

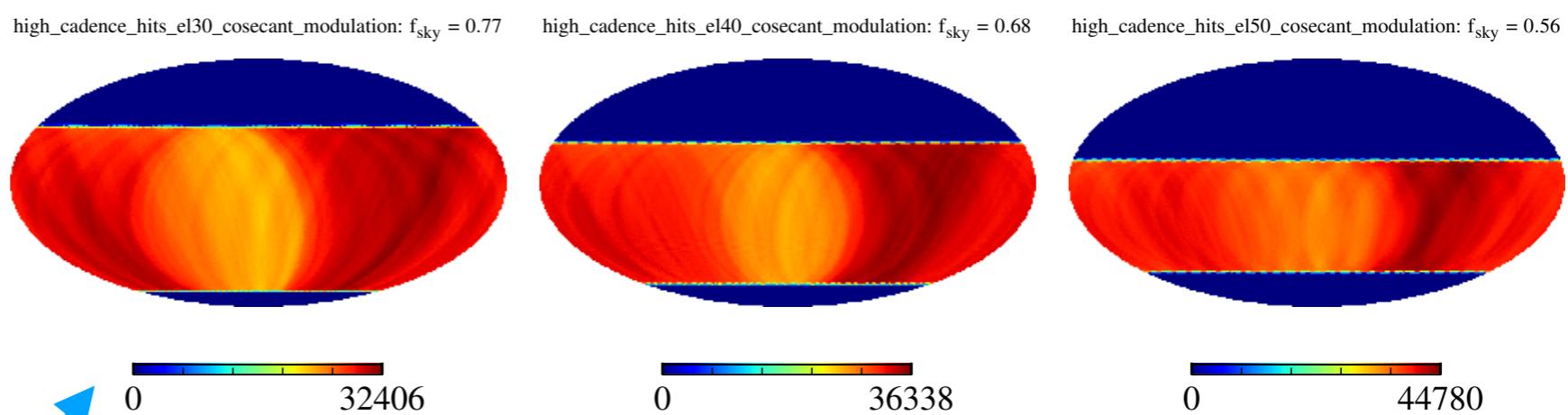
# DRAFT tool update: Including galactic emission

(Srinivasan Raghunathan: 30 April, 2020)

- Plan is to compute and store the covariances for galactic emission for some set of masks and footprints.
- $C_\ell \in [C_\ell^{\text{CMB}}, C_\ell^{\text{white}}, C_\ell^{1/f}, C_\ell^{\text{radio}}, C_\ell^{\text{CIB}}, C_\ell^{\text{tSZ}}, C_\ell^{\text{ksZ}}, C_\ell^{\text{galdust}}, C_\ell^{\text{galsync}}]$
- **To be fixed:** currently using *Planck* galactic mask.

