HFI data processing: calibration and maps

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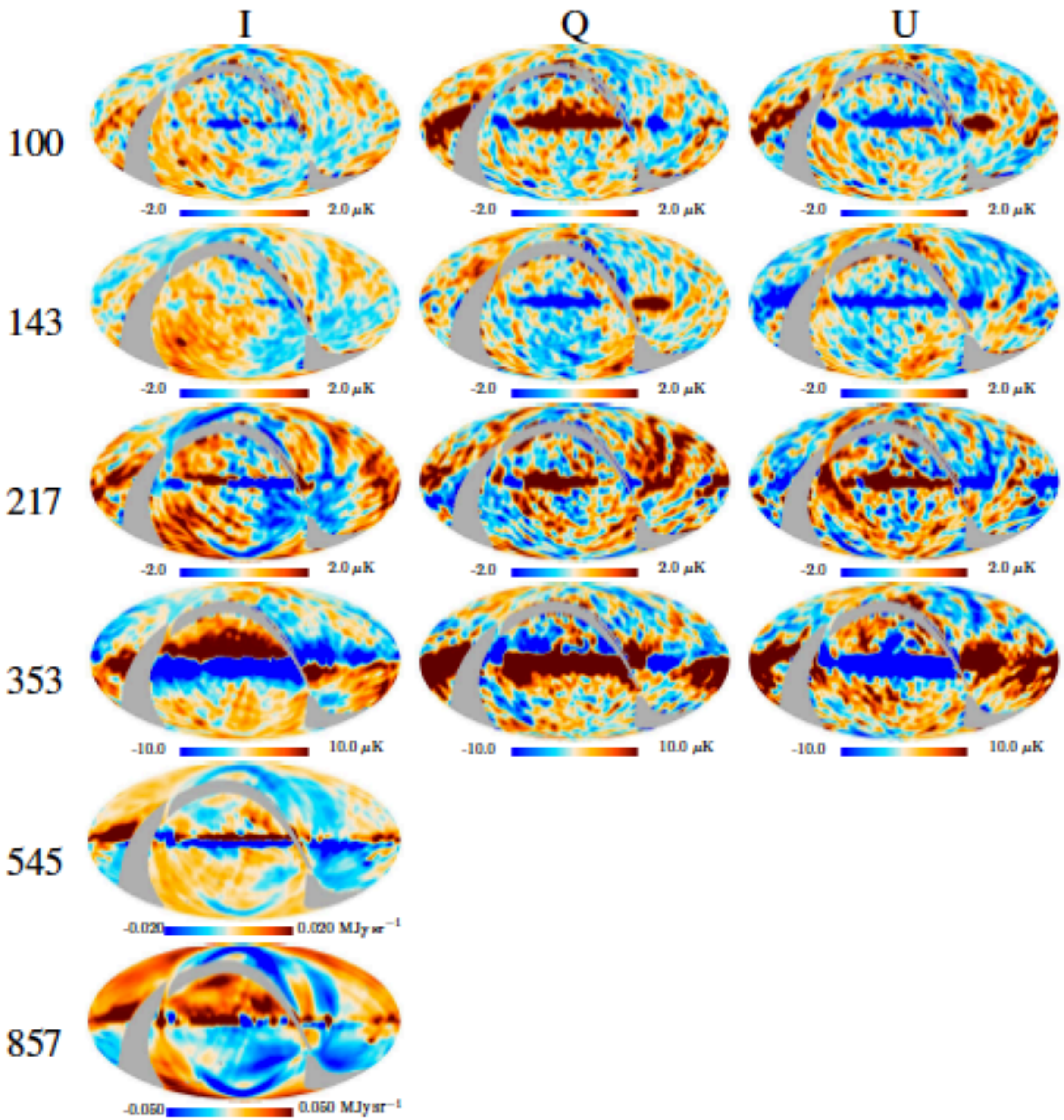
San Diego Nov 2017

Odd even rings null test 2015

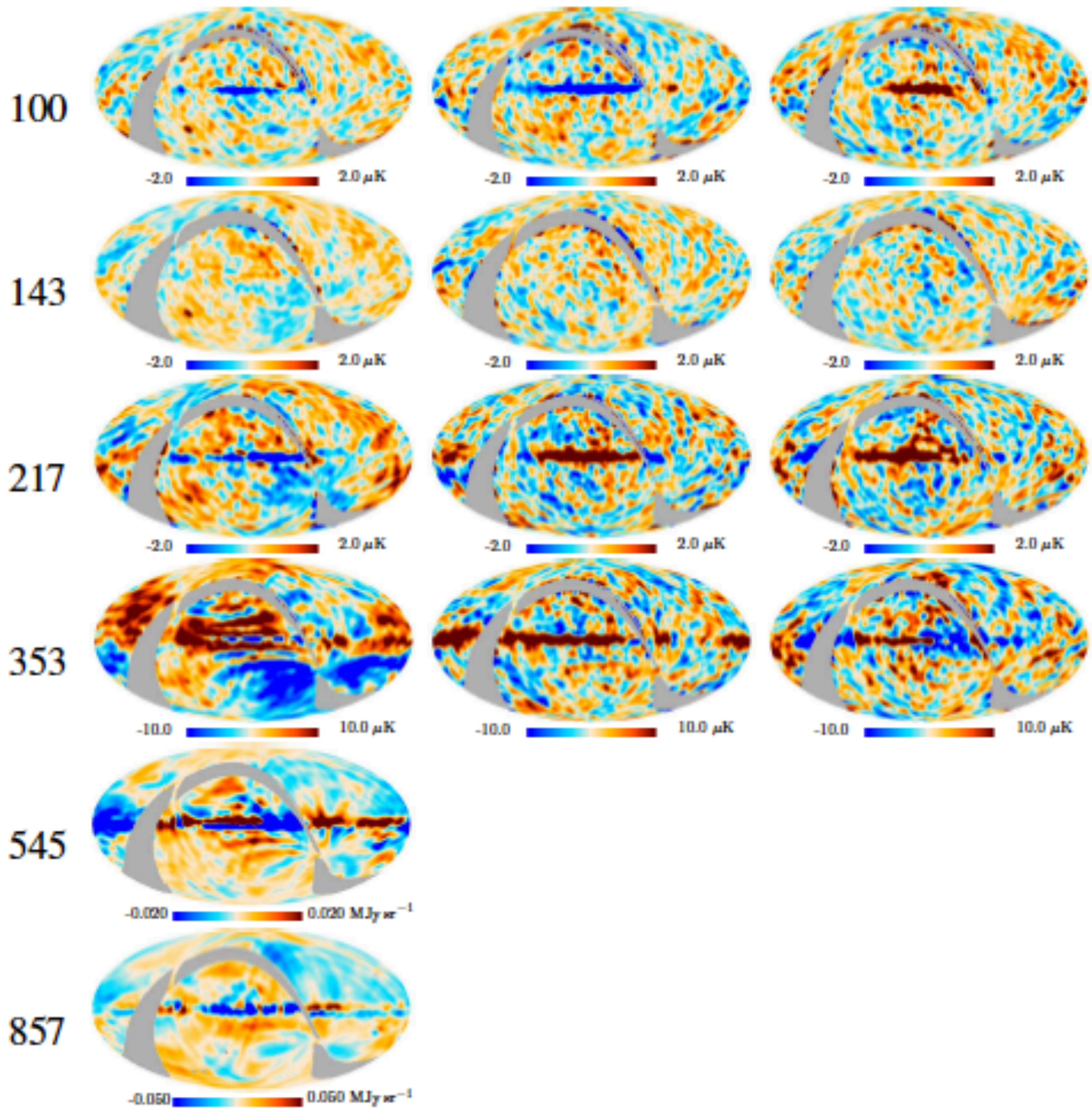
- null test showing noise and systematics residual (dominant)
- + - 2 µK range for CMB channels
- + - 10 µK for 353 GHz

