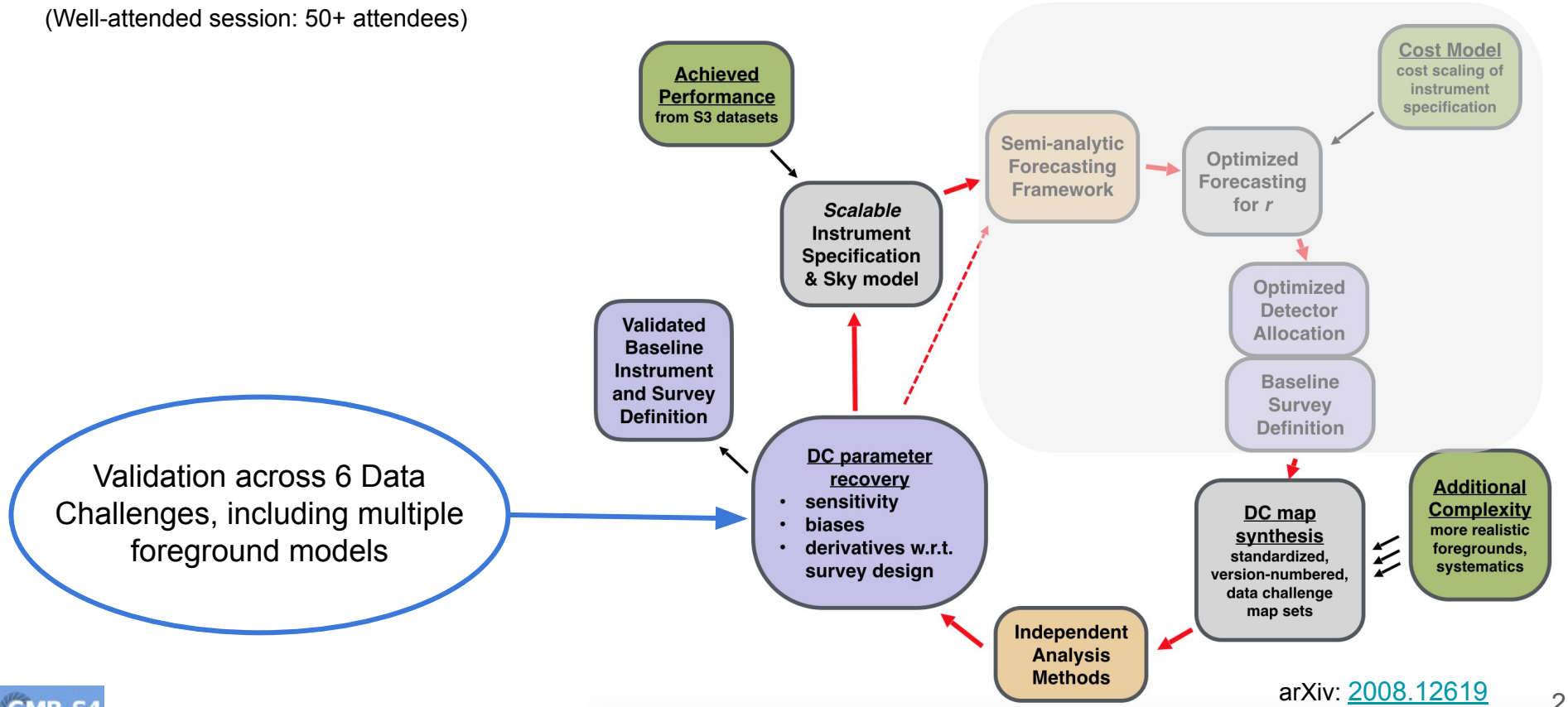
Design Validation: Tensor-to-scalar ratio (r)

Colin Bischoff and Kimmy Wu
for the Low-ell BB Analysis Working Group
2021-03-11 // CMB-S4 Collaboration Meeting

CMB-S4

Forecasting loop: validation

(Well-attended session: 50+ attendees)



arXiv: 2008.12619

Generation of simulated maps *a la* performance-based forecasting

Clem Pryke +
low-ell BB group

Where data cuts from e.g. weather, systematic cuts, and observing efficiency enters

$$N_{\ell,\mathrm{S4}} = N_{\ell,\mathrm{BK}} \frac{w_{\mathrm{BK,\,achieved}}}{w_{\mathrm{S4,\,projected}}} \frac{B^2_{\ell,\mathrm{S4}}}{B^2_{\ell,\mathrm{BK}}}$$

