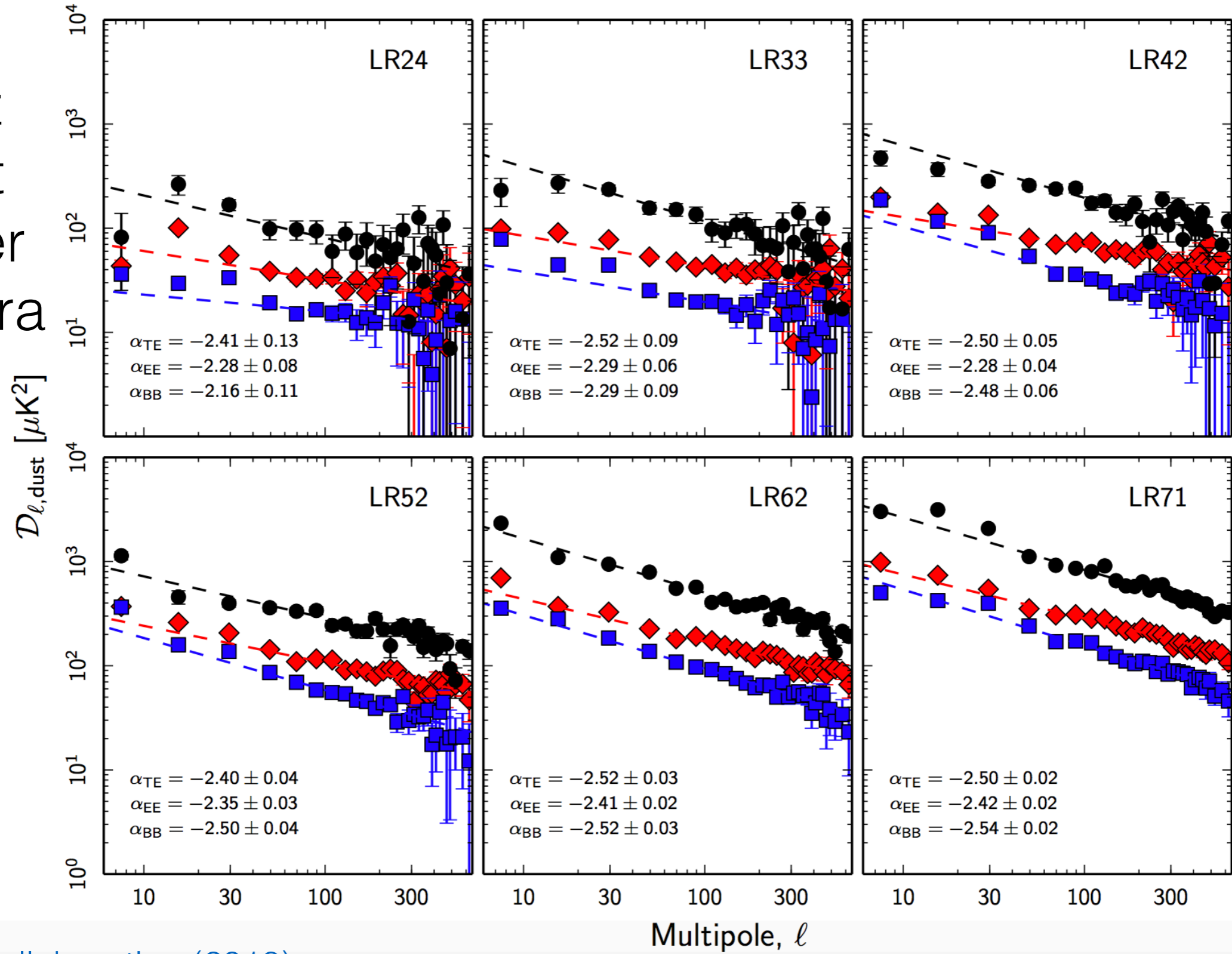


How does the Galaxy impact N_{eff} inference and does this drive frequency coverage?

- Constraints are driven by TE (+ EE)
- Relevant Galactic foregrounds:
 - Thermal dust
 - Synchrotron
- For TT, we'd also have to consider CO, free-free, AME, ...

How does the Galaxy impact N_{eff} inference and does this drive frequency coverage?

353
GHz
Dust
Power
Spectra



TE
EE
BB

How does the Galaxy impact N_{eff} inference and does this drive frequency coverage?

- What was done in DSR N_{eff} forecasts:
 - Galactic cirrus (thermal dust), using model of Dunkley+2013
 - Only TT dust included (not TE or EE, as far as I can tell)
Update: Raphael did include polarized dust/synch at the power spectrum level, which went into ILC curves used for forecasting (Appendix A of DSR does not include this info)
 - Amplitude of the Dunkley+ model is probably very wrong for $f_{\text{sky}}=70\%$, as it's based on a small, clean ACT patch
- Two things to consider:
 - Possible bias on N_{eff} , e.g., if dust is present in data but not included in the model fit
 - Inflation of error bars due to presence of dust

How does the Galaxy impact N_{eff} inference and does this drive frequency coverage?

Back of the envelope estimate

- Consider LR62 (62% of sky)
- Scale from 353 to 150 GHz: factor of ~ 625 in μK^2
- Assume Planck power-law fit holds out to $l \sim 2500$
- This yields $D_{\text{ell}}^{\text{TE}} \sim 0.2 \mu\text{K}^2$ at $l \sim 2500$ and 150 GHz
- Planck 2018 LCDM: $D_{\text{ell}}^{\text{TE}} \sim -3 \mu\text{K}^2$ at $l \sim 2500$
- Suggests CMB-S4 N_{eff} forecast is safe from large dust biases, but dust is not completely negligible
- Synchrotron is likely less of an issue than dust

How does the Galaxy impact N_{eff} inference and does this drive frequency coverage?

- Use Planck 353 GHz results to include dust in TT, TE, EE power spectra model at all S4 frequencies (w/ MBB SED)
- Exercise 1: propagate through harmonic ILC for various detector frequency allocations and obtain effective noise curves, forecast N_{eff}
- Exercise 2: run MCMC chains for parametric fit to power spectra (as done in Planck/ACT/SPT likelihoods) — still treating dust as Gaussian field
- Exercise 3: do exercise 2 using actual simulated non-gaussian sky maps (thereby including dust 4-pt in power spectra covariance matrix)