PRELIMINARY, DO NOT DISTRIBUTE



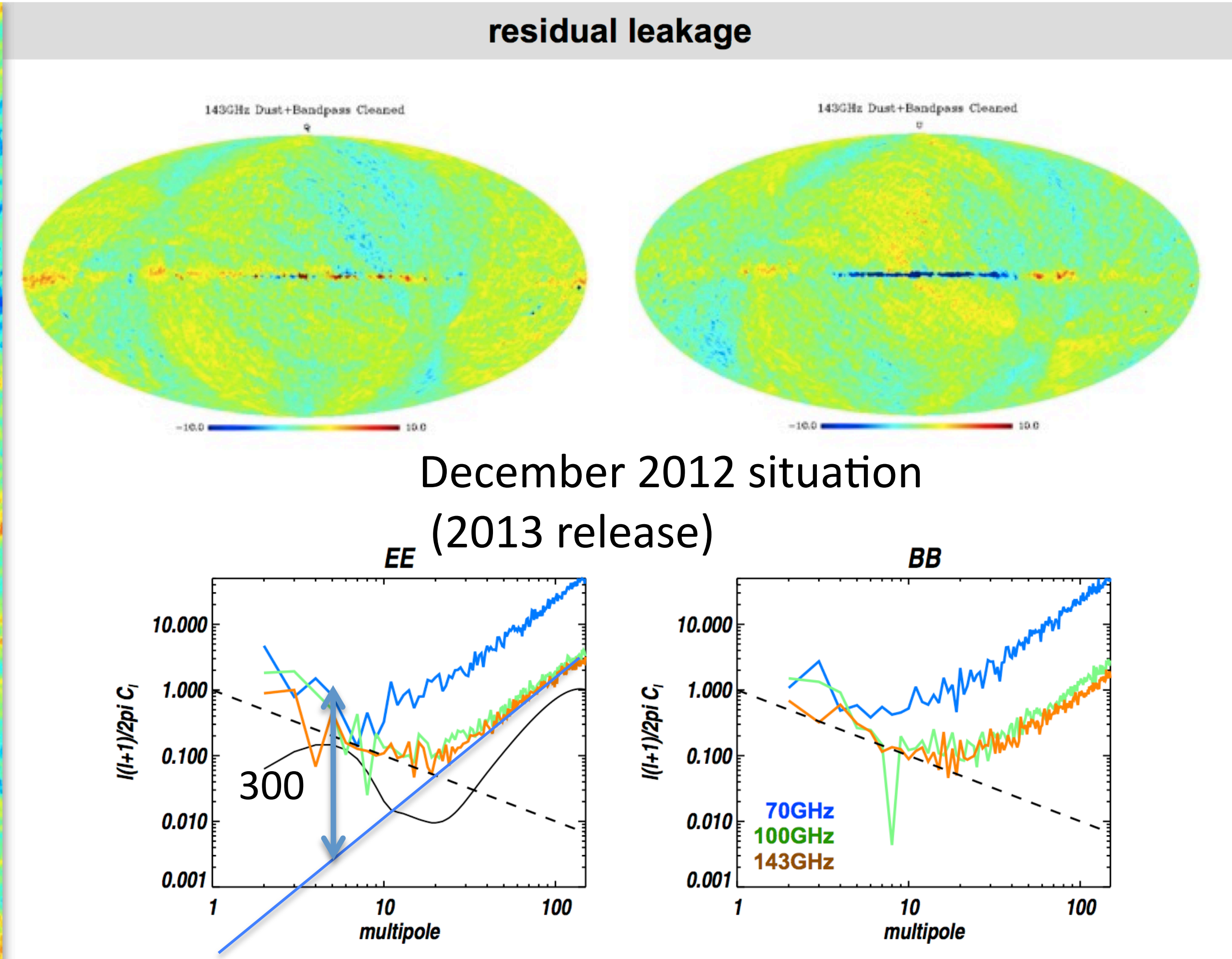
Odd even rings null test 2017

- much lower level of systematics residuals



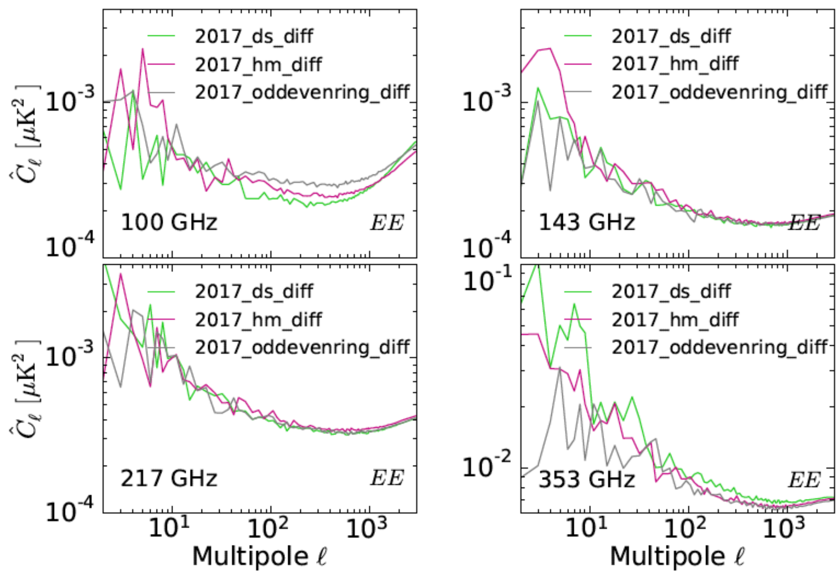
The 2013 data had strong noise/systematic excesses at low ℓ in Polarization