Where det counts and years of obs enter

$$\frac{w_{\mathrm{S4,\,projected}}}{w_{\mathrm{BK,\,achieved}}} = \frac{n^{\mathrm{det-yr}}_{\mathrm{S4}}}{n^{\mathrm{det-yr}}_{\mathrm{BK}}} \frac{NET^2_{\mathrm{BK,\,ideal}}}{NET^2_{\mathrm{S4,\,ideal}}}$$

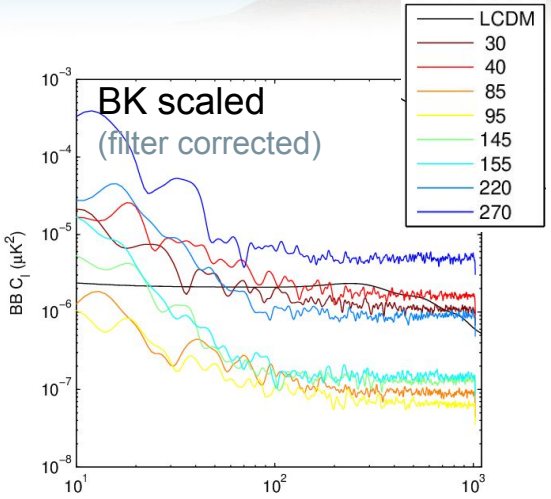
Where instrument parameters that controls det NET can enter: currently 100mK bath temperature, different bandwidths

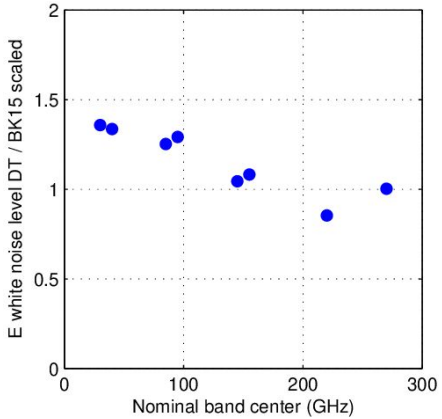
- Walked through how the the relative hitmaps from BK and from DM PBDR are used to generate this set of noise maps: simpler method than previous DCs.
- Outstanding issue: effects that produce ℓknee and αknee in Nℓ in current experiments may scale less quickly with number of detectors. Current experiment folks need to do deep dive in these data to produce useful input for S4 sims.

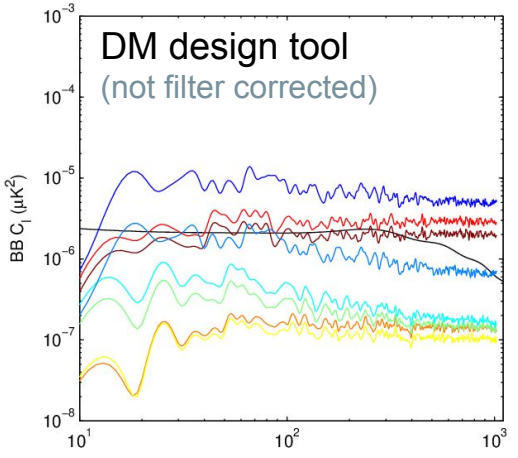
Compare performance-based sim map noise with DM design tool sim map noise

- DM design tool sims incorporate effects on data cuts using inputs from current experiments (on-sky time, data cut fraction)
- Ratio of noise between the two approaches are close to 1, but should be even closer given that the overall efficiency numbers are taken from BK.

- Discussion:
  - How should we approach modeling the Chilean SAT noise?
  - What are entry points to granularize this scaling to aid margin building?







