How map non-idealities impact delensing efficiency

(from part of the SO delensing studies)

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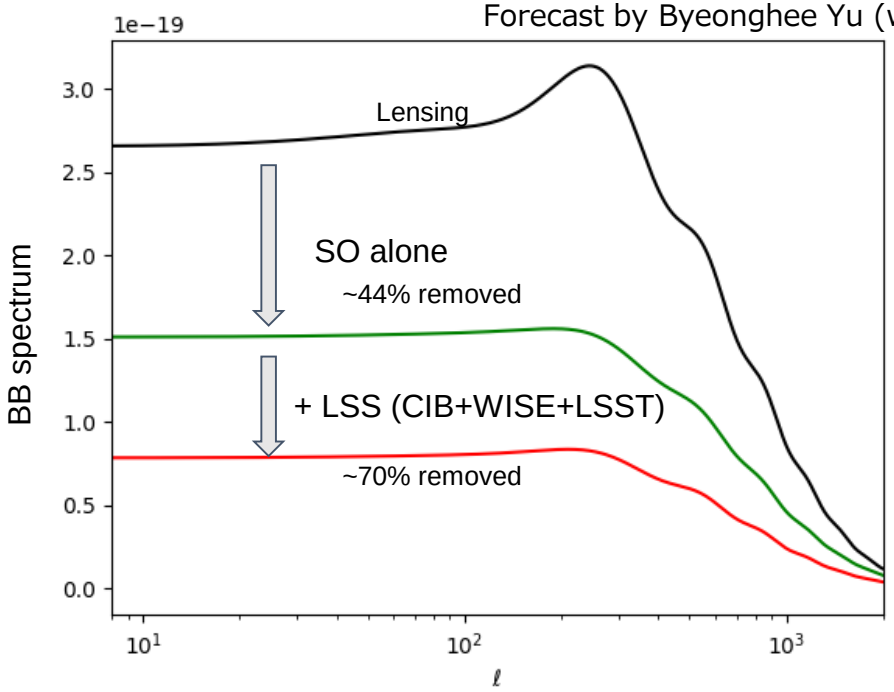
Delensing efficiency in idealistic case (for SO)

In SO, combining available lensing tracers (CMB phi, CIB, galaxies),
we can potentially remove ~70% of the lensing B-modes

Forecast by Byeonghee Yu (with Blake and Colin)

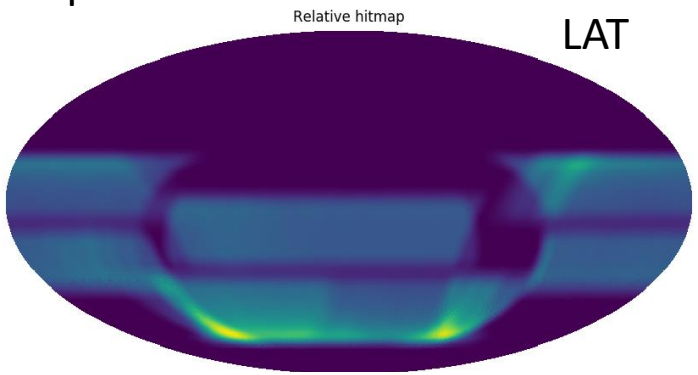


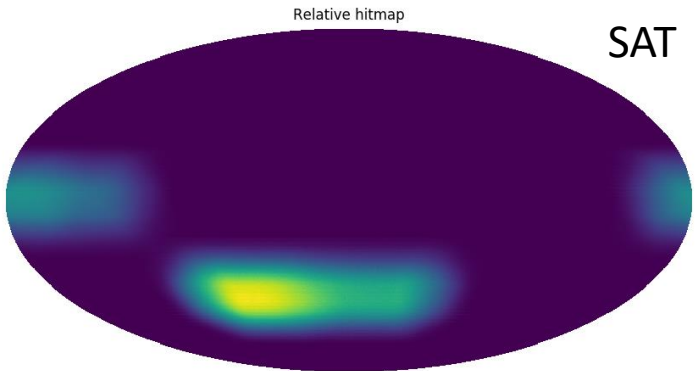
- However, the delensing efficiency could be degraded if
  - Anisotropic window + noise with non-appropriate filtering
  - Foregrounds ➡ discussed by Anton