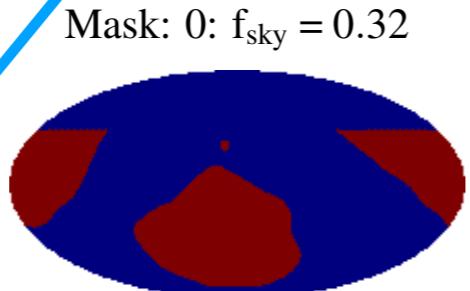
**CMB-S4 footprints:**

high cadence cos mod footprints

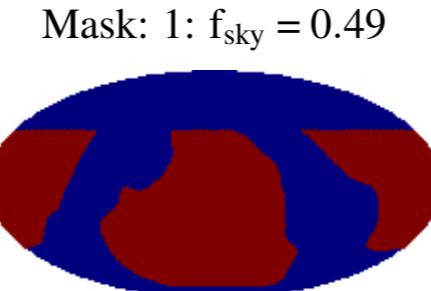


**Masks:**

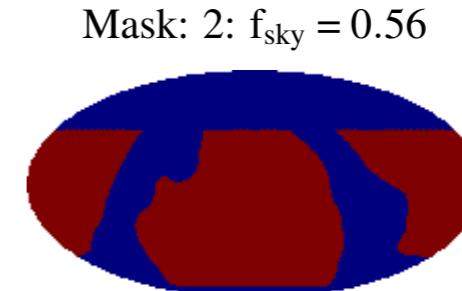
(Modified) Planck galaxy  
mask



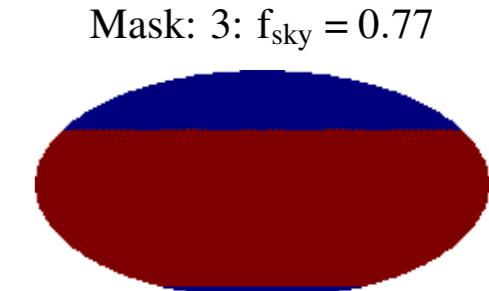
Mask: 0:  $f_{\text{sky}} = 0.32$



Mask: 1:  $f_{\text{sky}} = 0.49$



Mask: 2:  $f_{\text{sky}} = 0.56$



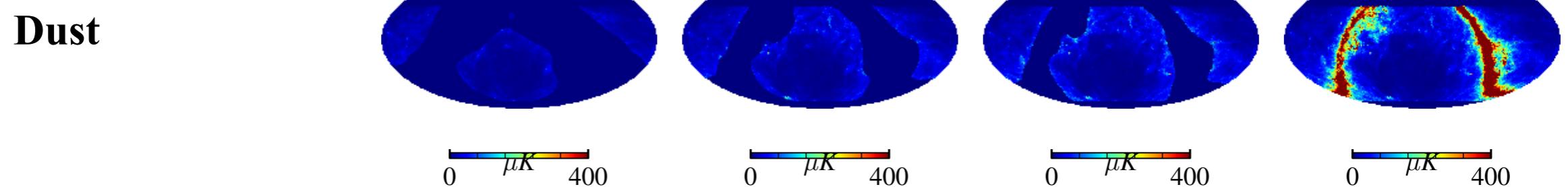
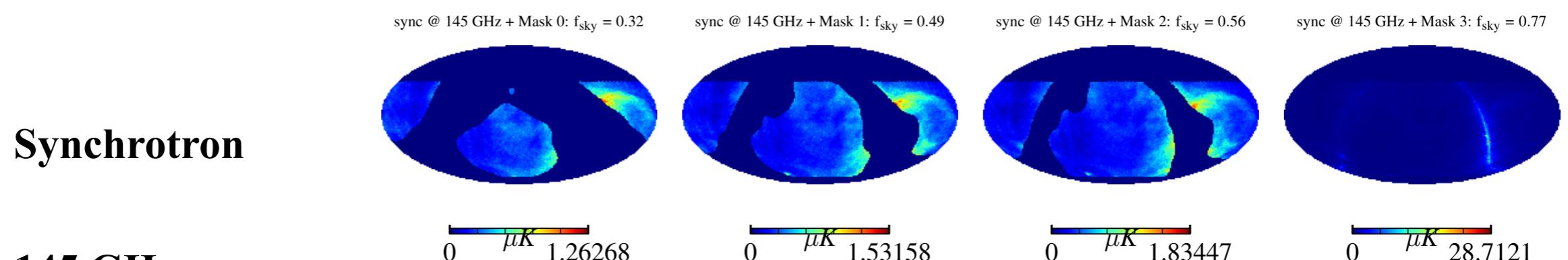
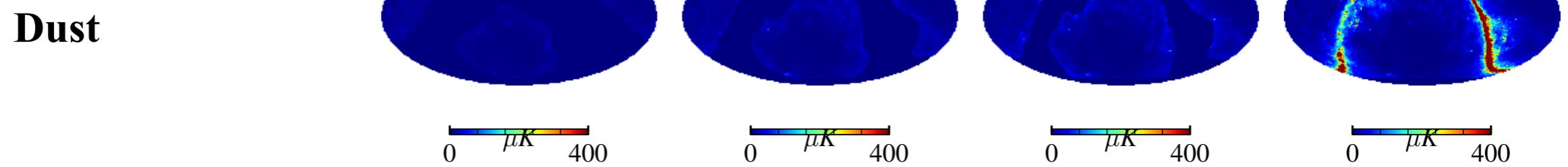
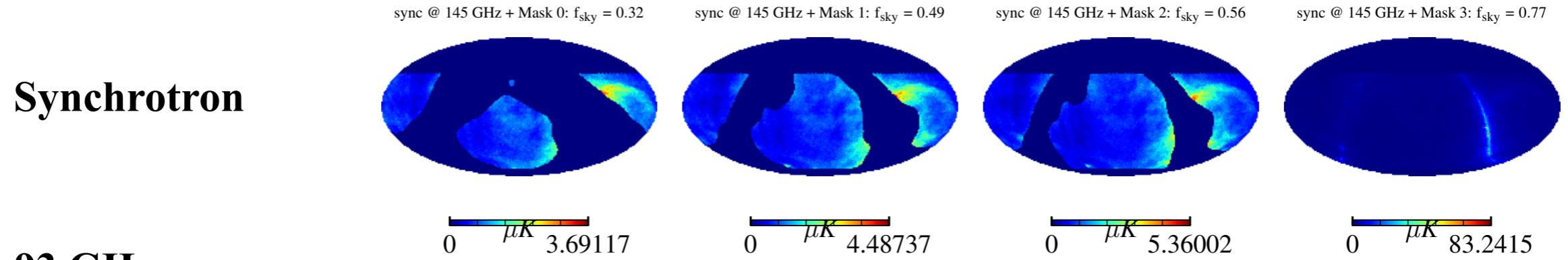
Mask: 3:  $f_{\text{sky}} = 0.77$

**Covariance for galactic emission:** 12 set of covariances: 3 footprints \* 4 masks

**To be fixed:** Currently just tried the first footprint ( $f_{\text{sky}} = 0.77$ )

# Galactic simulations: pySM3

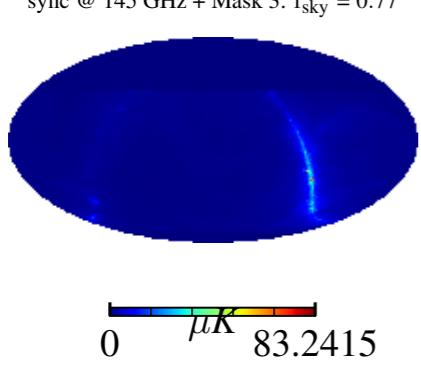
Link: [https://github.com/CMB-S4/s4mapbasedsims/tree/master/202002\\_foregrounds\\_extragalactic\\_cmb\\_tophat](https://github.com/CMB-S4/s4mapbasedsims/tree/master/202002_foregrounds_extragalactic_cmb_tophat)