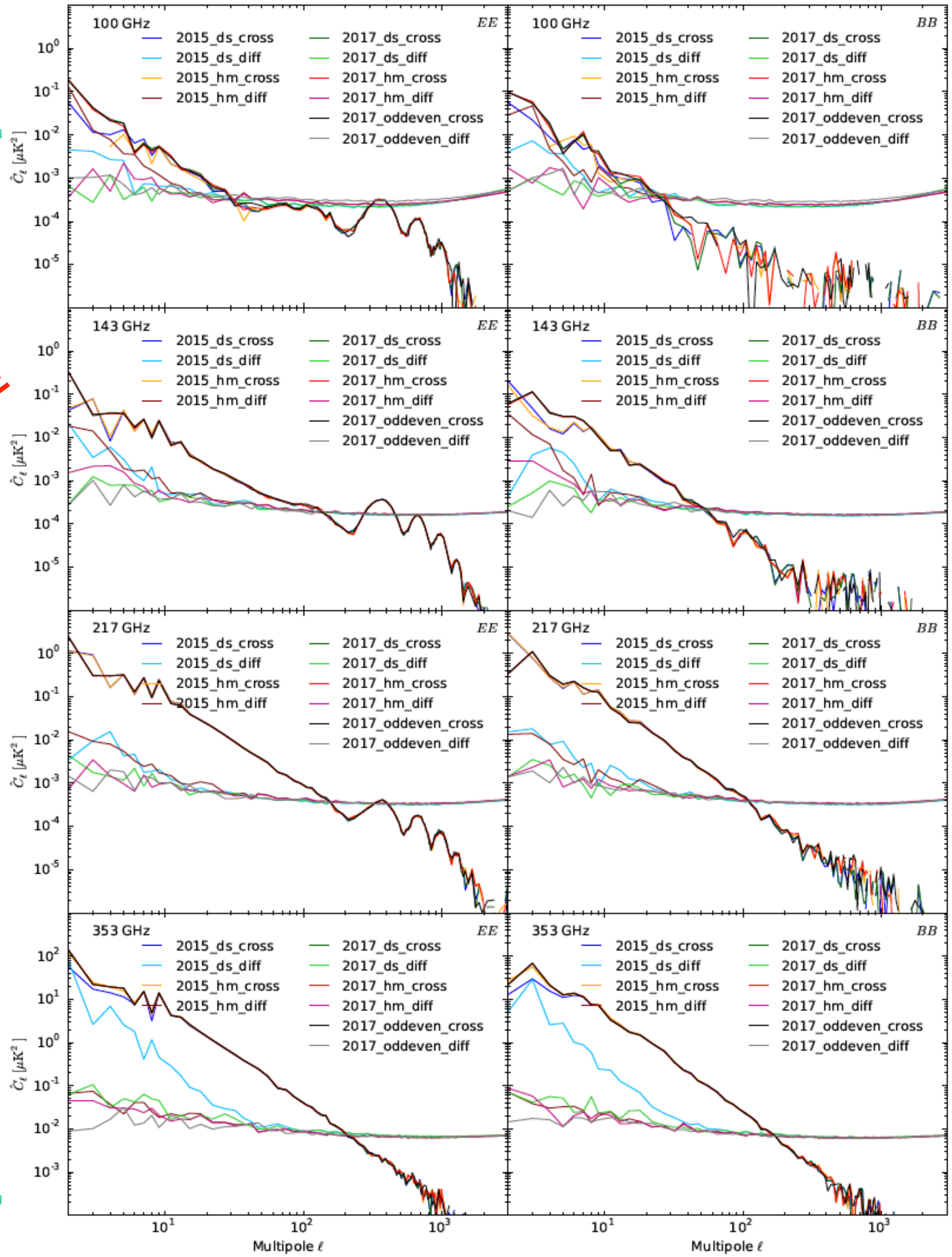
- noise limited sensitivity of Planck channels maps limited at 100, 143 and 217 GHz
- Gaussian 1/f noise mostly associated with glitches tails not removed
- strong low ℓ excess due to leakages T into E and B
- the problem was more severe in relative terms for HFI than for LFI



December 2012 situation (2013 release)

- EE and BB cross and difference spectra for three different null tests:
  - det set
  - half mission
  - odd-even rings
- 2015 and 2017





Dipole from Solar system motion

- Solar system motion w.r.t the CMB induces a strong dipole common to all frequencies when main foregrounds are remove
- direction and amplitude should coincide
- this constrain the SED of the dust foregrounds dipole ad quadrupole

