BICEP/*Keck* Constraints on Primordial Gravitational Waves

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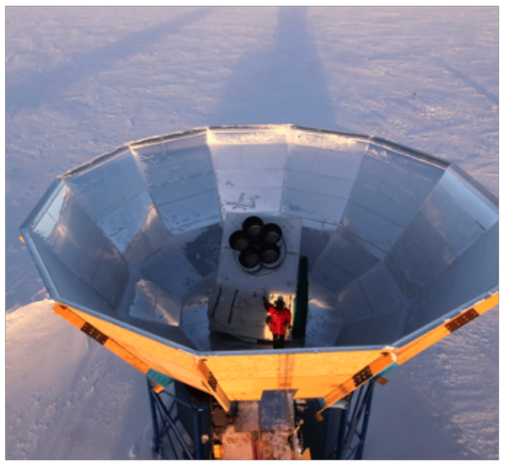
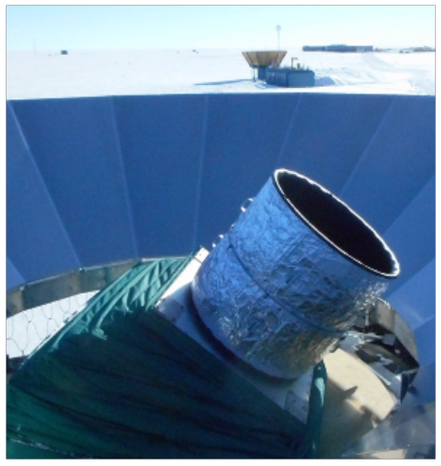
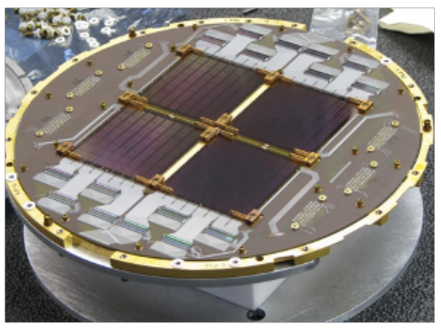
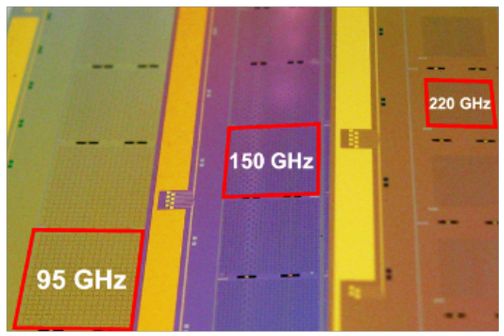