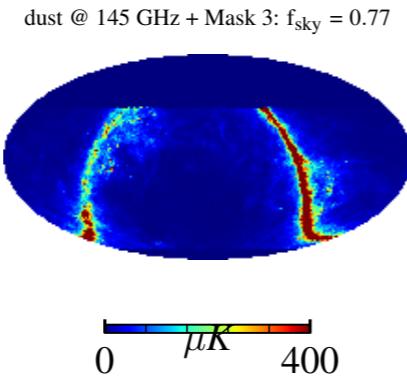
# Compare to sims by C. Umilta

**93 GHz**

**Synchrotron**

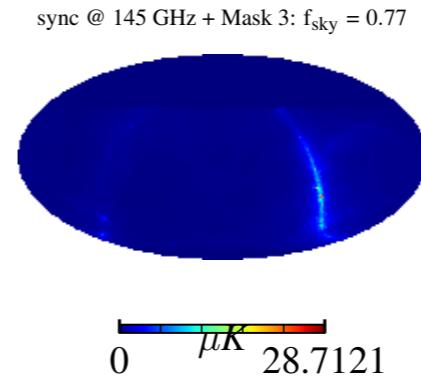


**Dust**



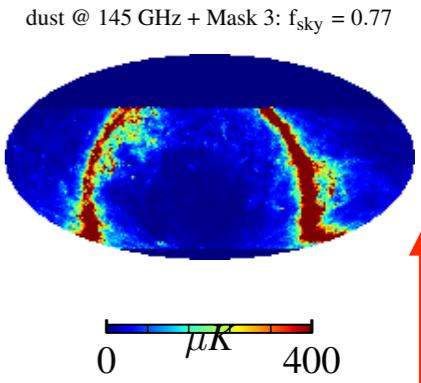
**145 GHz**

**Synchrotron**



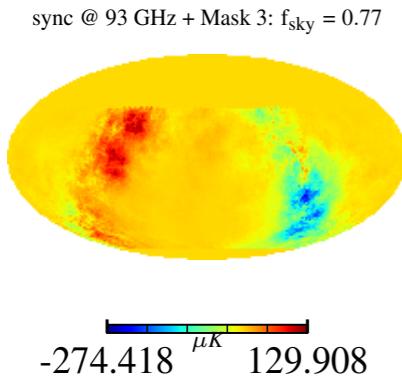