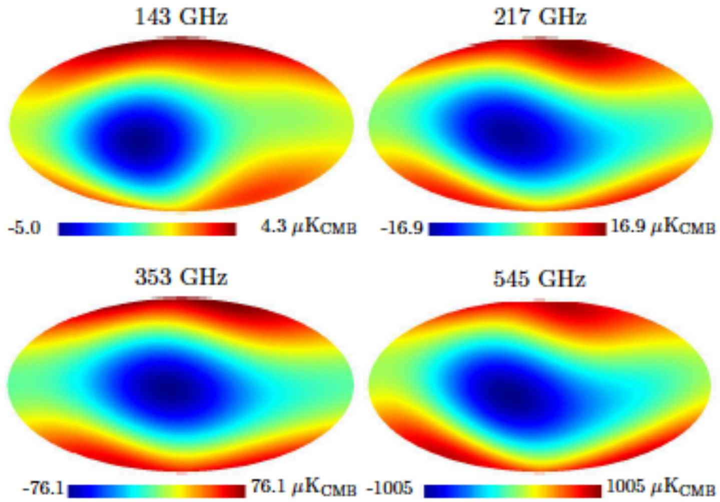
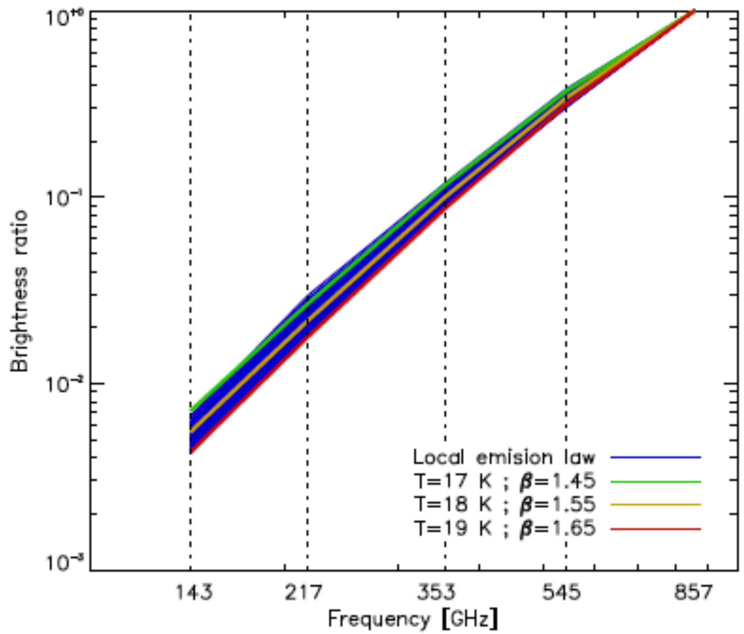


Fig. 17: Maps at $N_{\rm side}$=32 of the dust removal correction due to the SED variations for the four frequencies to which this correction has been extracted in SRoll.



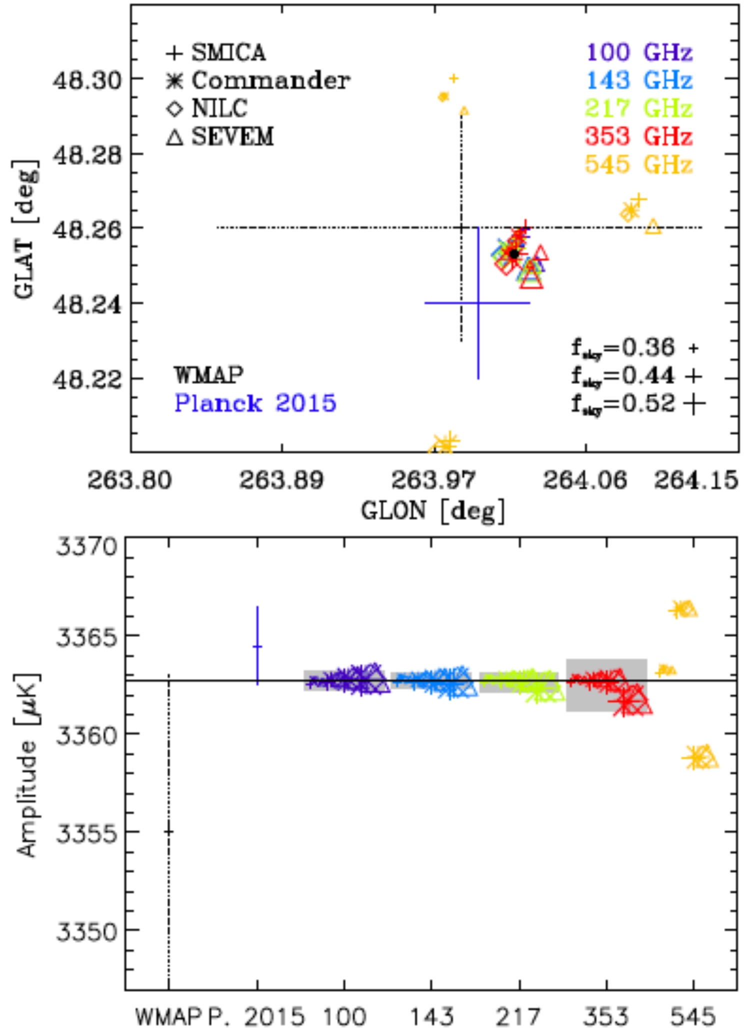


Fig. 19: Solar dipole directions (top panel) and amplitudes (bottom panel) are shown for the four component separation methods (SMICA, Commander, NILC, Sevem) by different symbols of size increasing with sky fraction used. The color refer to frequencies; the WMAP 2009 is the black dotted cross; the *Planck* 2015 the blue one. Grey boxes give the absolute bias uncertainties as measured on 100 E2E realizations (column F of Table 5). Note that, at 545 GHz, the points for the largest sky fraction fall outside of

