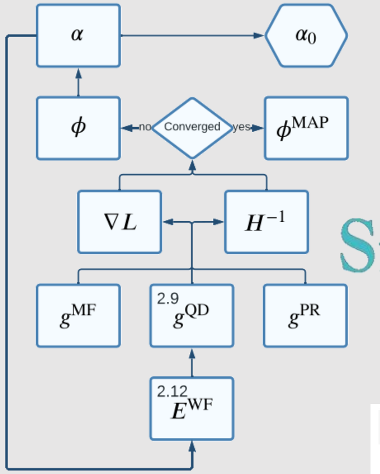
CMB-S4 Spring Collaboration Meeting: Fireslides-I

1. Sebastian **Belkner**
2. Louis **Legrand**
3. Yin-Zhe **Ma**
4. Joel **Meyers**
5. Toshiya **Namikawa**
6. Grant **Teply**
7. Giuseppe **Puglisi**
8. Cynthia **Trendafilova**
9. Andrea **Zonca**

10 May, 2022

Sebastian Belkner
Julien Carron | Louis Legrand | Omar Darwish
UNIVERSITÉ DE GENÈVE

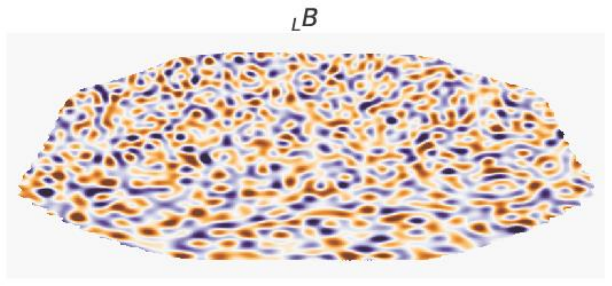
2nd year PhD student
CMB Delensing
low-ell-BB working group

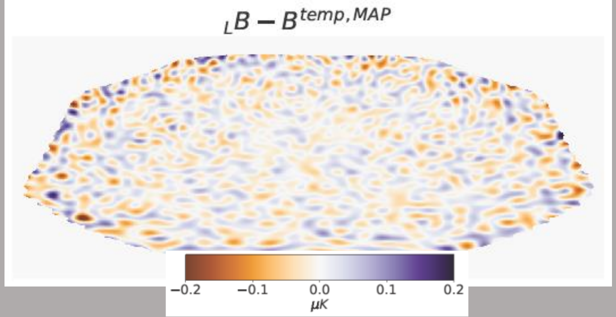


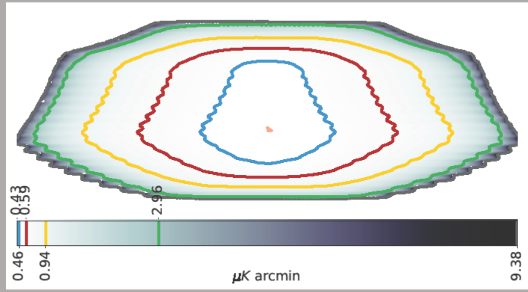
Sir D.Lensalot

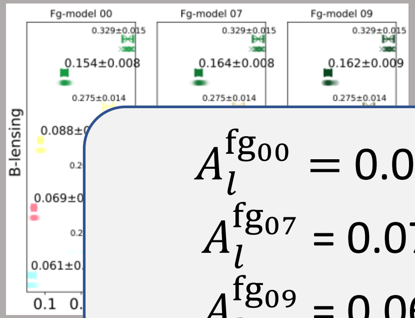
User	Charged Hours
Belkner, Sebas...	995,992

CMB-S4 collab. et al. (inc. SB), in prep.



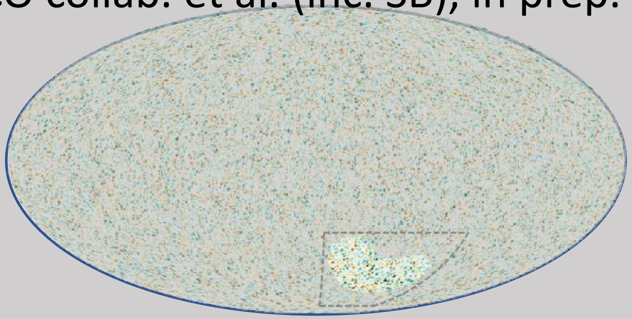


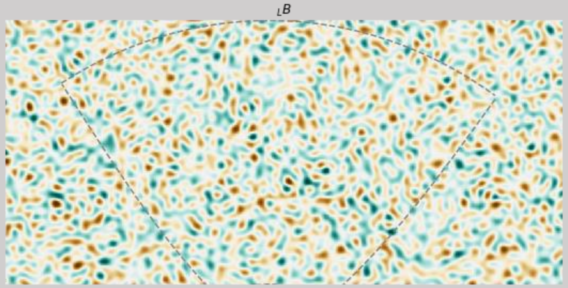


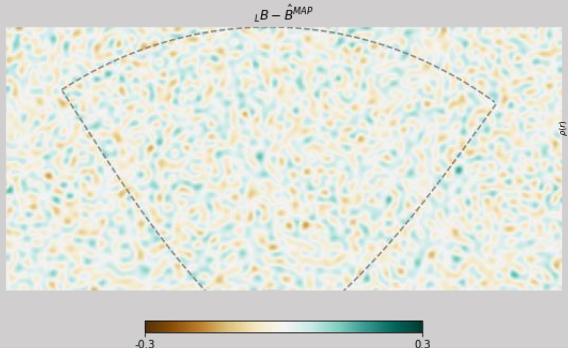


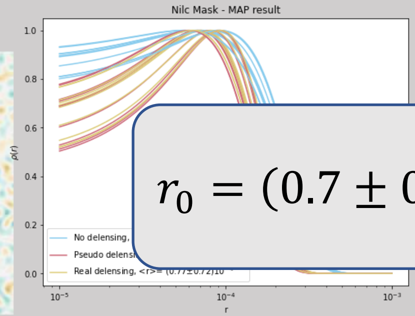
$$A_l^{\mathrm{fg}_{00}} = 0.069$$
$$A_l^{\mathrm{fg}_{07}} = 0.079$$
$$A_l^{\mathrm{fg}_{09}} = 0.063$$

