

# CMB-S4 “Real Delensing” Sims

Argonne Workshop

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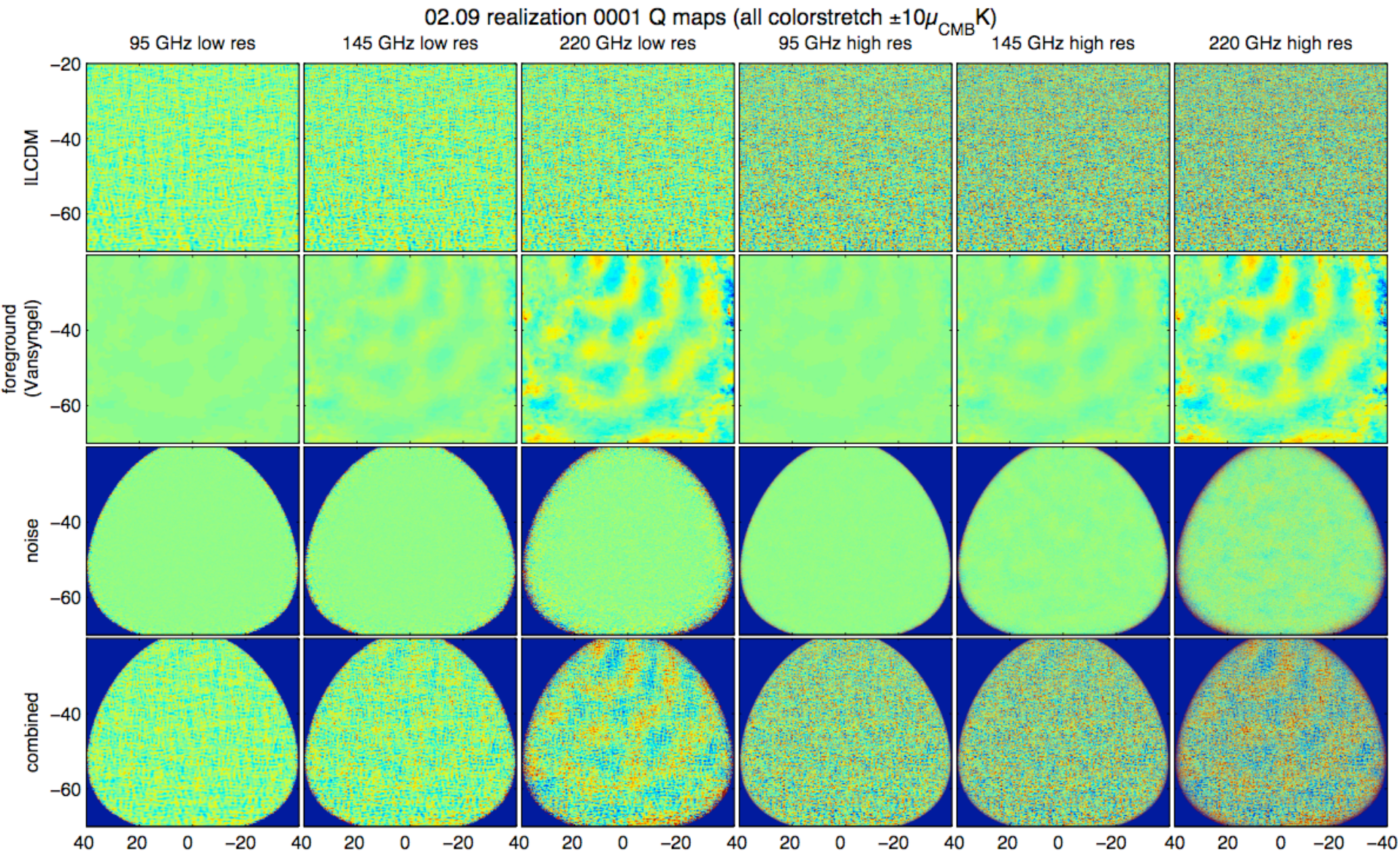
# CMB-S4 Sims for $r$ Forecasting

- “Data Challenge” approach – sets of shared simulated data maps on NERSC.
  - Combination of lensed-LCDM+foreground+ $r$
  - Each realization “observed” in multiple frequency bands with appropriate resolution and noise
  - Multiple foreground models available (PySM, MHD, simple Gaussian, etc)
- Idea is to have multiple groups and individuals run re-analysis on these with using multiple techniques
- The method with the best  $\sigma(r)$  and the lowest bias across the range of foreground models wins...

