Advanced stream search for galaxy clusters with multifrequency microwave data[a].

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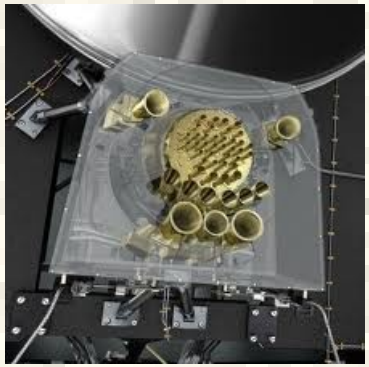
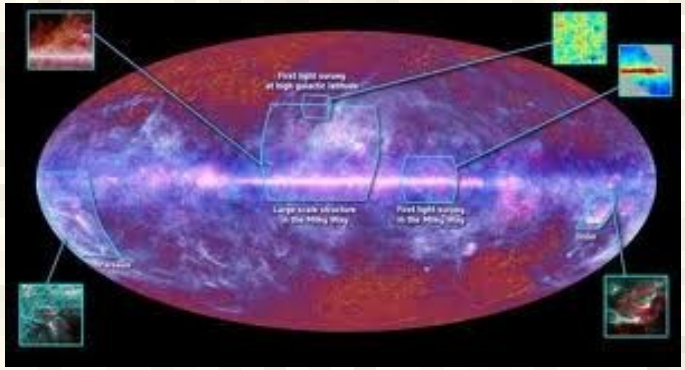
QUARKS-2018
1.06.2018

Planck mission, ESA

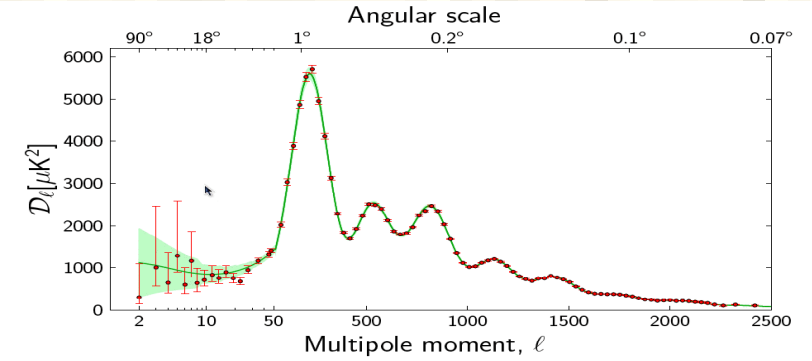




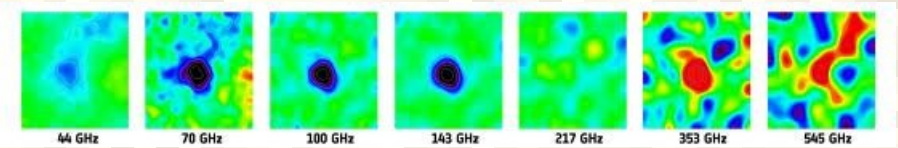
Low Frequency Instrument: 30,44,70
HFI: 100, 143, 217, 353, 545, 857 GHz

2010-2013

1)



2) Zeldovich-Sunyaev effect (~1.6 th. objects)



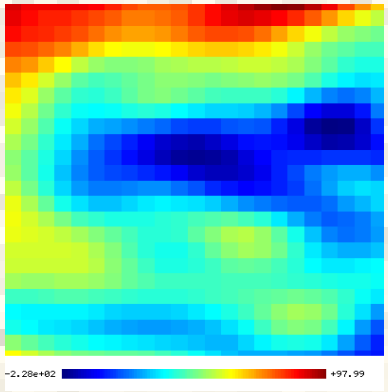
3) Gravitational waves in the B-mode of polarization ?

To the history of interest

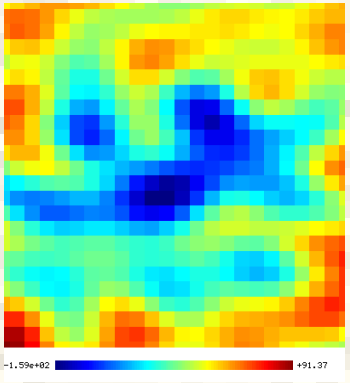
Missed sources on Planck maps (including CMB maps):
Radio sources at S/N < ~3.5

Expected number of secondary anisotropy sources:
>20000 radio galaxies ?

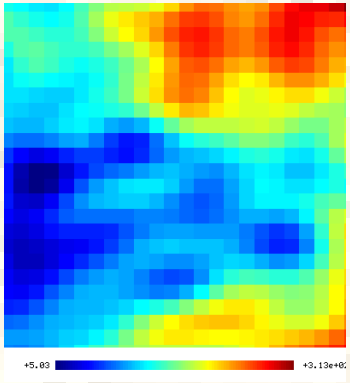
0015+0501

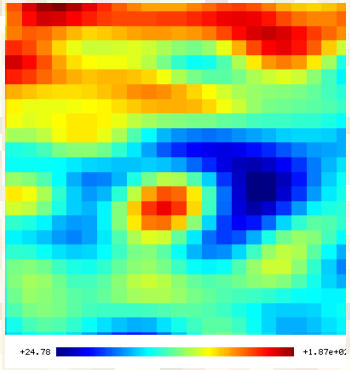


0226+0512



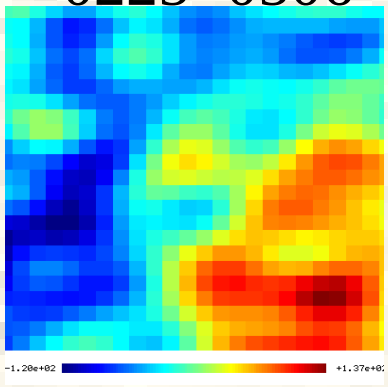
0311+0507, z=4.514



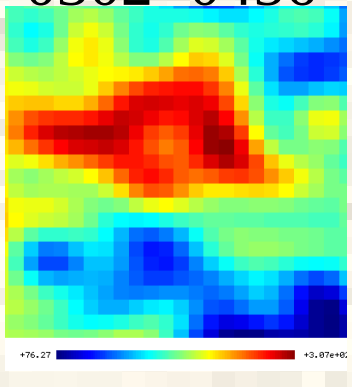


1113+0436
RG in cluster ?

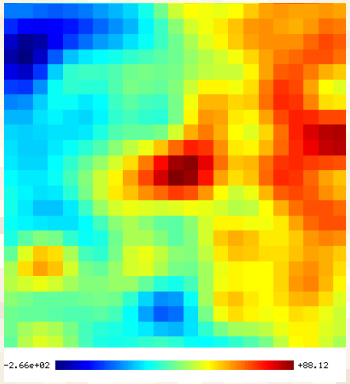
0225+0506

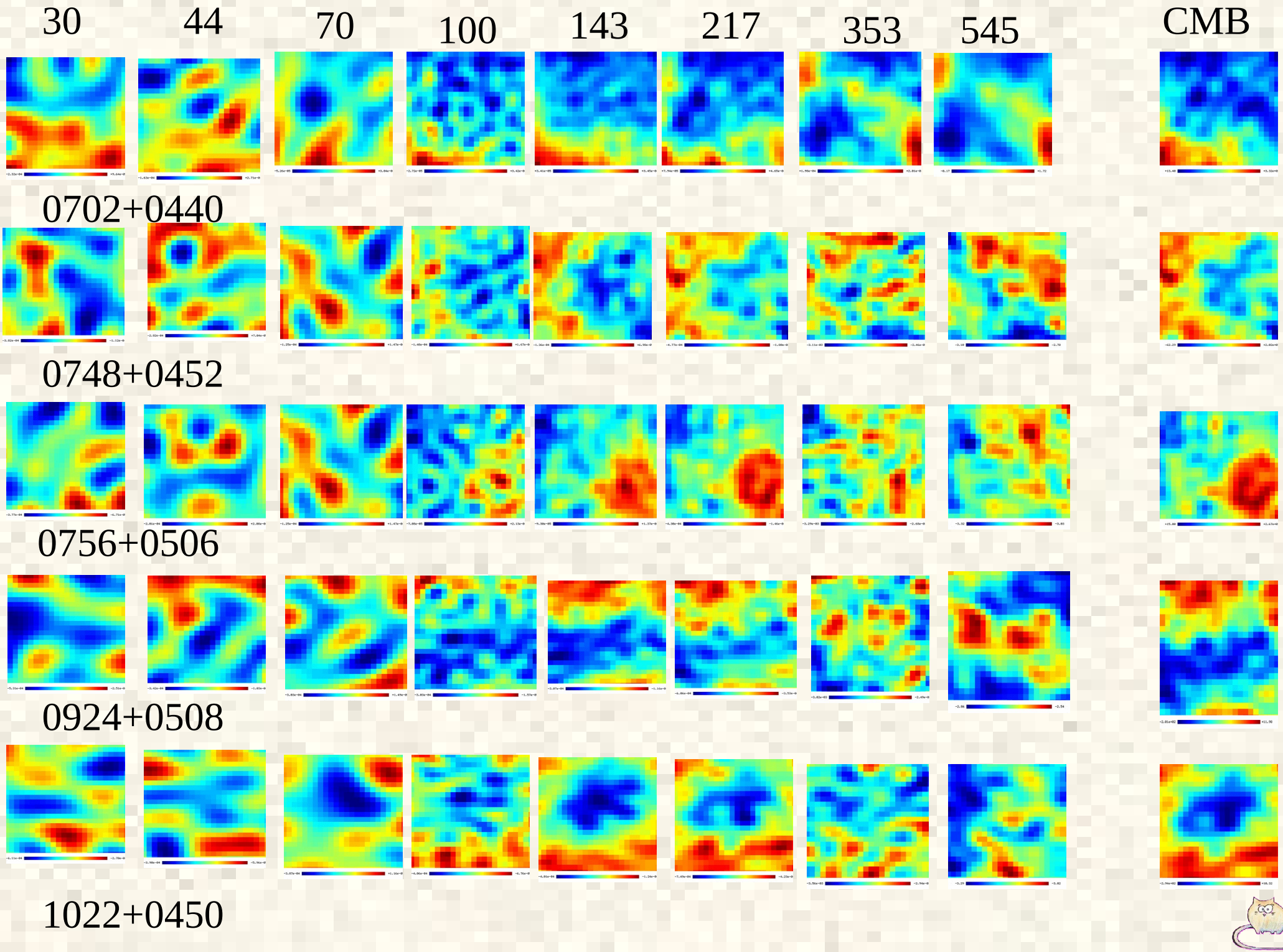


0302+0456



0427+0457




30
44
70
100
143
217
353
545
CMB
0702+0440
0748+0452
0756+0506
0924+0508
1022+0450

What should we check ?