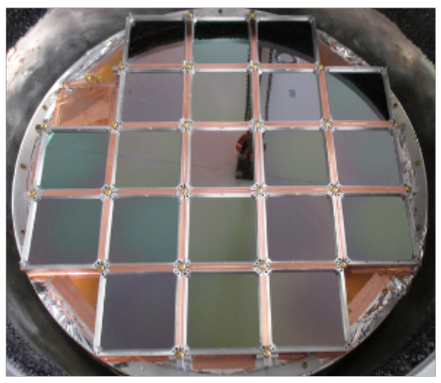
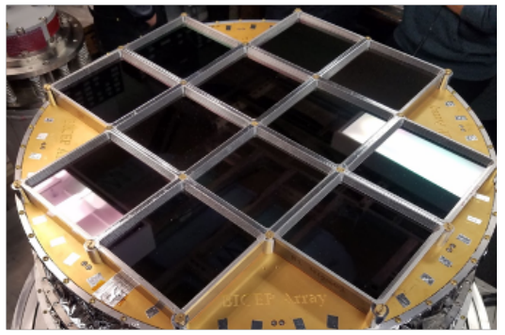
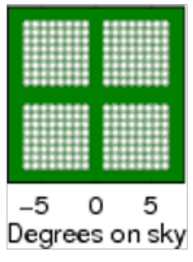
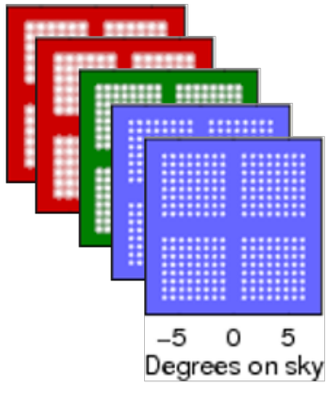
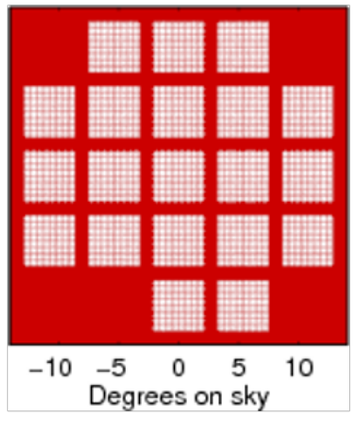
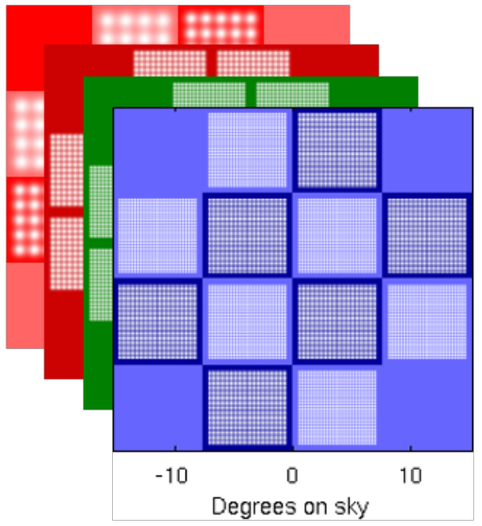
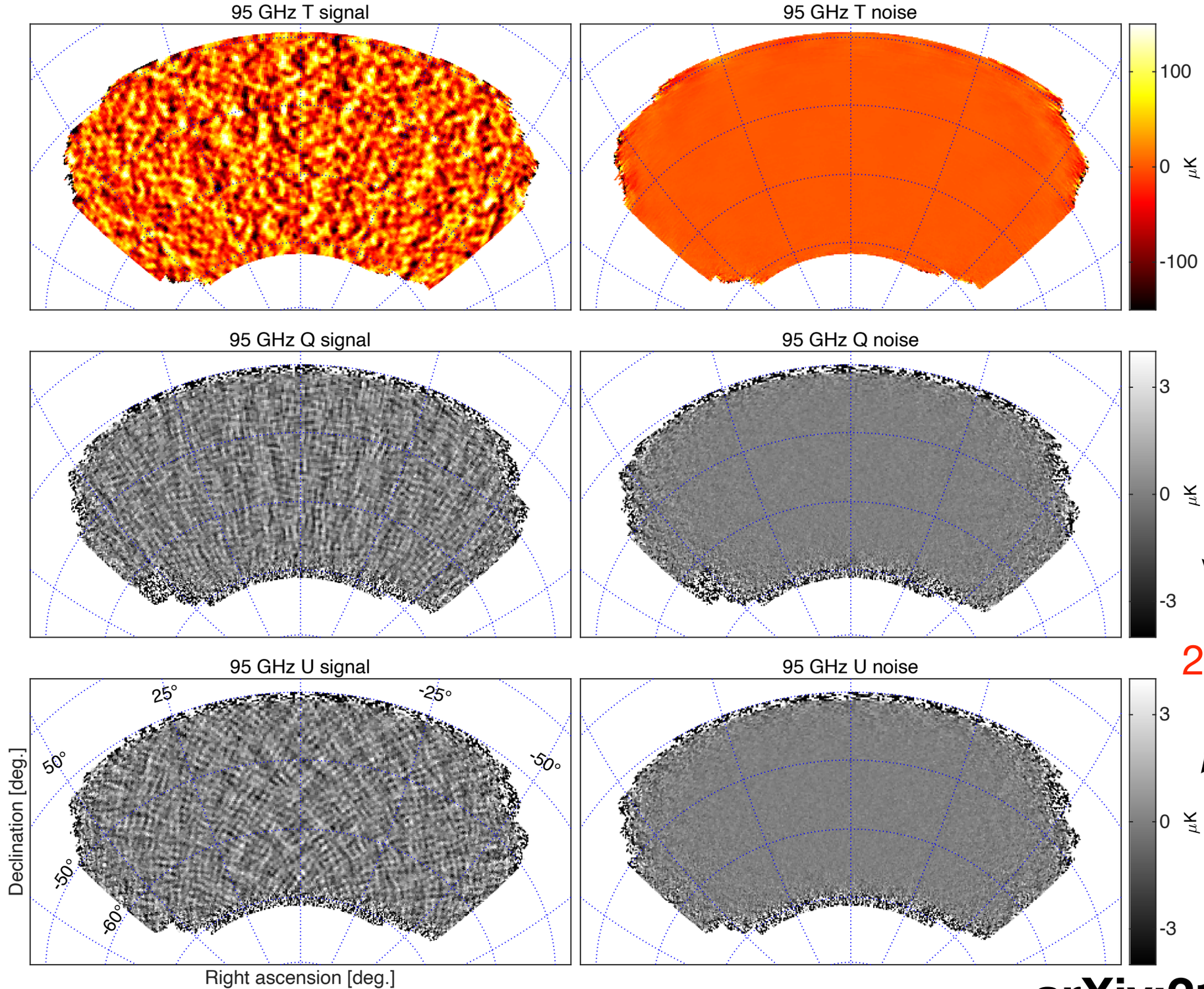
CMB-S4 Meeting 2022-08-17