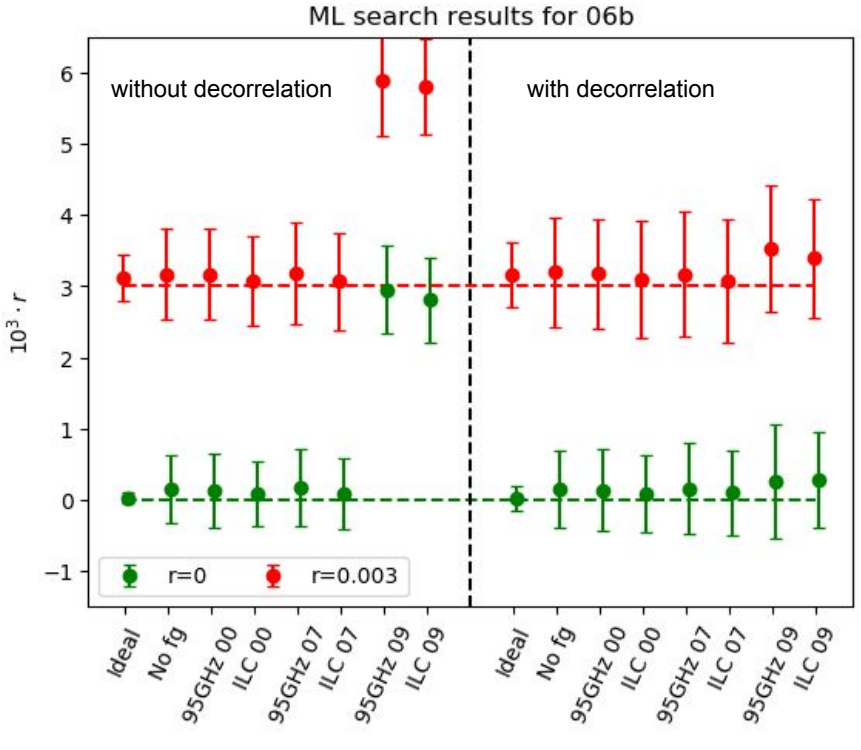
Data Challenge 06 results

Caterina Umilta

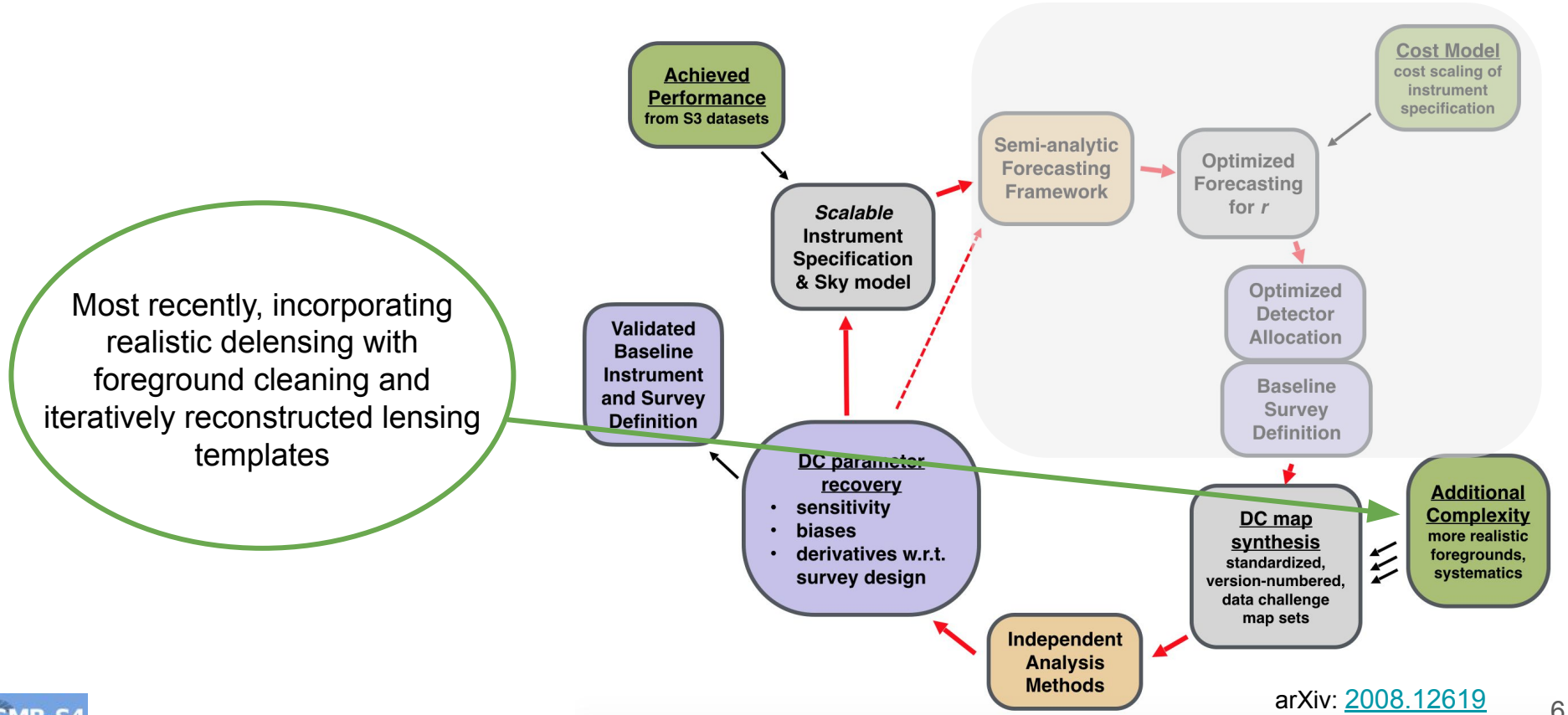
- Map-based sims following the DSR instrument configuration (06)
  - 00, 07, 09 denote three Galactic foreground models
  - 95GHz vs ILC denote input map for lensing B template construction