1) Clusters of galaxies ~1-3 th.objects
   a) MSX
   b) Planck SZ-catalog
   …) SDSS (132684, 0.05<=z<=0.43)
   [Wen et al., 2012, 2015]

2) Catalogs of radio sources ~2 mln.objects
   (RC, WENSS, NVSS, ...)

3) Positions of gamma-bursts ~2-3 th.objects

Cosmology with Zeldovich-Sunyaev effect ?

Planck: 2013

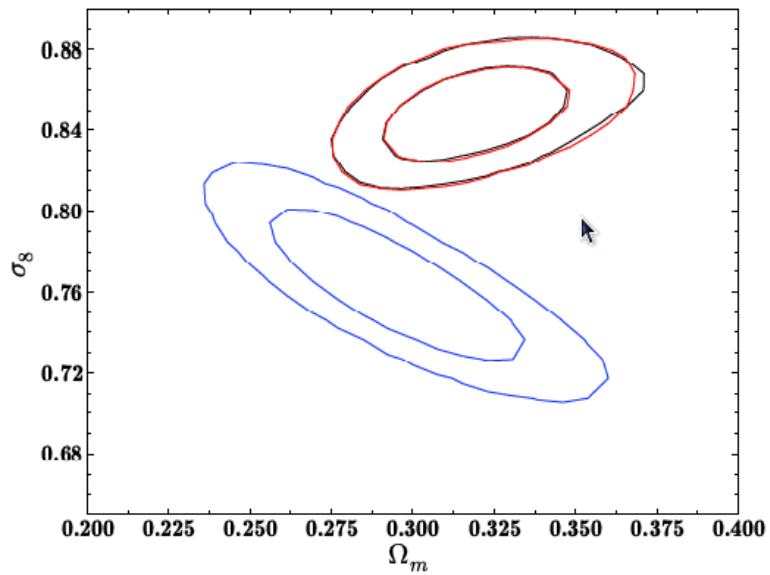


Fig. 11. 2D Ω_m–σ_8 likelihood contours for the analysis with *Planck* CMB only (red); *Planck* SZ + BAO + BBN (blue); and the combined *Planck* CMB + SZ analysis where the bias $(1-b)$ is a free parameter (black).

$$T(M,z) = T_{15} h^{2/3} \left[\frac{\Omega_0 \Delta_c(\Omega_0, z)}{180}\right]^{1/3} \left(\frac{M}{M_{15}}\right)(1+z),$$

2014

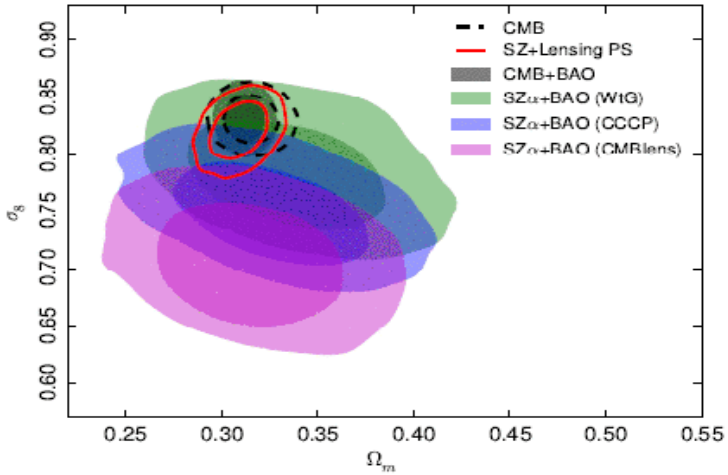


Fig. 7: Comparison of constraints from the CMB to those from the cluster counts in the (Ω_m, σ_8)-plane. The green, blue and violet contours give the cluster constraints (two-dimensional likelihood) at 1 and 2σ for the WtG, CCCP, and CMB lensing mass calibrations, respectively, as listed in Table 2. These constraints are obtained from the MMF3 catalogue with the SZ+BAO+BBN data set and α free. Constraints from the *Planck* TT, TE, EE+lowP CMB likelihood (hereafter, *Planck* primary CMB) are shown as the dashed contours enclosing 1 and 2σ confidence regions (Planck Collaboration XIII 2015), while the grey shaded region also include BAO. The red contours give results from a joint analysis of the cluster counts, primary CMB and the *Planck* lensing power spectrum (Planck Collaboration XV 2015), leaving the mass bias parameter free and α constrained by the X-ray prior.

Problem with model parameters ?

Planck: optics and mm/submm centers differ from X-ray.

Incompleteness by z

Mass ditribution

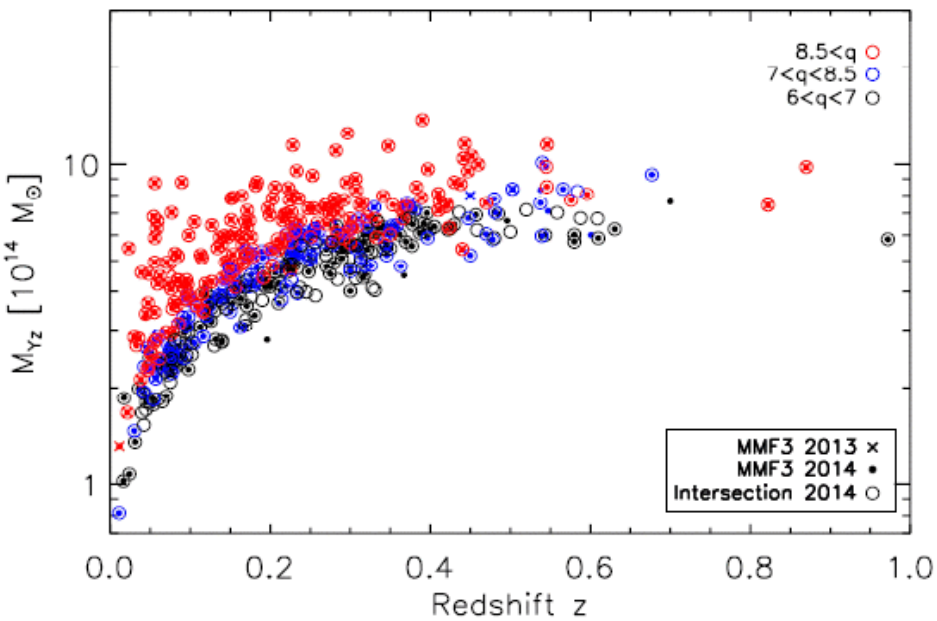


Fig. 1: Mass-redshift distribution of the *Planck* cosmological samples colour-coded by their signal-to-noise, q. The baseline MMF3 2015 cosmological sample is shown as the small filled circles. Objects which were in the MMF3 2013 cosmological sample are marked by crosses, while those in the 2015 intersection sample are shown as open circles. The final samples are defined by $q > 6$. The mass M_{YZ} is the *Planck* mass proxy (see text, Arnaud et al. 2015).

N(z) for various q=S/N

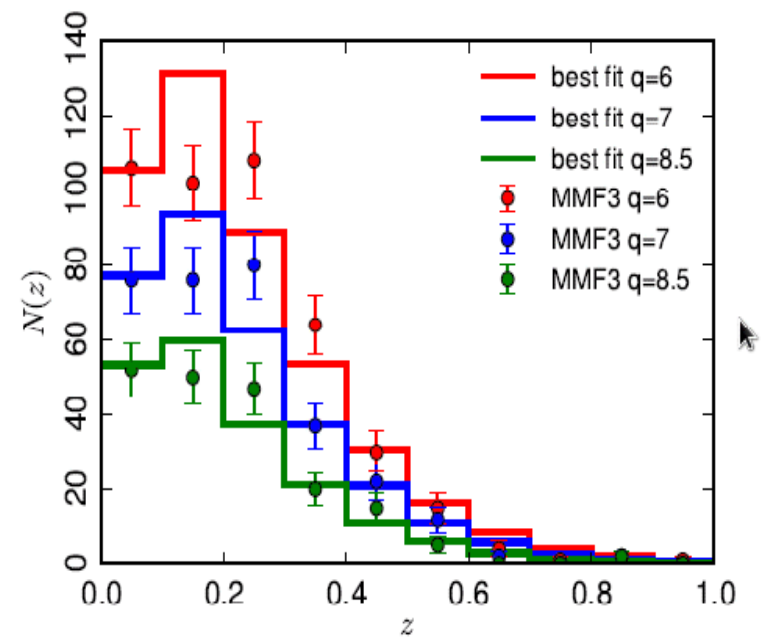
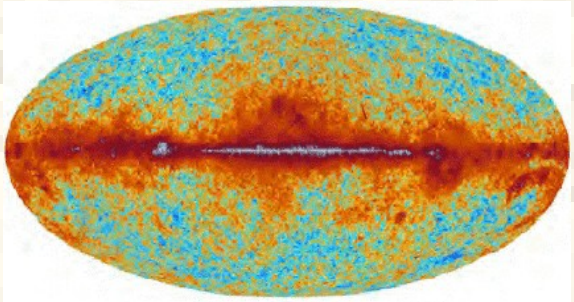


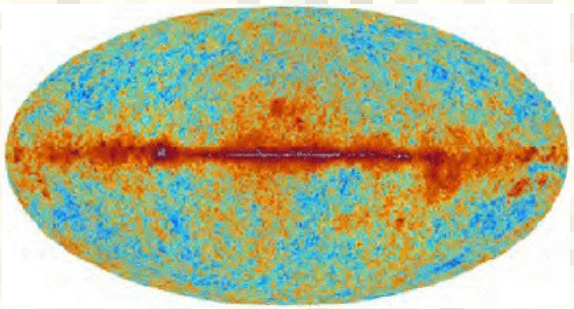
Fig. 4: Comparison of observed counts (points with error bars) with predictions of the best-fit models (solid lines) from the one-dimensional likelihood for three different thresholds applied to the 2015 MMF3 cosmology sample. The mismatch between observed and predicted counts in the second and third lowest redshift bins, already noticed in the 2013 analysis, increases at lower thresholds, q. The best-fit models are defined by the constraints shown in Fig. 3. For this figure and Fig. 3, we use our one-dimensional likelihood over the redshift distribution, dN/dz (Eq. 4).