BICEP/*Keck* Collaboration

BICEP/*Keck* Telescopes

	BICEP2 (2010-2012)	**Keck Array** (2012-2019)	**BICEP3** (2016-)	**BICEP Array** (2020-)
Telescope and Mount				
Focal Plane				
Beams on Sky				

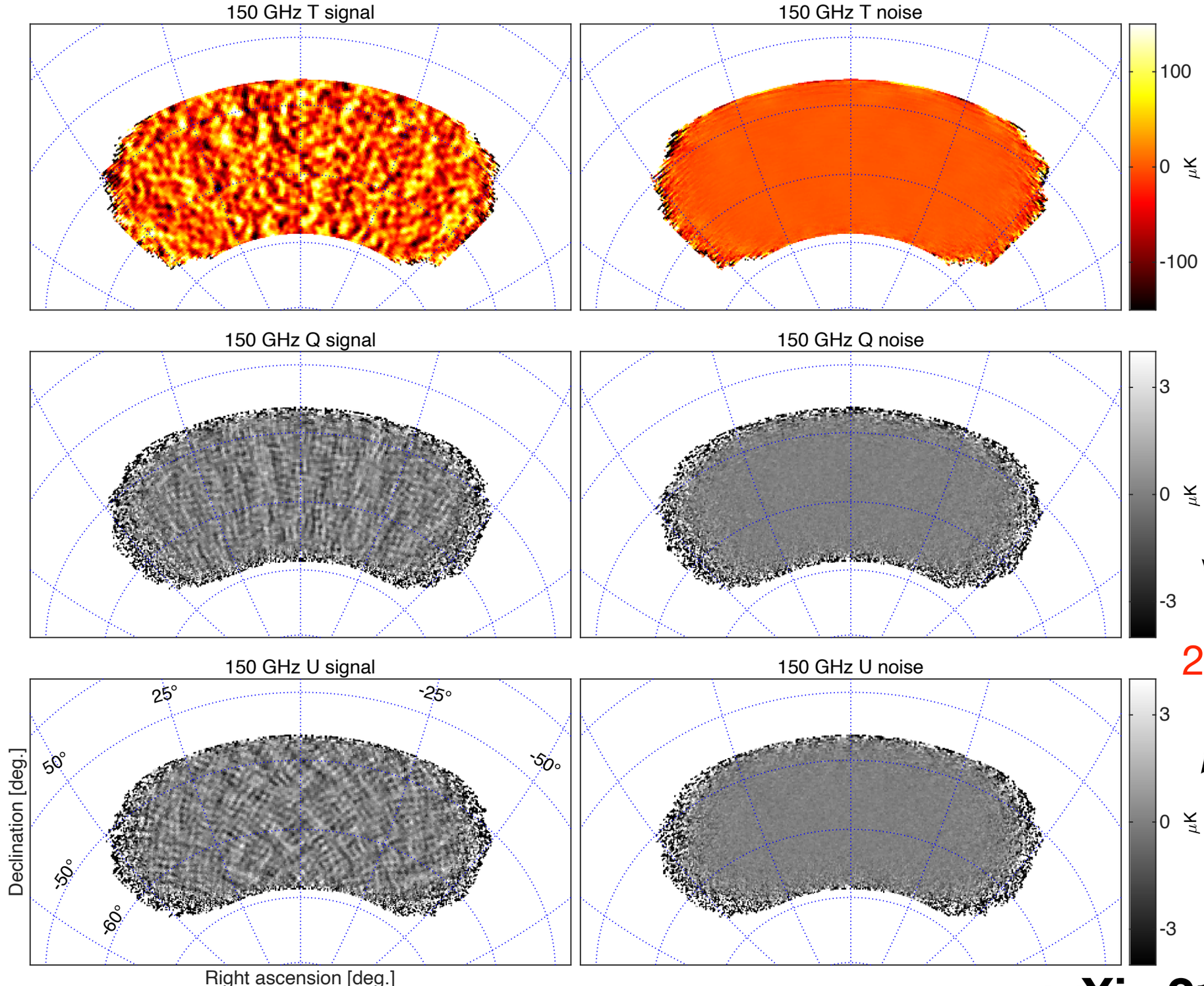
BK18: B3 95 GHz T/Q/U Maps



2.8 μK arcmin

arXiv:2110.00483

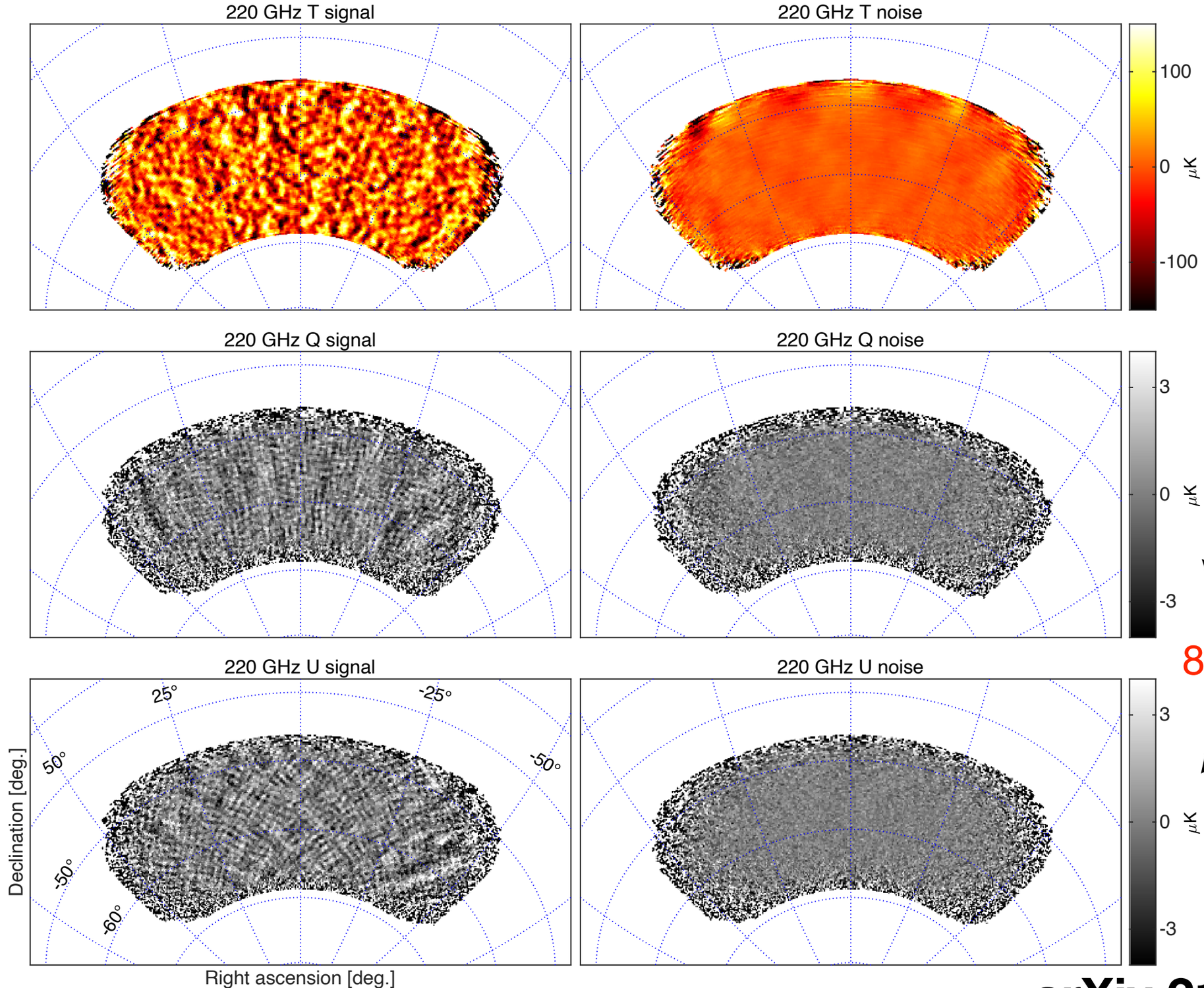
BK18: B2/K150 GHz T/Q/U Maps



2.8 μK arcmin