PICO collab. et al. (inc. SB), in prep.









$$r_0 = (0.7 \pm 0.7)10^{-4}$$

CMB lensing spectrum for next generation surveys

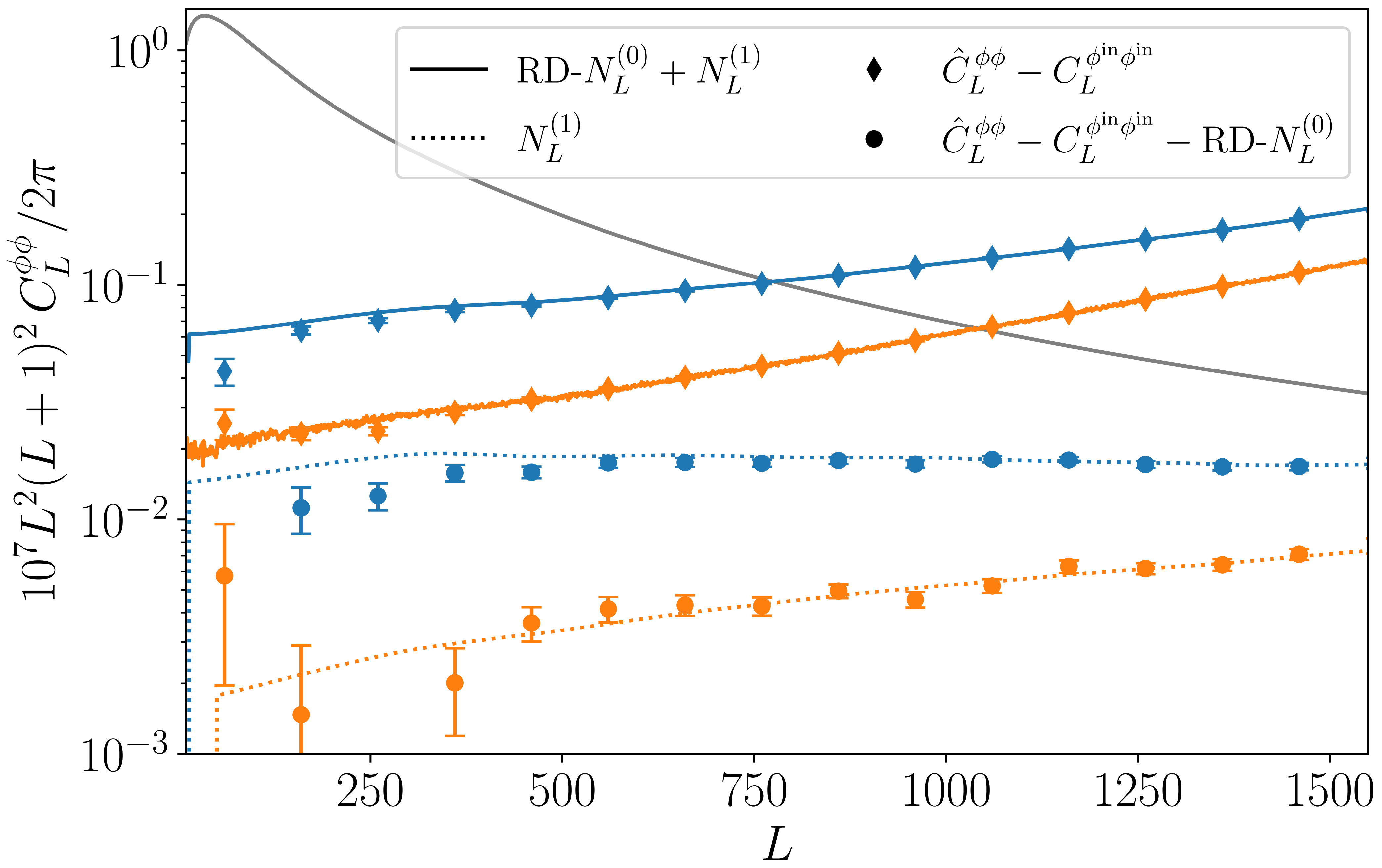
UNIVERSITÉ DE GENÈVE

L. Legrand and J.Carron [arxiv:2112.05764]

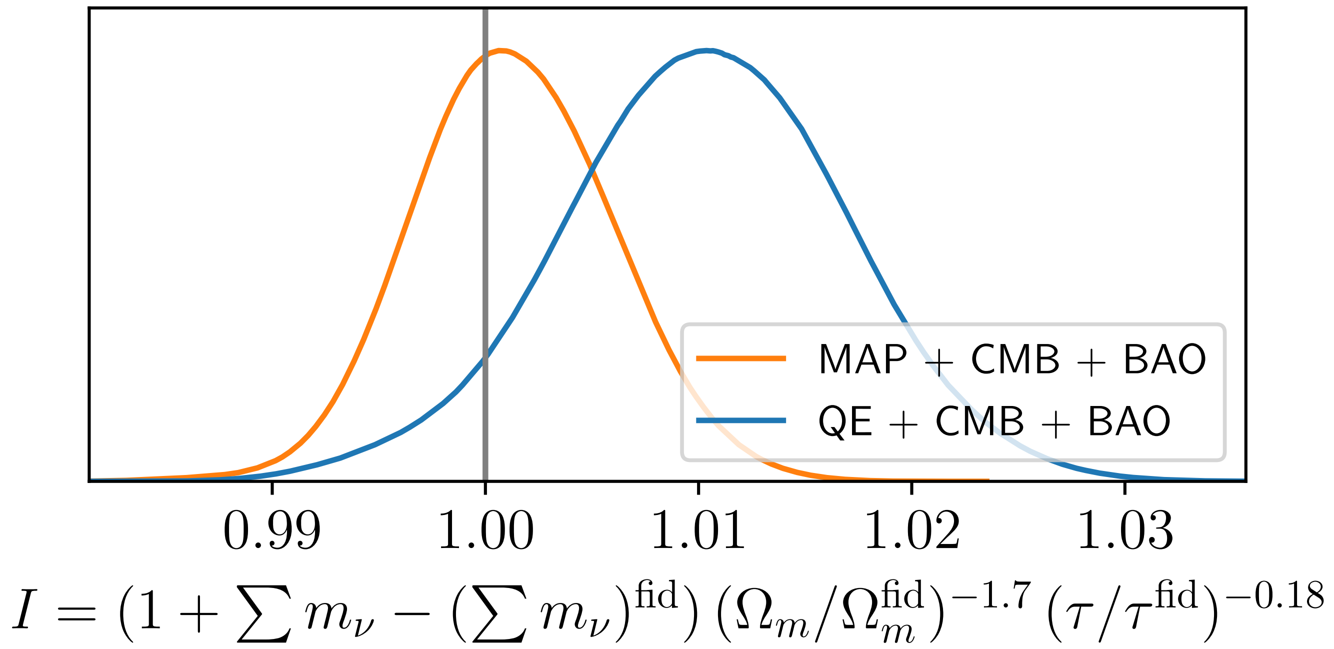
- For CMB-S4, maximum likelihood estimators will be more powerful than the quadratic estimator.
