



Status and future plans for the South Pole Observatory

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Colloque national CMB France #7 — October 14th, 2025

South Pole Observatory: BICEP + SPT

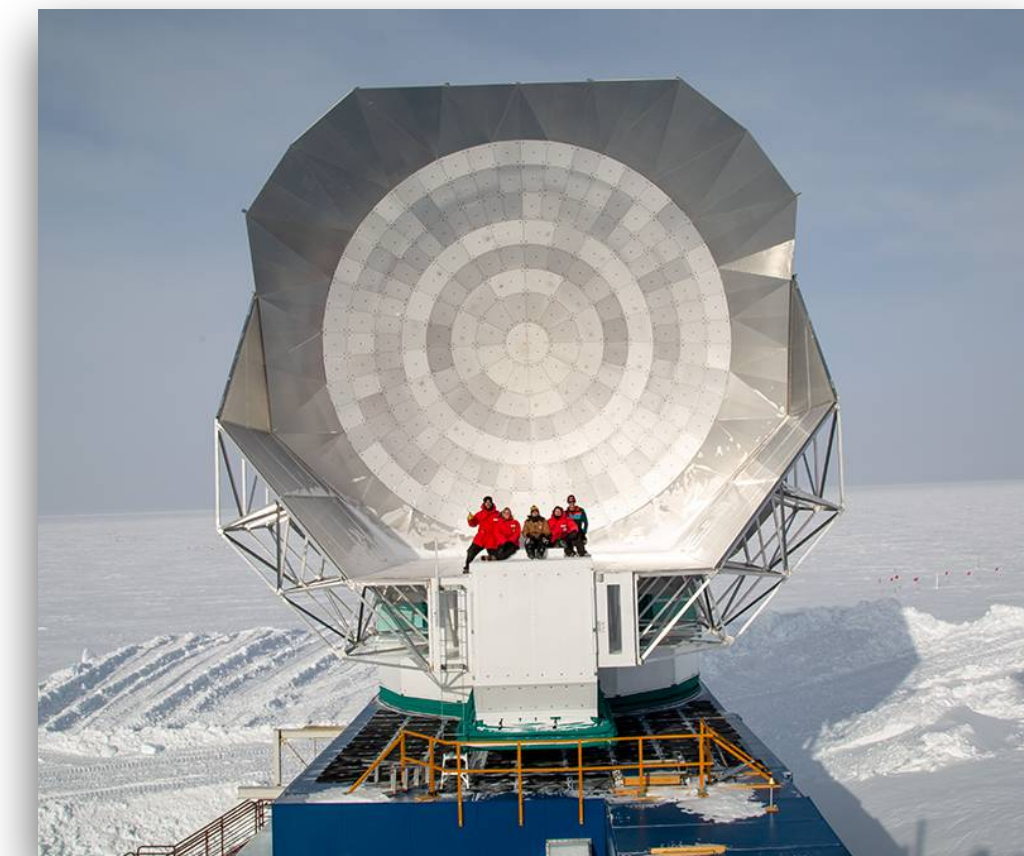


Telescopes

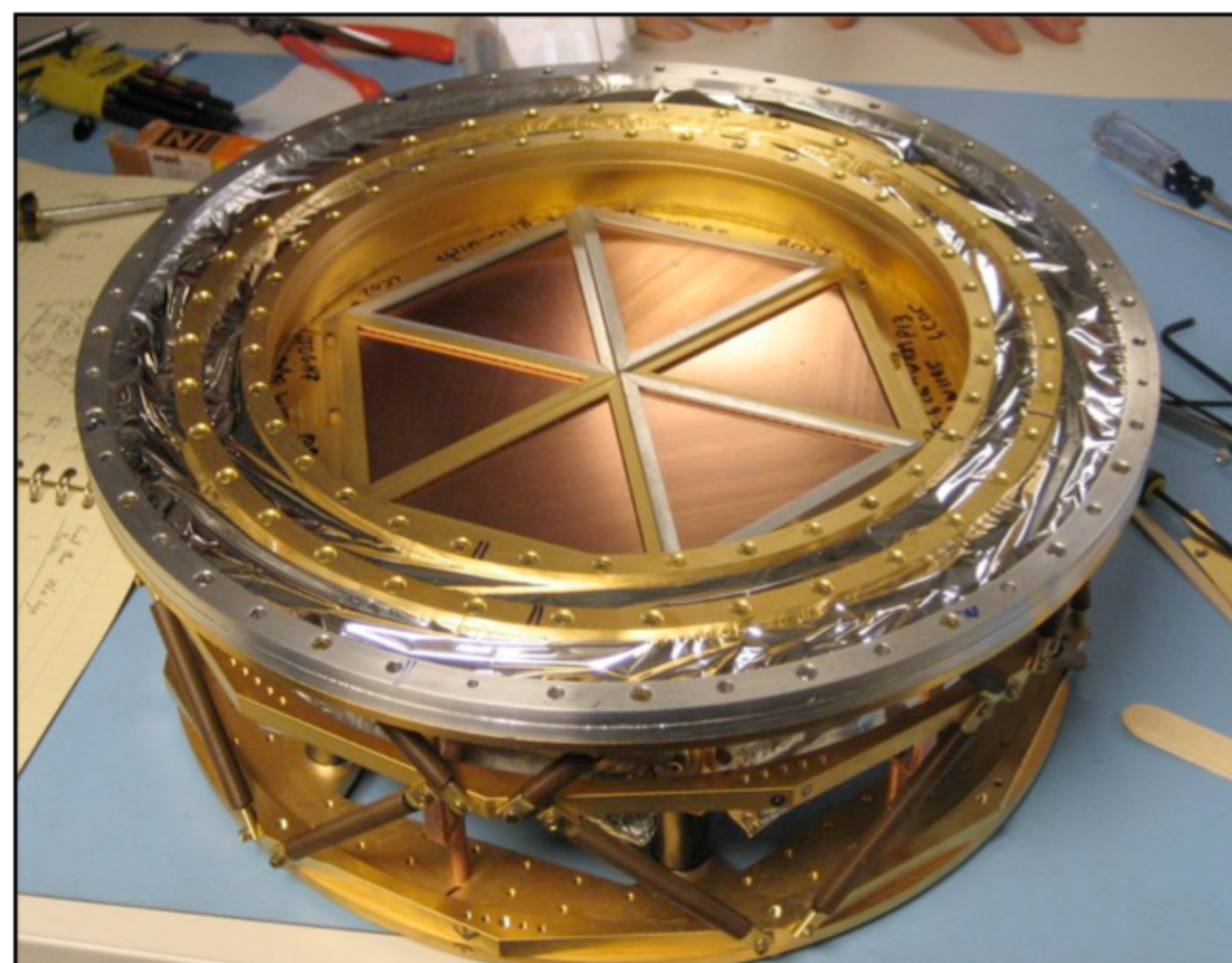


People

SPT program: 2007 – present

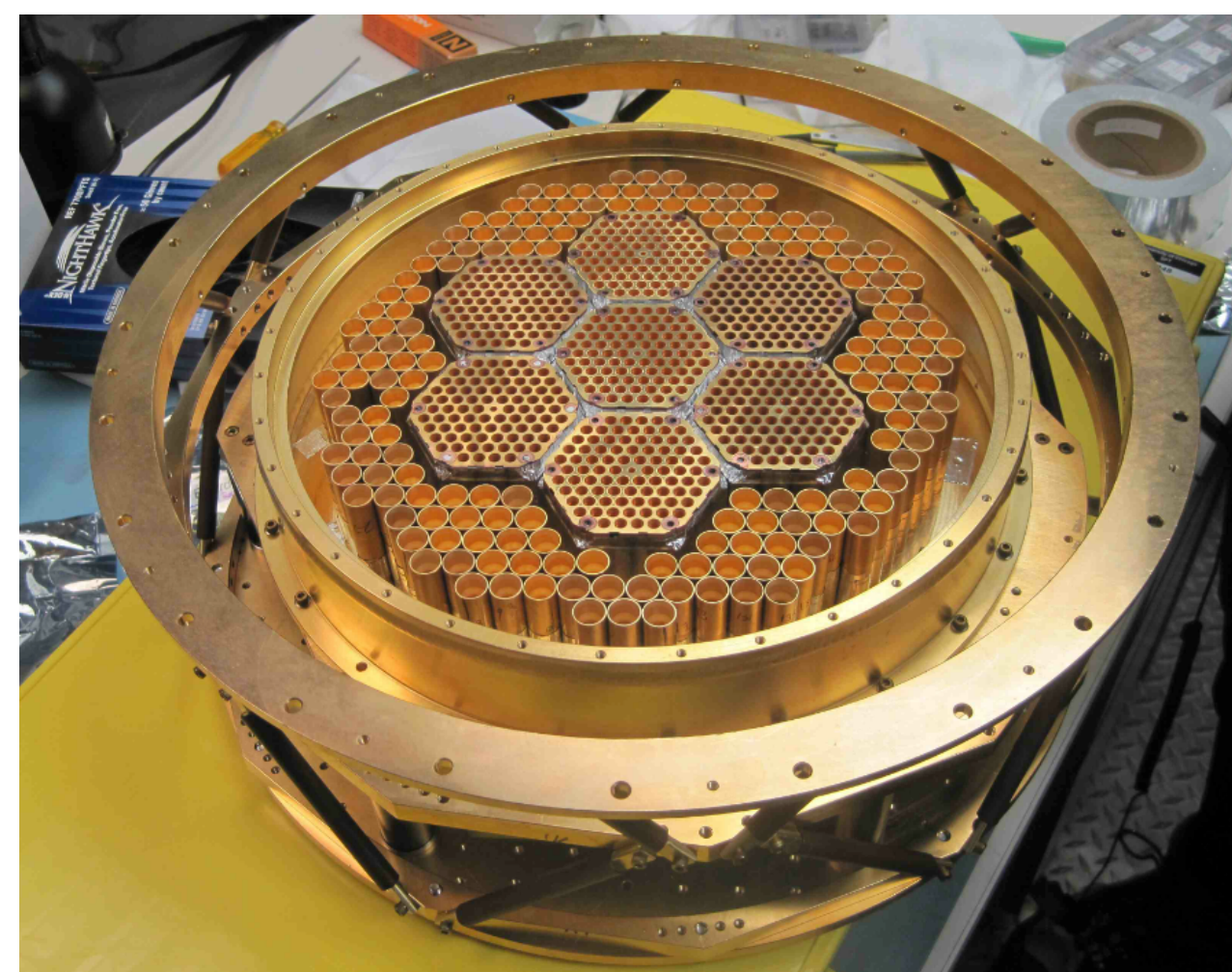