arXiv:2110.00483

BK18: K220 GHz T/Q/U Maps



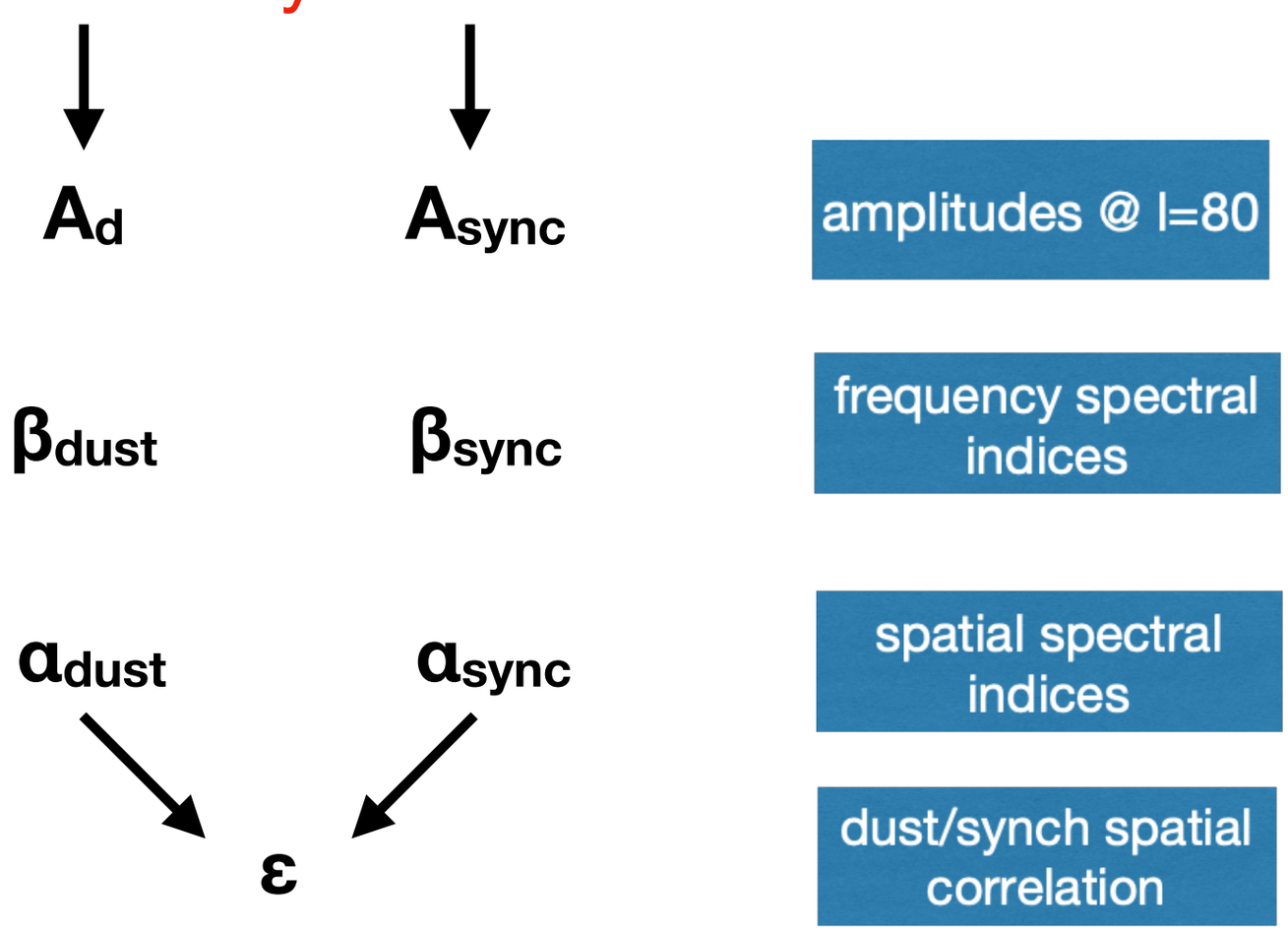
8.8 μK arcmin

arXiv:2110.00483

Multi-component Multi-spectral Likelihood Analysis

- Take the joint likelihood of all BB spectra simultaneously vs. the model for BB which is the lensed-ΛCDM expectation + 7 parameter foreground model + *r*

- foreground model = dust + synchrotron



11 maps in BK18:

