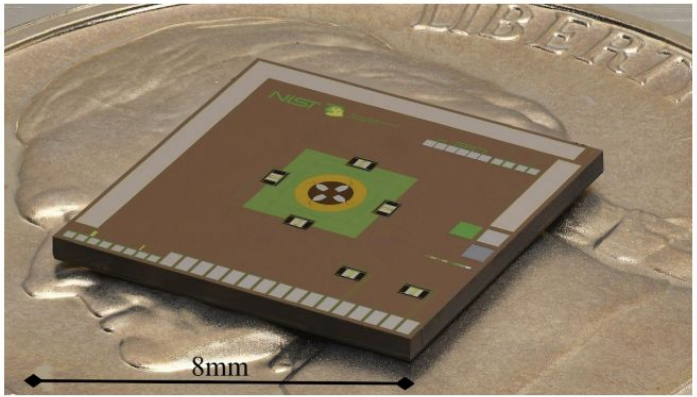
Closed-cycle system with no external gas handling

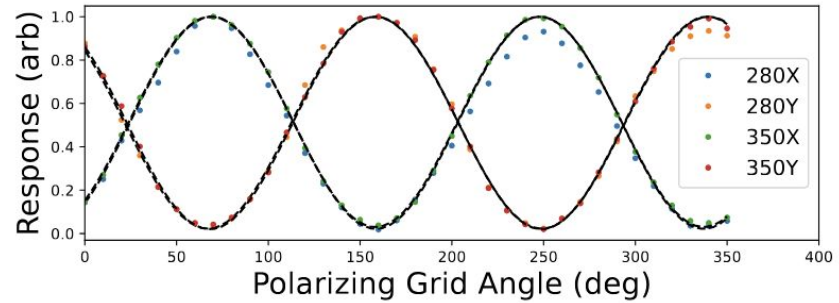
Taurus planning for dilutor module cooled by SPIDER He-3 fridges from superfluid tank

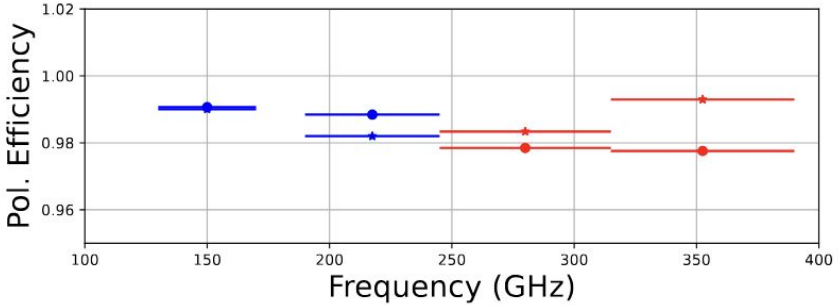
Do we even need to cool to 100mK?