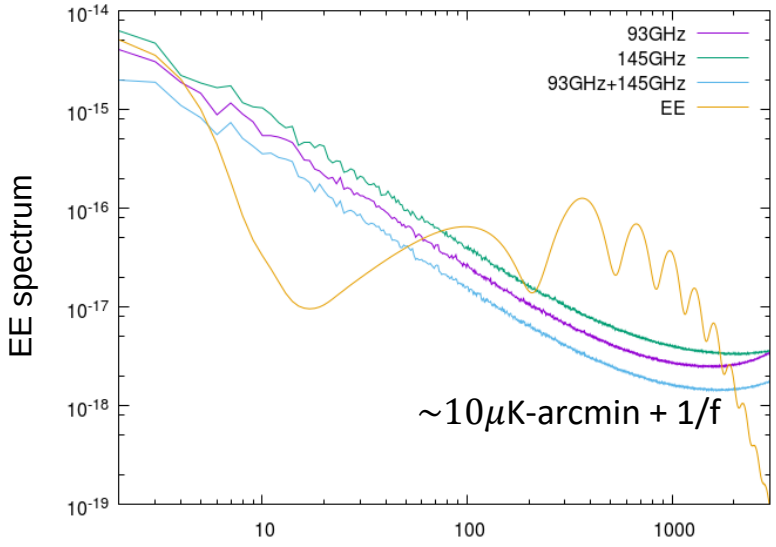
I show the efficiency in the presence of anisotropic masking + noise in CMB map

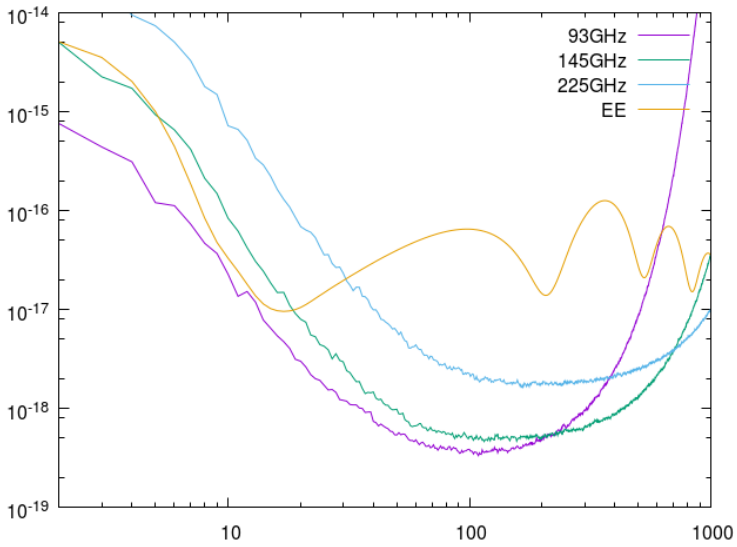
Realistic SO LAT and SAT polarization maps

- Hit maps









SO survey windows / noise are highly inhomogeneous

Delensing methods

- Consider the following methods to compute the lensing template

(1) Diagonal filtering to E modes e.g. SPT collaboration (2017), BKSPT

E-modes from LAT with a diagonal filter $\frac{C_\ell^{EE} E_{\ell m}^{LAT}}{C_\ell^{EE} + N_\ell^P}$

$$B^{\rm temp} = E^{f,LAT} \star I$$

Mass tracers (CMB phi + LSST + CIB)

$$B^{\rm obs} = B^{SAT}$$

- ✓ Computationally very easy (very happy if this works fine)
- ✓ Not optimal in general

Delensing methods

- Consider the following methods to compute the lensing template

(2) Diagonal filtering to E modes + Matching the total window

$$B^{\mathrm{temp}} = E^{f,LAT} \star I \quad \rightarrow \quad \text{further SAT window is multiplied}$$
$$B^{\mathrm{obs}} = B^{SAT} \quad \rightarrow \quad \text{further LAT window is multiplied}$$

- ✓ Computationally very easy
- ✓ Not optimal in general ?