**Dust**

**Dust brighter here**

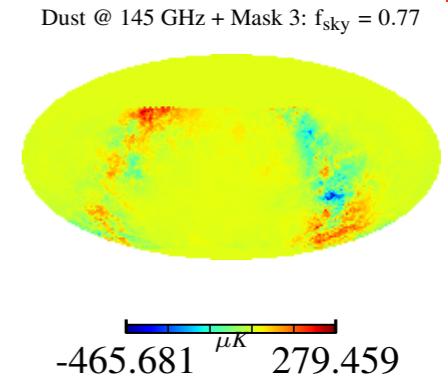
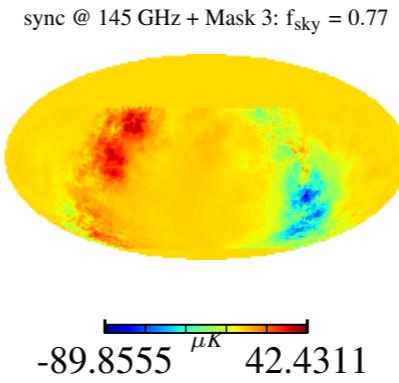
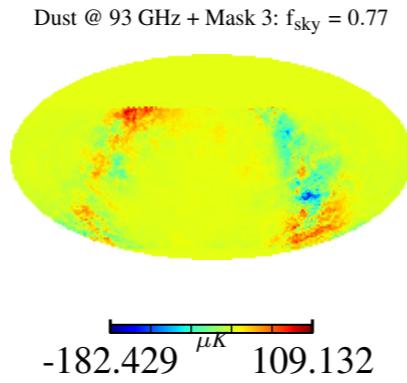


**pySM3**

**Sync. brighter here**

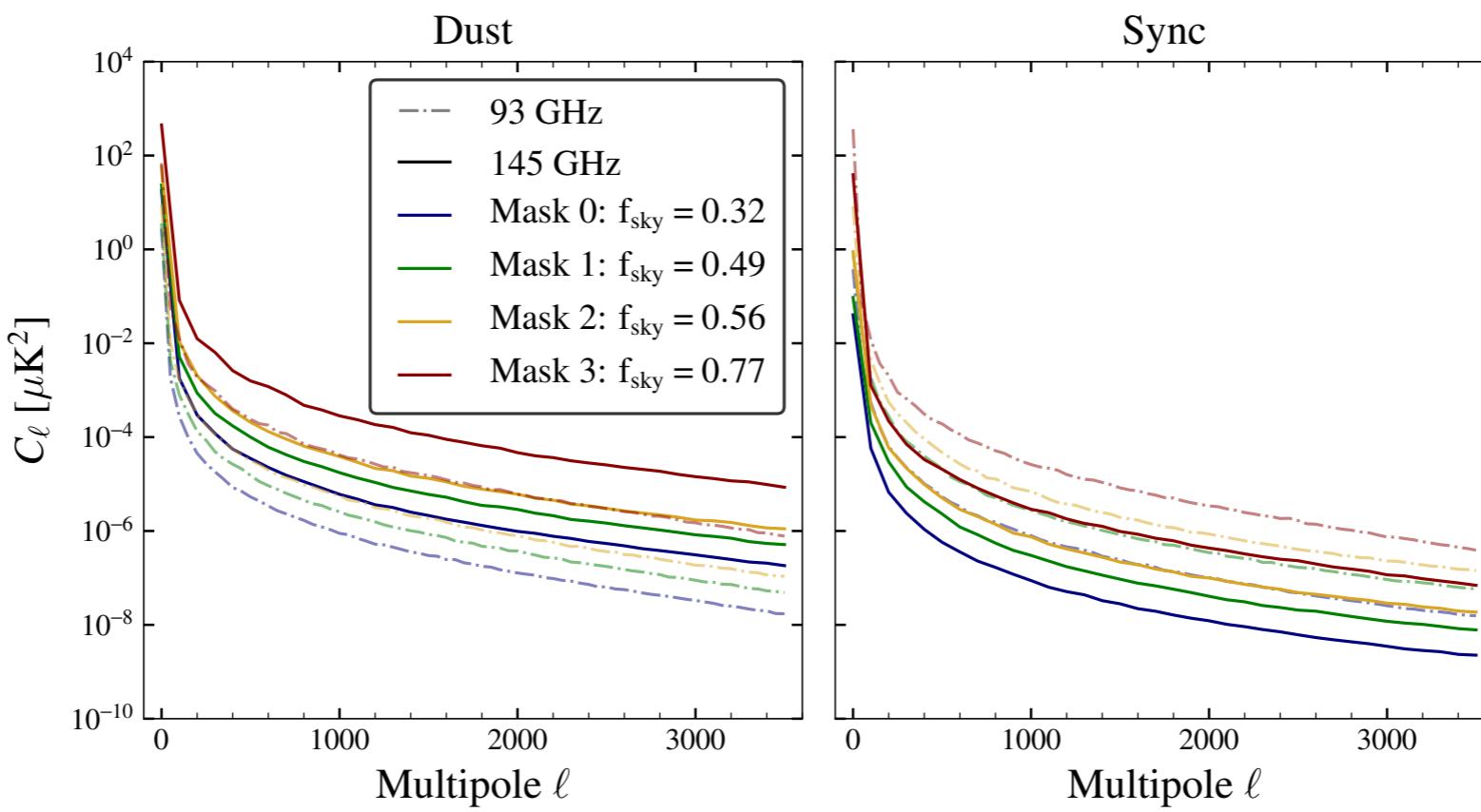
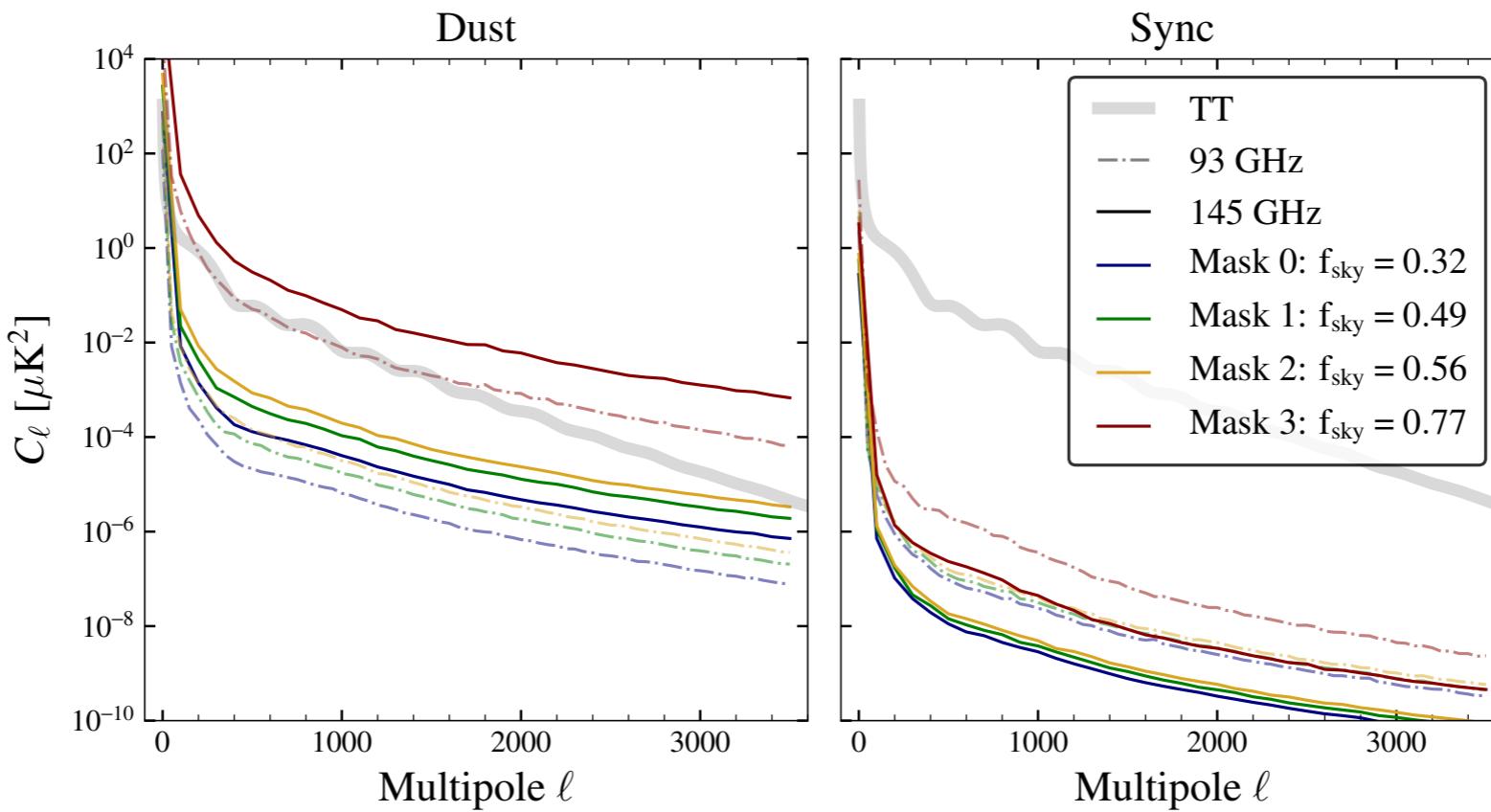