Courtesy of Prof. Johanna Nagy

Detector development

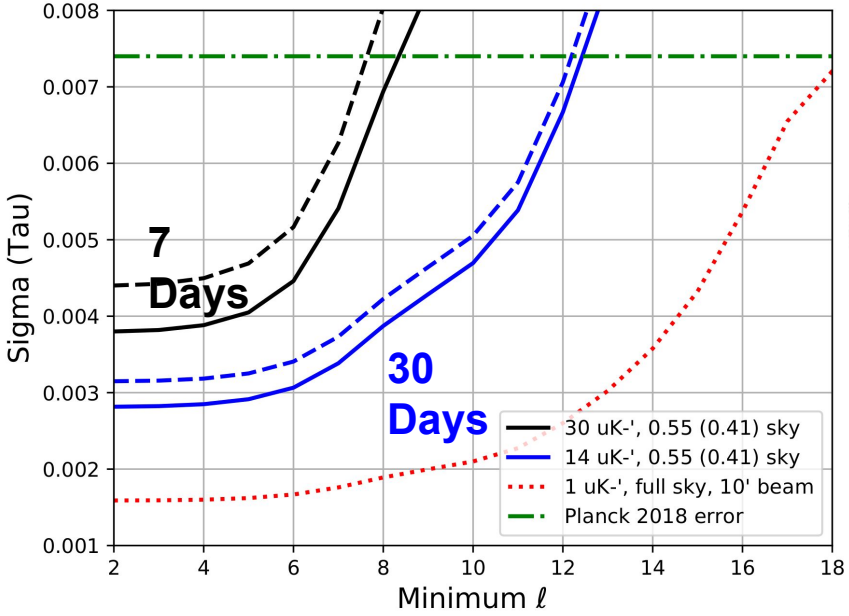


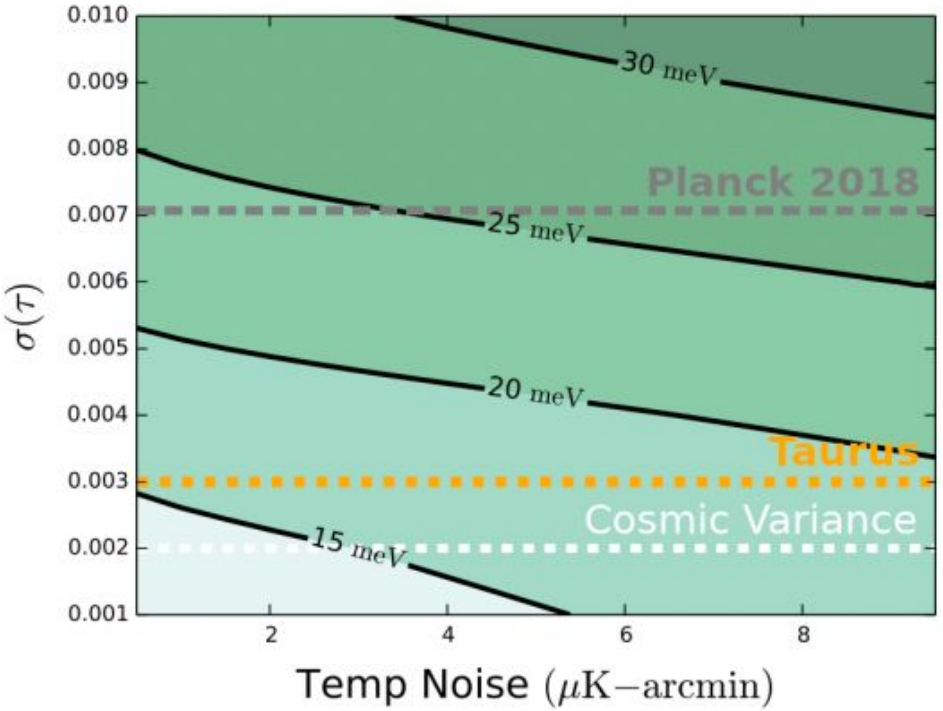




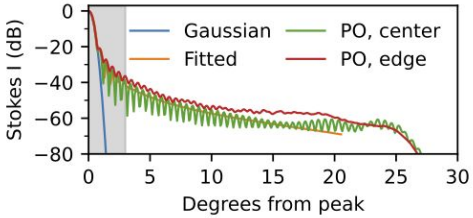
May et al. (2024)