Data

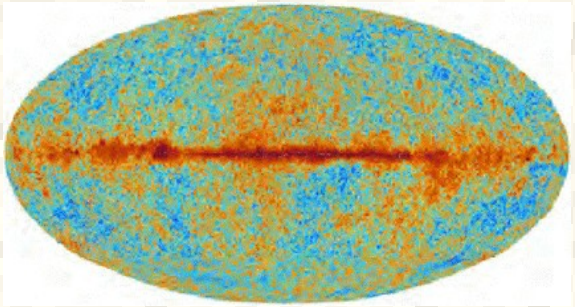
Planck maps



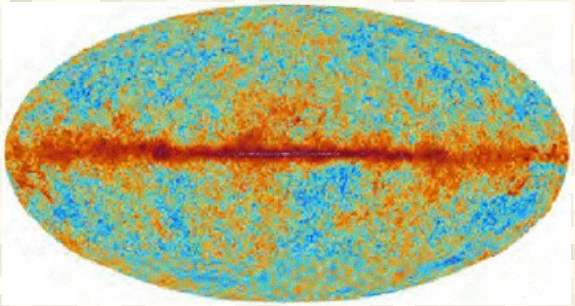
30GHz



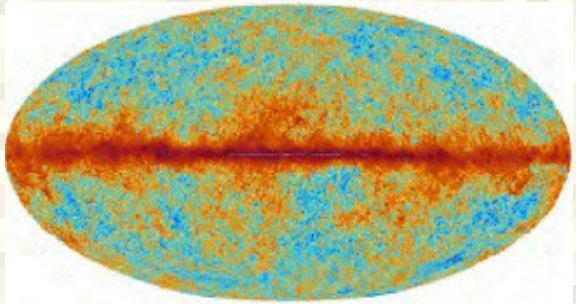
44GHz



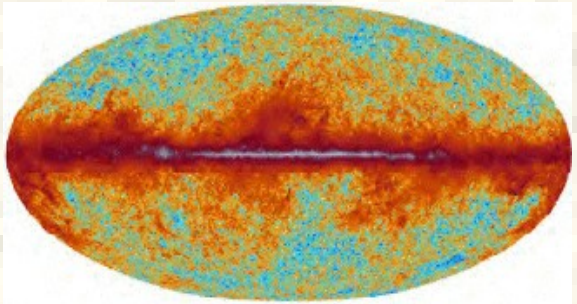
70GHz



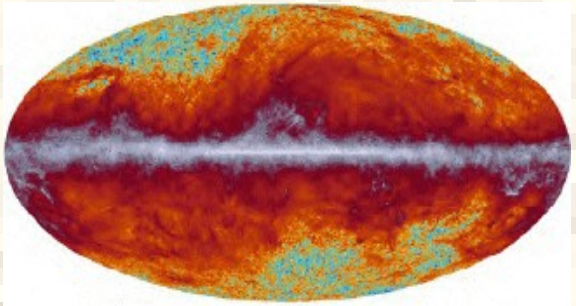
100GHz



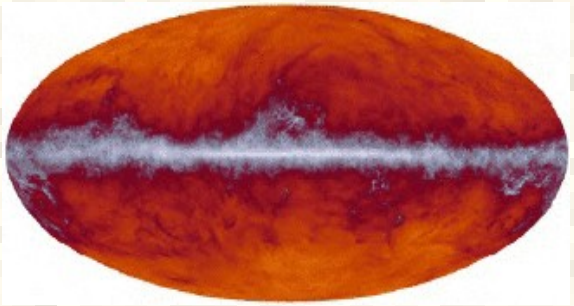
143GHz



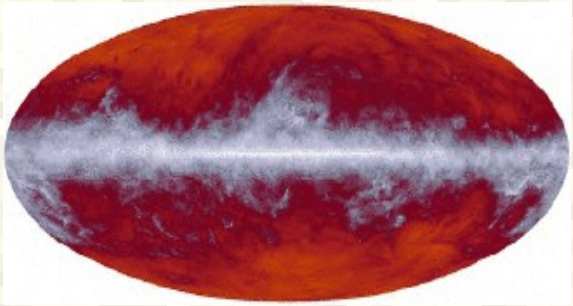
217GHz



353GHz



545GHz



857GHz

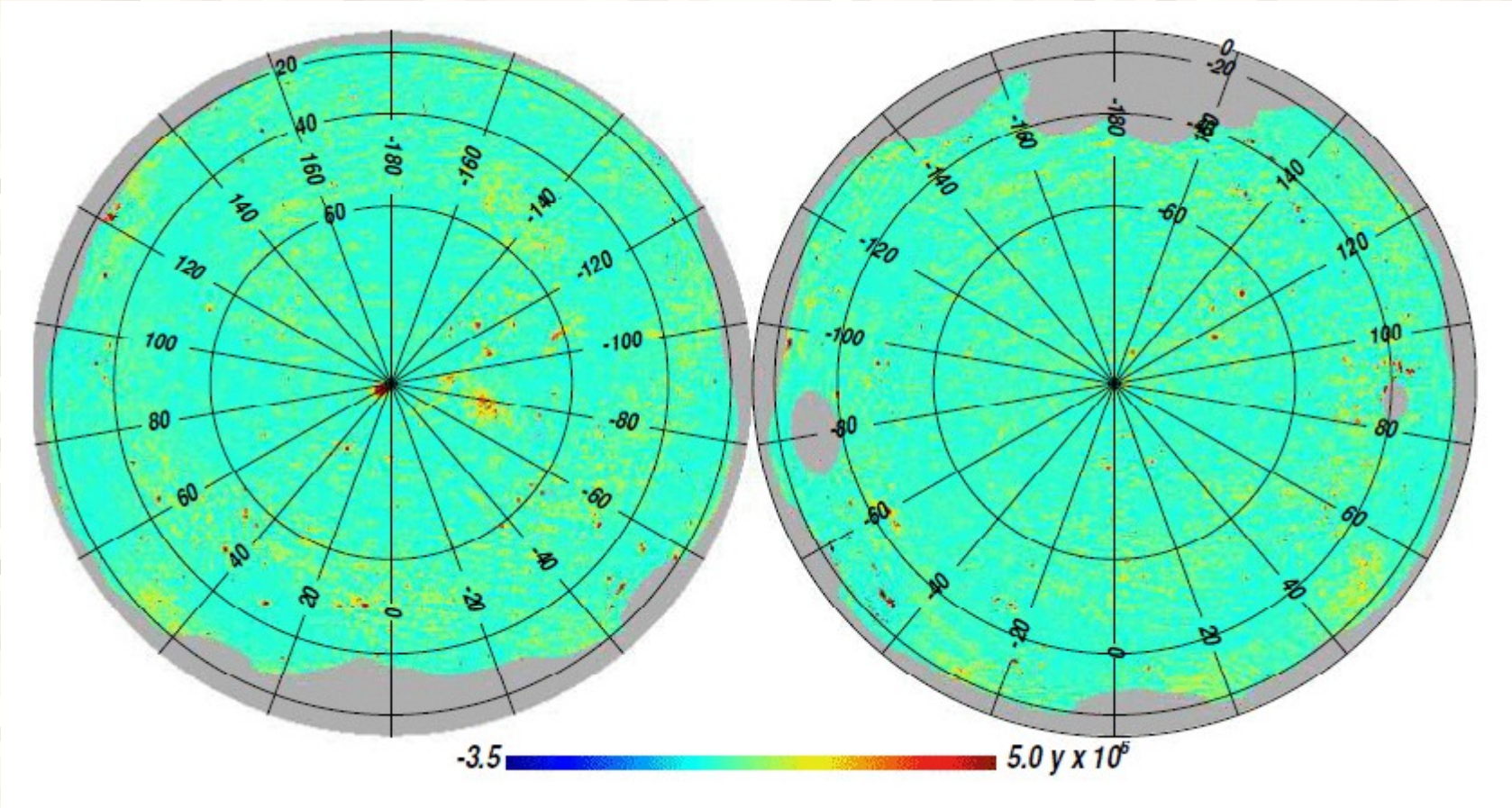
Observational frequency maps

Legacy Planck Archive (LPA)