**C. Umilta**



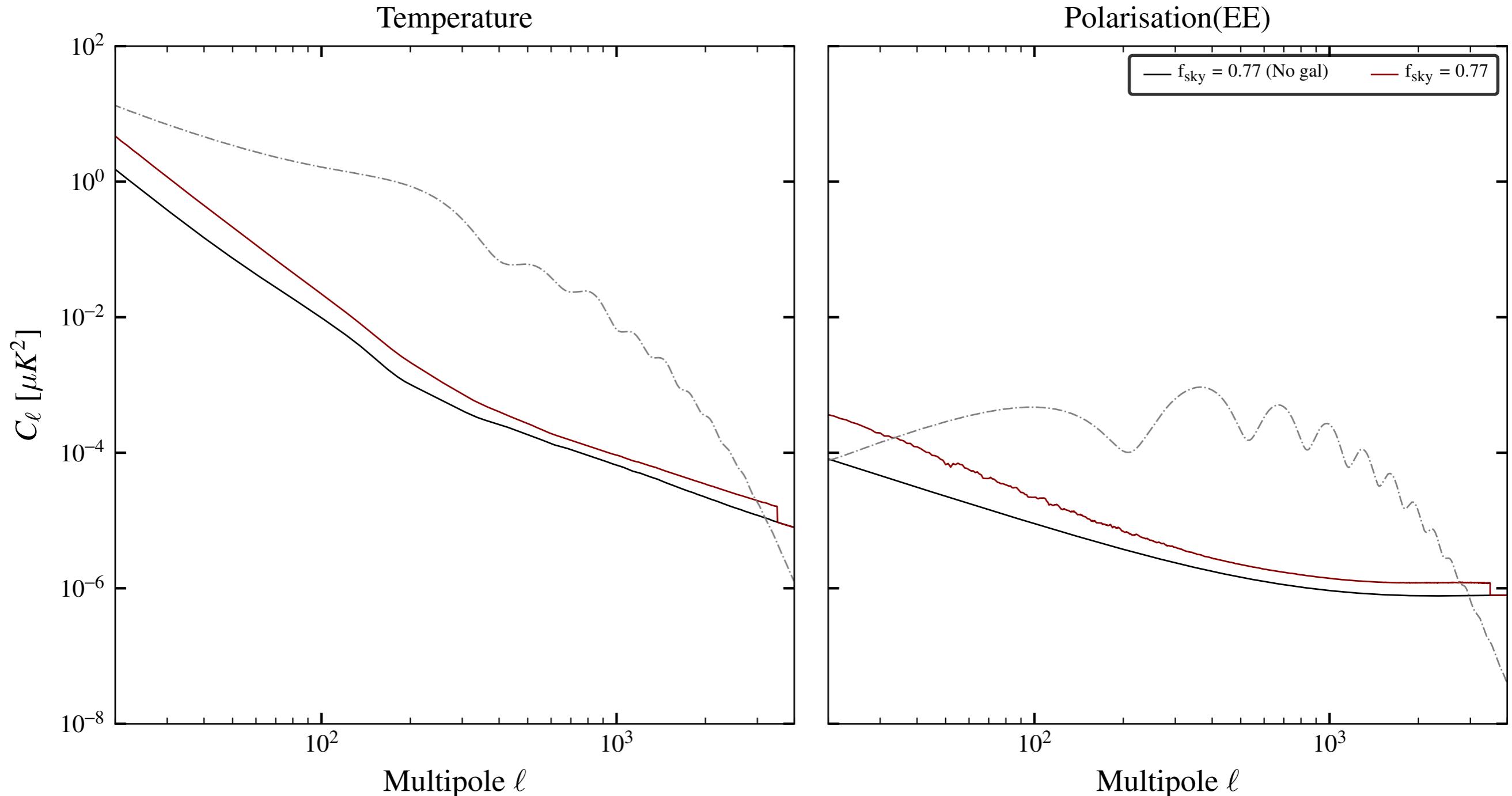
# Dust / Sync TT power spectra

Top: pySM3; Bottom: C. Umlita simulations



# ILC curves - W/o vs w/ galaxy (4 bands)

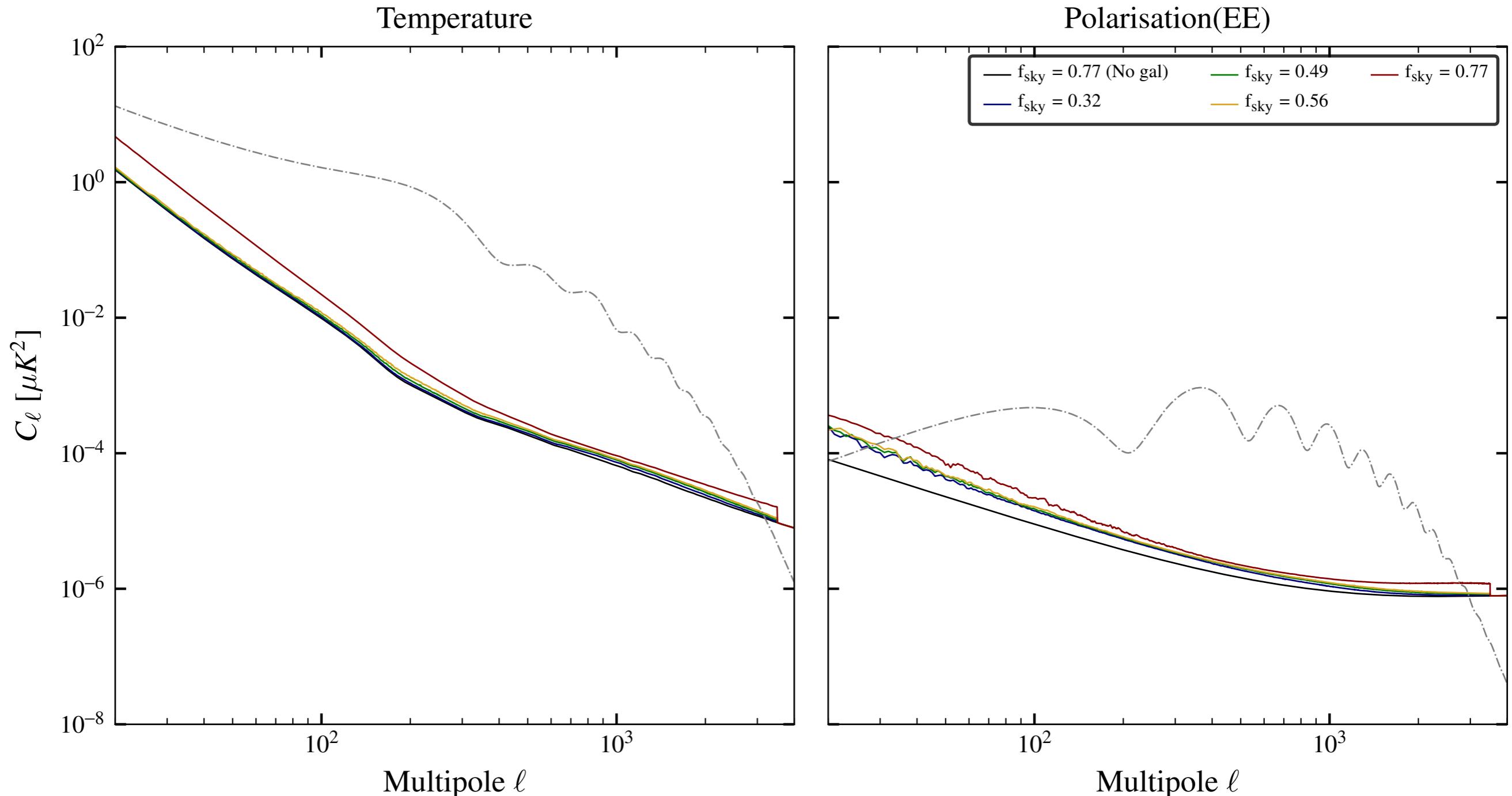
without\_vs\_with\_galaxy\_mask3\_93-145-225-278



Residual power increases when galactic emission is added (black vs red)

