



Maps to Other Statistics AWG Update

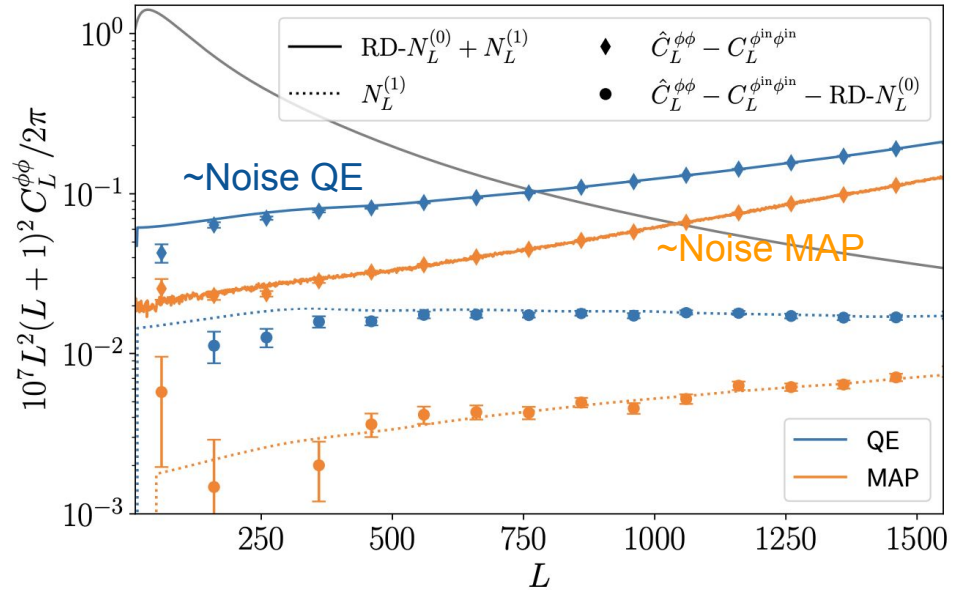
Marcelo Alvarez and Blake Sherwin

Reminder: Scope of our WG

- Focus is on science from statistics beyond the power spectrum
- Wide ranging topic including lensing/neutrino mass science, kSZ/baryons, reionization, and much more. Many cross-correlation studies are also within our remit
- Important point: our science areas are not design driving so less well defined “mission” than other AWGs
- Our focus: exploitation, firming up a few primary science areas of particular interest [e.g., neutrino mass from lensing, baryons and reionization from kSZ, cross-correlations] + exploration, establishing new S4 maps to other research areas. Often work for theory papers, with discussion/feedback/coordination in WG.

Research Focus Areas: Lensing

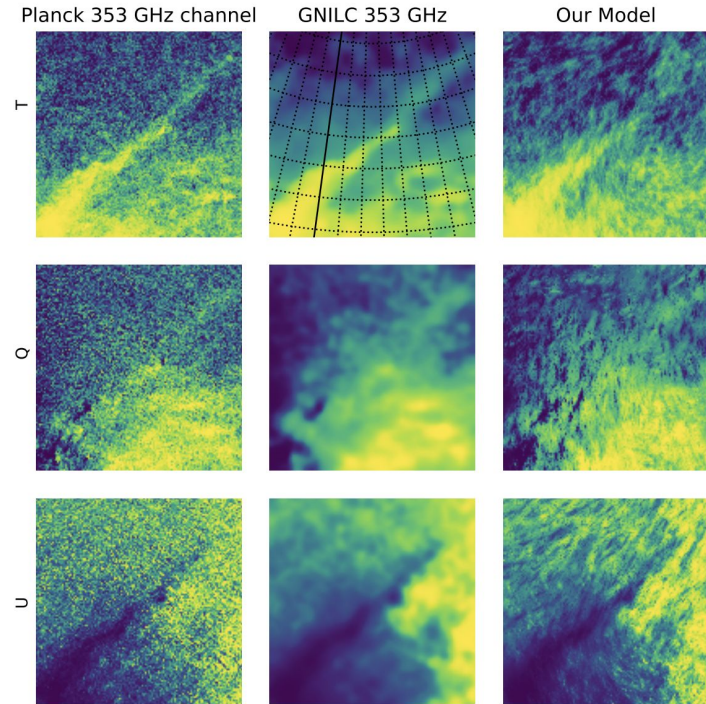
- Lensing science (on wide legacy survey fields)
 - Key for neutrino mass measurements, cross-correlation science, T/E delensing
 - Progress in both pipeline and foreground simulation efforts
 - Examples: Geneva group has made great progress in developing an optimal / MAP lensing power spectrum pipeline for legacy survey. Shows unbiased parameter recovery.