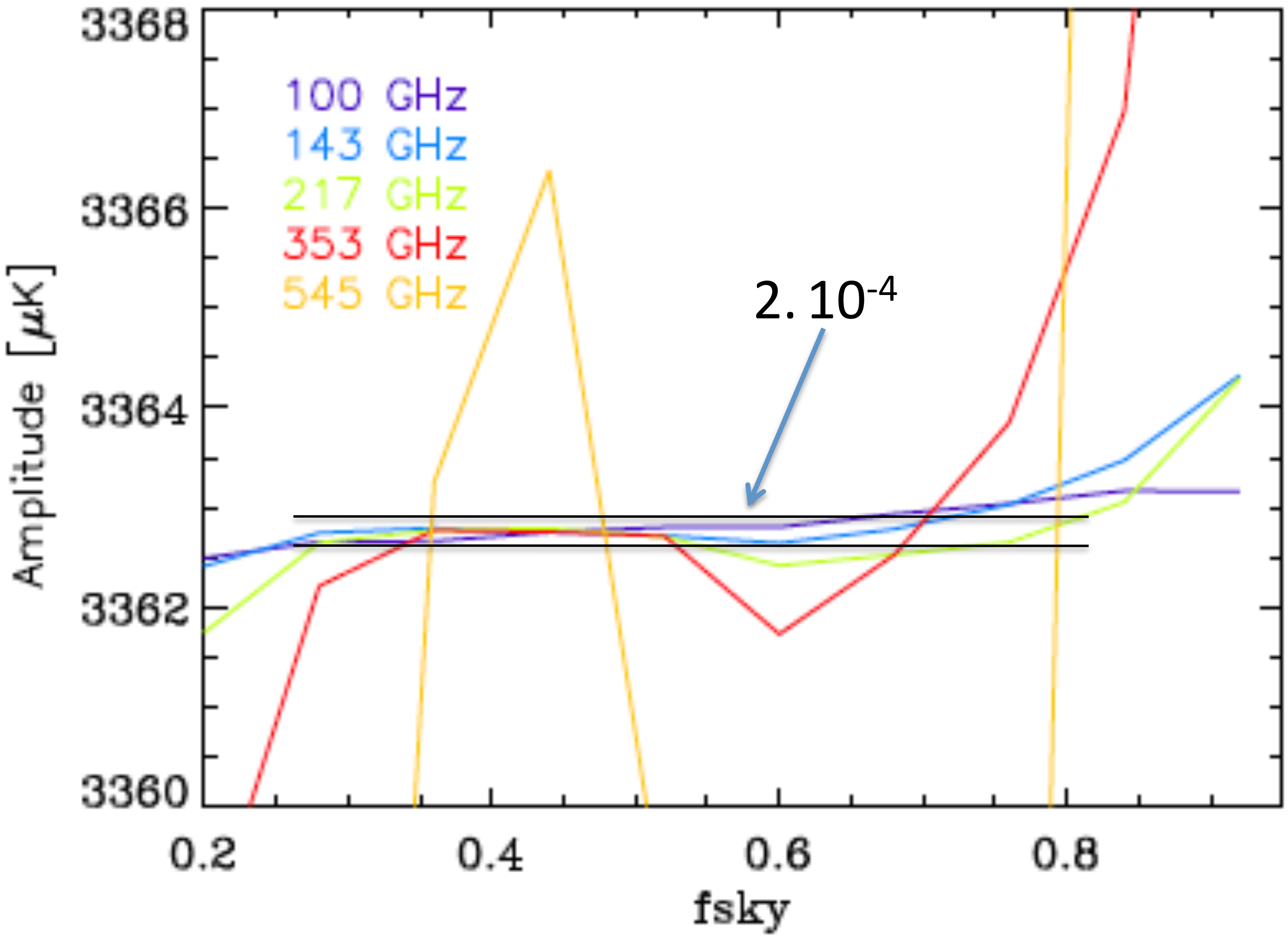
Dipole from Solar system motion

amplitude= 3362.71 ± 0.09 μK(stat. fg.) ± 0.35 μK(gain var.),
GLON= 264°.021 ± 0°.003,
GLAT= 48°.253 ± 0°.001.

V_{Sol} = 370.14 +-0.04 Km/sec

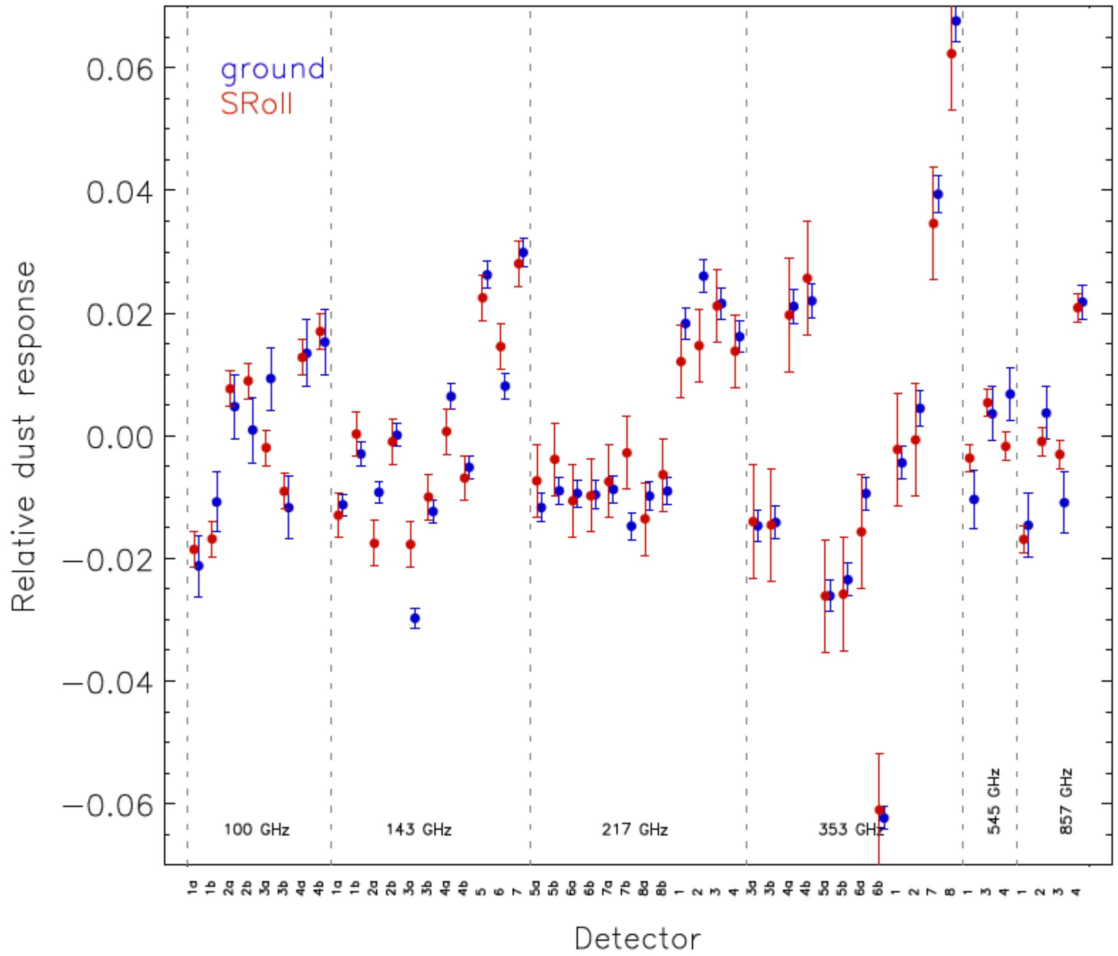
LFI

- 44 GHz δ A= 0.09 μK
  δ l = 0.003° δ b= 0.000°
- 70 GHz: δ A= 1.65 μK
  δ l = 0.023° δ b= 0.012°