- We develop a fast and robust pipeline to get unbiased CMB lensing spectrum and cosmological parameters.

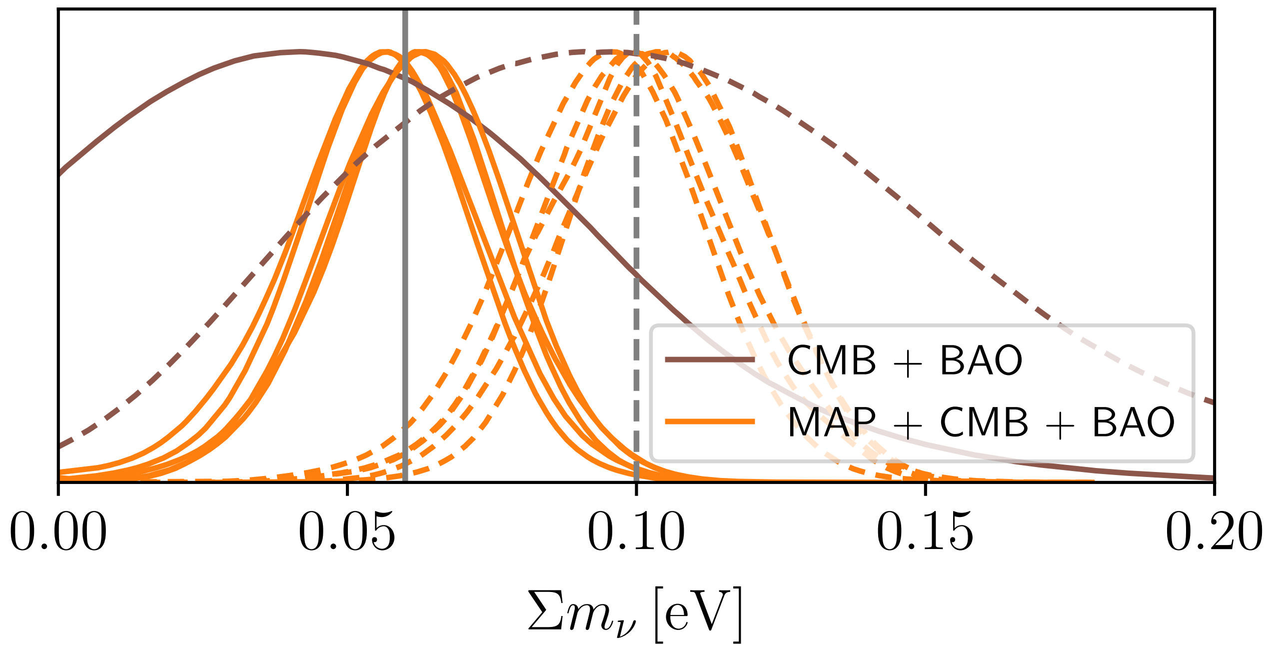
- Estimate iterative lensing spectrum and the iterative N0 and N1 biases.
- Unbiased recovery of cosmological parameters.
- Improve constraints on a combination of M_ν, Ω_m and τ by 30%

