

The background of the slide is a Cosmic Microwave Background (CMB) fluctuation map, showing a complex pattern of blue and orange spots. A magnifying glass is superimposed on the left side, focusing on a specific region of the map. The title text is contained within a light green rounded rectangle.

Impact of galactic foregrounds in delensing and r constrain

Kishan Deka

Astrophysics Division (BP4)
National Center for Nuclear Research (NCBJ), Warsaw

Tensor-to-scalar ratio, r

- ▶ Primordial CMB polarisation patterns - E-mode (scalar+tensor) and B-mode (tensor).
- ▶ Inflationary models predict B-mode polarisation.

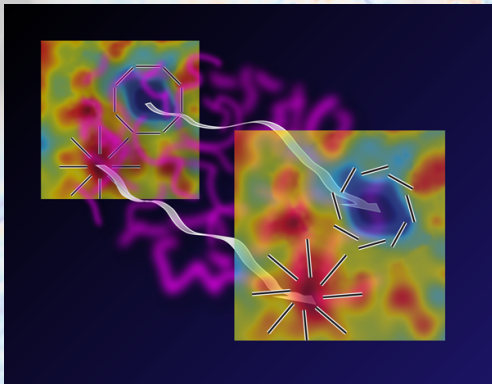
Tensor-to-Scalar ratio

$$r = \frac{\text{amplitude of tensor fluctuations}}{\text{amplitude of scalar fluctuations}}$$

- Current upper limit $r < 0.032$.
- Next generation survey (CMB Stage-4) targets to achieve $r = 0.001$.

Lensing B-modes

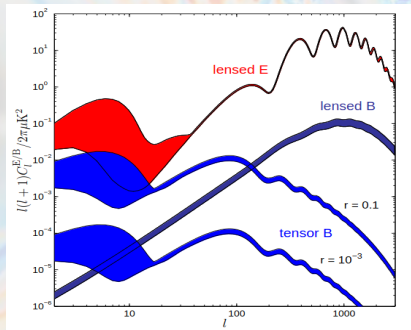
- Observed CMB polarisation patterns - E-mode (scalar) and B-mode (tensor + lensing).
- Lensing twists primordial E-modes to generate lensing B-modes.



APS / Alan Stonebrake

Motivation

Primordial tensor B-modes are dominated by lensing B-modes.

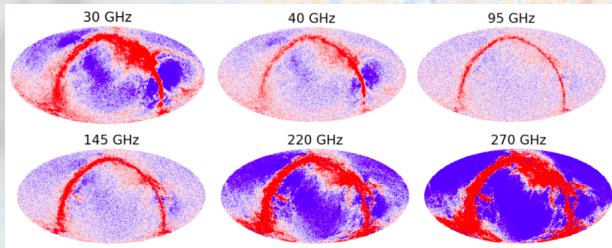


Lewis, Challinor (2006)

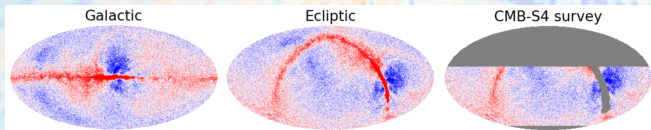
- Reconstruct the deflection field (Quadratic Estimator).
- Subtract a template of lensing B-modes.
- Improve constraints on tensor-to-scalar ratio (r).

Contaminations from galactic emissions

- CMB is contaminated by thermal dust emission.
- For CMB-S4, we have 20, 30, 40, 95, 145, 220, 270 GHz channels.

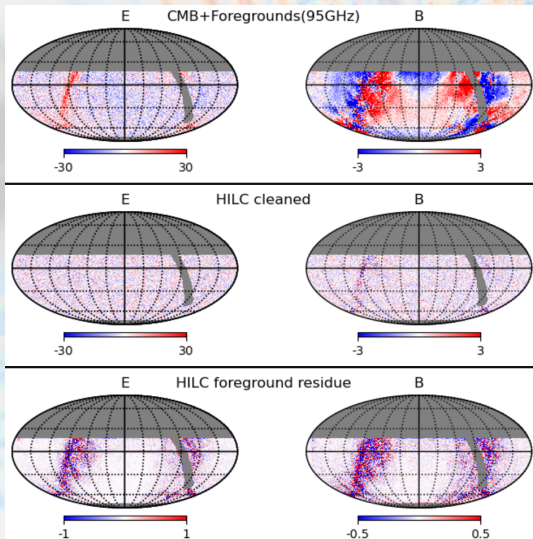


CMB-S4 frequencies, simulated E-mode polarisation maps

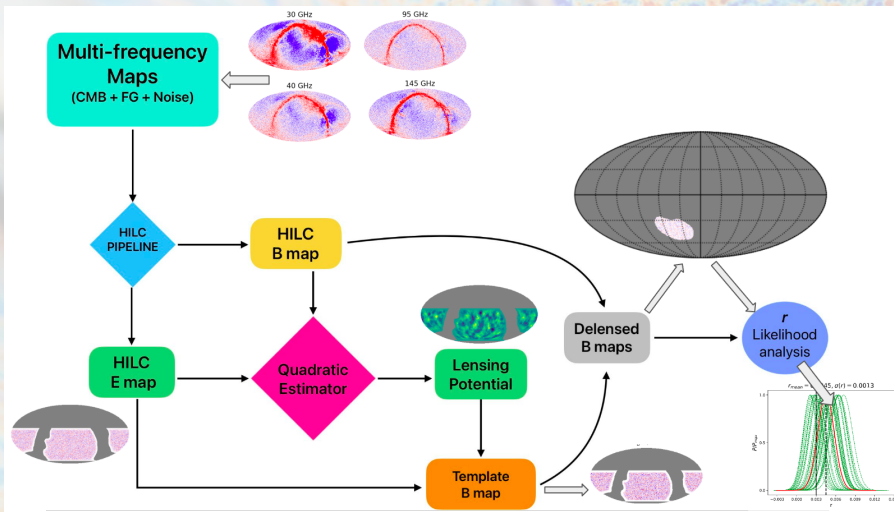


Component separation

- ▶ Harmonic Internal Linear Combination (HILC).



Pipeline Schematic

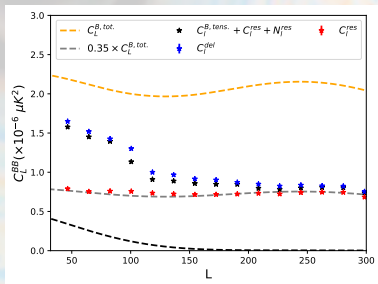


Bias in r constrain

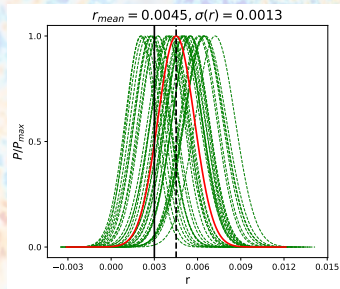
Constrain on tensor-to-scalar ratio (r) comes from,

$$C_l^{del} = rC_l^{prim.,r=1} + C_l^{res} + N_l^{nois.} + N_l^{del}$$

Residual foreground biases the estimate of tensor-to-scalar ratio (r).



(a) Delensed B-mode spectra.



(b) Posterior of r estimate.

Take away

- ▶ CMB Stage-4 experiments targets to constrain $r = 0.001$.
- ▶ Lensing reconstruction and delensing is important to achieve tighter constrain.
- ▶ Residual galactic foregrounds bias the estimate of r .
- ▶ Better understanding of galactic foreground is needed.

Thank You!