(values multiplied by 1000)	r=0	
	without decorr	with decorr
ILC Gauss fg	0.08 ± 0.45	0.09 ± 0.53
ILC Vansyngel fg	2.8 ± 0.6	0.28 ± 0.67

$\sigma(r)$



Forecasting loop: validation



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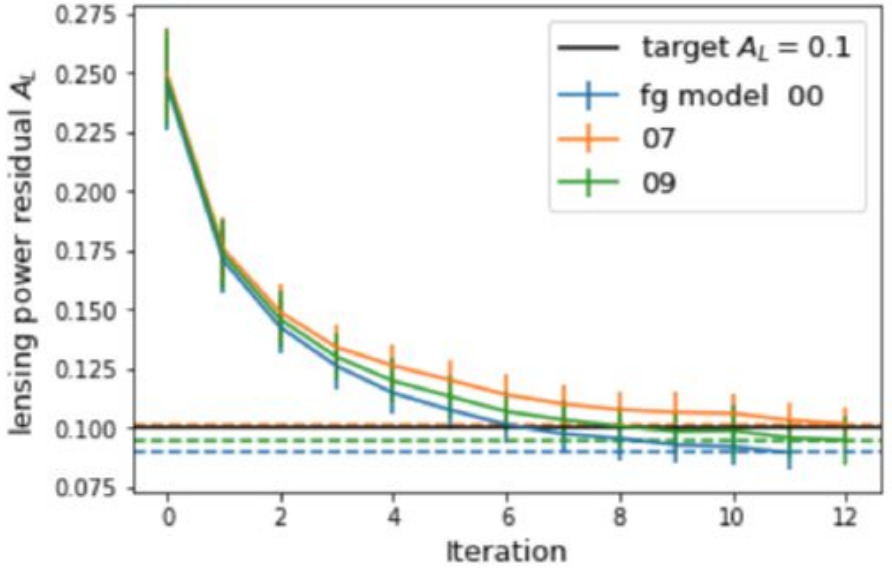
Lensing templates on DC06 sims

Julien Carron

- First real map-based delensing validation including foregrounds and using curved-sky iterative lensing map algorithm on S4 sims.
- Residual AL goal of 0.1 met for all three foreground models; using input maps that are ILC of the input freq.
- More complex foreground models?