http://pla.esac.esa.int/pla

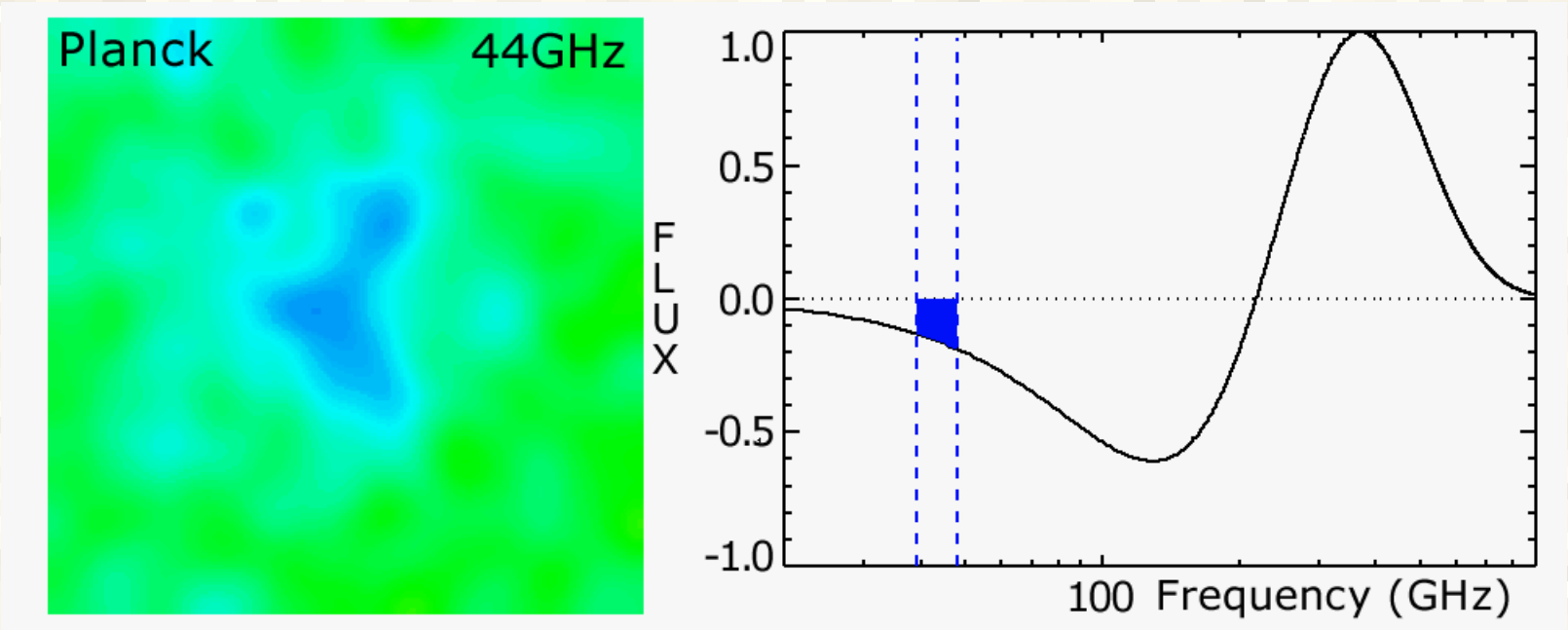
1) 4 CMB maps: **SMICA**, NILC, SEVEM, Comnander
2) maps at observational bands
   (30, 44, 70, 100, 143, 217, 353,545, 857 GHz)
3) CO emission maps
4) Maps of dust
5) Maps of galactic low frequency emission
   (synchrotron + free-free)
6) Zodiac light maps
7) Maps of gravitational lensing
8) y-comptonization maps
9) Masks

Y-comptonization map



ZS-эффект

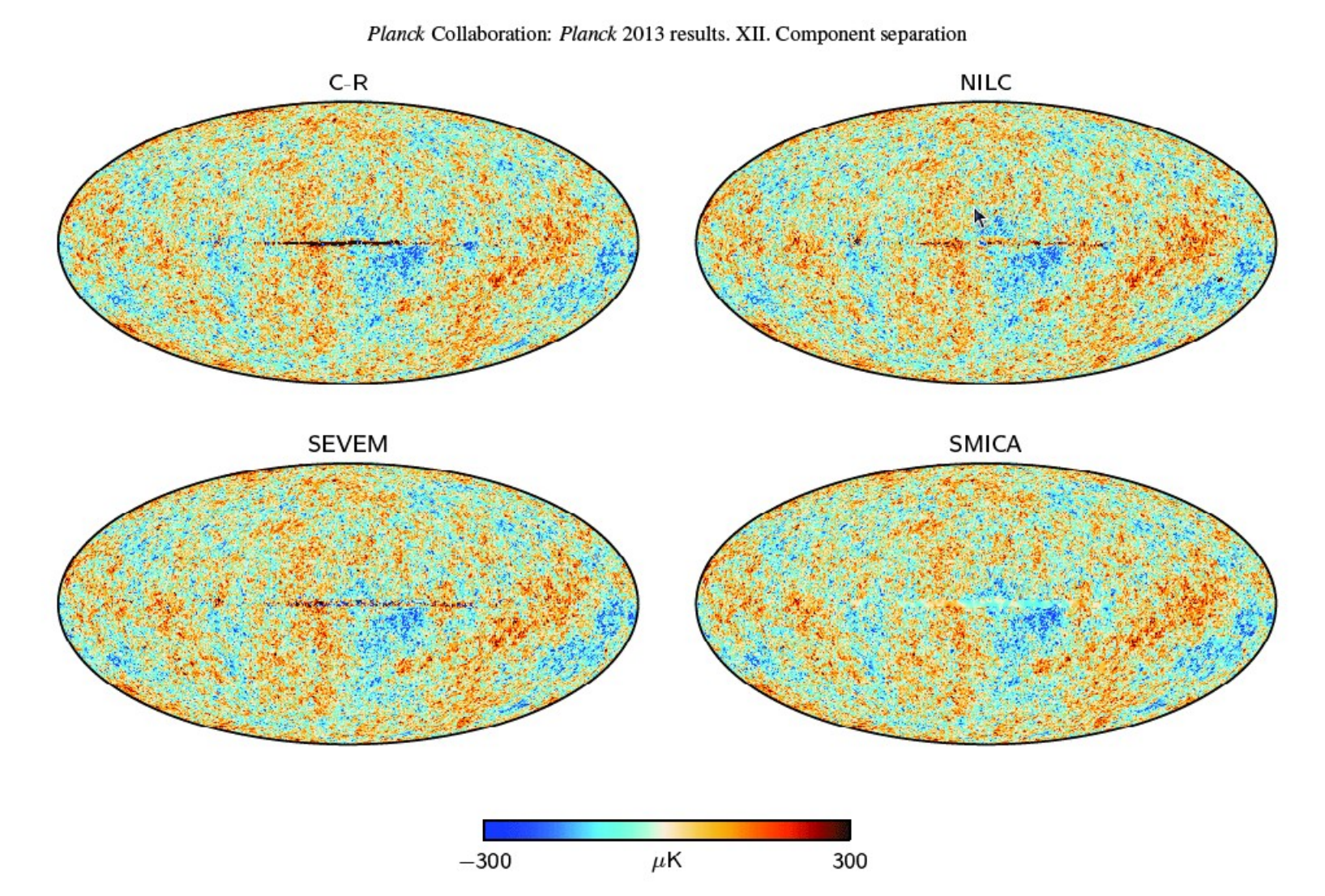
Abell 2313 (Planck collab., 2013)



$$y = \int \frac{kT_e}{mc^2} n_e \sigma_T dl$$

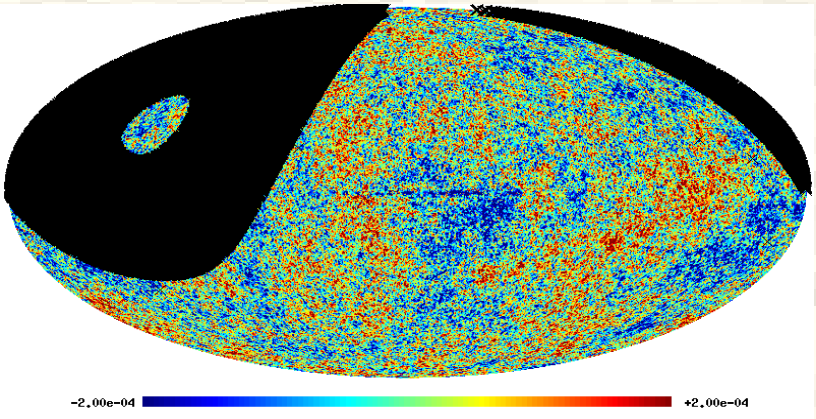
(Zeldovich, Sunyaev 1969)

CMB maps


Planck Collaboration: *Planck* 2013 results. XII. Component separation
C-R
NILC
SEVEM
SMICA
−300
μK
300

Westerbork Northen Sky Survey

325 MHz (92 cm)
28.5 deg < delta < 78.5 deg
Area ~10^4 sq.degs
Beam: 54"x54'
Min flux density: 18 mJy (5sigma)'
211234 sources



Method

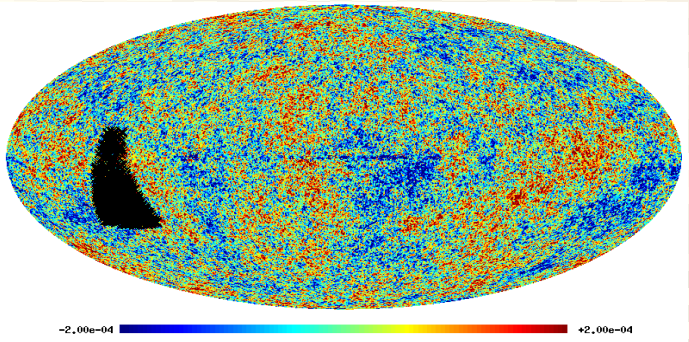
1) Subsamples: WENSS radio survey:
Sub-catalogs 0000, 0030, 0100, 0130

2) Extraction of 30'x30' areas at 9 Planck channels around WENSS objects

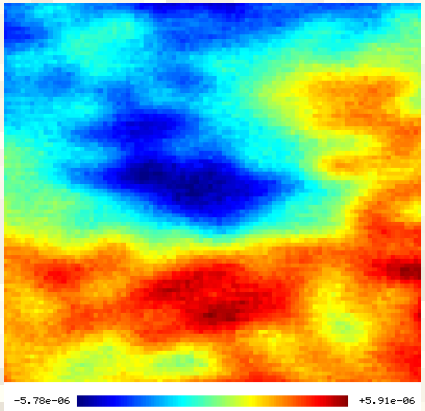
3) Search for minima in a circle of R=7 ' at 70,100,143GHZ and maxima at 353 и 545 GHz at level>1.5sigma (SExtractor)