$$C_L^{\hat\phi\hat\phi} = C_L^{\phi\phi} + N_L^0 + N_L^1$$



Quadratic estimator Iterative estimator

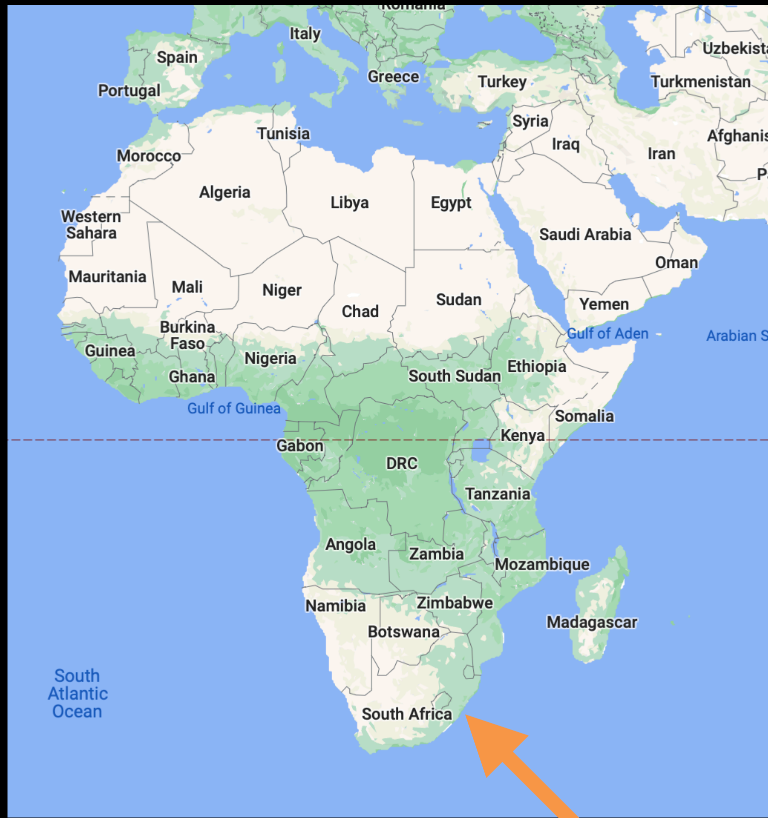




Yin-Zhe Ma
University of KwaZulu-Natal, South Africa

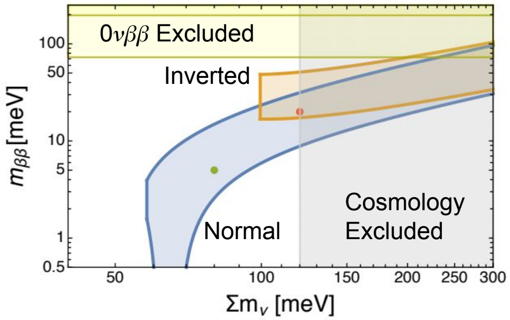
Sunyaev-Zeldovich/Secondary Anisotropy effect:

- tSZ X weak lensing
- Stacking tSZ on filaments/voids
- kSZ X velocity field
- Stacking of kSZ effect
- rotational kSZ effect
- Moving Lens effect



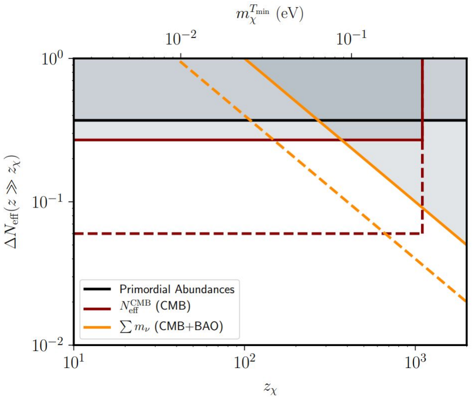
Value of Cosmological Neutrino Mass Measurement

Daniel Green, **Joel Meyers** (arXiv:2111.01096)



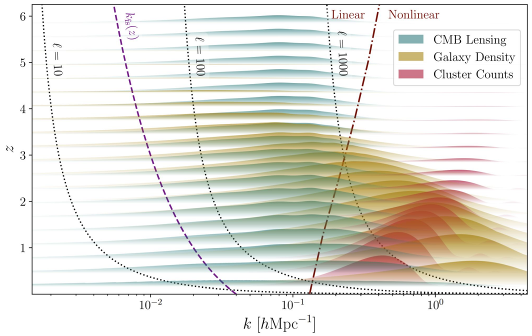
Particle Physics

- Absolute neutrino mass scale sets a target for complementary lab-based searches for neutrino mass



Cosmology

- Provides end-to-end test of cosmic history and is sensitive to new massive species (including gravitinos)



Astrophysics

- Multiple probes of matter power allow neutrino mass to be disentangled from nonlinear and baryonic effects

Gerbino, Grohs, Lattanzi, et al (2022) (arXiv:2203.07377)

Cosmic Birefringence Tomography

Toshiya Namikawa (Kavli IPMU, University of Tokyo)

Sherwin & TN (2021)   Nakatsuka, TN, Komatsu (2022)

