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# COSMOLOGY WITH THE SZ SPECTRUM: FROM RSZ TO CMB Y DISTORTIONS

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in collaboration with

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Capability and Science Objectives

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## WHAT WE CAN DO WITH PLANCK AND WHAT WE COULD DO WITH MILLIMETRON

1

The hot gas in clusters of galaxies creates a distinctive spectral distortion in the cosmic microwave background (CMB) via the Sunyaev-Zel'dovich (SZ) effect. To first order, the shape of the spectral distortion is fixed, but relativistic corrections (rSZ) introduce a dependence on the gas temperature. By applying a specific treatment (spectral imaging) of Planck maps we can aim at showing evidence for the rSZ signature in individual clusters.

2

Departures of the CMB frequency spectrum from a pure black body encode information about the thermal history of the early Universe. We show that, using Millimetre simulated SZ spectra, it is possible to improve the constraints on the cosmological spectral distortions (type y) of the CMB.

### BACKGROUND

#### Sunyaev Zel'dovich effect

- Comptonization of the CMB by electrons in the hot gas of galaxy clusters.
- The scattering slightly modifies the incident Planck spectrum
- Spectral distortion of the CMB, function of the frequency, depends on the comptonization parameter, gas temperature, radial peculiar velocity, on the CMB temperature at cluster redshift and slightly on the cosmological compton distortions of the CMB.