4) Condition S100 < ~S143 + maxmimum at 353ГГц

5) Control: "hollow" on the CMB map

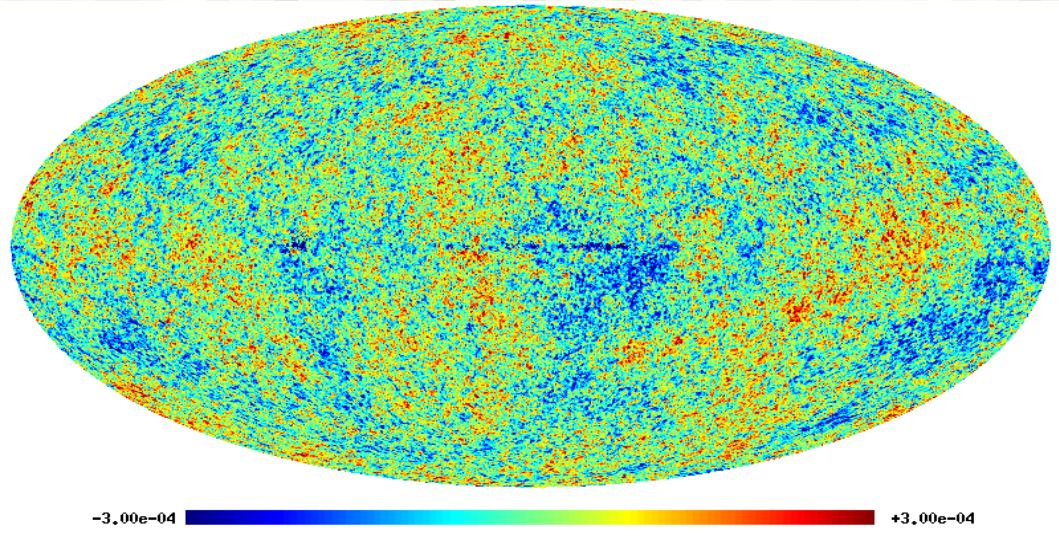


00:00-02:00

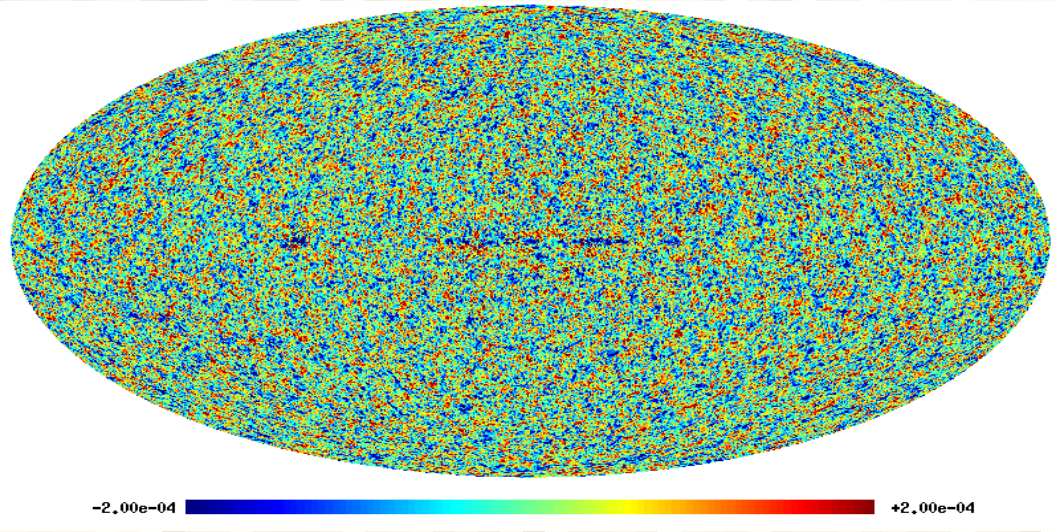


CMB average of 1000 Abell clusters

CMB SMICA map



L > 1



L > 20

Statistics for steps of selection

	N_WENSS	N_100~143	N_visual
0000	4170	421(10.1%)	142 (3.4%)
0030	4215	481(11.4%)	102 (2.4%)
0100	4021	428(10.6%)	164 (4.1%)
0130	3958	448(11.3%)	68 (1.7%)

Visual selection *00:00-02:00*

N 1778 (10.9%)

Nzs 376 (2.3%)

Ns 72 (0.4%)

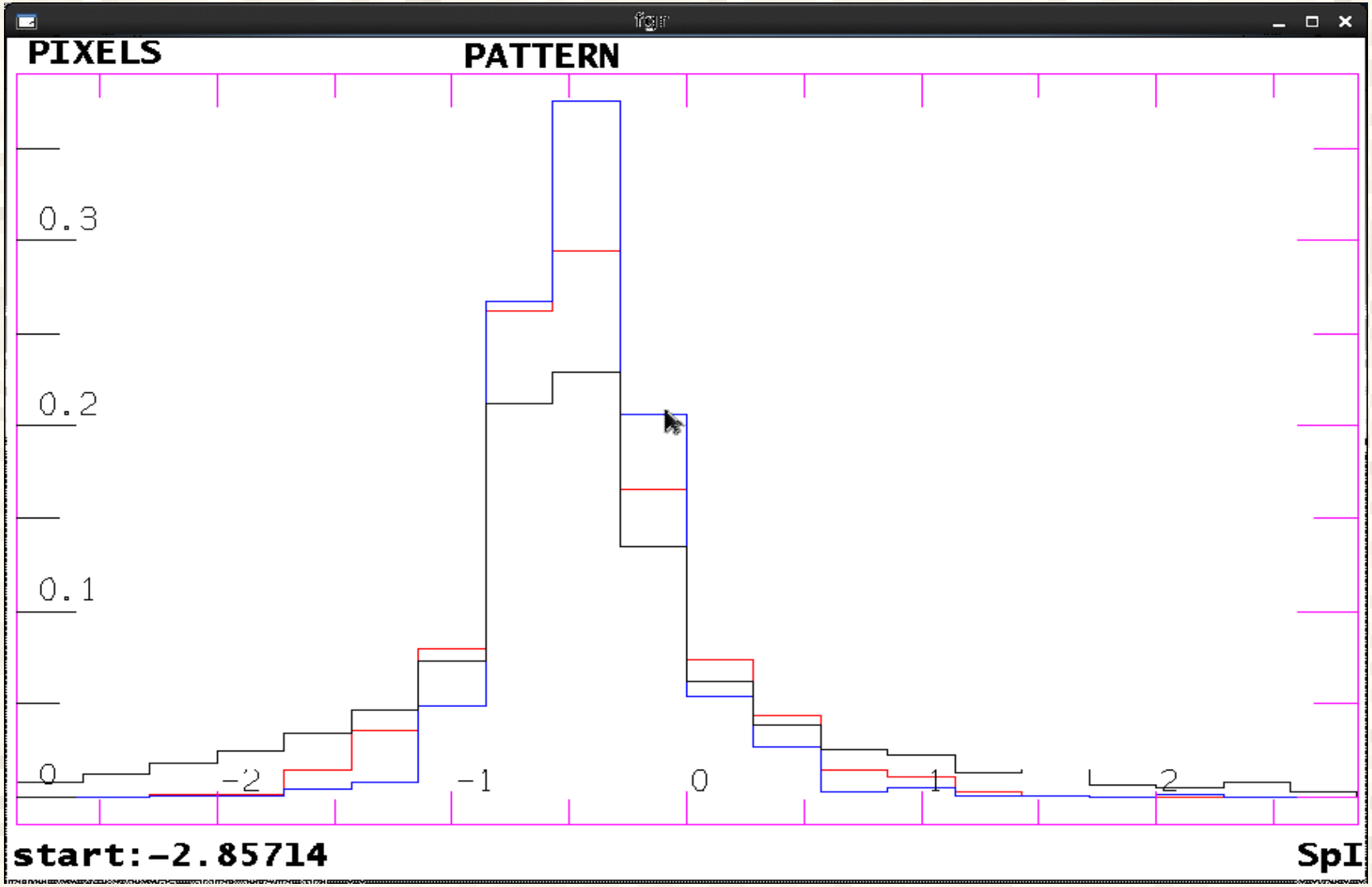
Pl_cat: 5

SDSS clusters: visible: 51

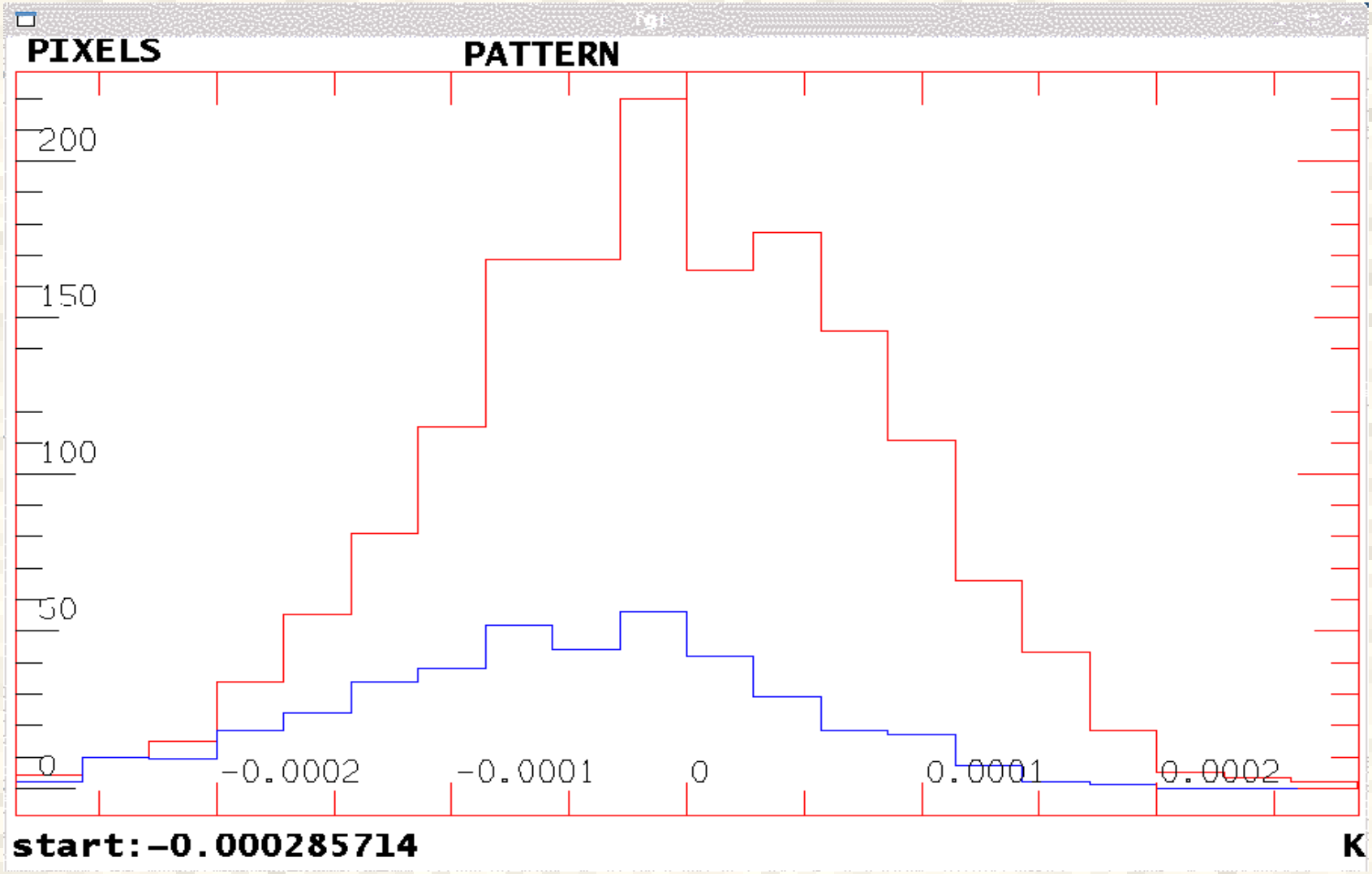
tot.sel 205 (1.2%)