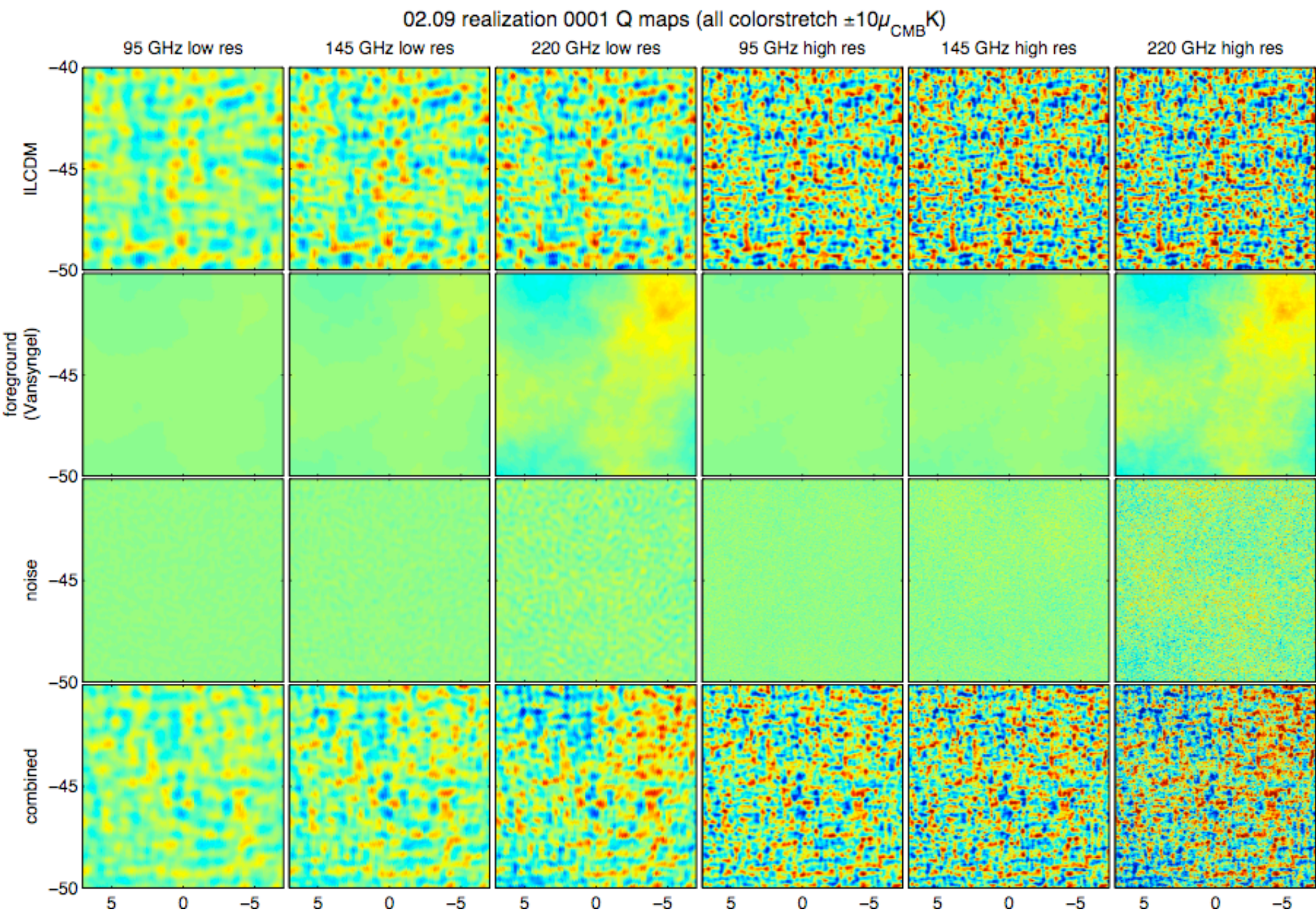
# Sims of Hybrid Observations

- S4 plan is for small and large apertures to observe the same patch of sky
- Small apertures cannot delens alone – to beat the sample variance of the lensing B-mode need to delens using large aperture data
- Up to now we cheated – we made low res. maps with the lensing contribution artificially turned down
- In reality need algorithm(s) which deal with lensing and foregrounds sequentially or simultaneously
- First step is to make joint low/high res sims with similar white noise levels, but different  $1/f$  knee –  $\approx 50$  versus 200 for  $Q/U$