SPT-SZ
2007-2012



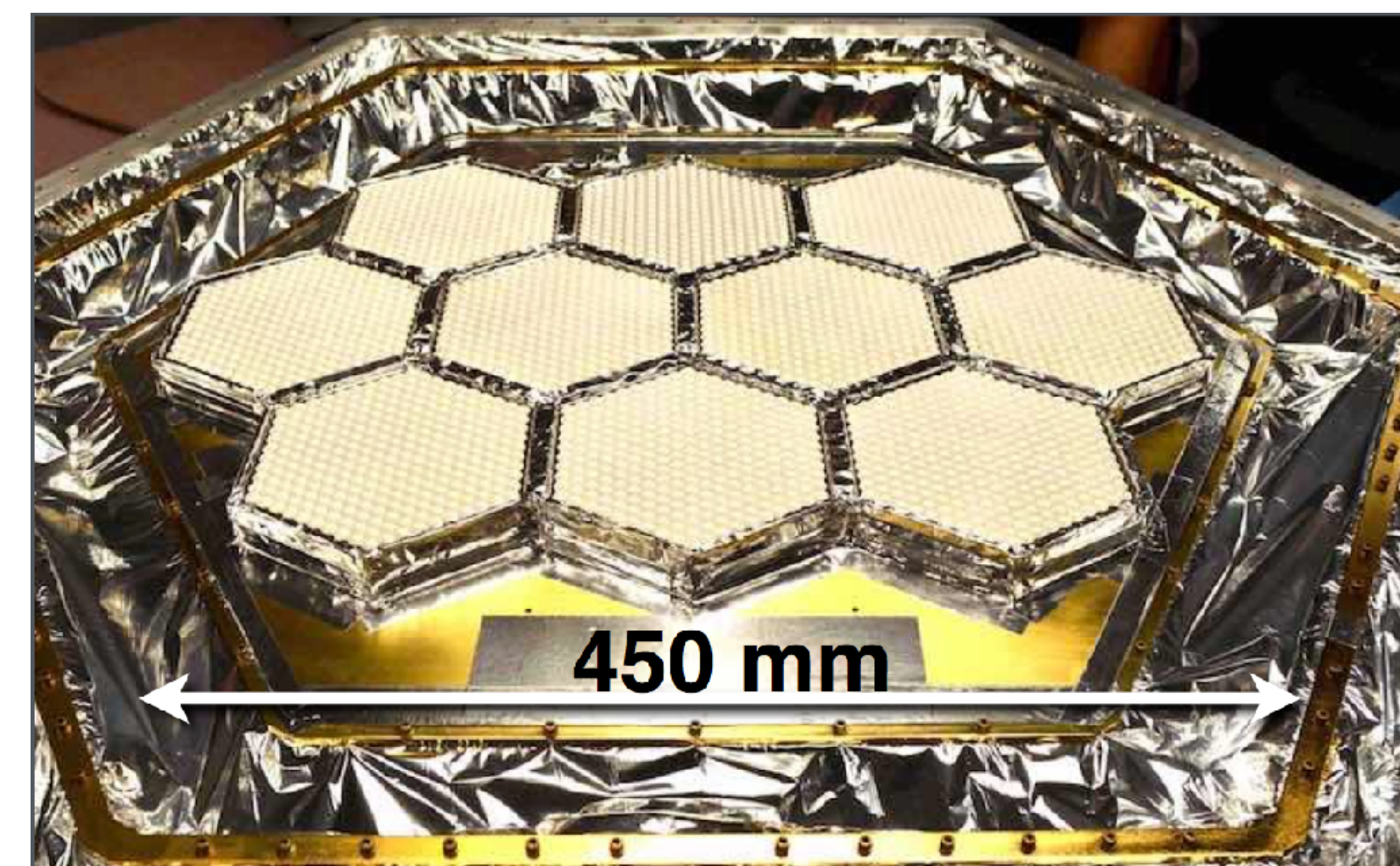
~ 950 dets
100, 150, 220 GHz

SPTPol
2012-2017



~ 1600 dets
100, 150 GHz

SPT3G
2017-present



~ 16,200 dets
100, 150, 220 GHz

BICEP program: 2006 – present

Generation 1

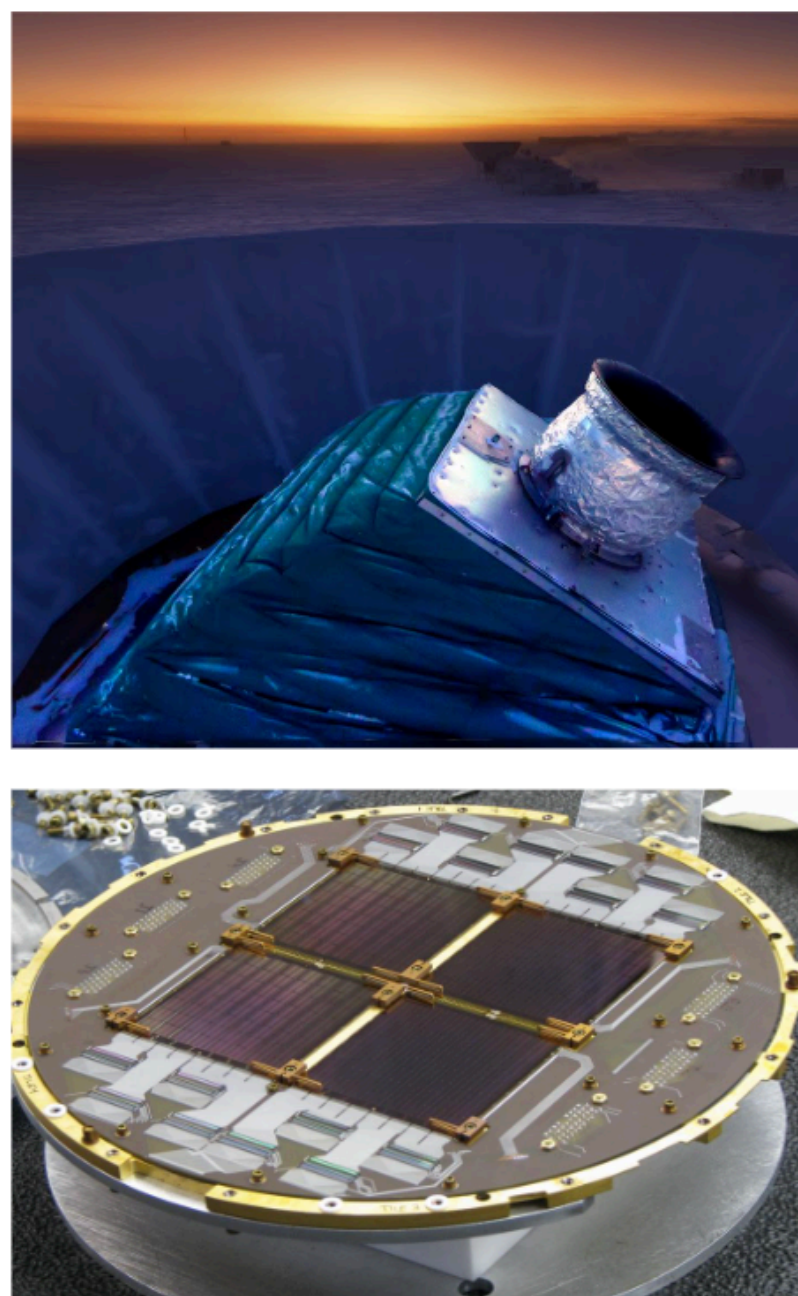
BICEP1
2006-2008



~ 100 dets
100, 150 GHz