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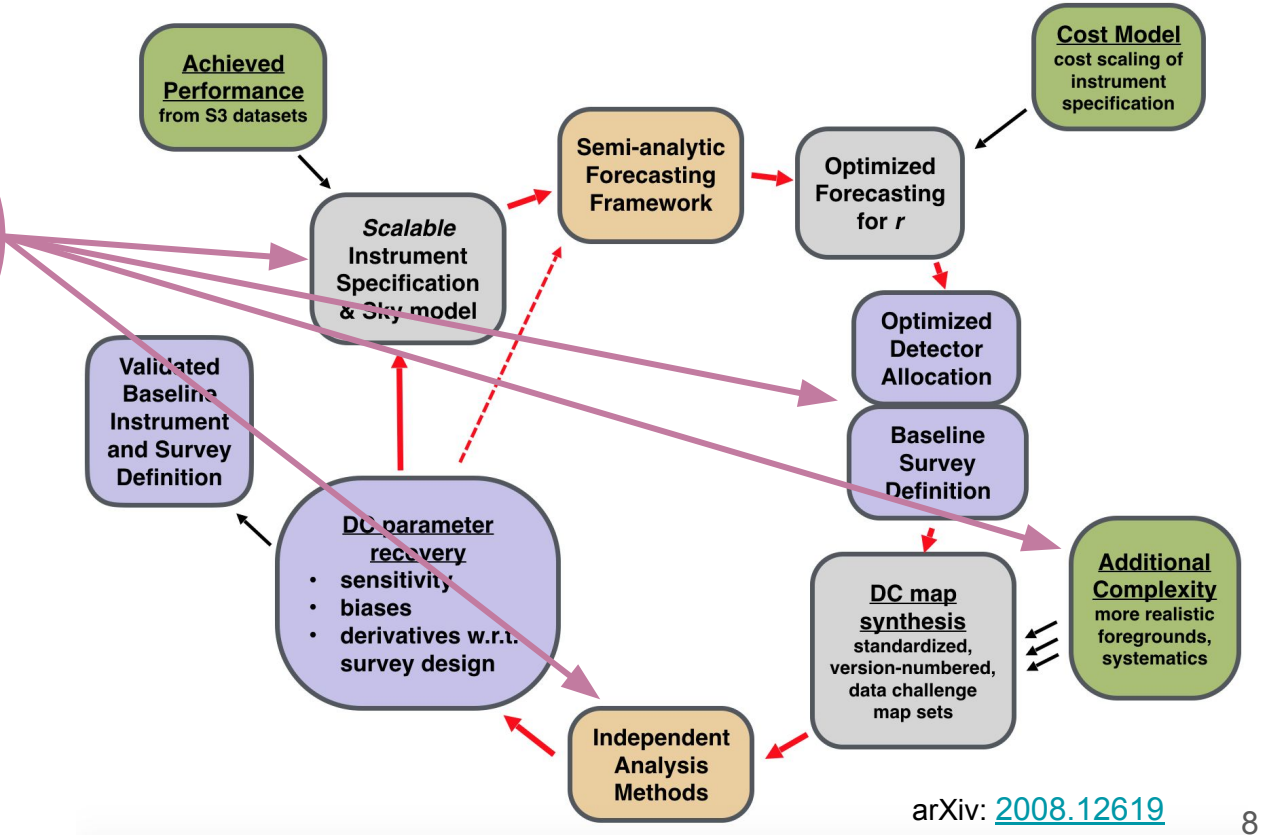
Forecasting loop: validation

Continuing to work on systematics (SAT and LAT), improved foreground models, alternate analysis techniques, support of PBD.



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Foreground model updates

Brandon Hensley + pan-Experiment Galactic Science group

- Pan-experiment Galactic Science group + PySM3 development
- Updated templates for dust: use GNILC dust to avoid CIB contamination
- Currently filling in small-scale polarization using Frolov model, a recipe that generate non-Gaussianity in Q/U space.
  - Next steps include using ML, MHD, and basing on other ancillary data (HI, WISE)
- Adding CO polarization
- Towards building 3D/multi-layer models to capture LOS effects