Spectral index histograms

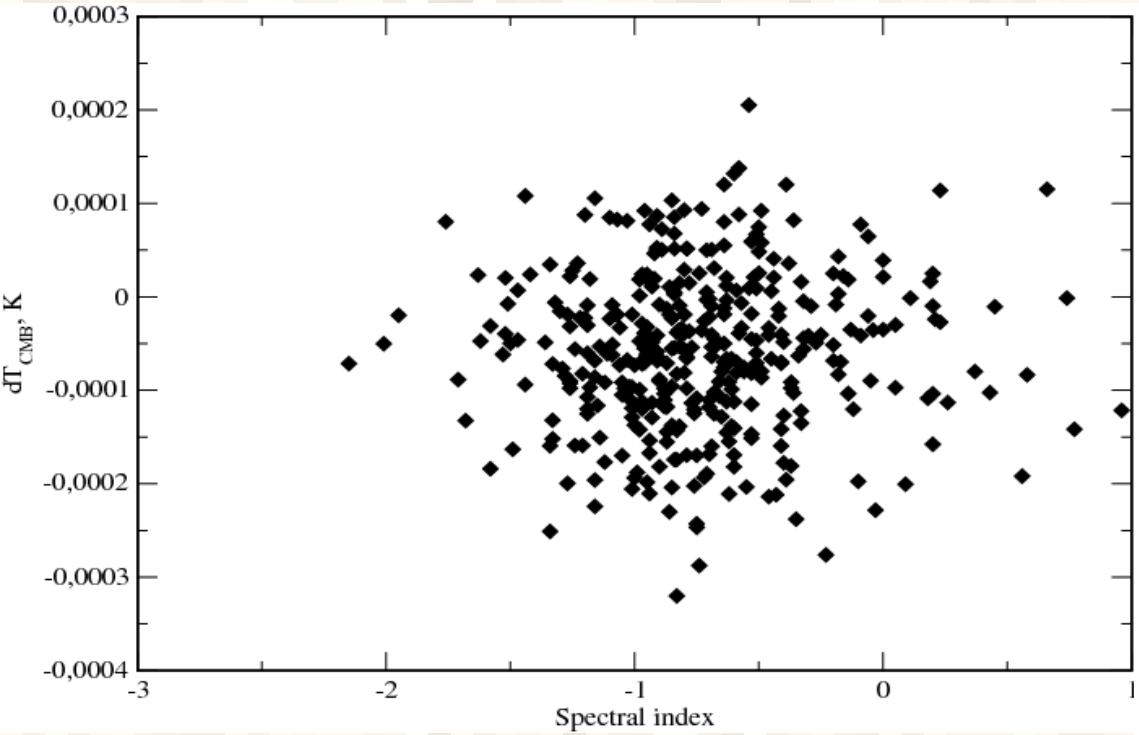
WENSS (325MHz), NVSS (1.4GHz), GB6 (4.85GHz)



Distribution of CMB map value (SMICA)

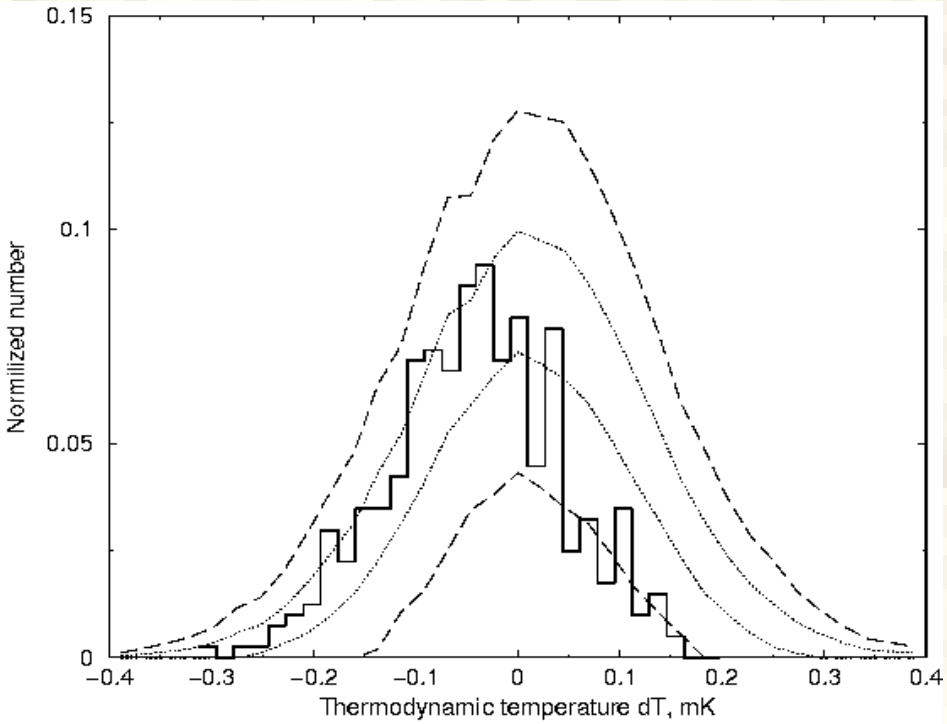


Two distributions

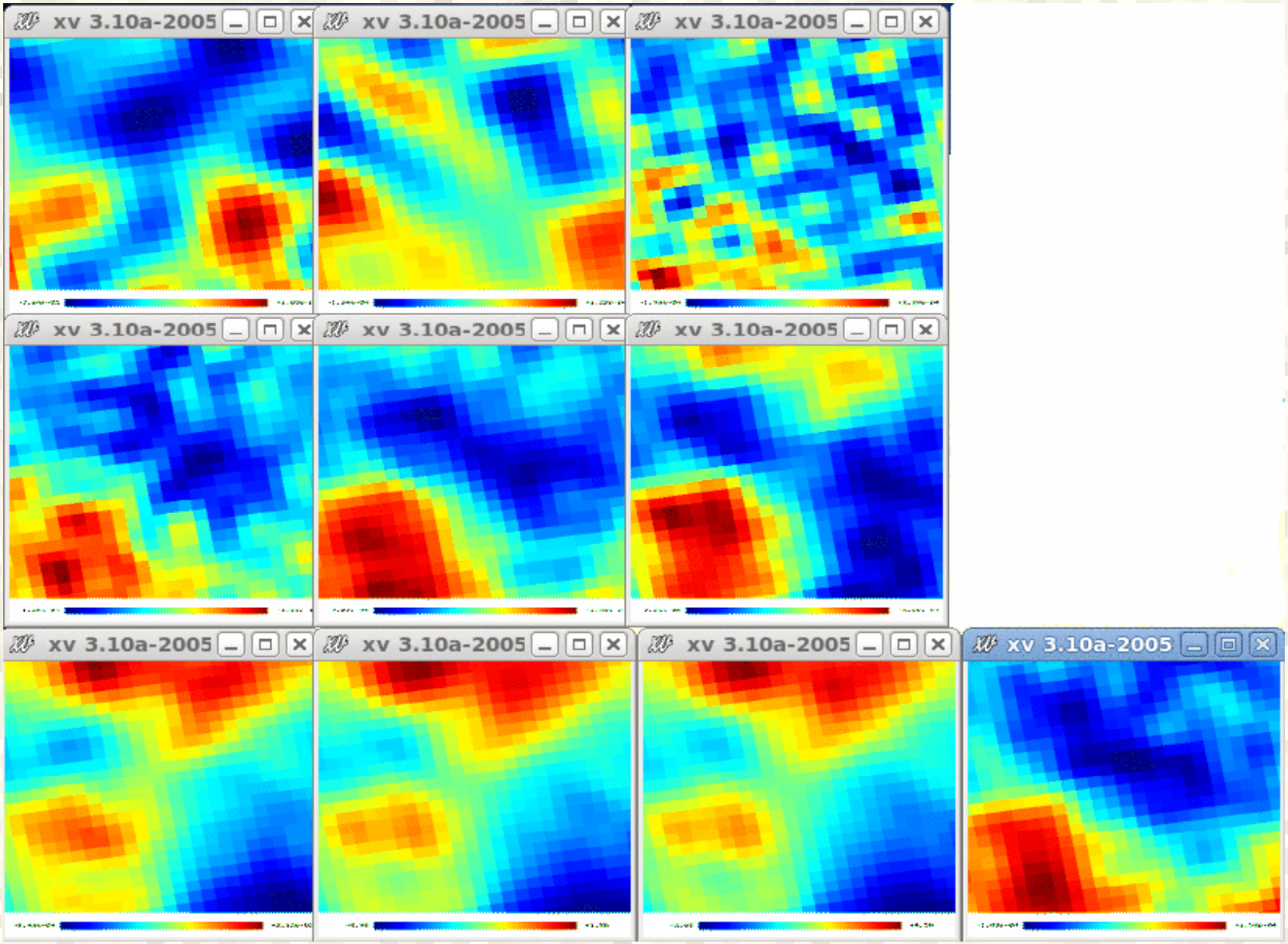


"dTcmb - Spectral Index"