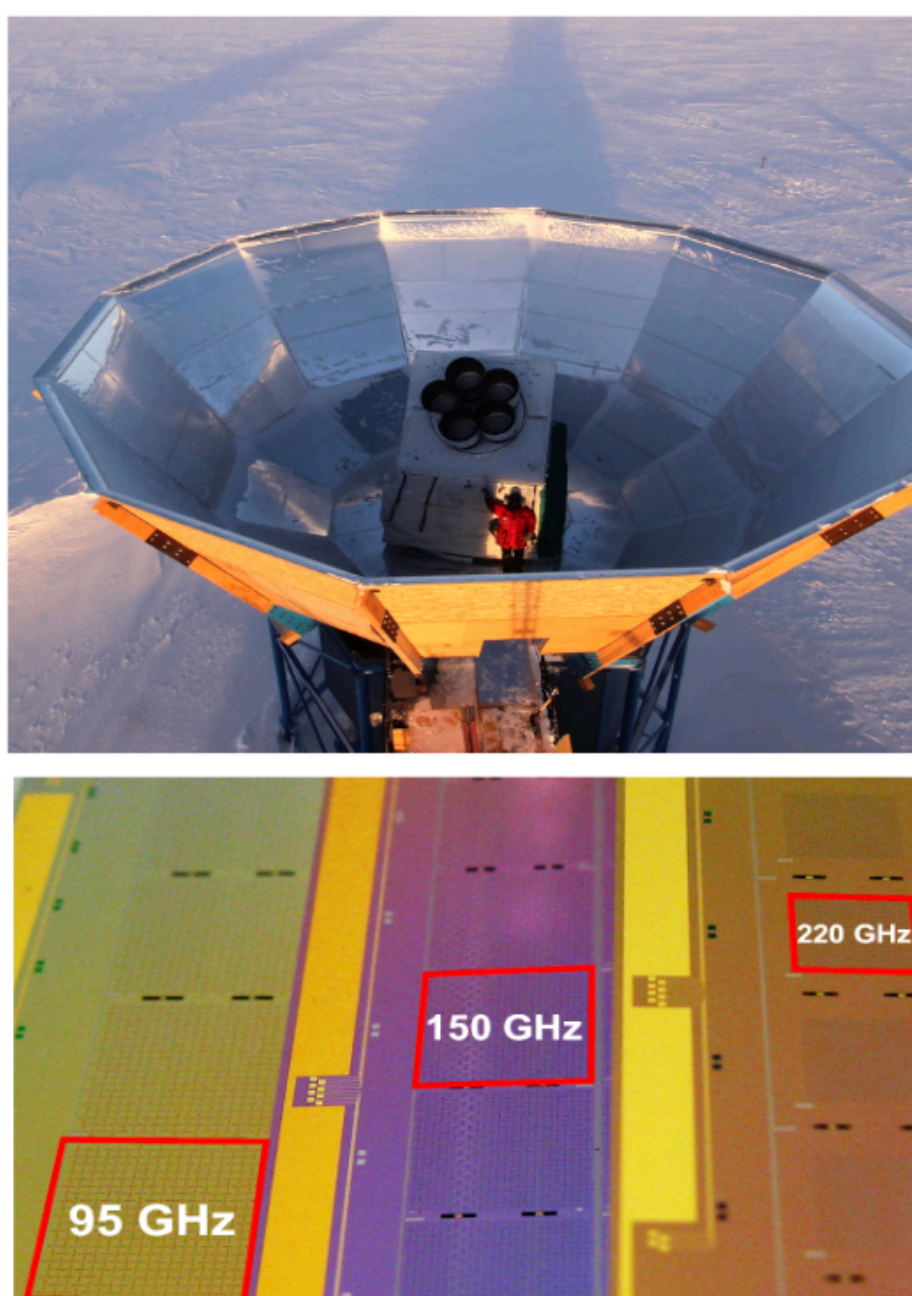
Generation 2

BICEP2
2010-2012



~ 500 dets
150 GHz

Keck Array
2012-2019



~ 2500 dets
95, 150, 220, 270 GHz

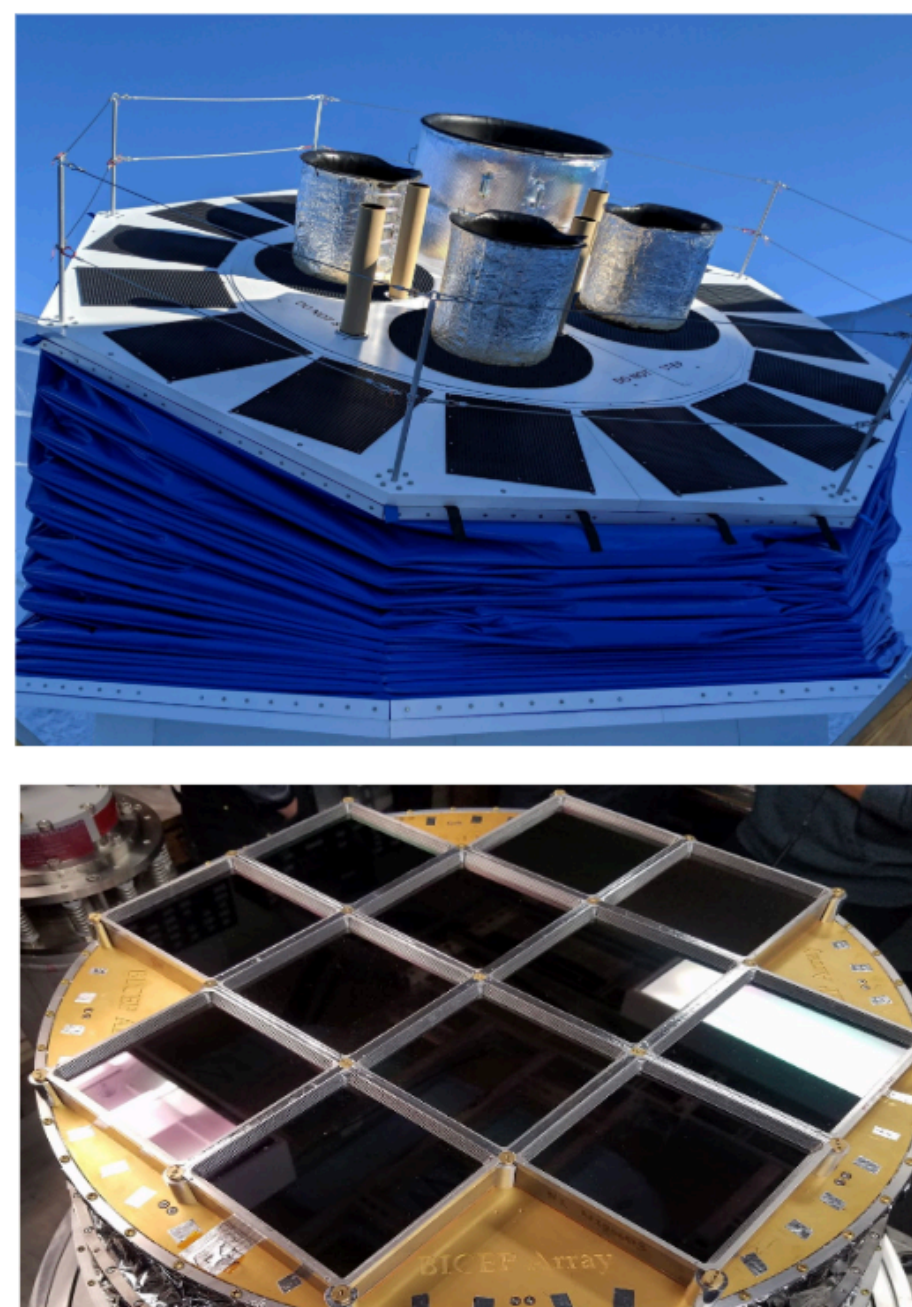
Generation 3

BICEP3
2015-present



~ 2500 dets
95 GHz

BICEP Array
2020-present



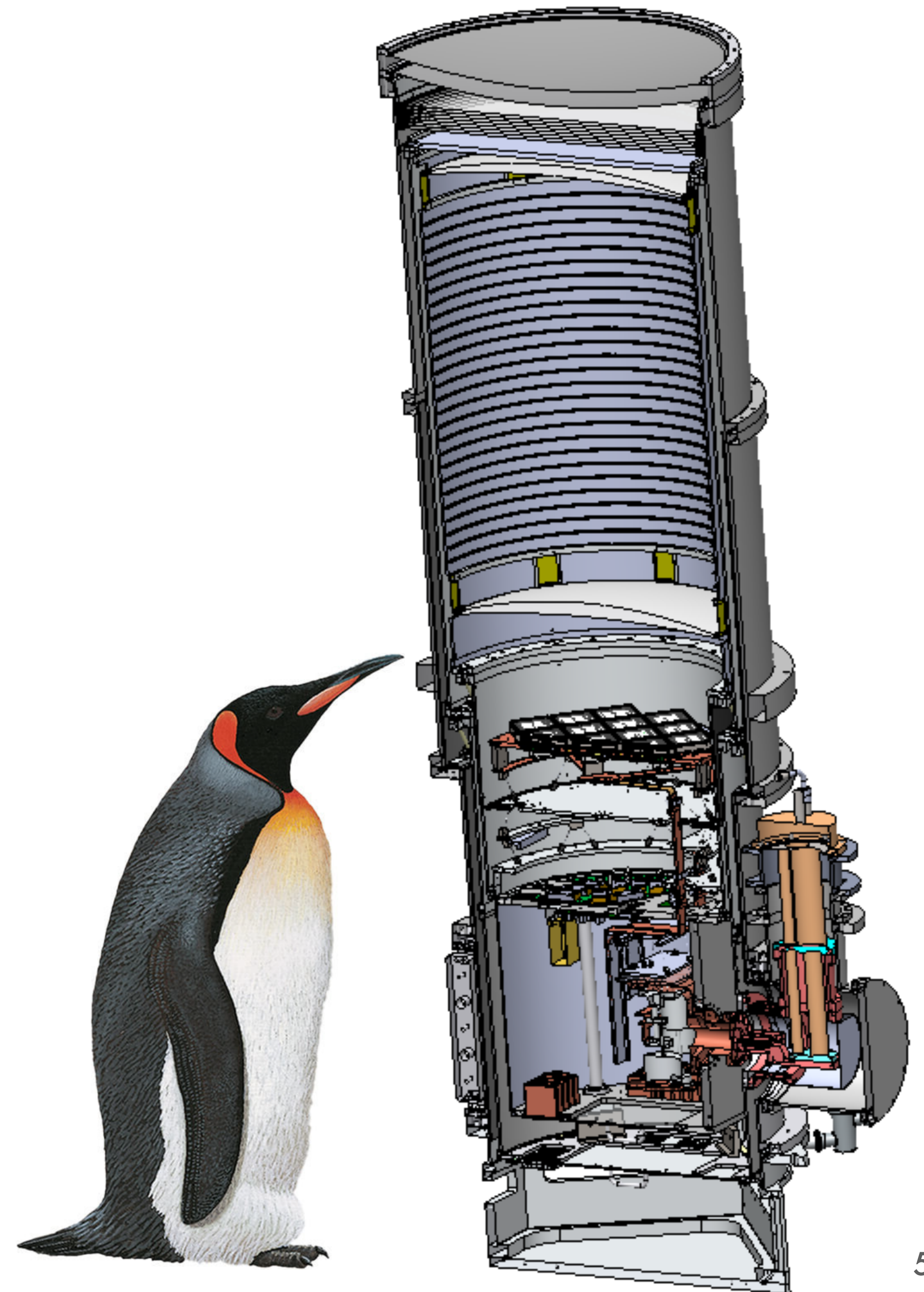
~ 25,000 dets
30/40, 150, 220, 270 GHz
(+90 GHz in 2027)