# ILC curves - W/o vs w/ galaxy (4 bands, 4 masks)

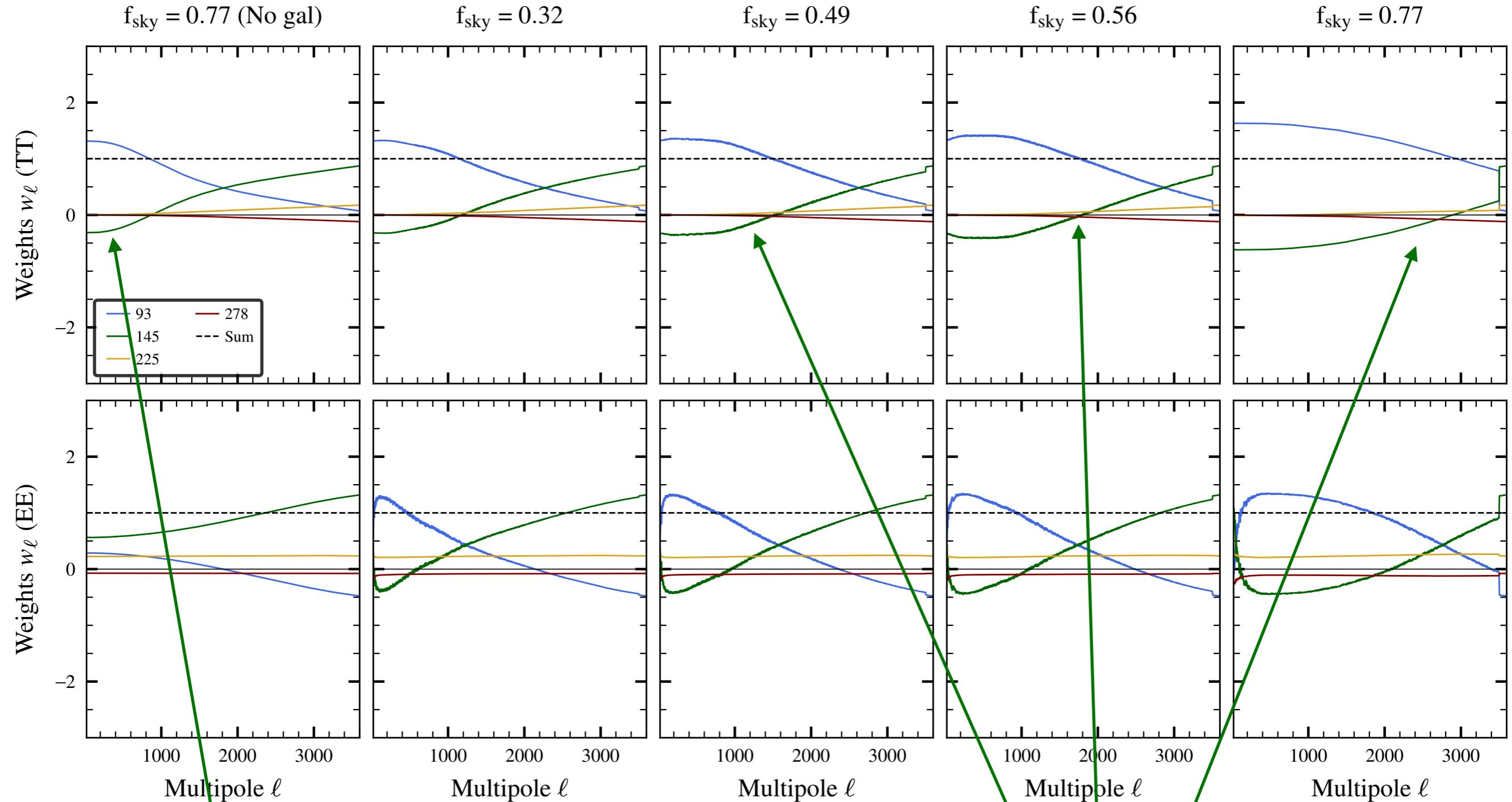
without\_vs\_with\_galaxy\_allmasks\_93-145-225-278



Residual power increases with more  $f_{\text{sky}}$  (blue to red)

# Weights (4 bands, 4 masks)

without\_vs\_with\_galaxy\_allmasks\_93-145-225-278

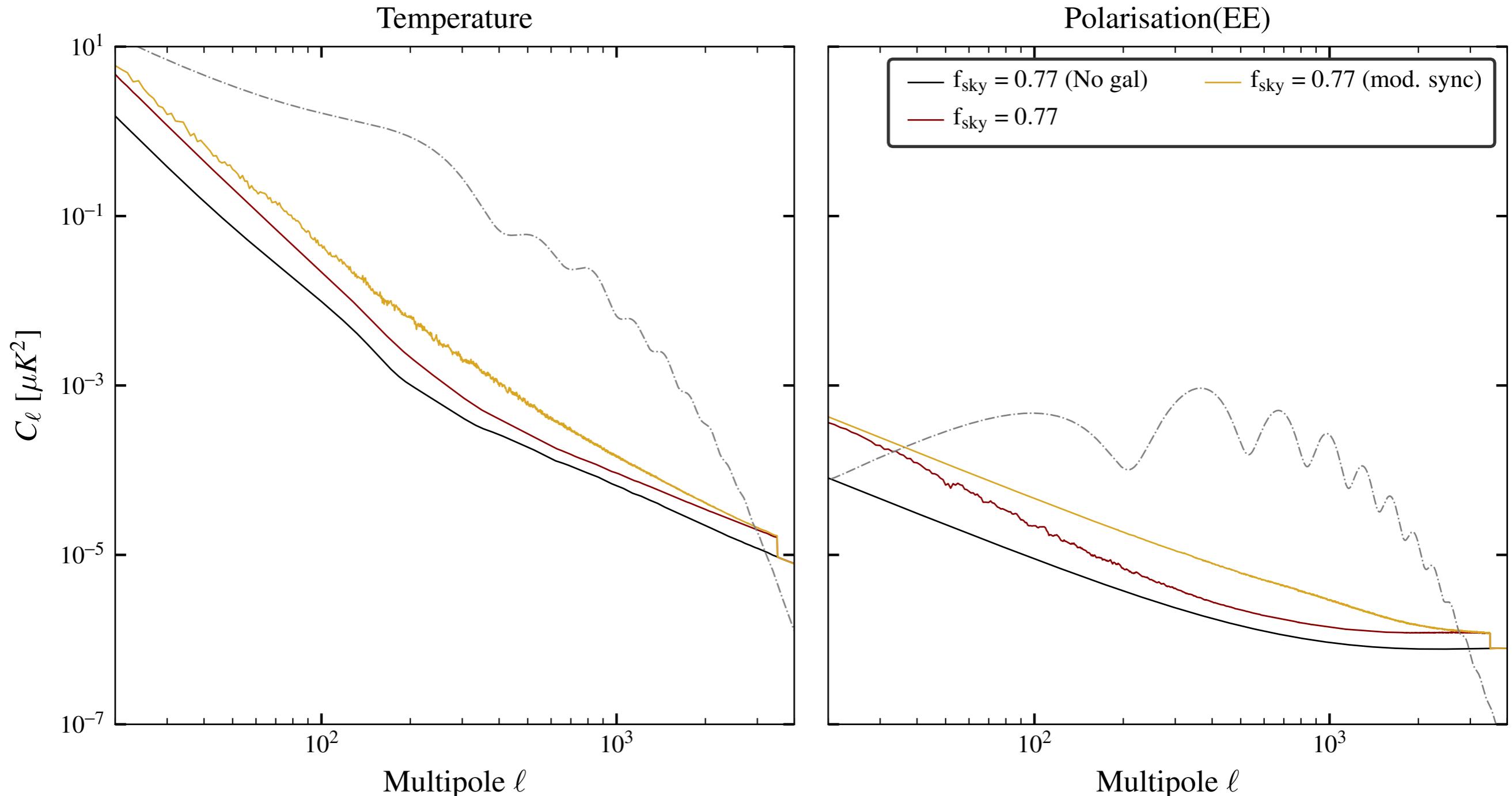


- 90 gets most of the low-\ell weights as it has very low 1/f in T. P looks different.
- **Negative weights for 150 at low-\ell** to cancel the correlated 1/f. The \ell range with negative weights increases when gal. dust is added.