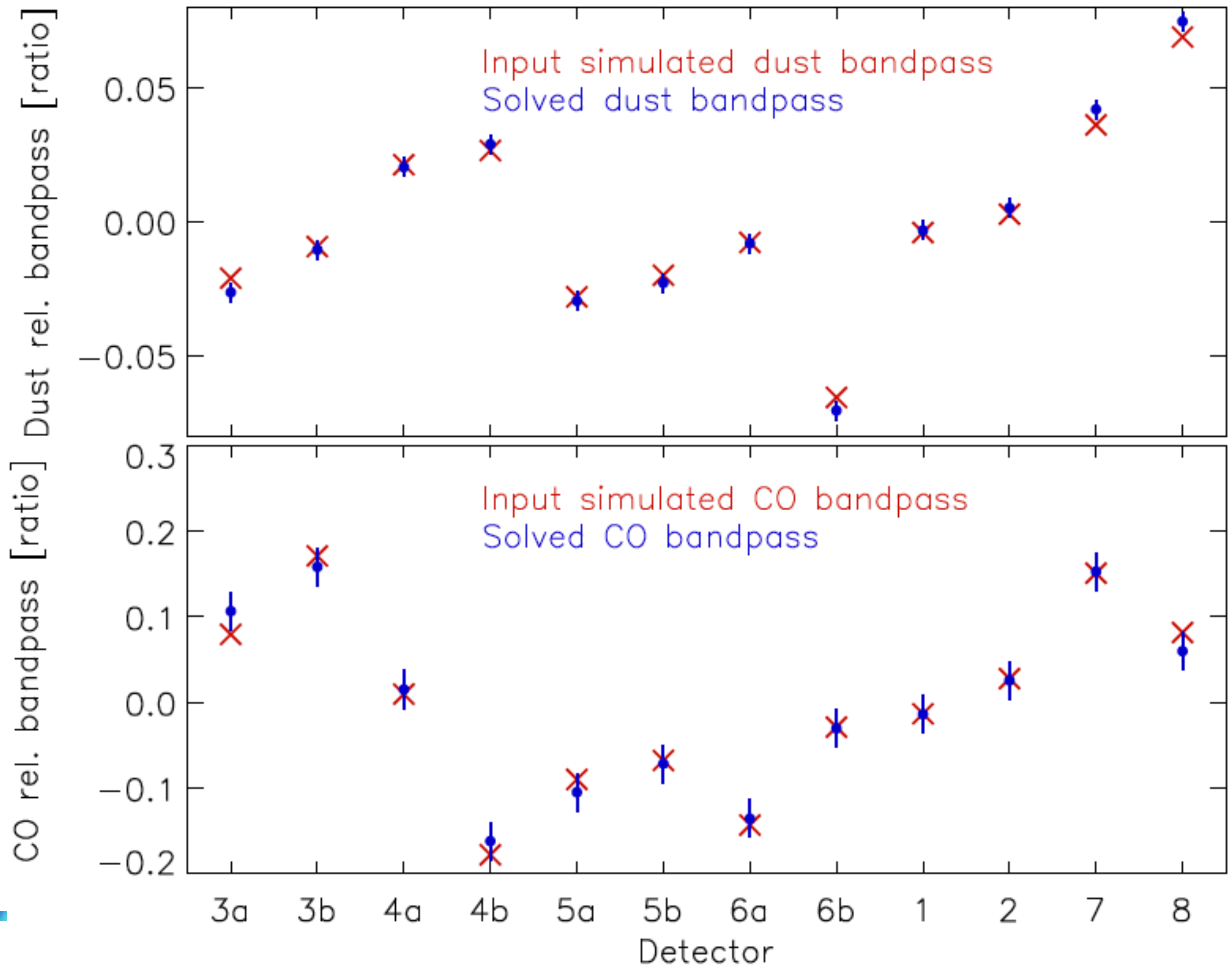
bandpass mismatch I→P leakage

- very good agreement between dust bandpass mismatch coefficients from ground measurements and Sroll extraction using a dust spatial template (2015 dust map)

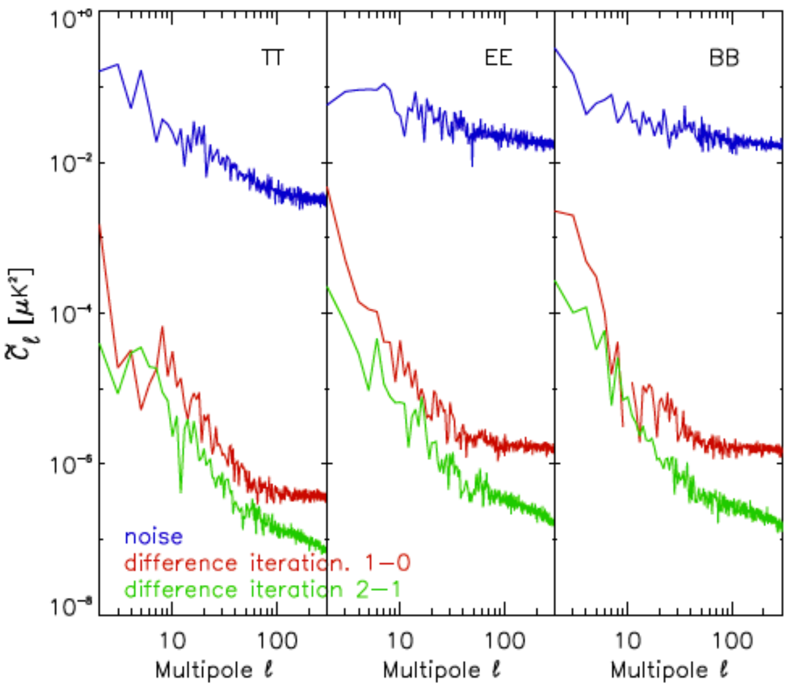


Simulations of accuracy of leakage recovery

- E2E simulation of the leakage recovery for dust and CO at 353 GHz
- dust show recovery with errors rms 3 10^{-3} TBC
- CO show 5$10^{-3}$