BICEP receivers

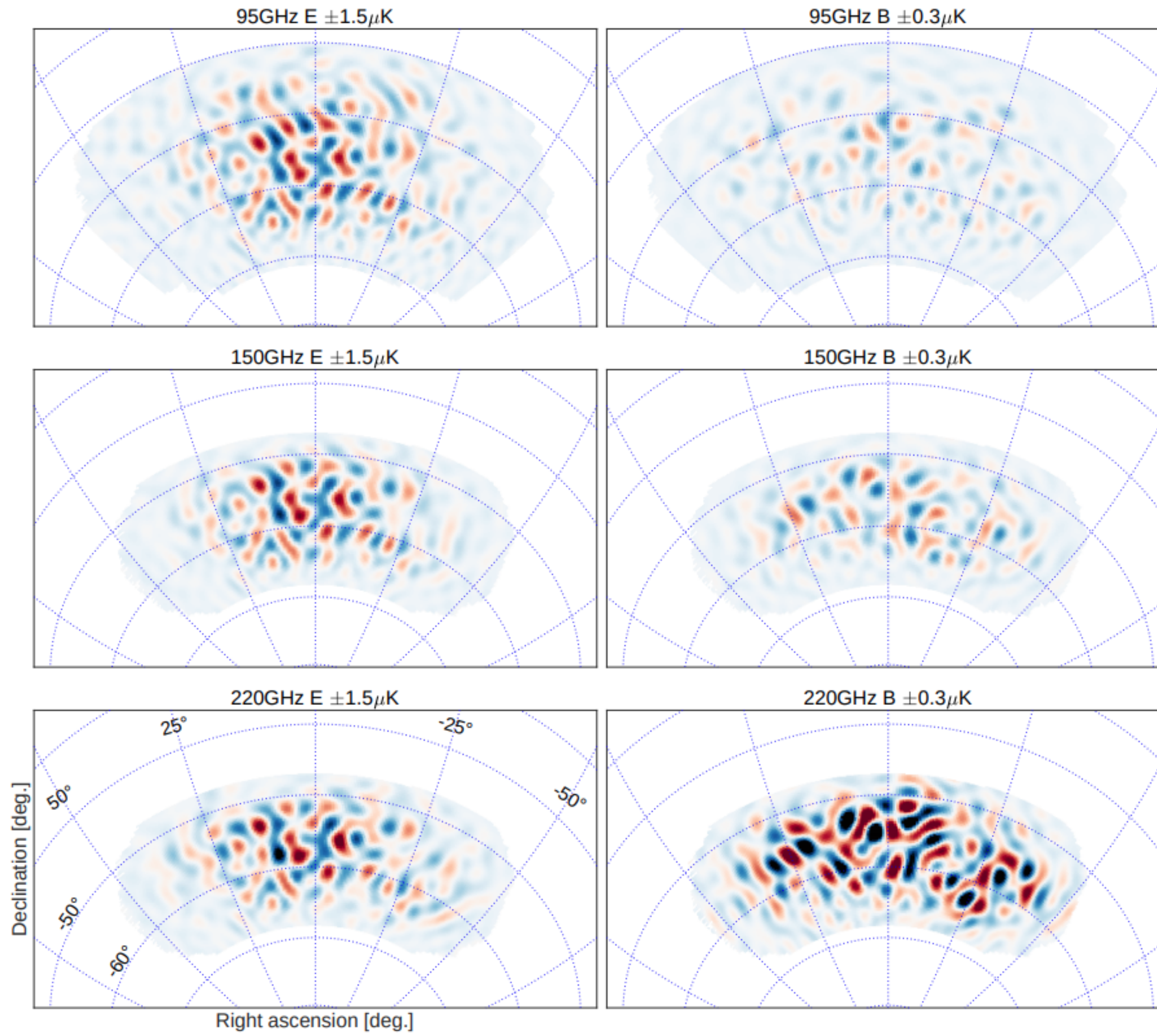
Small Aperture Telescopes

Compact, on-axis optics design

Targets a small and deep sky patch



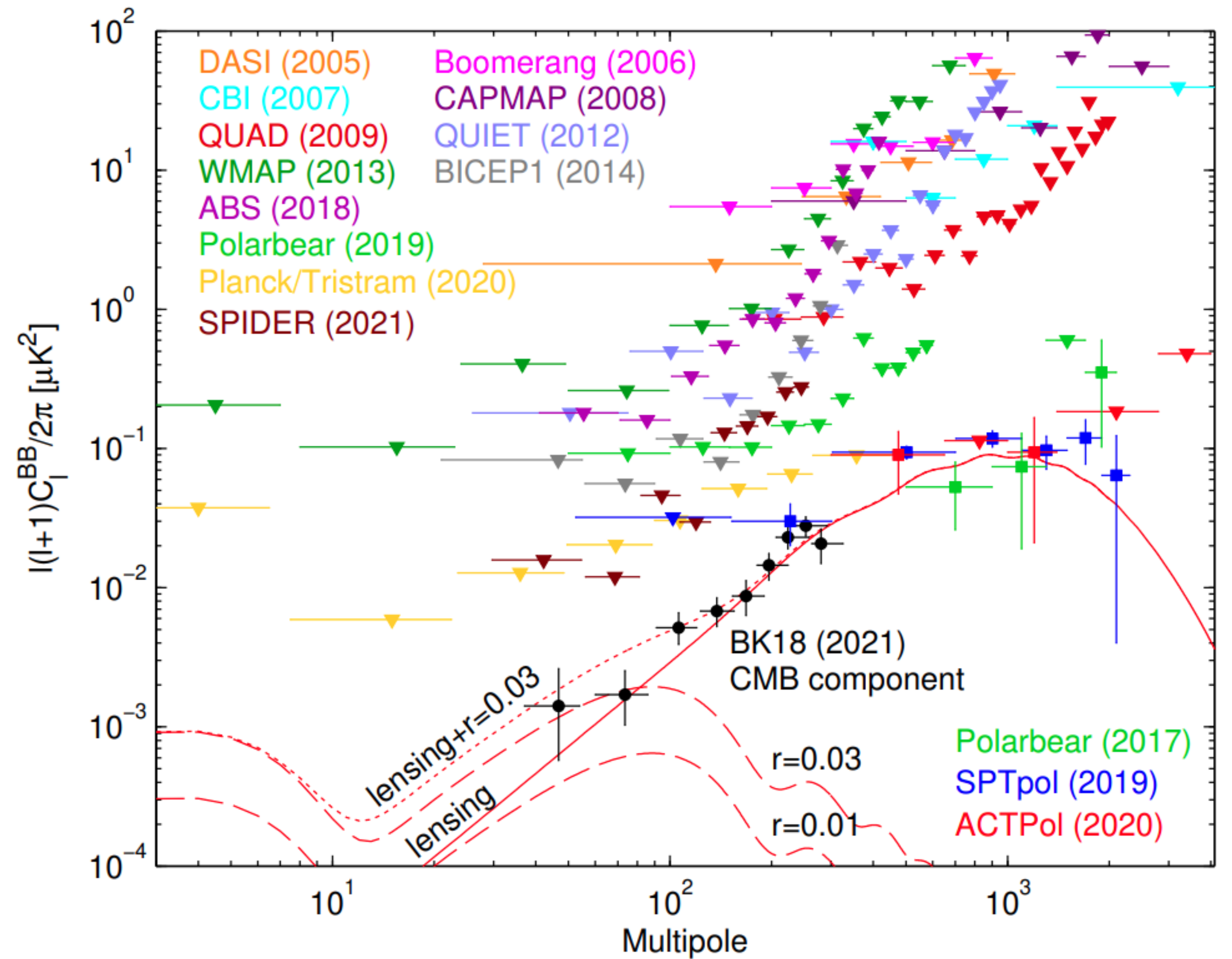
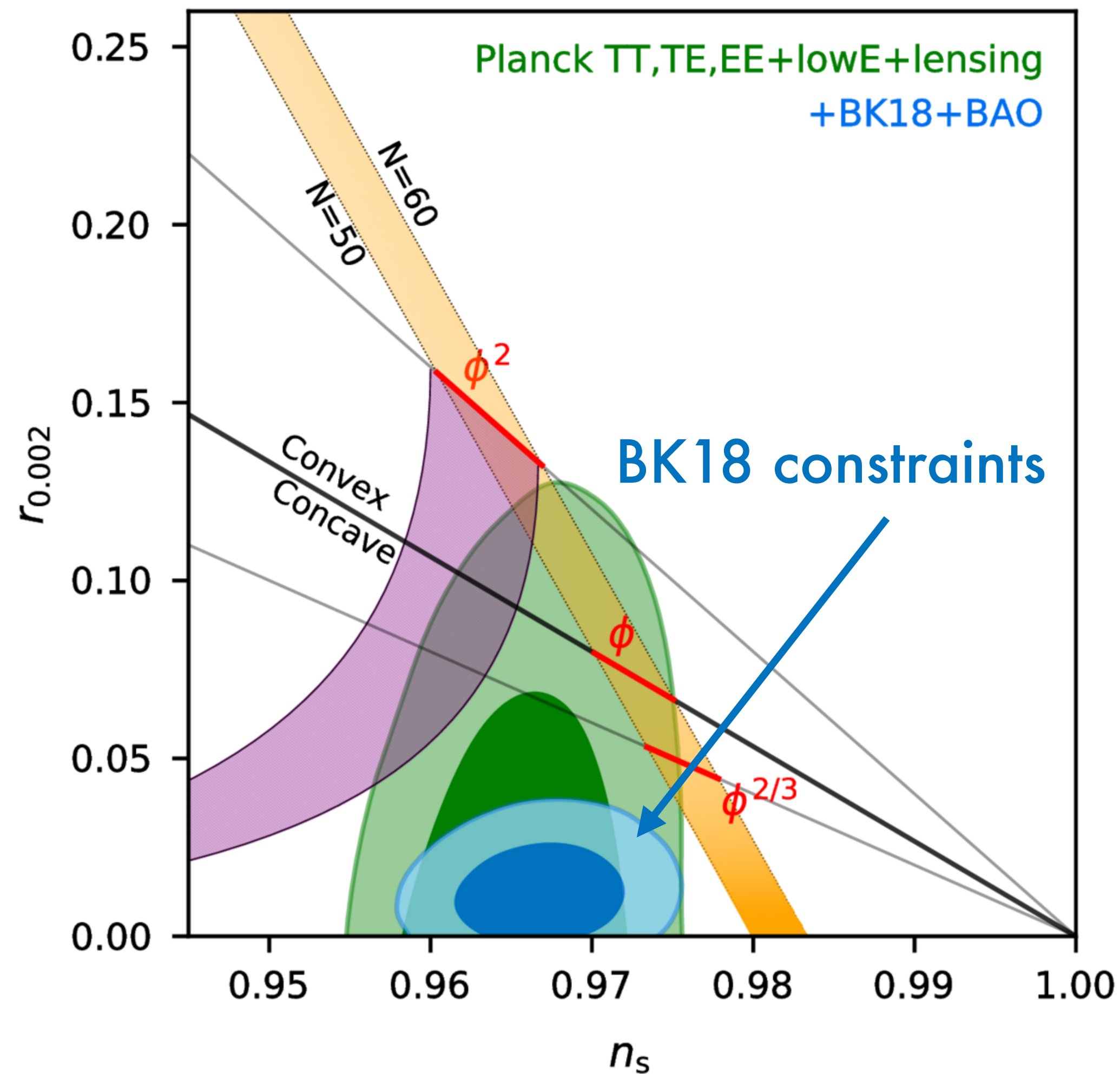
BK18 Final maps



BK18 constraints

$$r < 0.036 \text{ (95\% C.L.)}$$

$$\sigma(r) = 0.009$$



Next – SPO24!