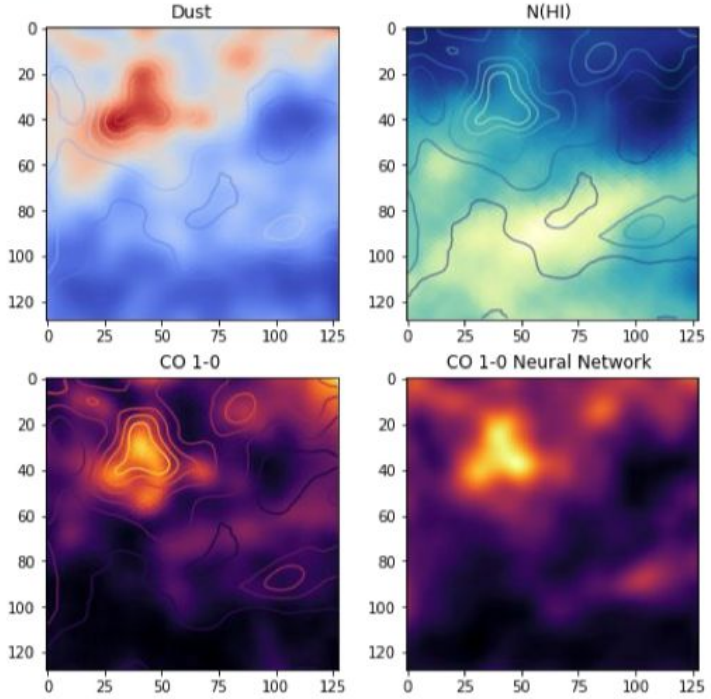
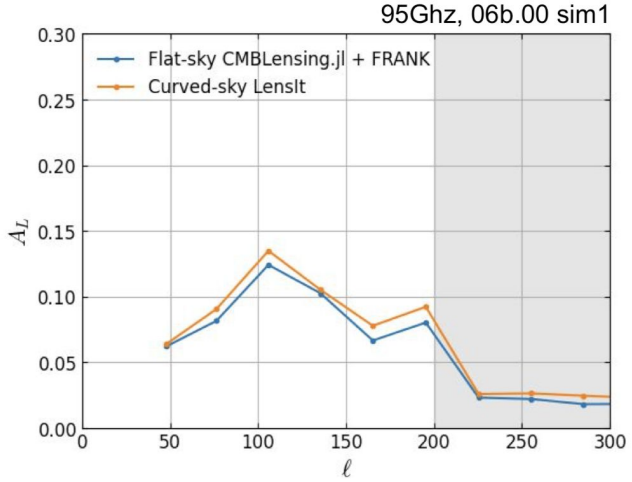


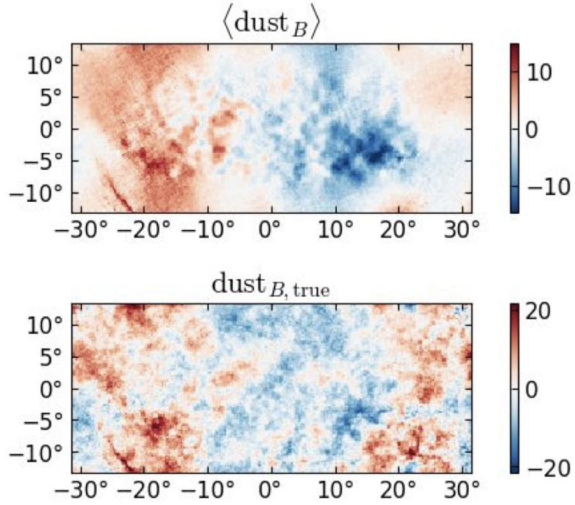
Fig by Giuseppe Puglisi

Bayesian r analysis

Marius Millea and Ben Thorne

- Jointly sample phi, CMB, fg fields, cosmological and nuisance parameters given SAT and LAT data.
- At S4 noise levels, flat-sky analysis with curvature correction recovers similar residual AL as curved-sky analysis.
- Bayesian sampling possible for S4 deep survey.





Frolov model dust

Colin Bischoff, Kimmy Wu

Sketch towards incorporating SAT and LAT systematics

- Many instrumental systematic effects
  - Need prioritization informed by experience and measurements from current experiments
  - Potentially an infinite task; early coordination with various instrument group important
- For CDT, looked into modeling SAT systematics as additive and multiplicative effects in spectra.
- Effort with John R. and Jeff M. to generate map-based systematics maps
  - Overlap with DM simulation of systematics, which is timestream-based.
- Highly cross-cutting activity -- intersections with flowdown, SAT/LAT (esp. calibration), detectors/readout/modules, sites/EMI, and data management (for analysis mitigation and perhaps sims).

PBDR prep

- Groundwork in place for low-ell BB data challenge 07 updating the noise numbers (esp. the LAT; SAT noise similar) to match those in the PBD instrument.