Delensing methods

- Consider the following methods to compute the lensing template

(3) Wiener filtering E modes e.g. Planck collaboration (2018), POLARBEAR collaboration (2019)

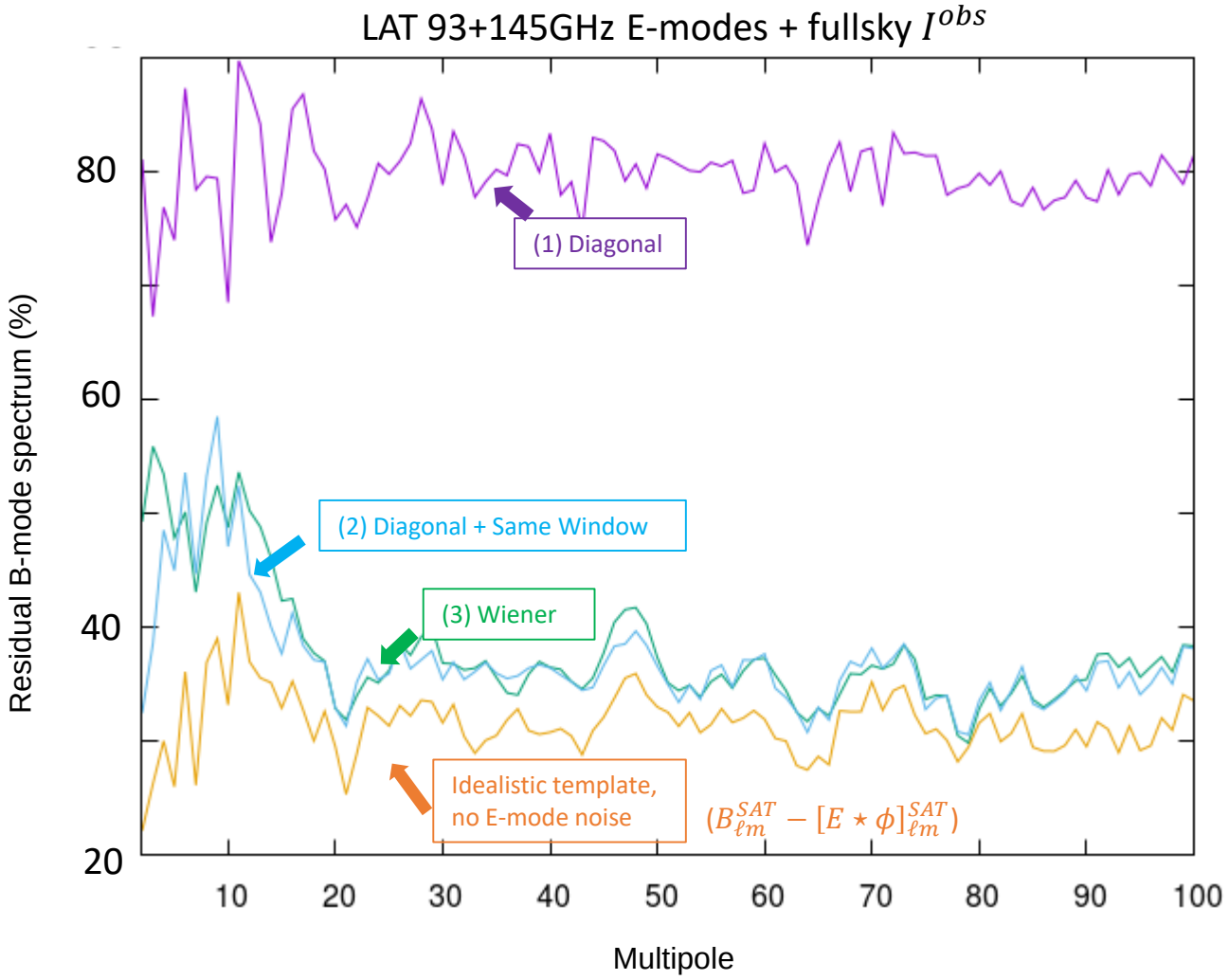
Wiener filtered E-modes at LAT

$$B^{\mathrm{temp}} = E^{w,LAT} \star I \quad \rightarrow \text{ further SAT window is multiplied}$$

$$B^{\mathrm{obs}} = B^{SAT}$$

- ✓ Computationally expensive
- ✓ Optimal

Impact of Anisotropic Survey Window



- (1) is not good at all, (2) and (3) are almost identical

(We can further reduce residual BB with Wiener filtering by adding SAT E-modes)

Conclusion

For the SO specific case,

- A naive diagonal filtering leads to significant degradation of the delensing efficiency

- Applying the same windows to both B-modes realizes the delensing efficiency almost equivalent to the Wiener filtering approach