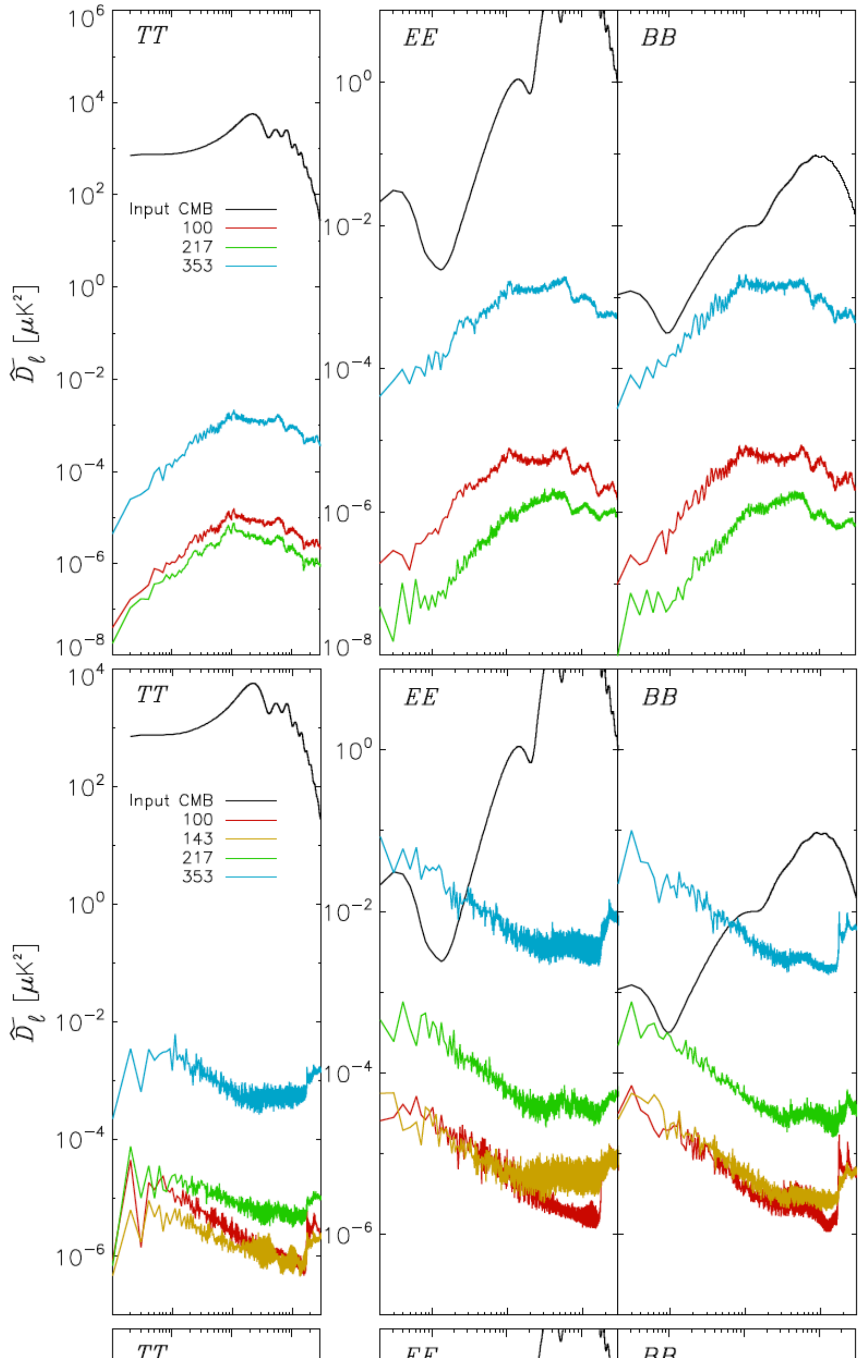


- use of Planck 2015 dust template
- do a component separation
  → dust template
- then 2nd iteration