- Planck data suggests a hint of cosmic birefringence

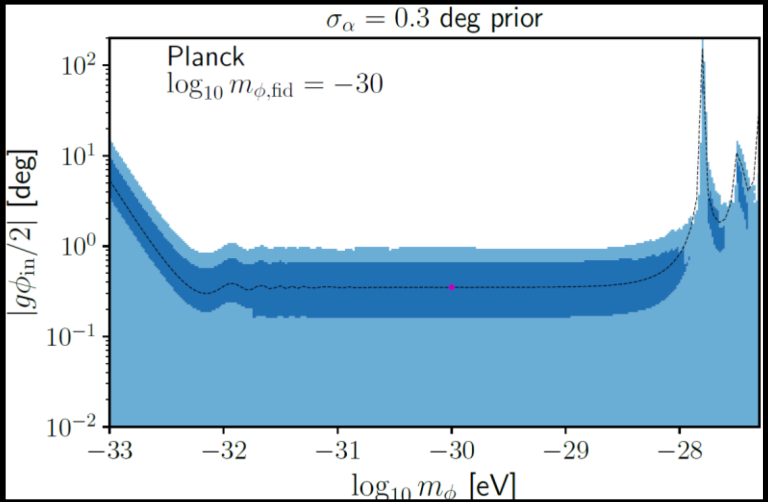
  0.35 ± 0.14 deg Minami & Komatsu (2020)

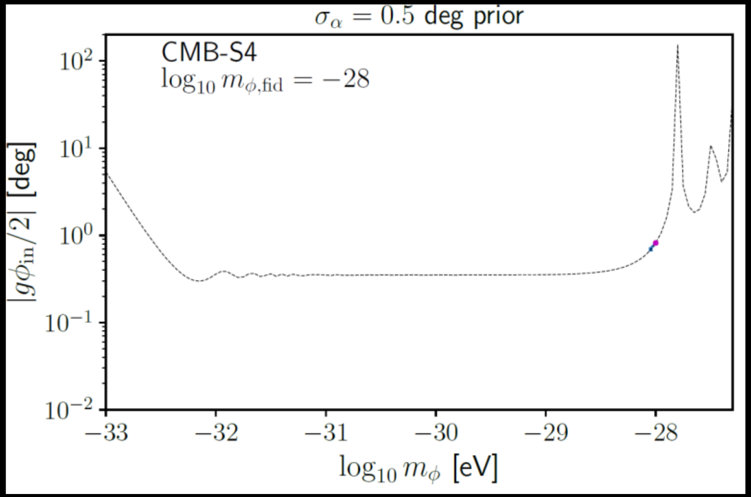
  0.36 ± 0.11 deg Diego-Palazuelos et al. (2022)

- EB signal has been assumed to have the simple form: $C_\ell^{EB} = 2\beta C_\ell^{EE}$ $\quad \beta = \frac{g\Delta\phi}{2}$

  However, EB significantly depends on axion dynamics (mass): $C_\ell^{EB} \neq 2\beta C_\ell^{EE}$

- Using S4, we can constrain m_ϕ from C_ℓ^{EB} to determine e.g. whether axions behave as DE or (a fraction of) DM





S4 is very sensitive to axion mass of $m_\phi > 10^{-28}\, eV$

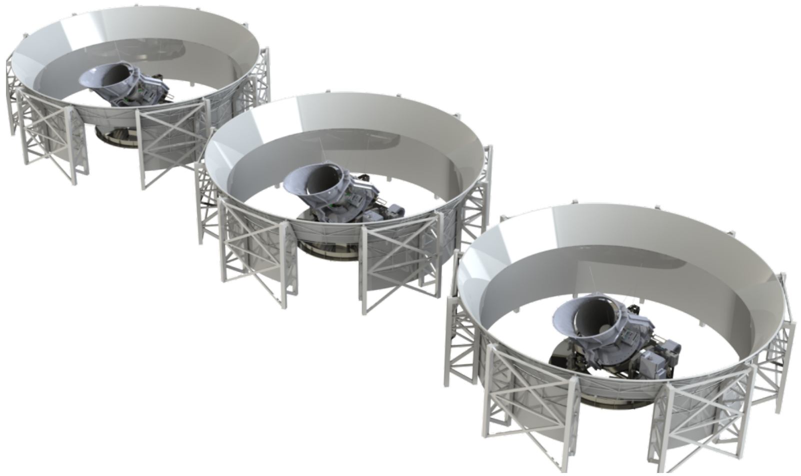
- Ongoing works: Galactic FG (Guan++), lensing (Naokawa++), back reaction (Murai++)

Grant Teply – SATP from concept to delivery

As of last week we have moved all the Simons Observatory small aperture telescope platform bulk hardware to Chile and performed the major crane lifts.

Wiring up is expected in September, ground shield largely pre-assembled and staged.