- B95/K95/BK150/ K220 up to 2018
- WMAP 23/33
- Planck 30/44/ 143/217/353

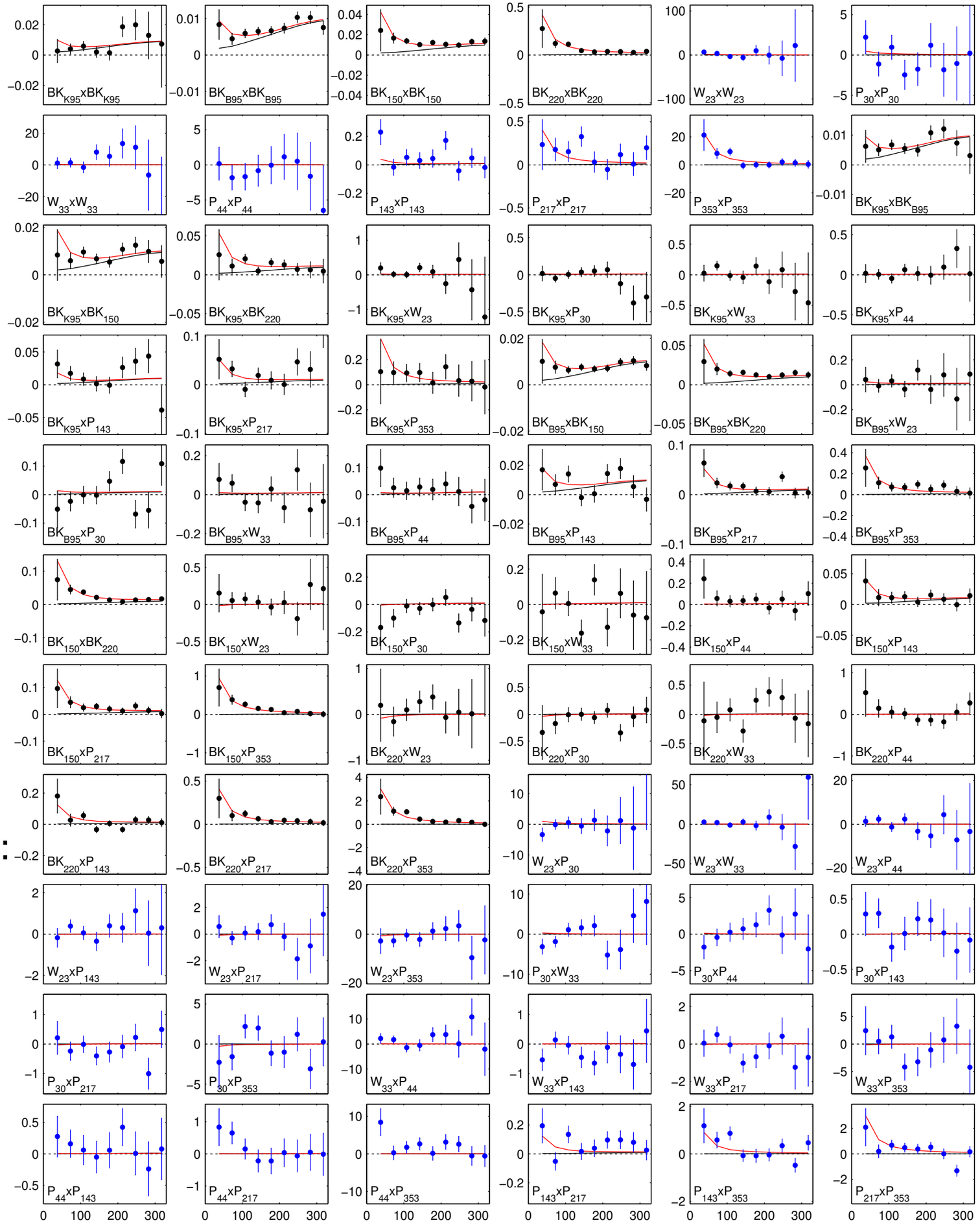
↓

Matrix purified and inverse noise variance apodized

↓

66 BB spectra in BK18:

- Black data points have BK