# ILC curves - W/o vs w/ galaxy (4 bands)

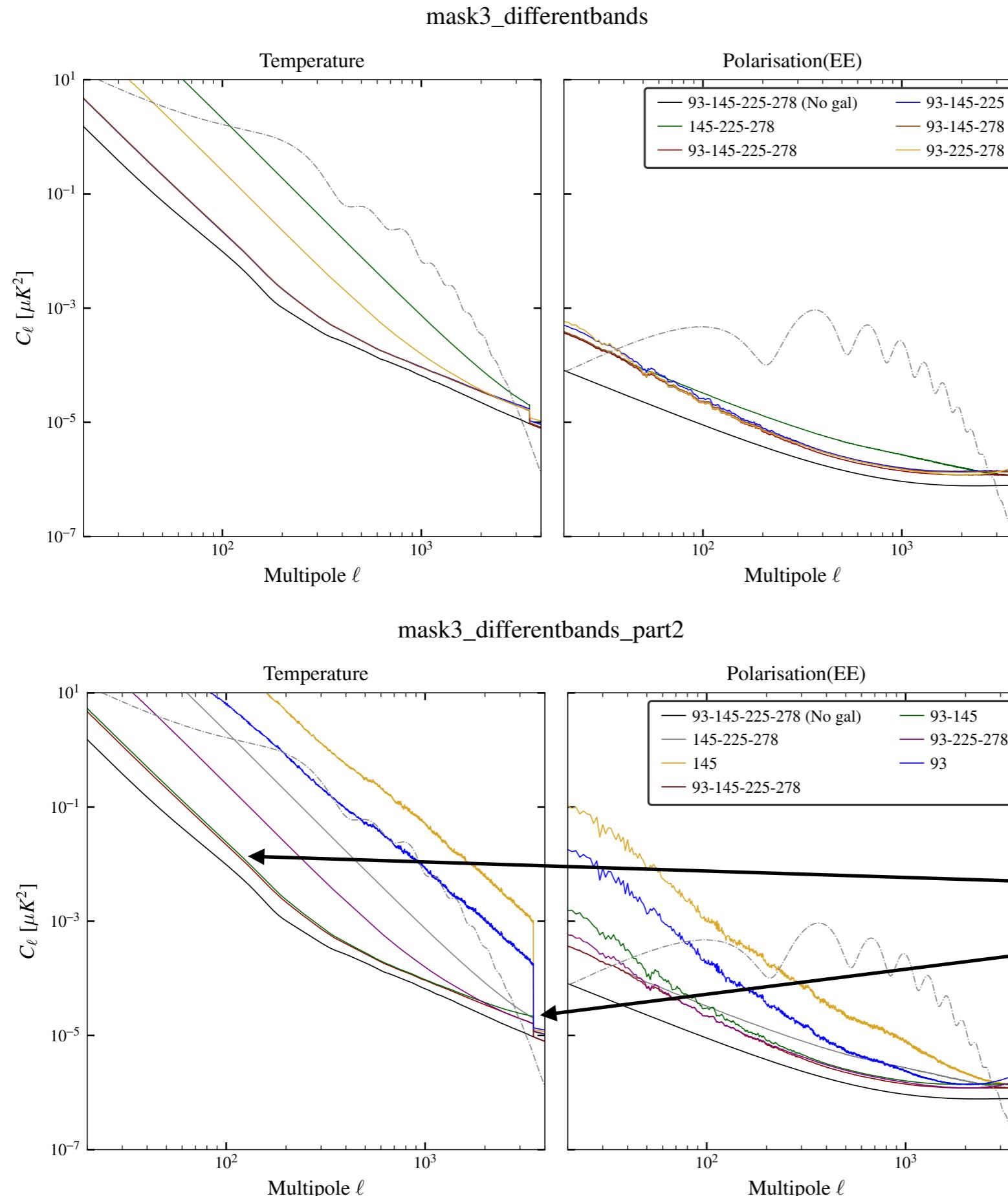
(Synchrotron from C. Umilta simulations)

without\_vs\_with\_galaxy\_mask3\_93-145-225-278\_modsync



Synchrotron power is increased using simulations from C. Umilta. Results in a slightly higher residual noise.

# ILC curves - Eliminating bands



## Top: Eliminating one band

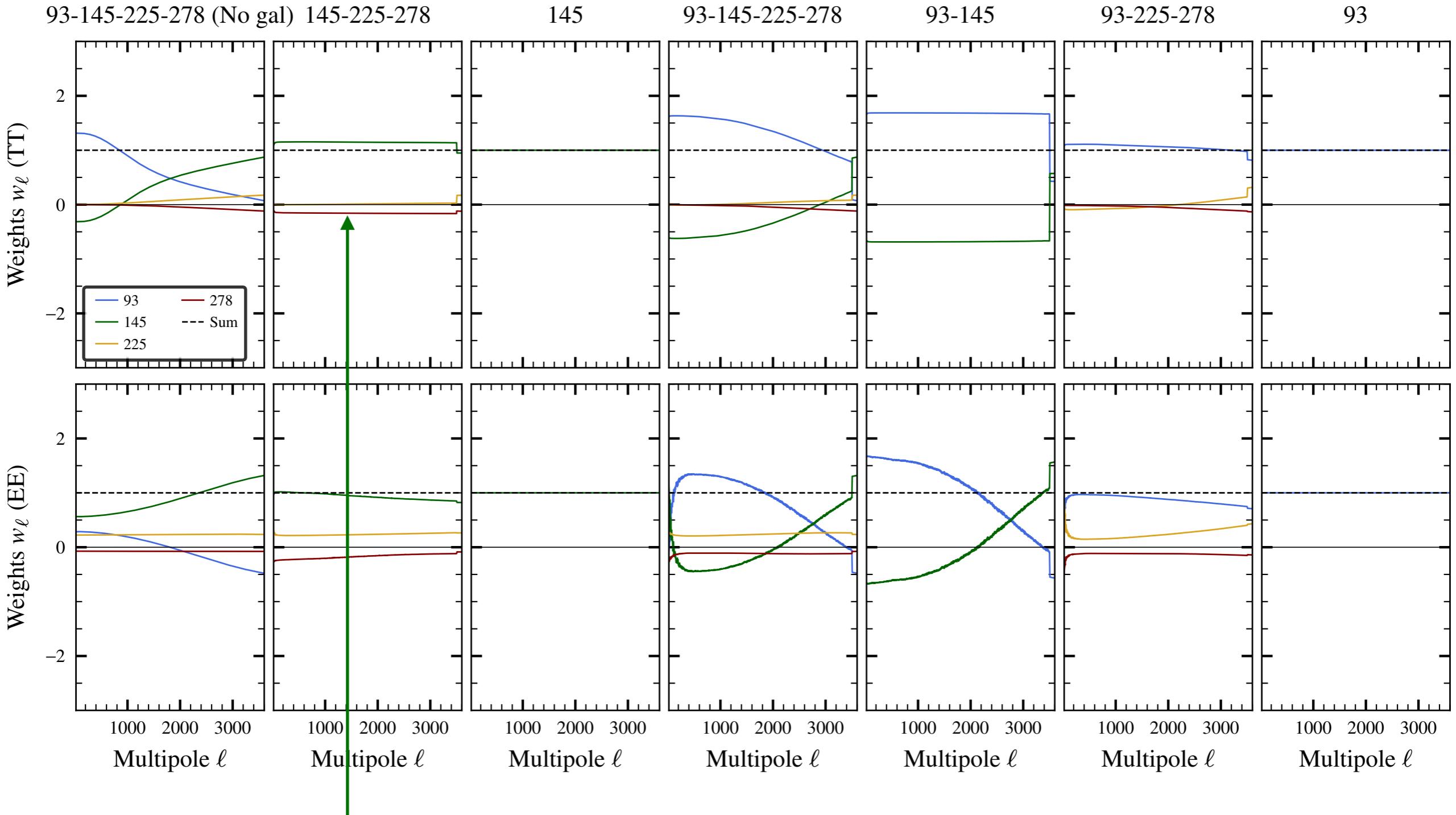
- Removing 90 hurts us the most. But this is mostly due to 1/f and not due to galaxy.
- 225/278 roughly add equal contribution. Not clear which is more important.