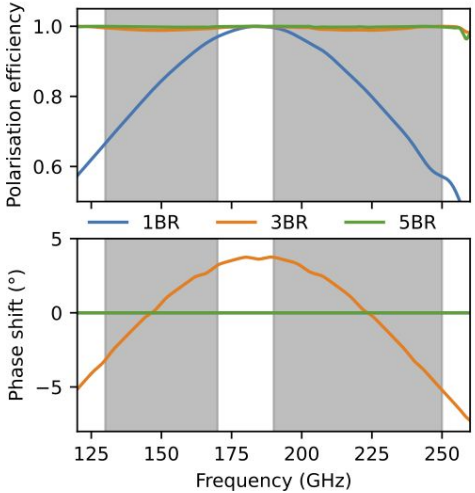
Fiducial Forecast

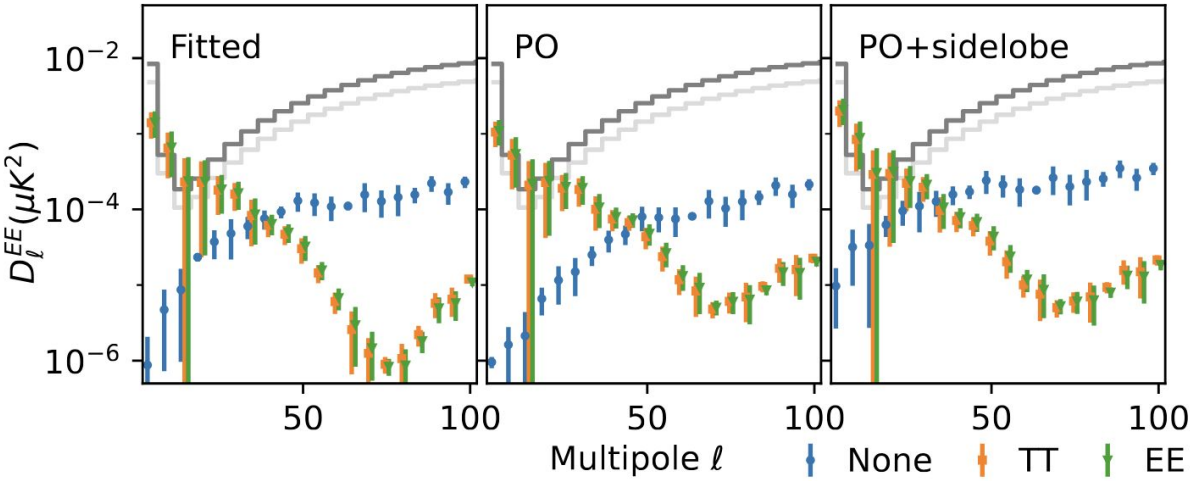




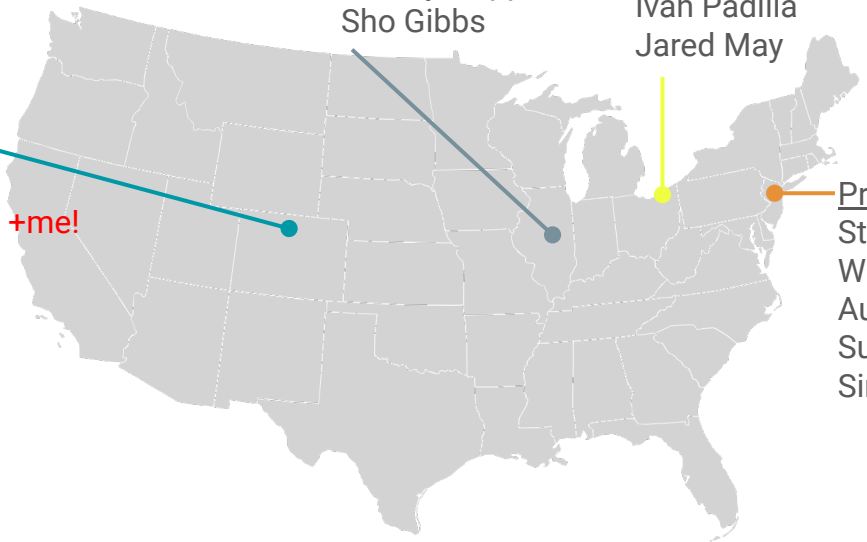
Simulating systematics (2406.11992)







Team Taurus



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Jared May

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William Jones
Aurelien Fraisse
Suren Gourapura
Simon Tartakovsky

U of Iceland
Jon Gudmundsson
Thomas Gascard

Atmospheric avoidance (backup)