N - dTcmb

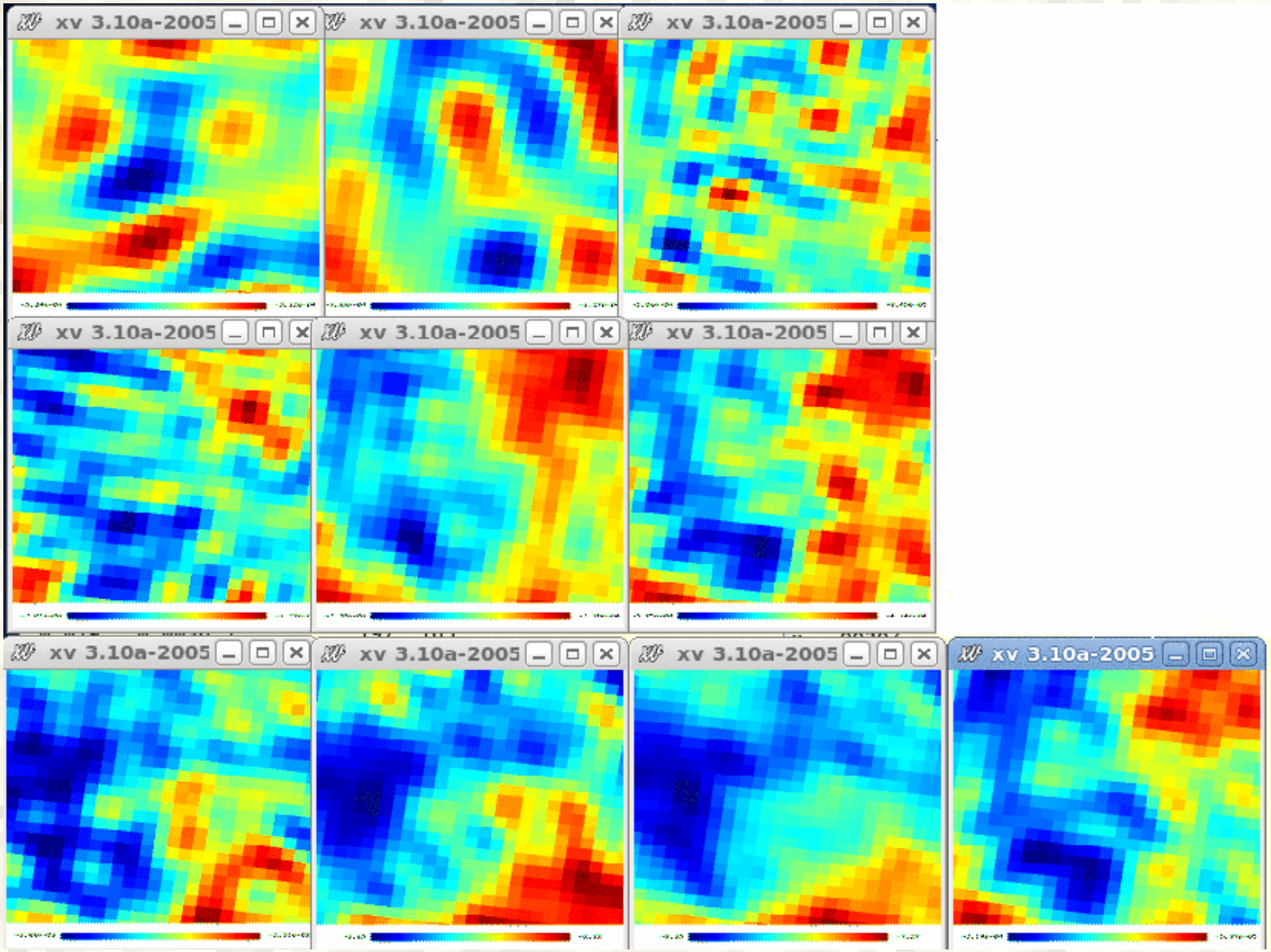


Detected object in this work and in Planck



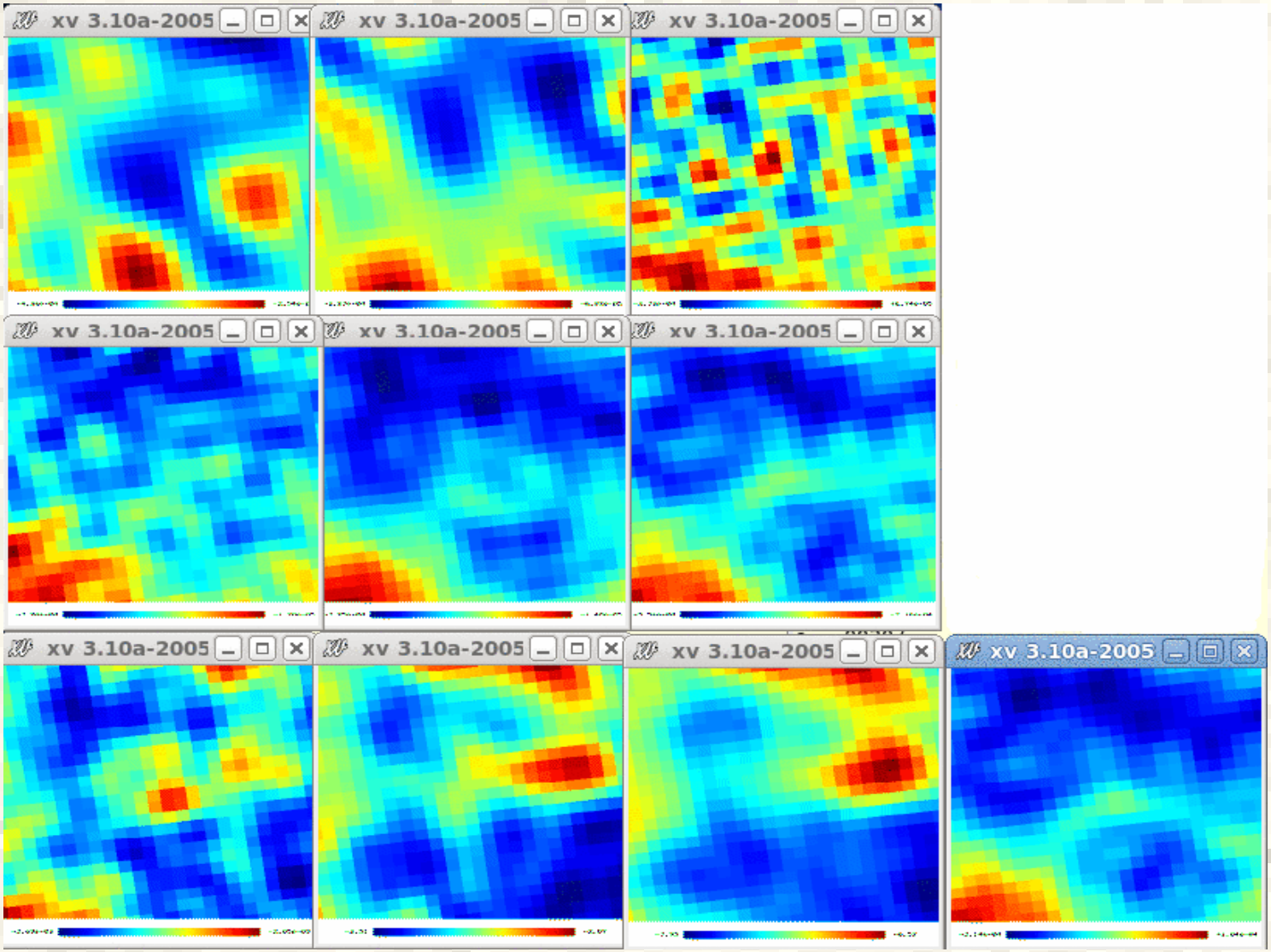
WNB 0008.7+5121

Detected object in this work and in Planck



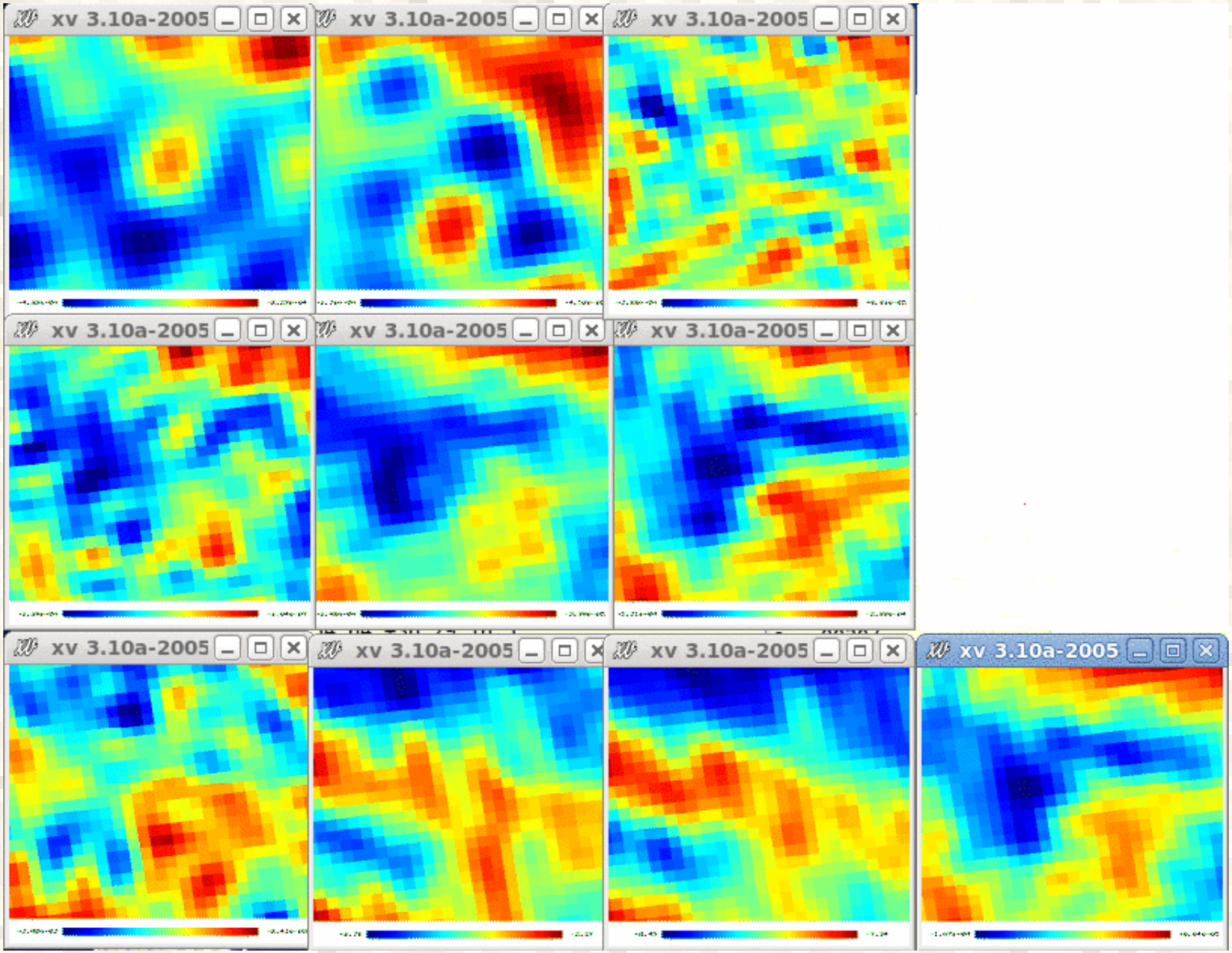
WNB 0119.4+4418

New candidates of ZS-objects



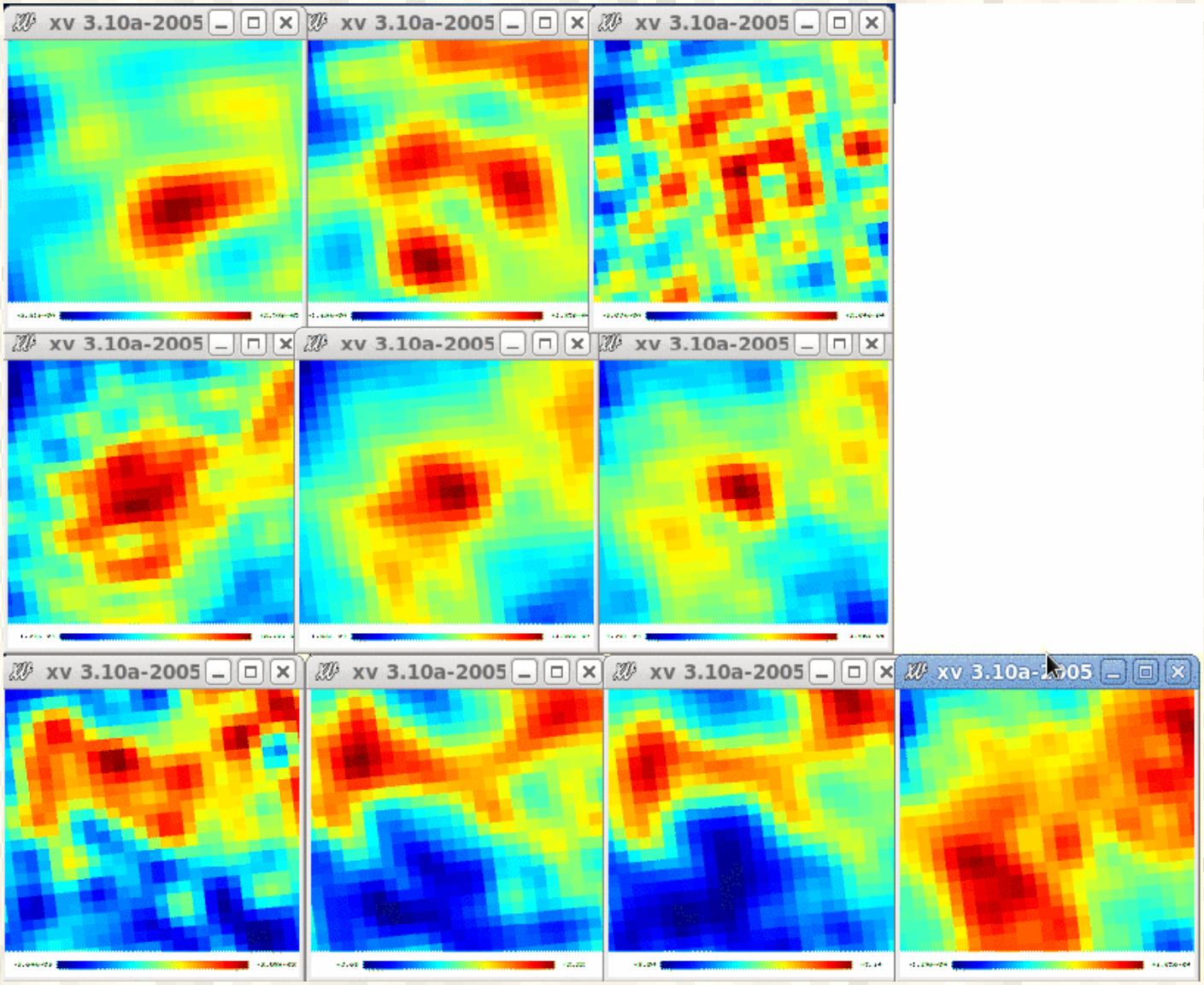
WNB 0016.5+4628A

New candidates of ZS-objects



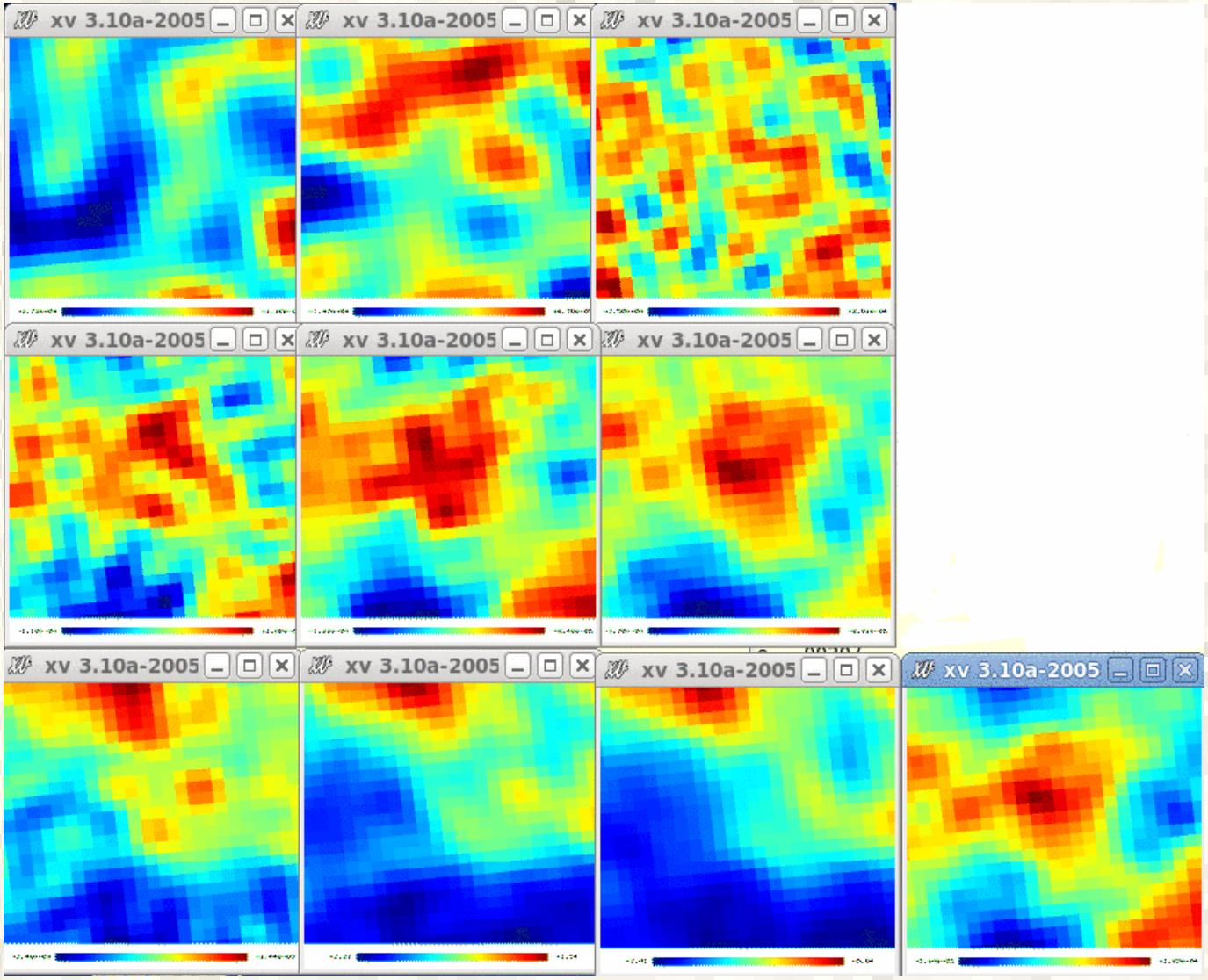
WNB 0019.3+3120

When something is detected



WNB 0021.6+4627

When something is detected



WNB 0023.6+4723

Last slide

1) There are a lot of candidates to ZS-objects
(awated N > 15 тыс.)

2) Effect of "the hollow" at the CMB map when
ZS-objects as selected exist

3) The CMB map often contains a parent galaxy of radio source

4) Radio sources in clusters of galaxies can "smear"
3C-effect on mm-waves maps