SATP photo courtesy Evelyn Cortes



Systematics & Foregrounds Simulations

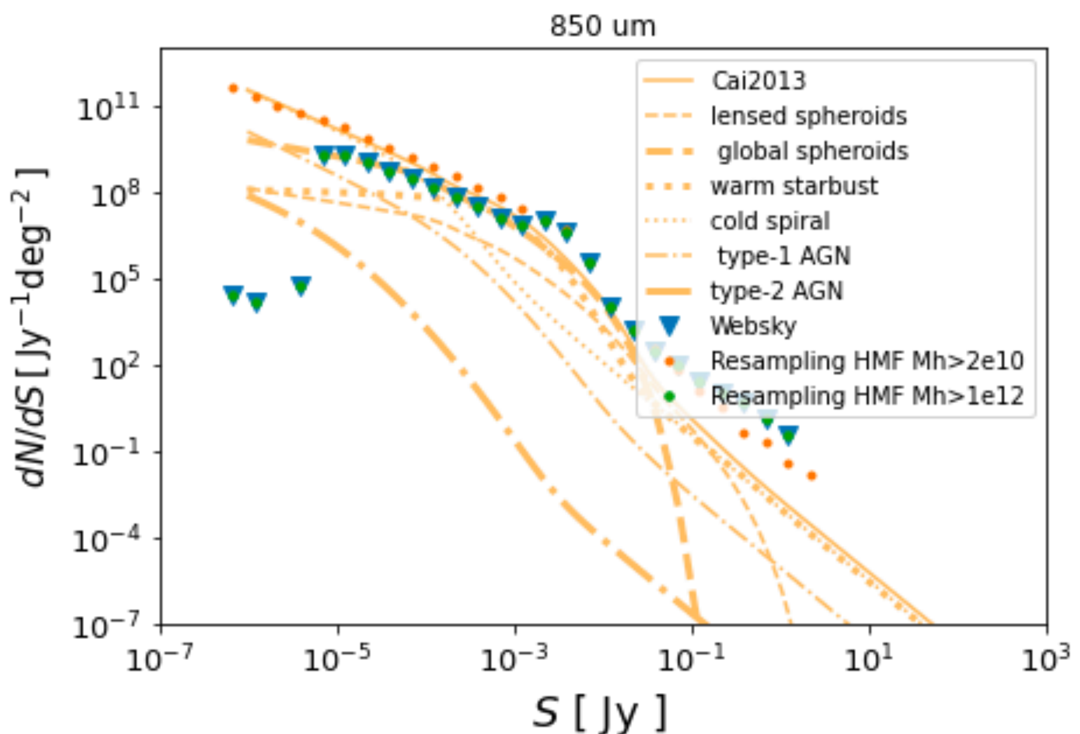
Giuseppe Puglisi - University of Rome

Systematics simulations with TOAST

- Beam convolution w/ HWP
- Gain drift mitigation
- Cross- Talk
- (HWP non-idealities …)

Dusty protoclusters in Websky (?)

- Look for protoclusters given CIB maps from Websky
- Compare Websky catalogs with observables e.g. number counts, dN/dz, etc..



InjectingDust and Synchrotron non-gaussian small scales in PySM3

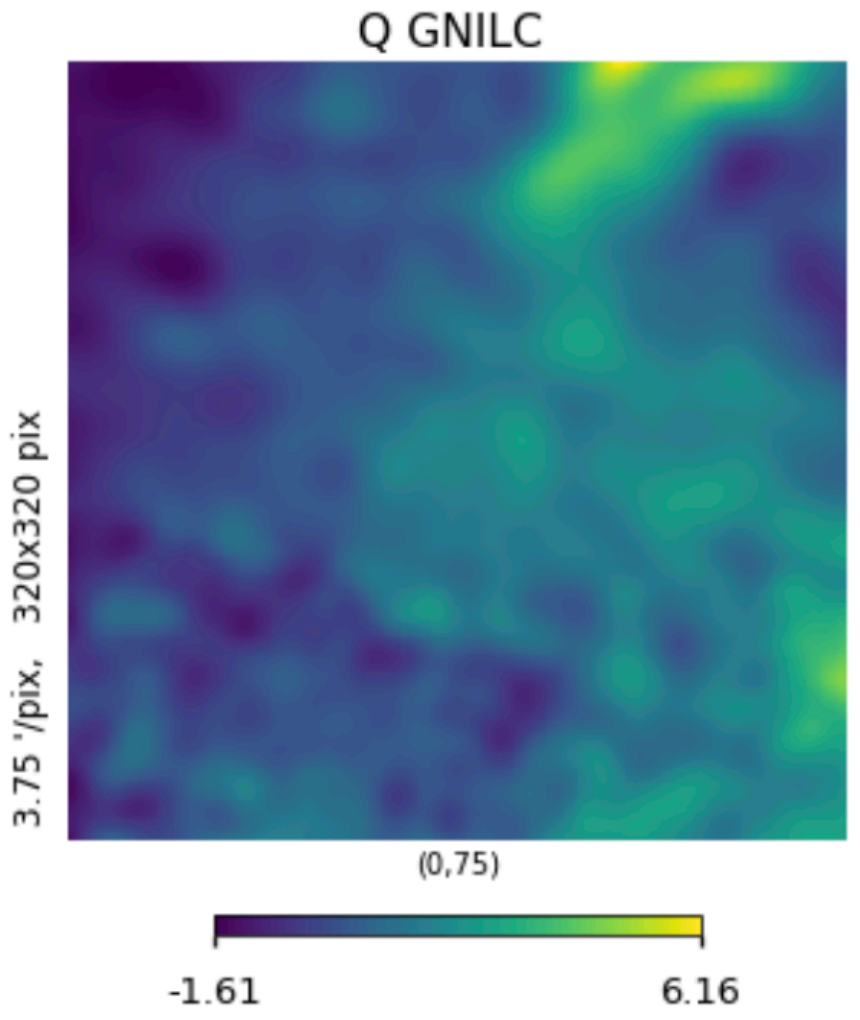
Use the logarithmic polarization tensor transformations