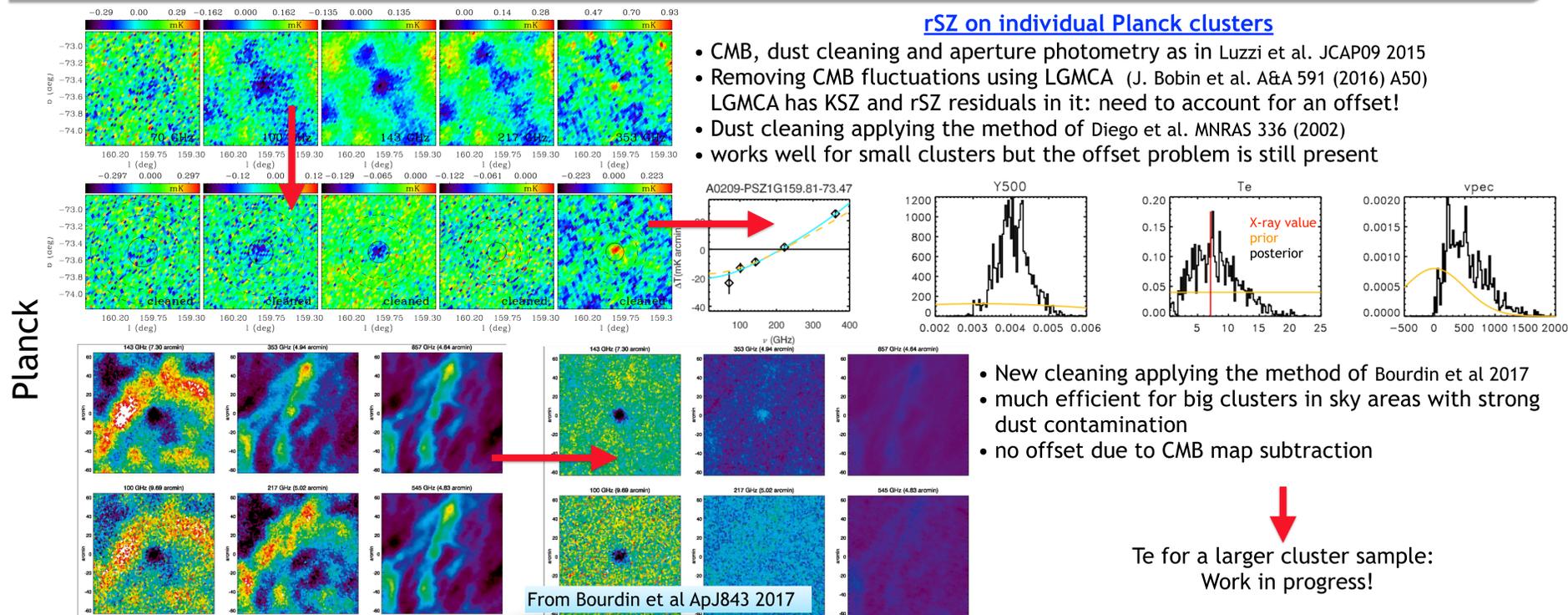
### OBJECTIVES

- Can we see rSZ on individual Planck clusters?  
Neglecting rSZ on high  $T_e$  clusters:
  - Underestimation of Y (Hurier A&A596, 2016, Erler et al MNRAS476, 2018)
  - Bias on the Y-M scaling relation (Hurier A&A596, 2016)
  - Bias on the tSZ power spectrum and  $\sigma_8$  (Remazeilles et al MNRAS483, 2018)
  - Bias on  $H_0$  derived from SZ/X-ray (Rephaeli ApJ445, 1995)
- Can we improve the limit on CMB y distortions via the SZ spectrum of Millimetre galaxy clusters? (Fabbri et al Ap&SS59 1978, Rephaeli ApJ241,1980)

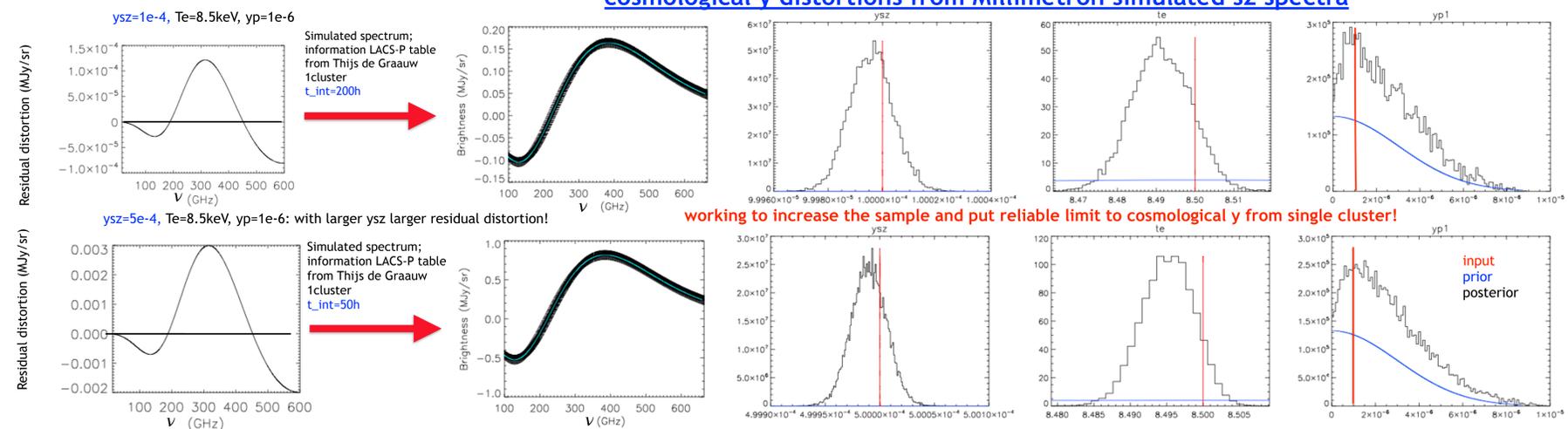
### METHODS

- For rSZ on individual Planck cluster:
  - Planck temperature maps (70-353 GHz) + LGMCA
  - revised version of CMB+dust cleaning and aperture photometry as in Luzzi et al. JCAP09 2015 + MCMC
  - New cleaning for CMB and dust anisotropies: these are spectrally modelled using all HFI frequency maps outside each galaxy cluster ( $7r500 < r < 12r500$ ), and spatially modelled using a linear combination of wavelet filtered frequency maps at 857 and 217 GHz (Bourdin et al ApJ843 2017) + MCMC including  $T_e$
- To constrain the cosmological y distortions using the SZ spectrum:
  - simulation of Millimetre SZ spectra for 2 clusters using info in table LACS-P from Thijs de Graauw
  - inclusion of the effect of primordial distortions  $y_p$  on the SZ spectrum following the formalism of Fabbri et al Ap&SS59 1978
  - MCMC to extract  $T_e$  and  $y_p$

### PRELIMINARY RESULTS



Millimetre



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