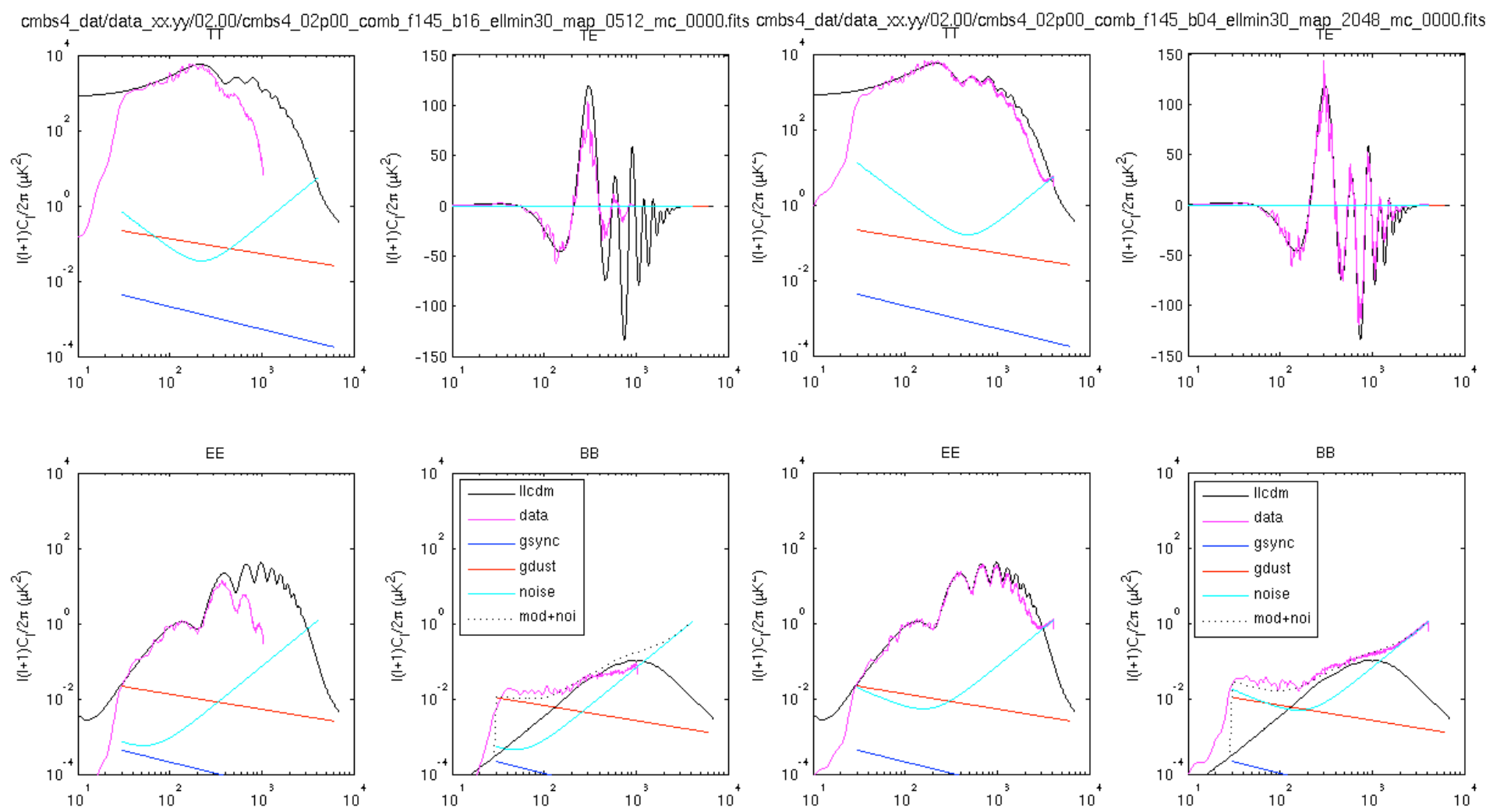
# First Realization of 02.09 Set





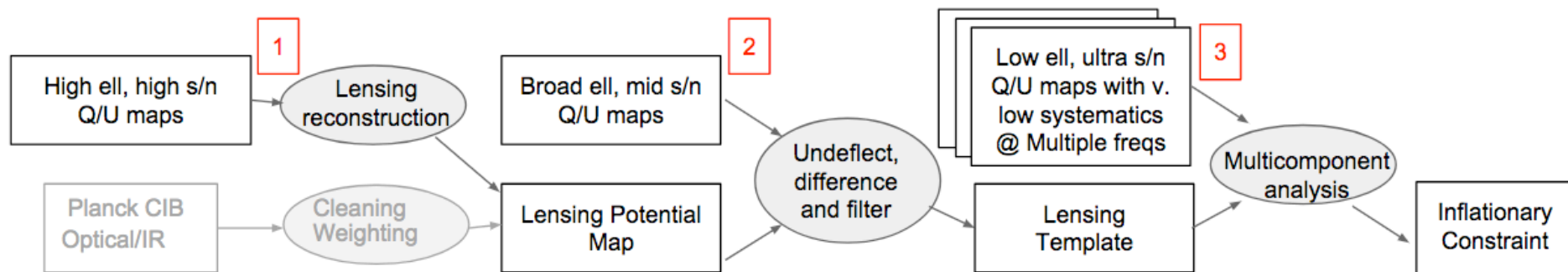


# Power Spectra of 145GHz low/high res



# Next step: Reconstruct lensing potential map(?)

- One possible way to proceed: take the high res maps, do a simple map based foreground cleaning, and then reconstruct the lensing potential ( $\phi$ ) map.
- Then use the  $\phi$  map to “undeflect” the low res  $Q/U$  maps...



# Interaction of foregrounds and delensing

- Galactic foreground might interfere with delensing – particularly if non-Gaussian.
- Right now have 02.00 set with strictly Gaussian sync/dust and 02.09 set which is Vansyngel model (based on [arxiv/1611.02577](https://arxiv.org/abs/1611.02577))
- The other models do not extend to high enough  $\ell$  to be useful



# Next steps

- Blake will now tell you about early efforts to run lensing reconstruction on these sims
- and Kimmy will then talk about how one can then use the resulting phi maps to add a “lensing template” to a parametric multi-component foreground separation analysis (similar to what is being used for BICEP/Keck)
- But other approaches and analyses are very much invited!