Legrand, Carron 2021

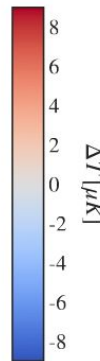
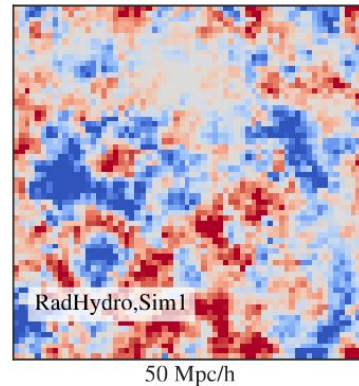
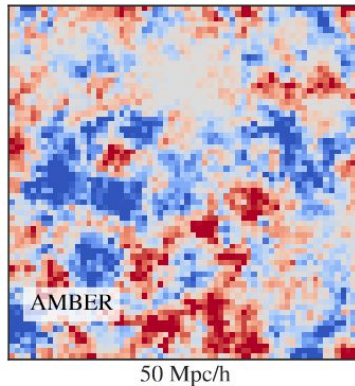
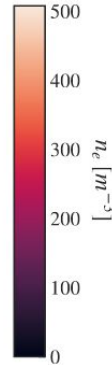
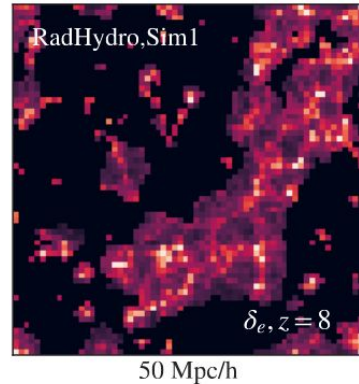
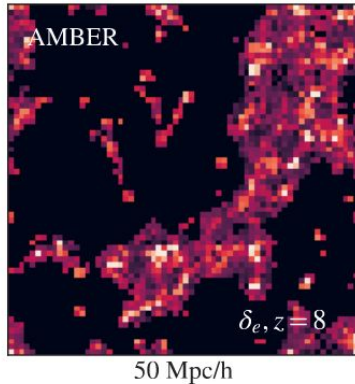
Research Focus Areas: Lensing

- Lensing science (on wide legacy survey fields)
 - Key for neutrino mass measurements, cross-correlation science, T/E delensing
 - Progress in both pipeline and simulation efforts
 - Examples: Non-gaussian foregrounds important for computing lensing biases; new sims by Carlos Hervas-Caimapo/Kevin Huffenberger v. useful!
 - + Great work on delensing at all orders (presented by Cynthia Trendafilova++), low-z cleaning (Frank Qu++),...



Hervas-Caimapo + Huffenberger 2021

Research Focus Areas: Reionization



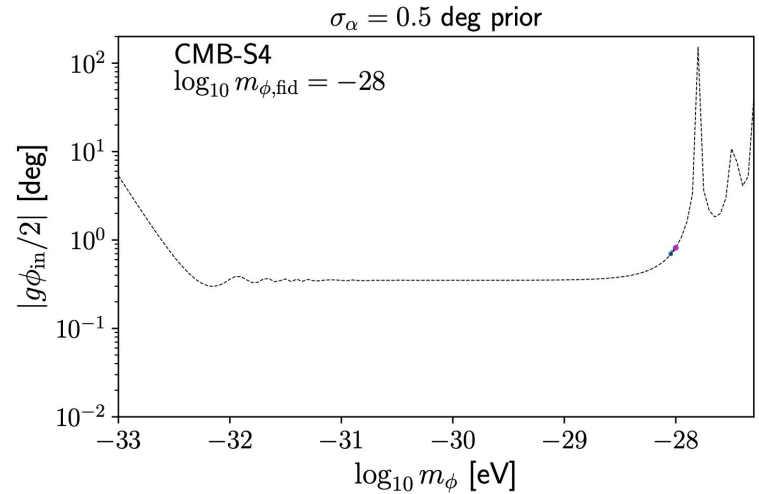
- Patchy kSZ

- Need to span highly uncertain parameter space of early galaxies and IGM to fit measurements
- Heard from Nianyi Chen about the AMBER (Trac et al. 2021) method to reproduce patchy kSZ efficiently, tuned to radiation hydro simulations
- Discussion within the group of an emulator that encompasses a wide class of models
- One goal is to mitigate astrophysical uncertainties on reionization history from 2pt/4pt
- Also: work on lensing and foreground biases to 4pt.

Chen, Trac + 2022

New research areas, examples:

- Cosmology with CMB x LSS + bispectra
 - (Shu-Fan Chen++) Combining S4 lensing x LSST galaxy 2pt with bispectra gives significant gains in neutrino mass ($<20\text{meV}$) and fNL bounds
- Cosmic birefringence tomography
 - (Toshiya Namikawa++) Redshift dependence means EB spectrum is not fully described with a single rotation; breaks degeneracy with angle error error. Implies powerful constraints on axion coupling from S4 for some masses
- non-Gaussianity from μ x T
 - (David Zegeye) μ -type spectral distortion correlated with temperature probes primordial non-Gaussianity in very squeezed triangles
 - fNL constraints in unique regime although foreground cleaning challenging



Defining cross-correlation key science

- What is key science for cross-correlations? Had long discussion as a group.
- Current proposal: Cosmological parameters and summary papers from $N \times 2pt$ cross-correlations with external large galaxy surveys (e.g. Rubin-LSST, DESI, next-gen surveys).
- The papers describing the technical details of the individual cross-correlations and tests of systematics can be Science Data papers rather than Key papers.
- SZ profiles from stacks on external galaxy survey samples also under discussion.
Current proposal: SZ profile likelihood, including external data, will be a Core Analysis product
- Interpretations and model constraints from SZ can be non-key Science Data papers rather than Key papers.

Summary and outlook

- Lots of interesting S4 maps2other science cases discussed and advanced by working group members
- Significant developments already in lensing, reionization/kSZ studies, and cross-correlations. In next steps, want to further focus on pipeline development and systematic mitigation for these science areas – more exploitation than exploration...
- Particular focus: run end-to-end tests with data challenge simulations.