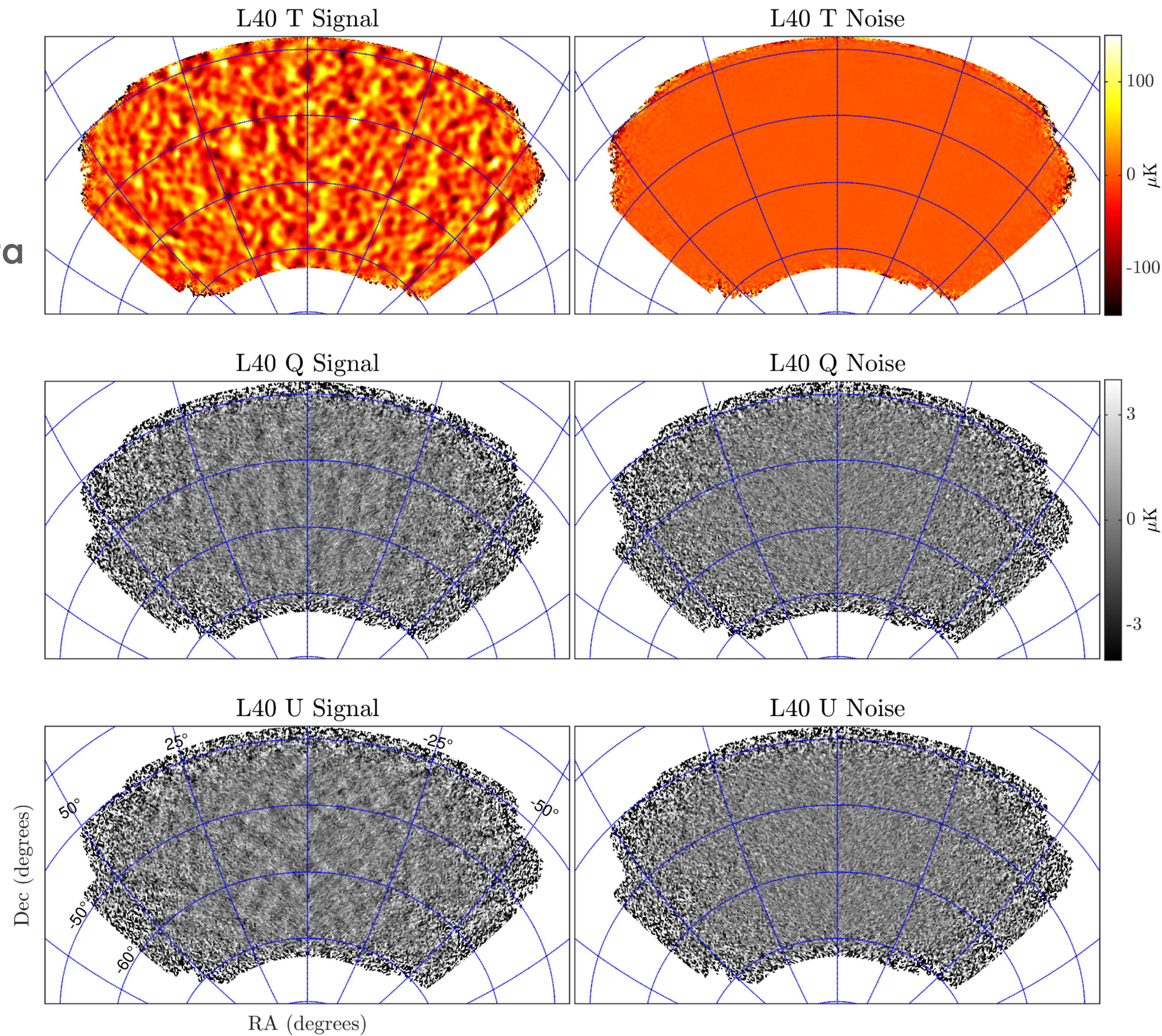
BK18 + 6 more years of BICEP data

- BICEP3 (95GHz)
- Keck 220GHz
- Keck 270GHz
- BICEP Array 30/40 GHz + 150 GHz

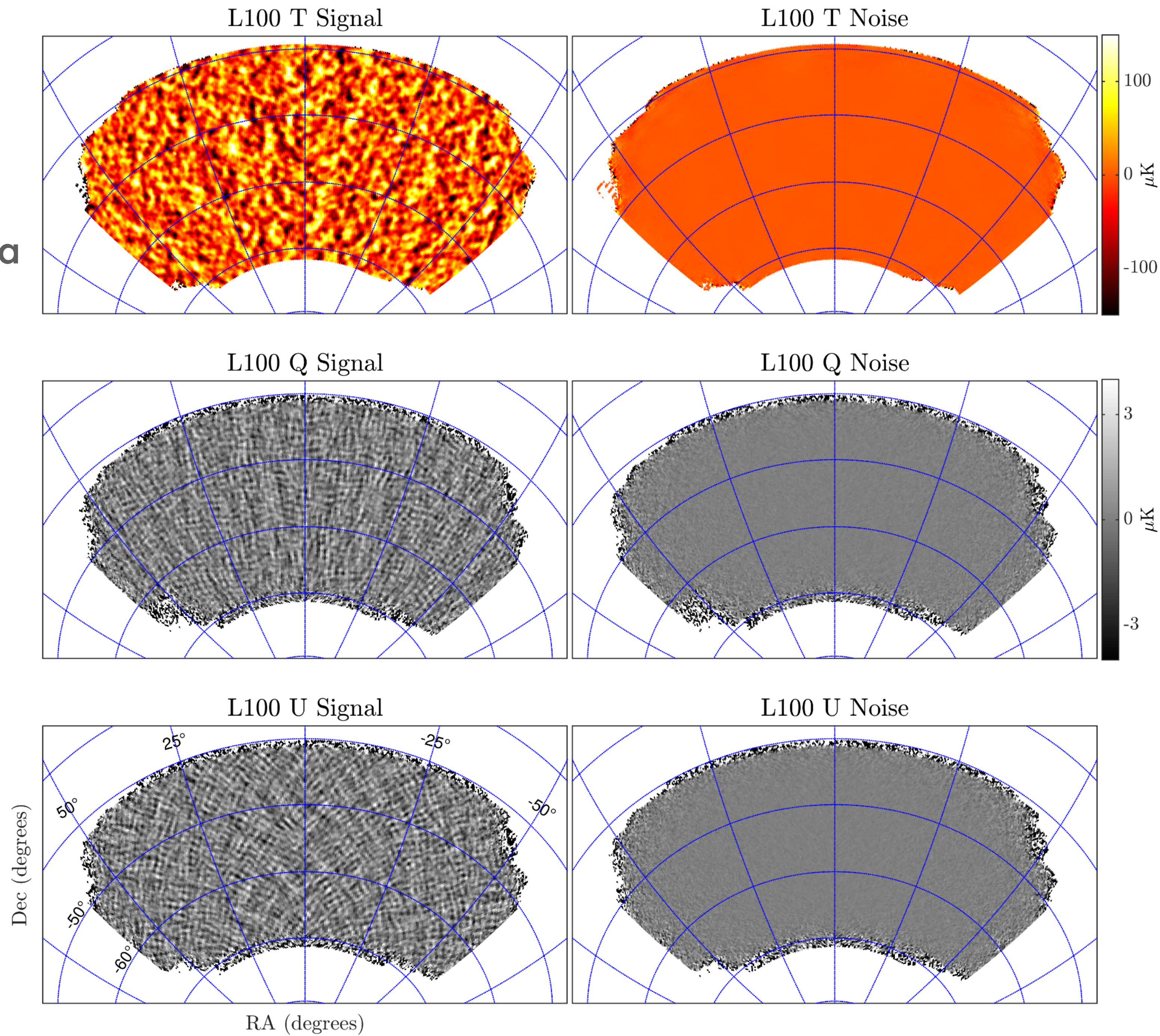
Delensing with SPT

- SPT3G 90/150GHz 2-year lensing template (2019-2020)