## Bottom: Eliminating multiple bands

- Removing both 225/278 increases the noise only slightly on large-scales. (Green vs red). But on small-scales the higher frequency bands might become important (to remove CIB).

# Weights (after eliminating bands)

mask3\_differentbands\_part2



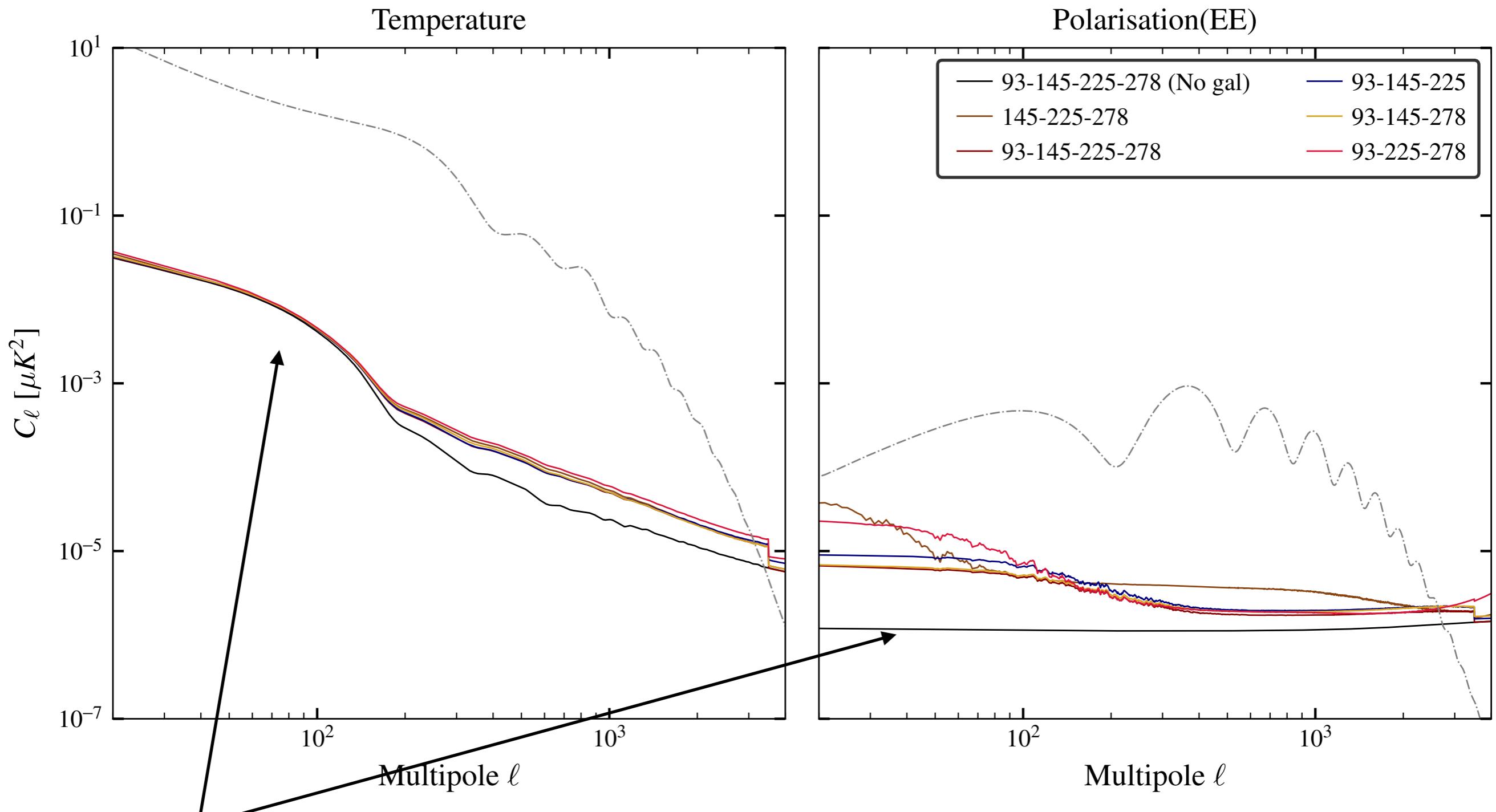
- 150 gets most of the weight when 90 is removed. 220/270 get negative weights now.

# Next steps

- Find out the correct set of galactic simulations.
- Galactic mask: Currently using *Planck*.
- S4 footprints: Currently using  $\text{fsky} = 0.77$ . Other two footprints to be included.
- Power spectra: Currently only has TT and EE. TE to be included.
- $\ell_{\text{max}}$ : Current limiting it to 3500. To be increased to 6000 or higher.

# ILC curves - Eliminating bands and no 1/f

mask3\_differentbands\_nooverf



The low- $\ell$  increase for black (despite removing galaxy and 1/f) is because extragalactic foregrounds are not white. This trend is absent for polarisation, as expected.