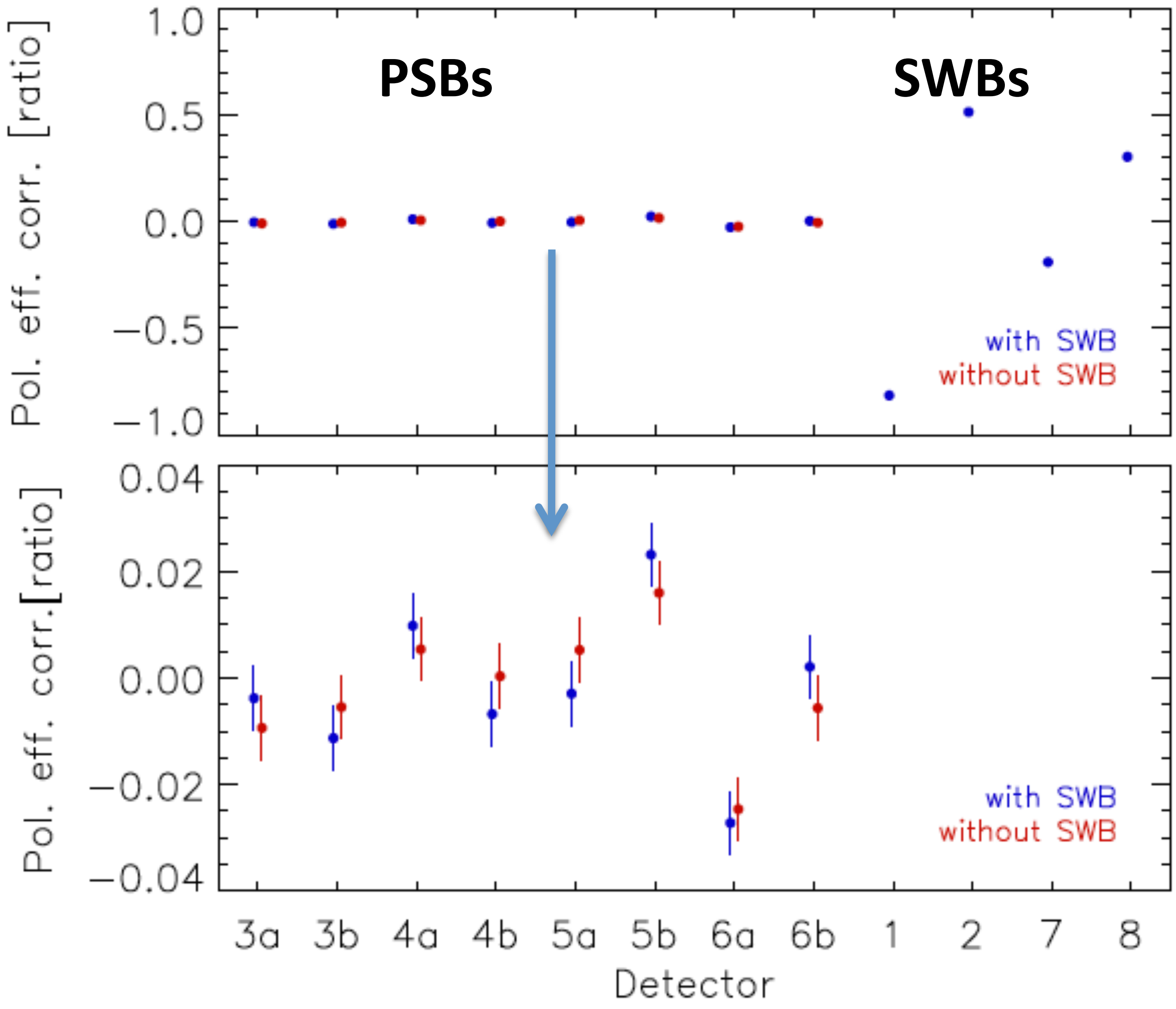
CO

Dust

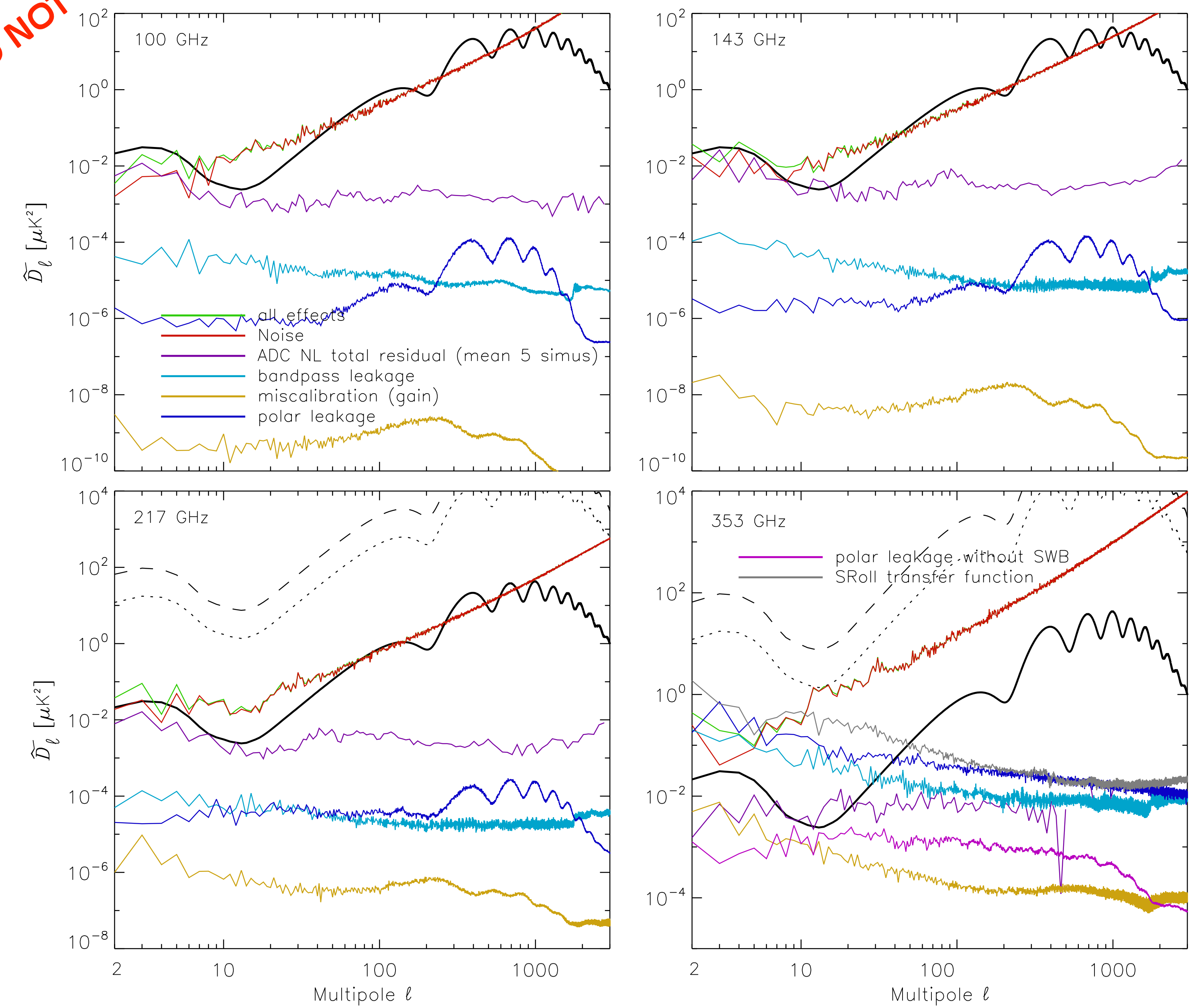


Recovery of polarization efficiency

- The recovery is very good for PSBs
- it is of course much worse for SWBs which have a small polarization sensitivity



Summary of systematic effects



New paradigm for CMB data processing

- initially destripers remove 1/f noise in intensity from redundant observations of the same pixel by a single detector
- Planck HFI Sroll is a « generalized destriper » which uses redundancy of several polarized detectors at the same frequency (intercalibration of CMB response, bandpass mismatch coefficients using foreground templates, relative polarization efficiency,…)
- we have also tested the extraction from the sky data of foreground templates (CO) and the iterative improvement in a single open loop (dust)
- we are developing the Sroll map maker integrating
  - multi frequency to do the component separation simultaneously
  - multi instruments which will use different technologies to remove systematic effects

Improving Planck HFI 353 GHz

- The Planck 353 GHz is the best all sky dust foreground tracer today
- we improve it by correcting systematic effects at very low ell
- for B-modes detection: limitation introduced the dust correction using 353 GHz assumed to be white noise limited