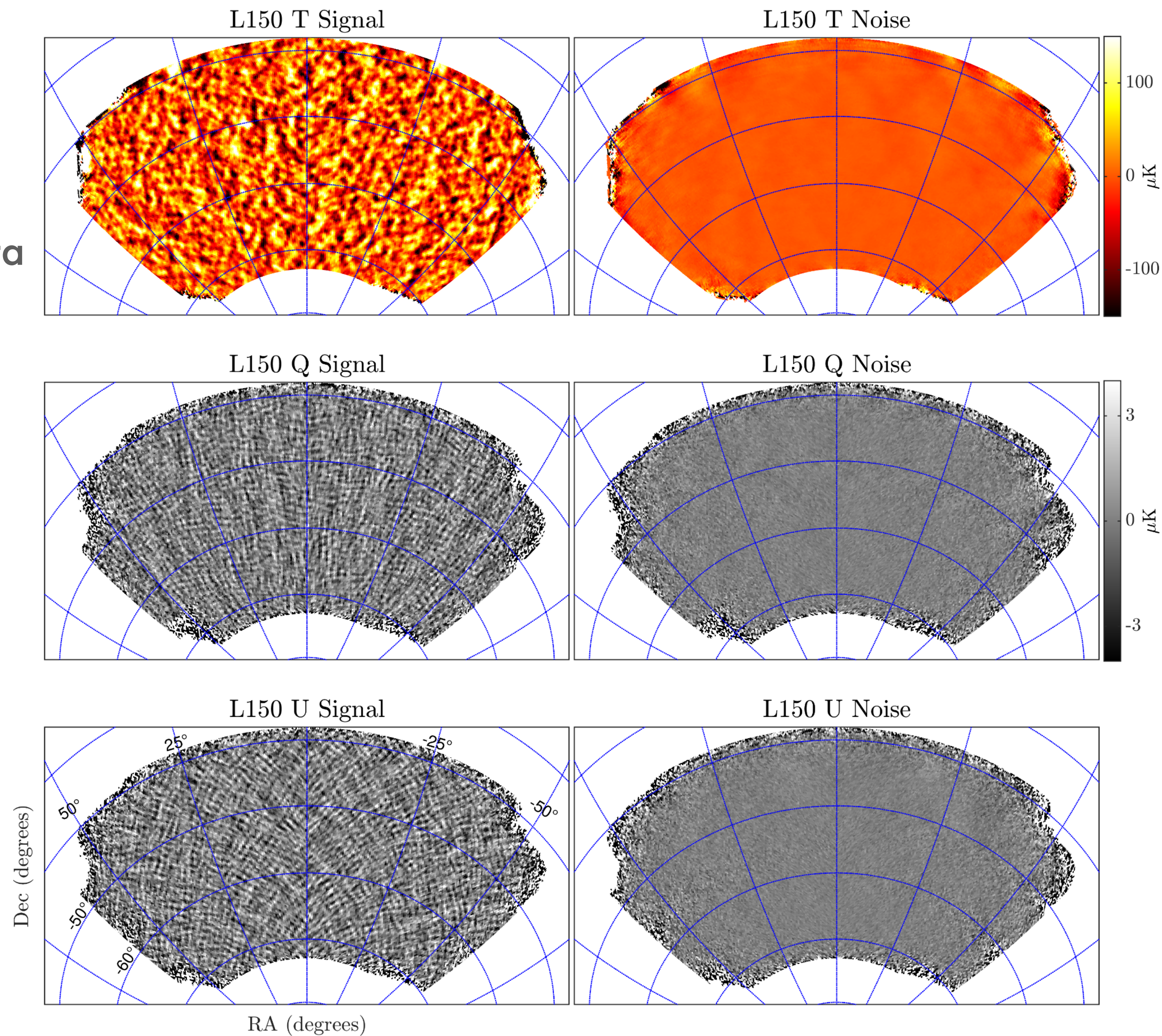
BK24
40 GHz
5 years of BA data



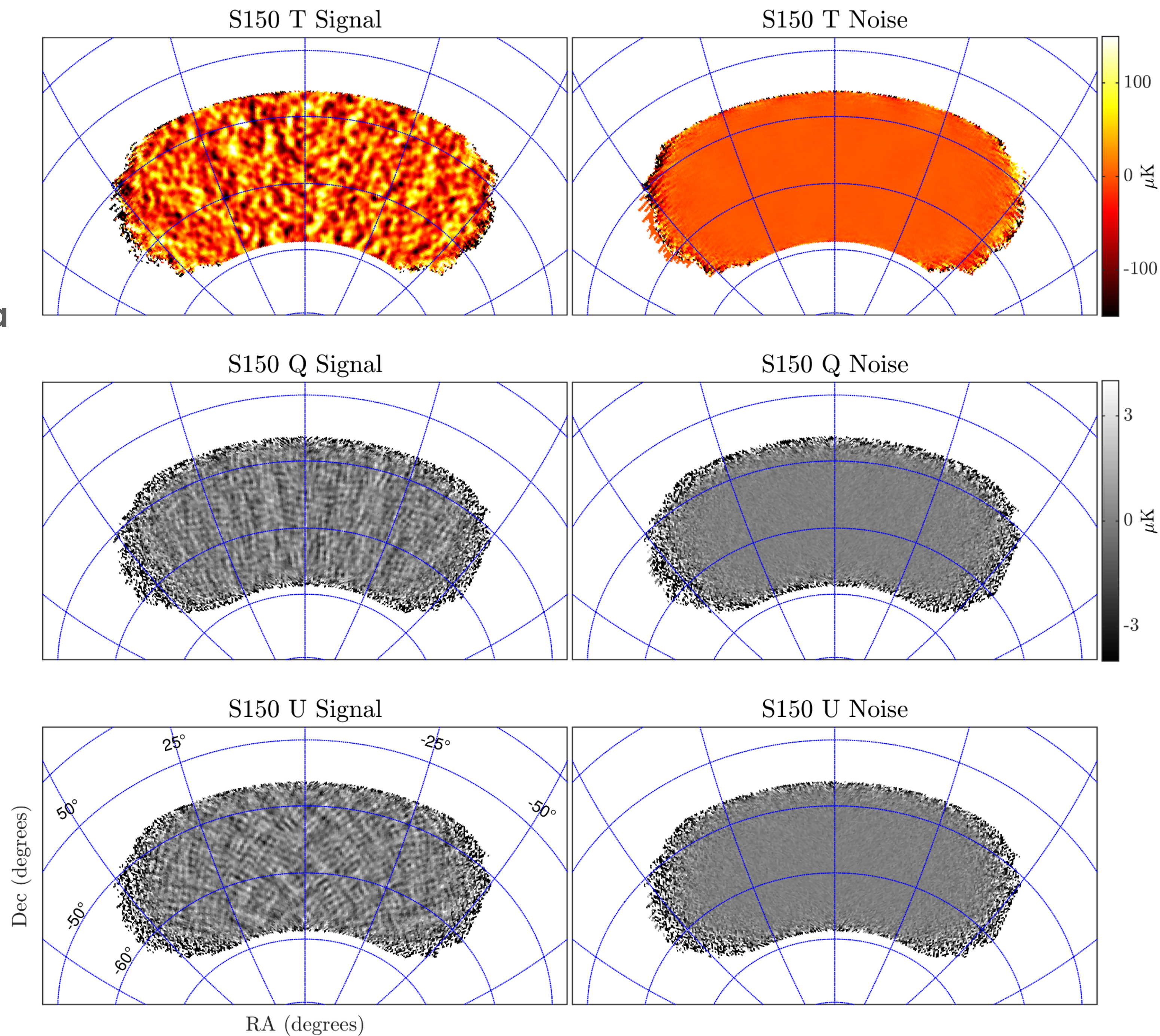
BK24
95 GHz
9 years of B3 data



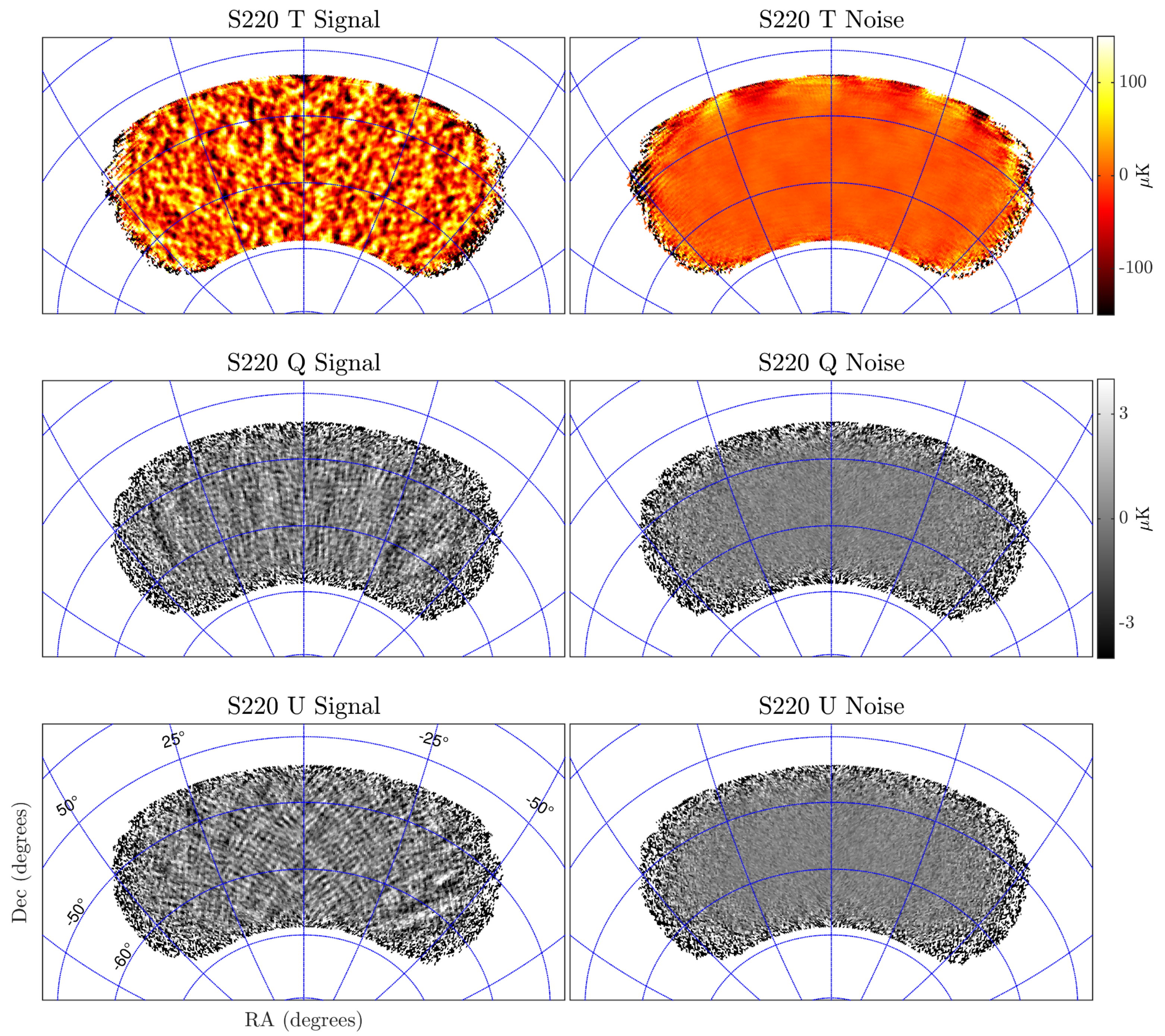
BK24
150 GHz
2 years of BA data



BK24
150 GHz
18 rx/years
of B2+Keck data

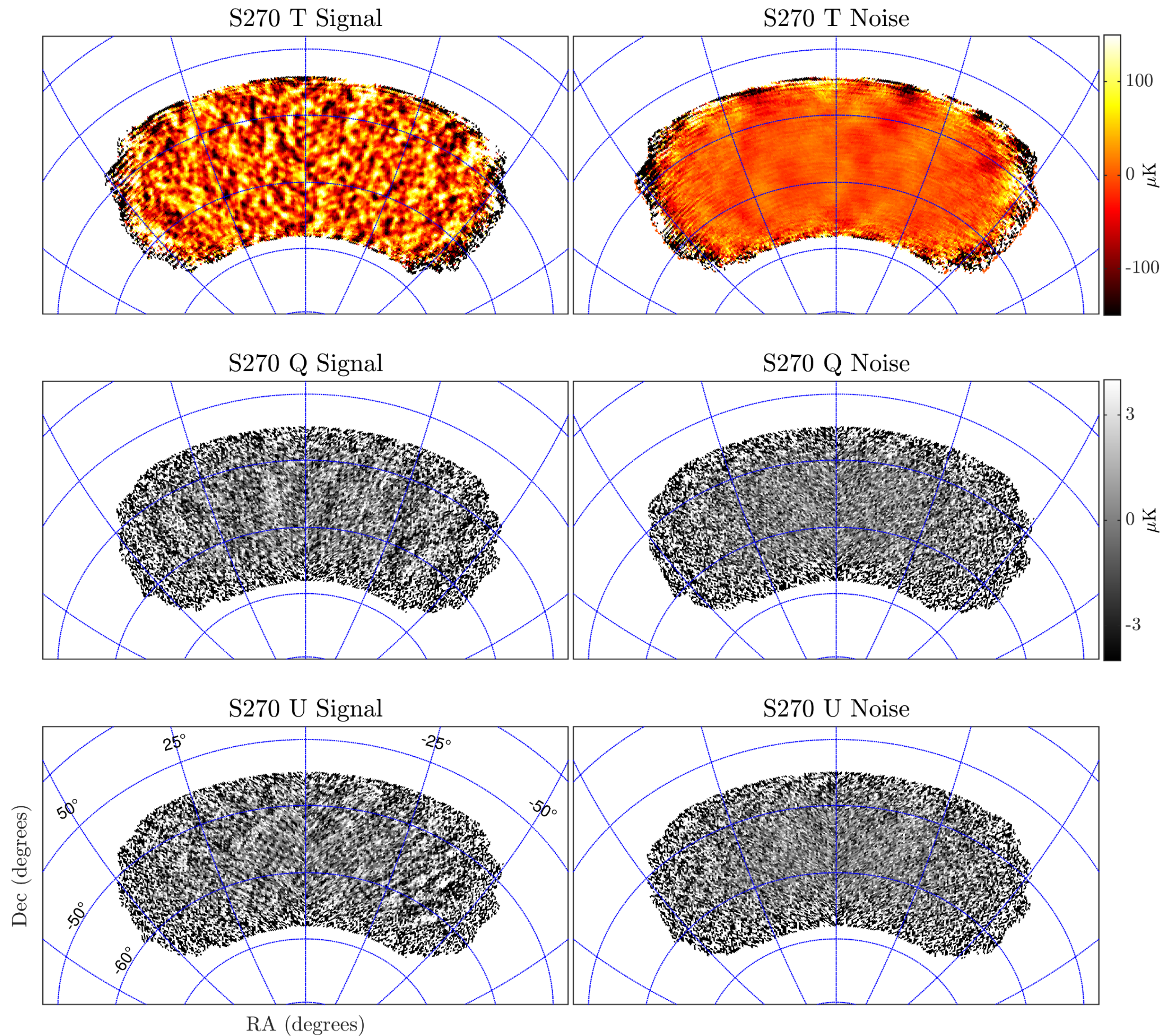


BK24
220 GHz
25 rx/years
of Keck data

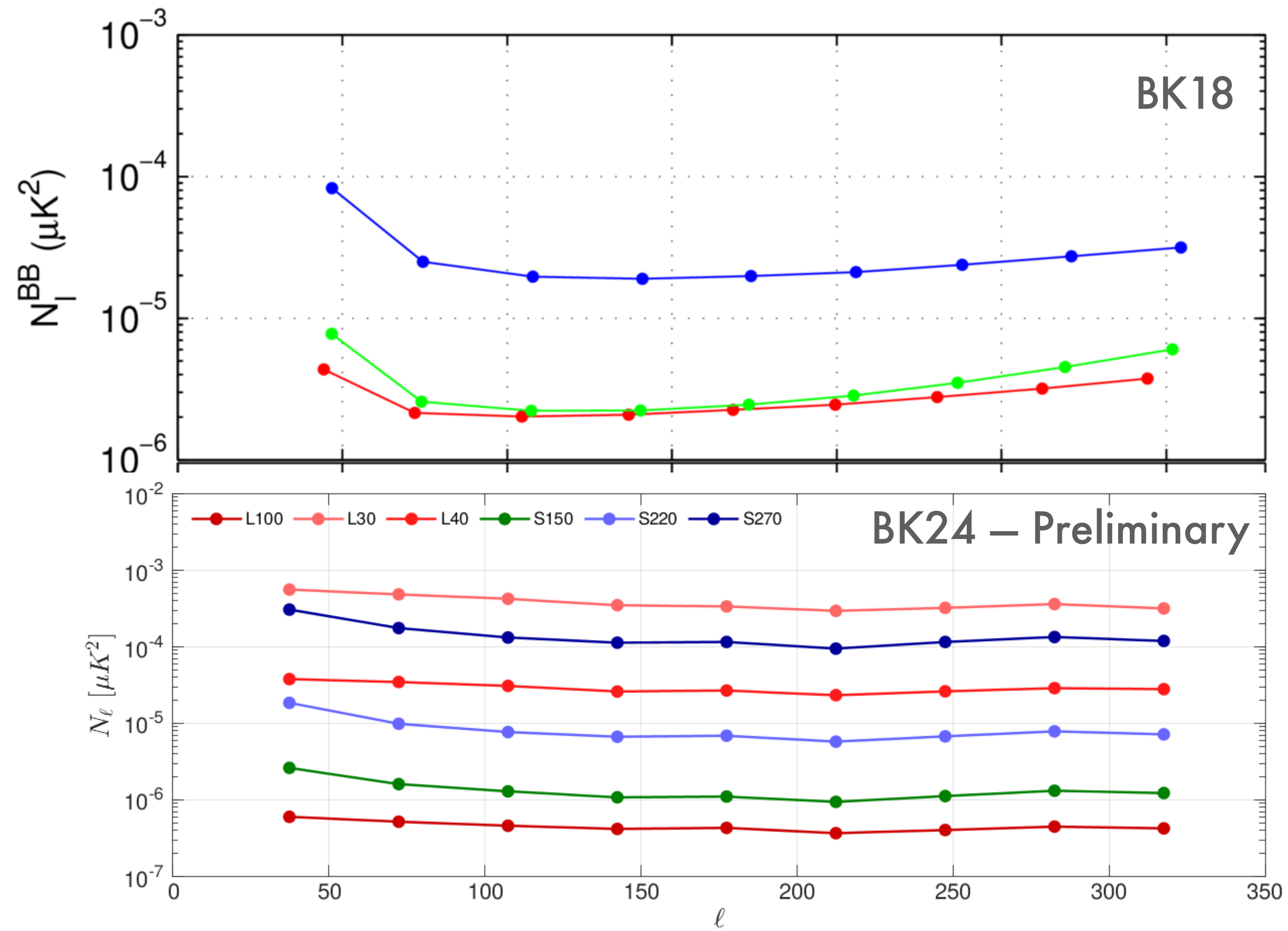


BK24 270 GHz

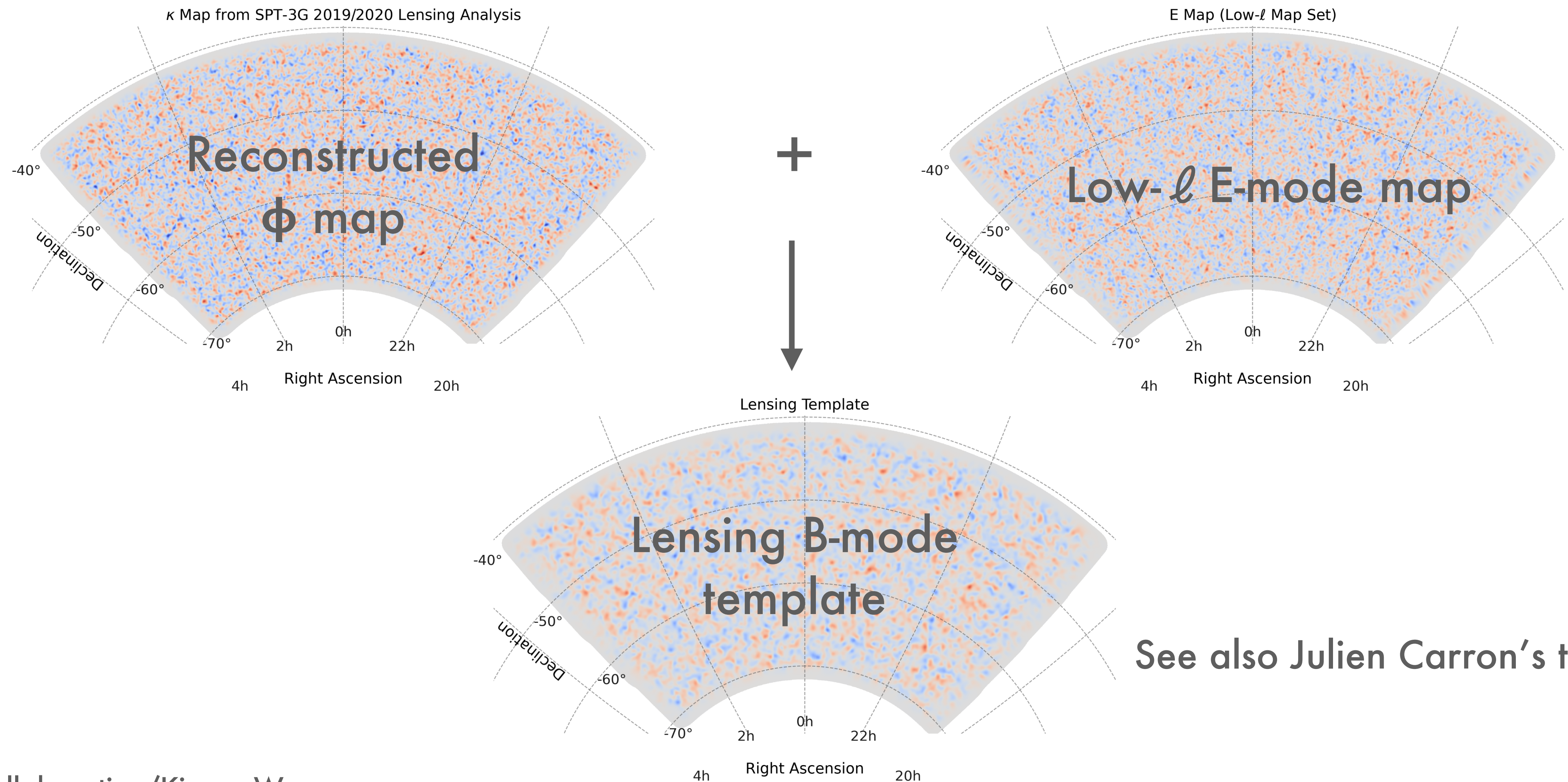
8 rx/years
of Keck data



BK18 to BK24



Lensing template reconstruction

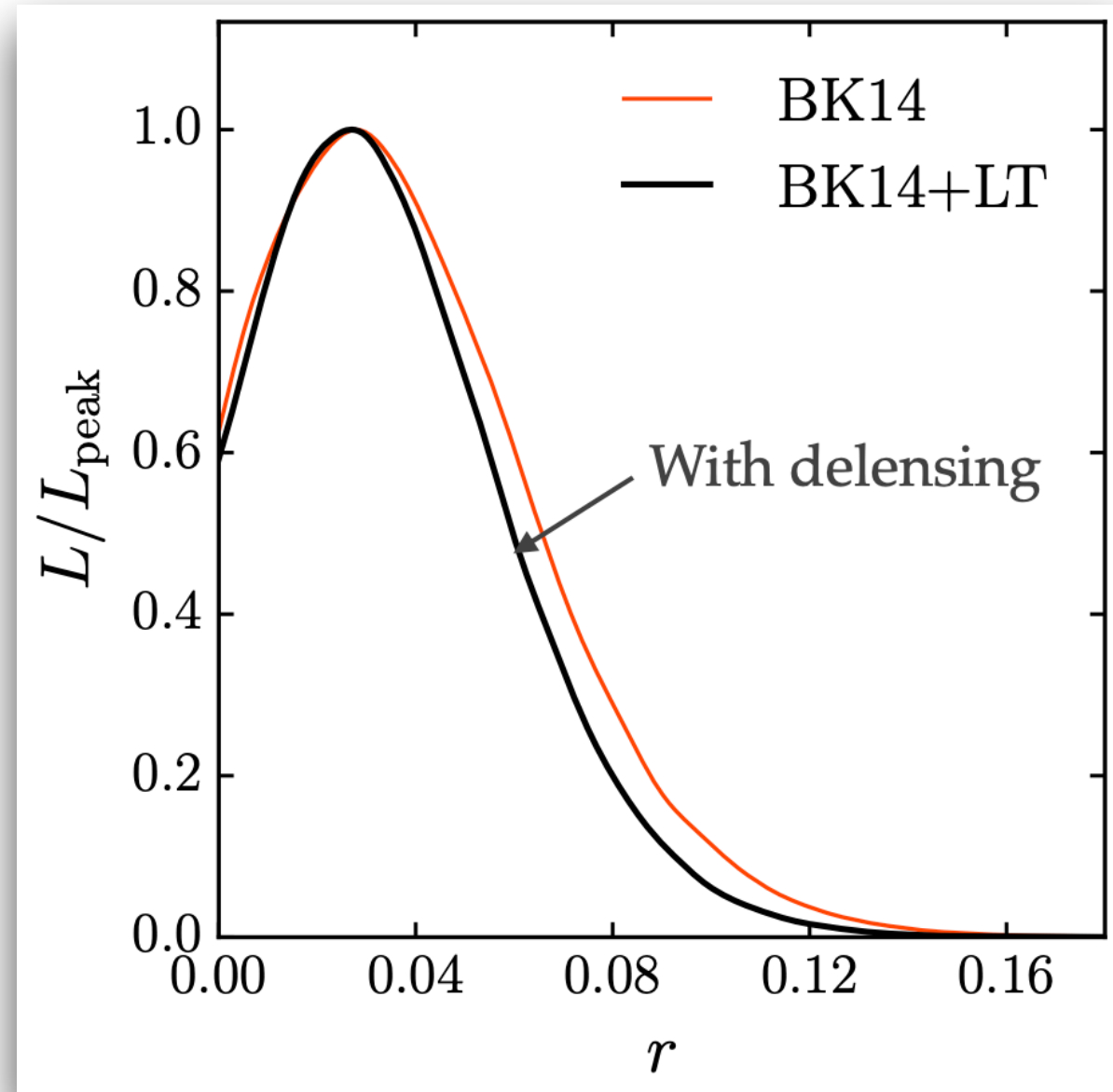


Likelihood analysis

Cross- C_ℓ parametric HL likelihood