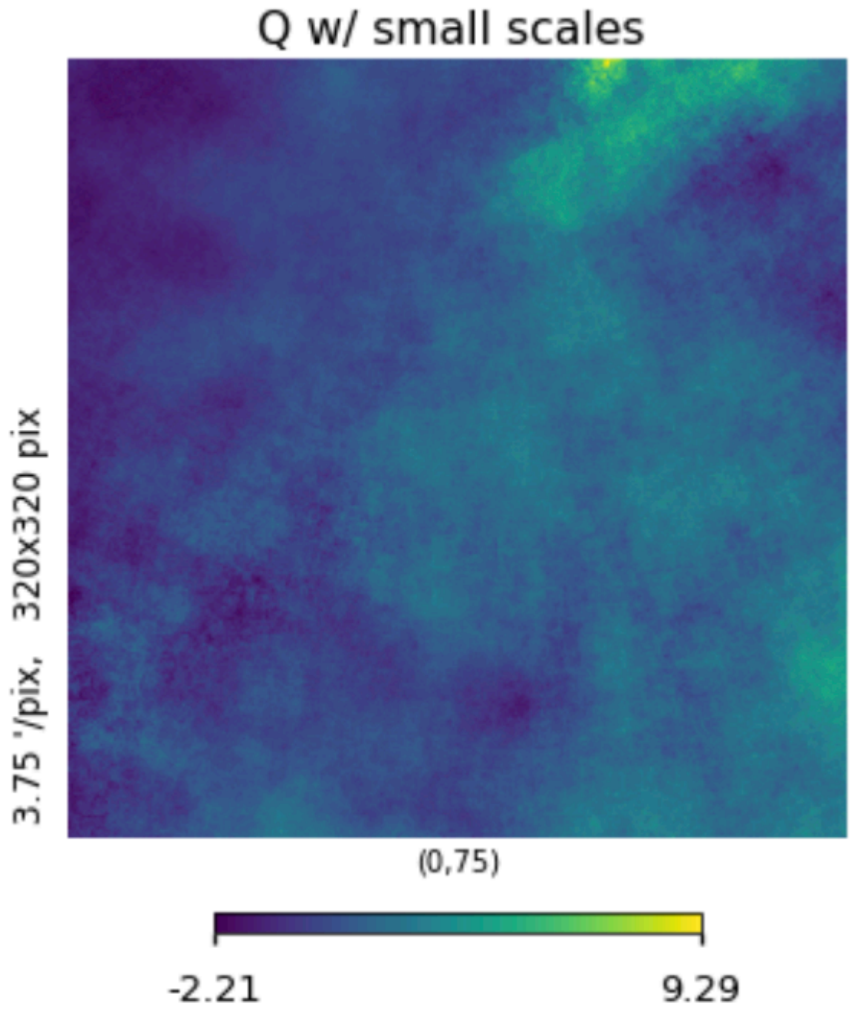
$$i = \frac{1}{2}\ln(I^2 - P^2)$$

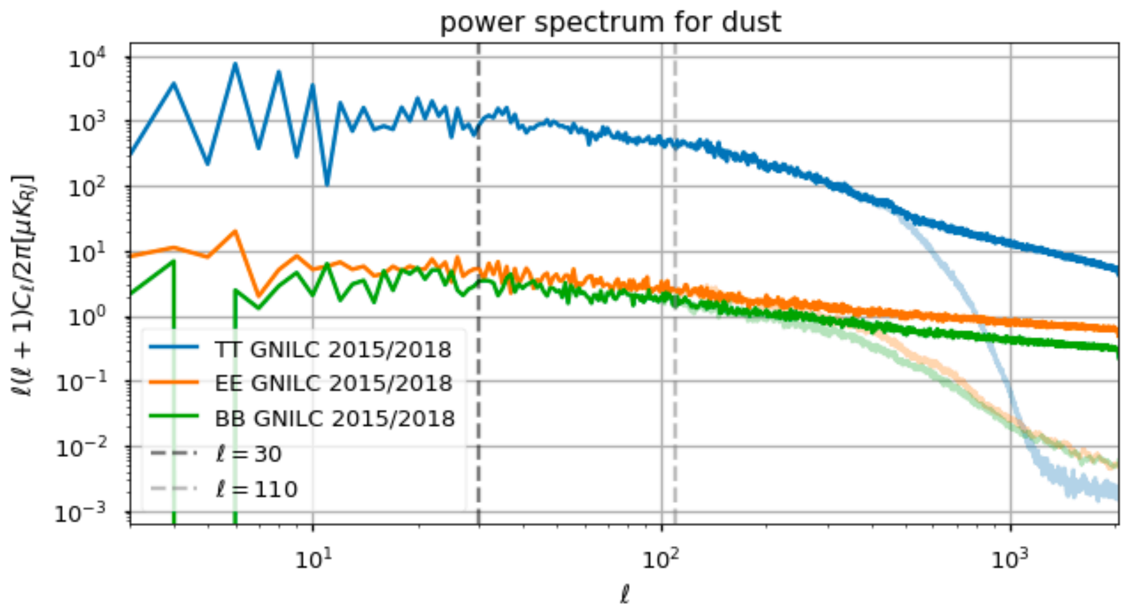
$$q = \frac{Q}{2I}\ln\frac{I-P}{I+P}$$

$$u = \frac{U}{2I}\ln\frac{I-P}{I+P}$$

Inject small scales on iqu maps

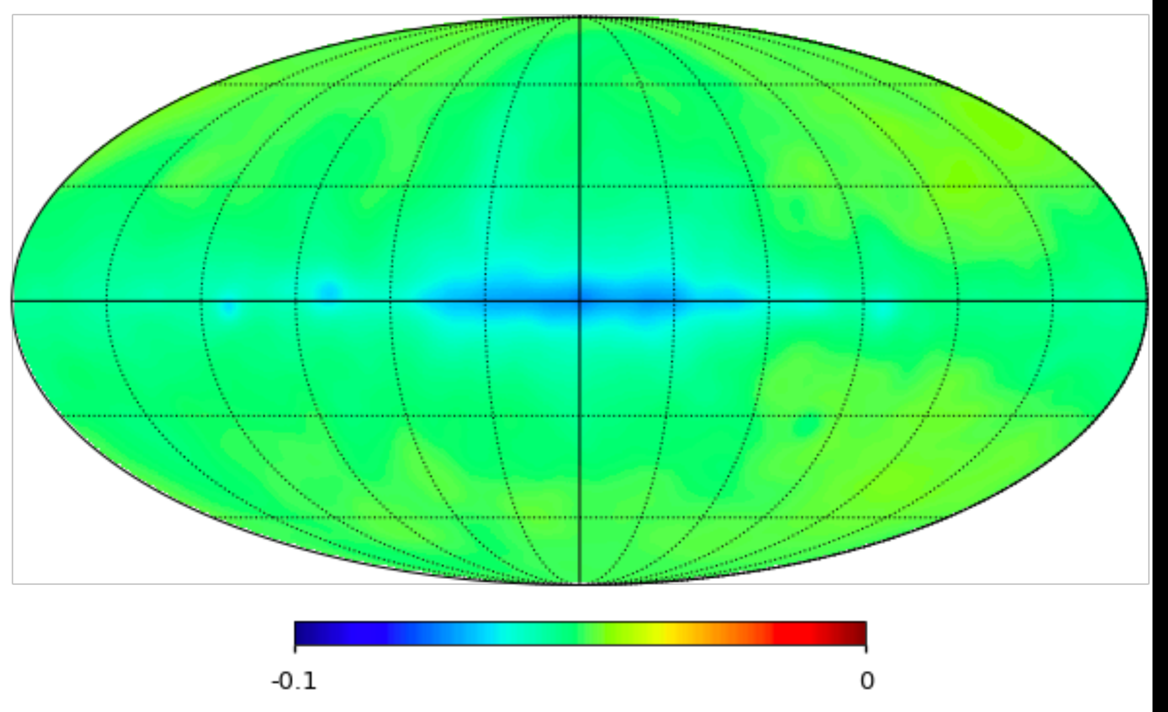






Small scales injected also onto Bd, Td, Bs,Cs

Synchrotron curvature, consistent w/ Kogut 2012

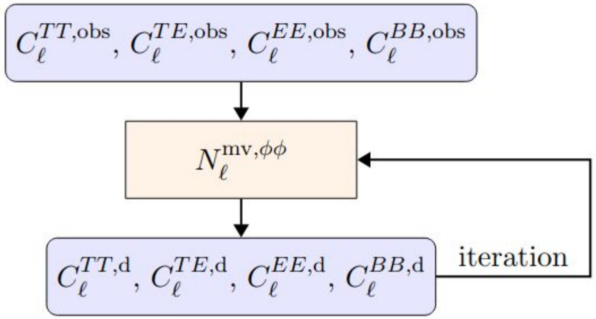


CMB Delensing and Forecasting with **CLASS_delens** and **FisherLens**

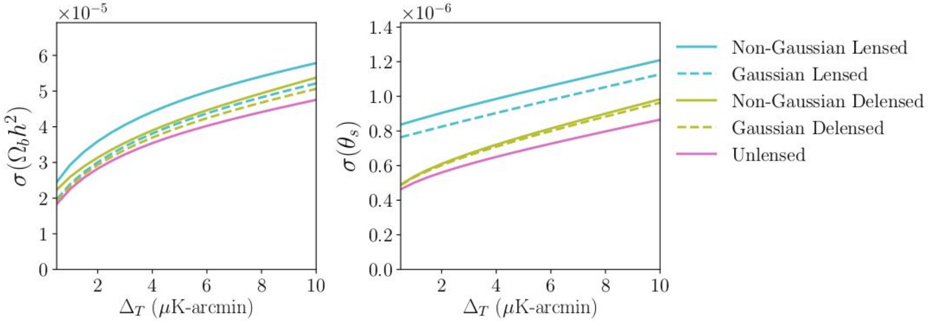
The Benefits of CMB Delensing

Selim C. Hotinli, Joel Meyers, **Cynthia Trendafilova**, Daniel Green, Alexander van Engelen

arXiv:2111.15036



- sharpen acoustic peaks
- reduce B-mode power induced by lensing
- improve lensing reconstruction
- reduce non-Gaussian covariances induced by lensing
- improve parameter constraints
- reduce bias from mismodeling of lensing spectrum



- **CLASS_delens**
  https://github.com/selimhotinli/class_delens/
  Produces delensed CMB spectra and lensing-reconstruction noise for given CMB experiment specifications and cosmology.
- **FisherLens**
  https://github.com/ctrendafilova/FisherLens
  Facilitates Fisher forecasting using spectra from **CLASS_delens**.

PySM 3.4.0b3 pysm3.readthedocs.io - Andrea Zonca

- GNILC Dust + polarization tensor + small scales (N_side 8192)
  - **d9**, **d10**: flat/variable spectral index and dust temperature
  - **d11**: stochastic small scales generated on the fly
- 3D multi-layer dust, MKD model Arxiv: 1706.04162 (N_side 2048)
  - **d12**: 6 layers generated by the Planck Sky Model
- WMAP/Haslam Synchrotron + polarization tensor + small scales (N_side 8192)
  - **s4**, **s5**: flat/variable spectral index
  - **s6**: stochastic small scales generated on the fly
  - **s7**: added curvature based on ARCADE
- CO Lines from Planck SMICA, 3 rotational lines (N_side 2048)
  - **co1**: unpolarized emission 115/230/345 GHz
  - **co2**, **co3**: + polarized emission, + cloud maps