- Blue data points are W/P



arXiv: 2110.00483

Constraining power of B3

Agreement with BK15 baseline which did not have B3

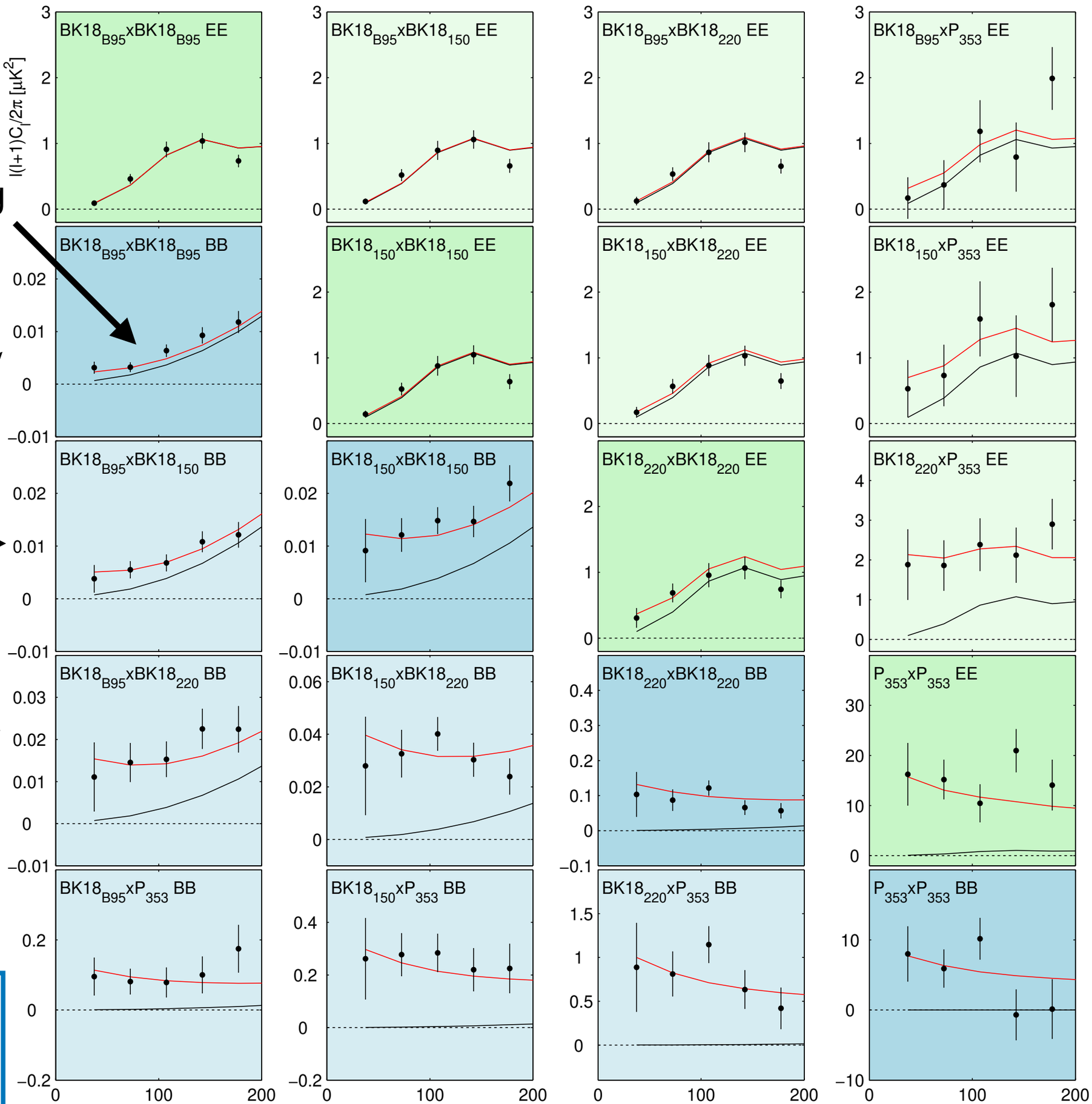
Blue Panels are BB spectra

Green Panels are EE spectra (EE/BB = 2)