Auto/cross spectra of all frequency maps + **lensing template**

Model: lensed Λ CDM + tensor-to-scalar ratio r + foreground model



SPO Collaboration, 2020

We expect to achieve
 $\sigma(r) = 0.004 - 0.005$ for SPO24
BK24 + SPT3G 2-yr

Data validation & systematics

Null tests

14 data splits (temporal/pair-selection) to “enhance” systematics

Need to pass for each receiver individually before unblinding

→ recently led us to additional analysis steps (crosstalk, time constants, point sources)

Instrumental systematics

T→P leakage (beam mismatch)

Bandpass systematics

Extended and polarised beam response

Path forward

BICEP

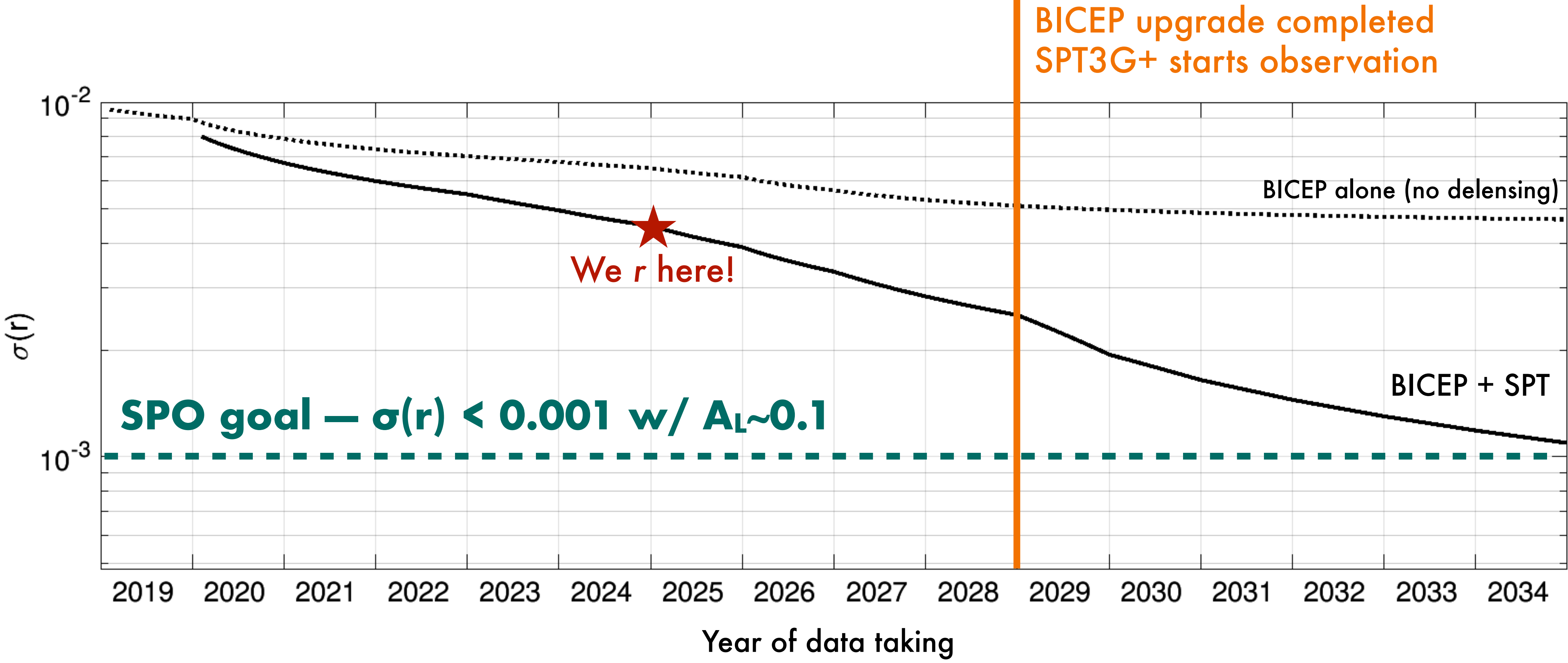
- 2025-2026: complete 220/270GHz BA receiver
- 2026-2028: deploy and complete 90/150GHz BA receiver
- 2028+: additional upgrades to improve sensitivity

SPT

- 2025-2028: continue observations with SPT3G
- 2029: deploy new 100/150GHz SPT3G+ camera

Continuous observations through at least 2034

SPO forecasts



Conclusion

SPO has observed from the South Pole continuously for 20 years

→ BICEP leads the way in constraining inflation

→ SPT delensing has been demonstrated on archival data + recent sims

→ **Already acquired data: $\sigma(r) = 0.004 - 0.005$**

Continued observations and upgrades to reach $\sigma(r) \sim 0.001$ by 2034