Black lines: lensed-ΛCDM

Red lines: lensed-ΛCDM +foreground

arXiv: 2110.00483



Baseline Constraints on *r* & Foreground

- Only BB:

  $r_{0.05} < 0.072$

  $\rightarrow \ < 0.036$

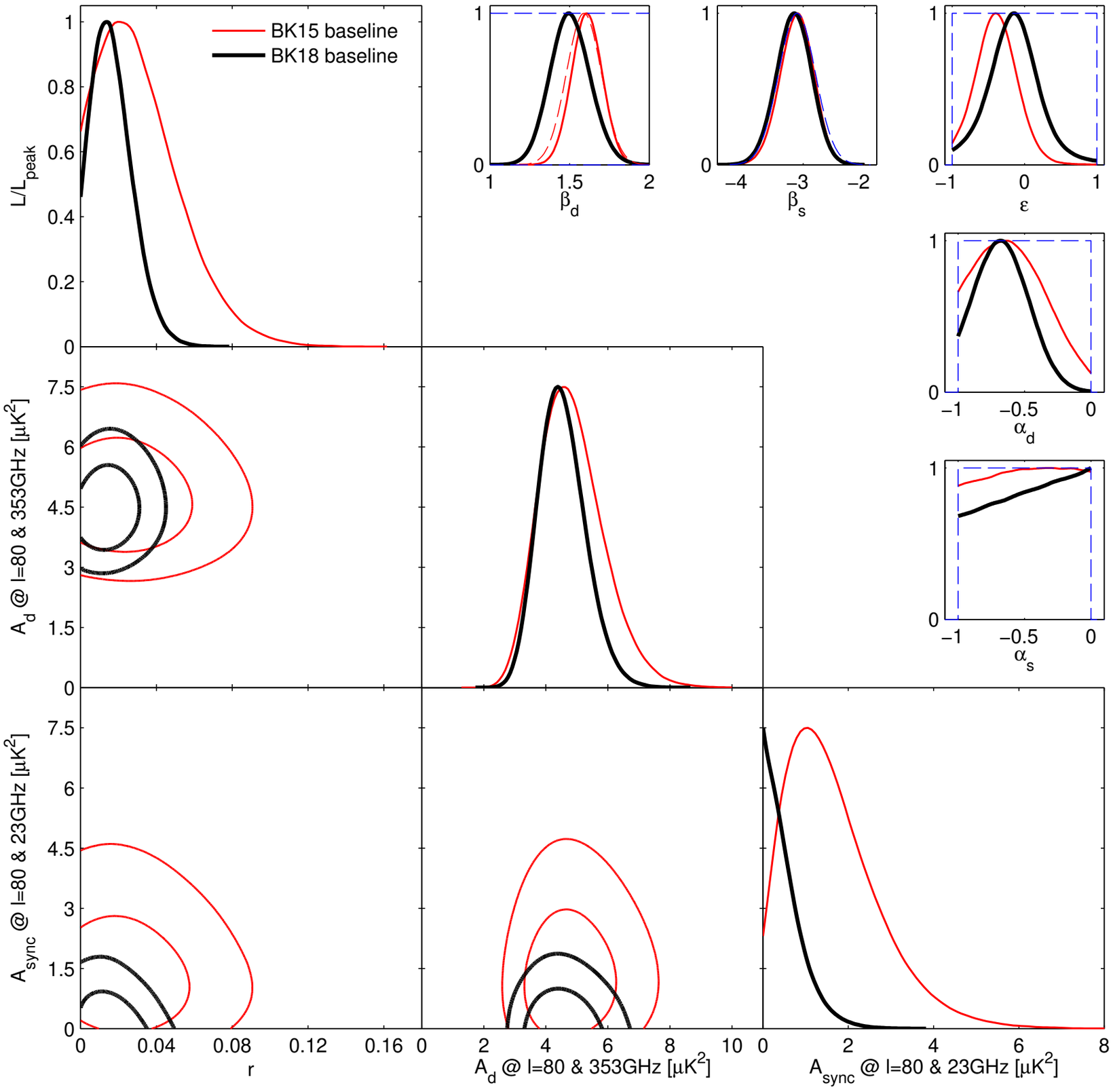
- $r_{0.05} = 0.020^{+0.021}_{-0.018}$

  $\rightarrow 0.014^{+0.010}_{-0.011}$

- $\beta_{\rm d}$ prior is removed

- $A_{d,353} = 4.4^{+0.8}_{-0.7}\mu K^2$

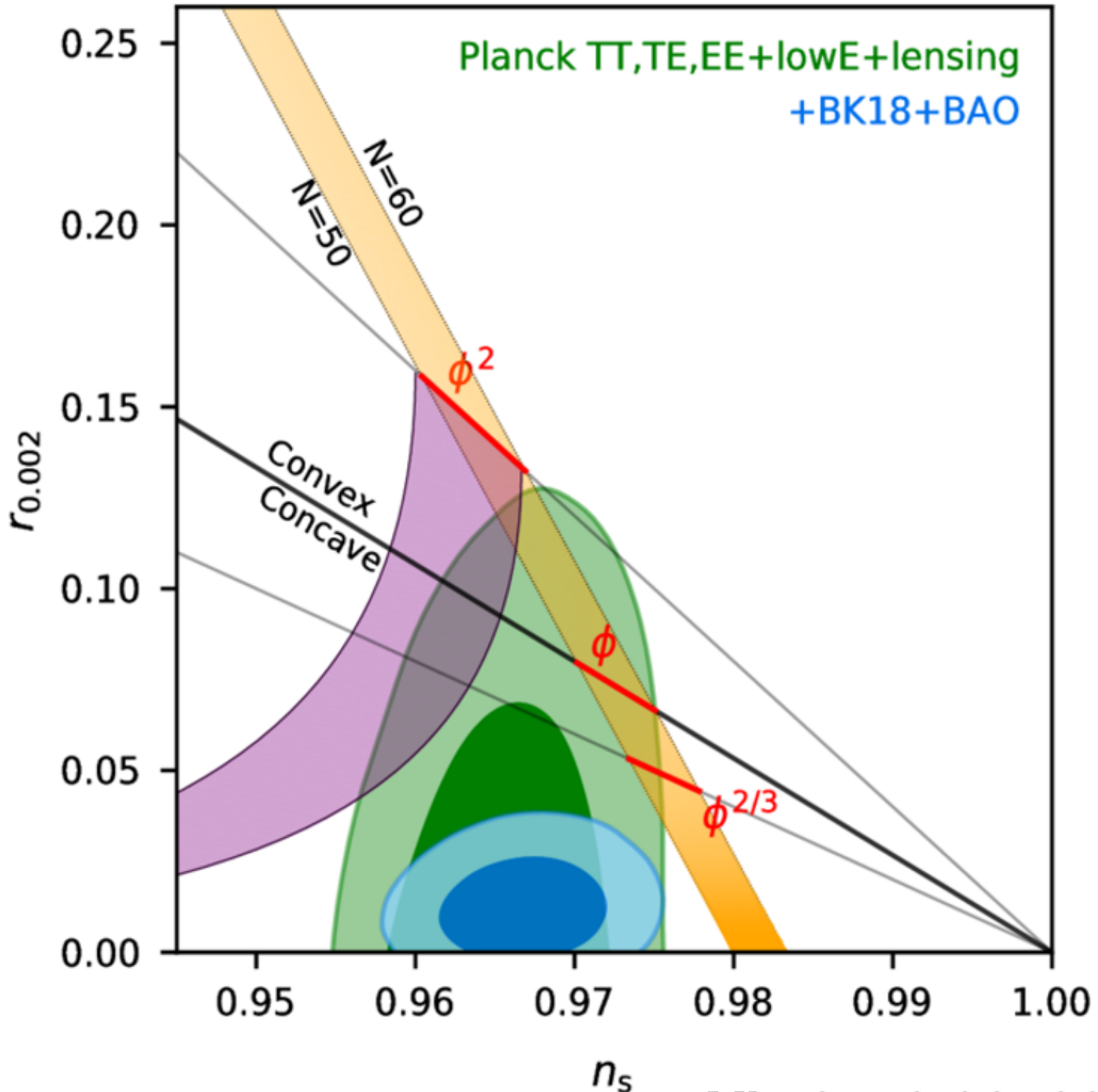
- $A_{s,23} < 1.40\mu K^2$



arXiv:2110.00483

Constraint on Inflation

- *r*+foreground+ΛCDM
- BK18+Planck2018+BAO:
  $r_{0.05} < 0.035$
- **Monomial Inflation** and **Natural Inflation** are strongly disfavored
- The progress is entirely driven by B-modes!



arXiv:2110.00483

Conclusions

- BICEP2: 2010-2012 (150 GHz), *Keck Array*: 2012-2019 (95/150/220/270 GHz) & BICEP3: 2016-present (95 GHz)

- BK18: $\sigma(r) = 0.009$ & $r < 0.035$

- BICEP Array: 2020-present (30/40/95/150/220/270 GHz)

- BK27+SPT3G delensing (with > 2yrs of COVID delay):

  $\sigma(r) \lesssim 0.003$, extrapolated from achieved map depth!