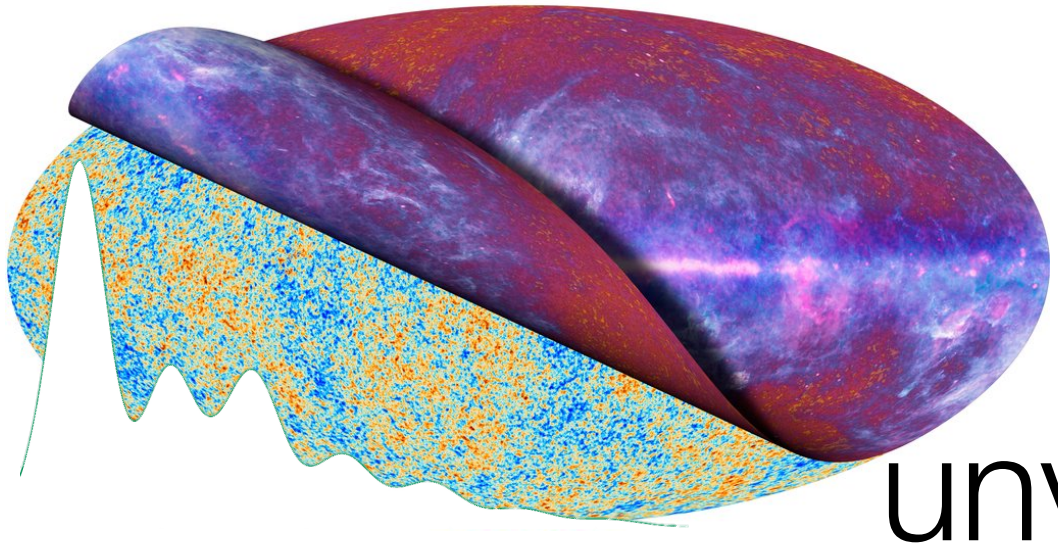


Herschel unveils enigmatic Planck extreme high-z candidates

introduction 1.
digging into the CIB 2.
lensed sources 3.
overdensities 4.
conclusions 5.

presented by Hervé Dole
on behalf of the Planck collaboration

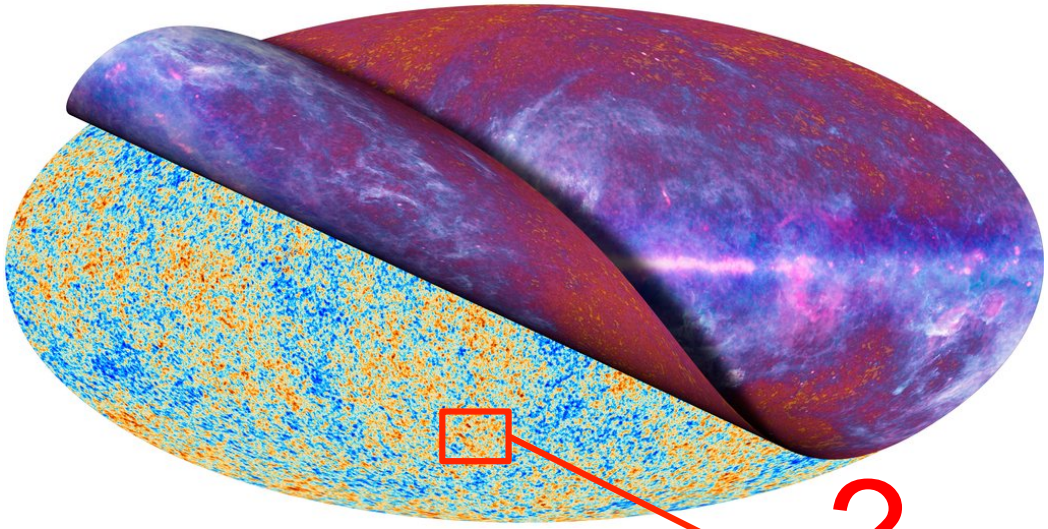
Institut d'Astrophysique Spatiale, Orsay, France
Université Paris Sud & CNRS
Institut Universitaire de France
http://www.ias.u-psud.fr/dole/


last few minutes
to check email or FB
before lunch !

The scientific results that we present today are a product of the Planck Collaboration, including individuals from more than 100 scientific institutes in Europe, the USA and Canada

Planck is a project of the European Space Agency, with instruments provided by two scientific Consortia funded by ESA member states (in particular the lead countries: France and Italy) with contributions from NASA (USA), and telescope reflectors provided in a collaboration between ESA and a scientific Consortium led and funded by Denmark.

1. some of the challenges



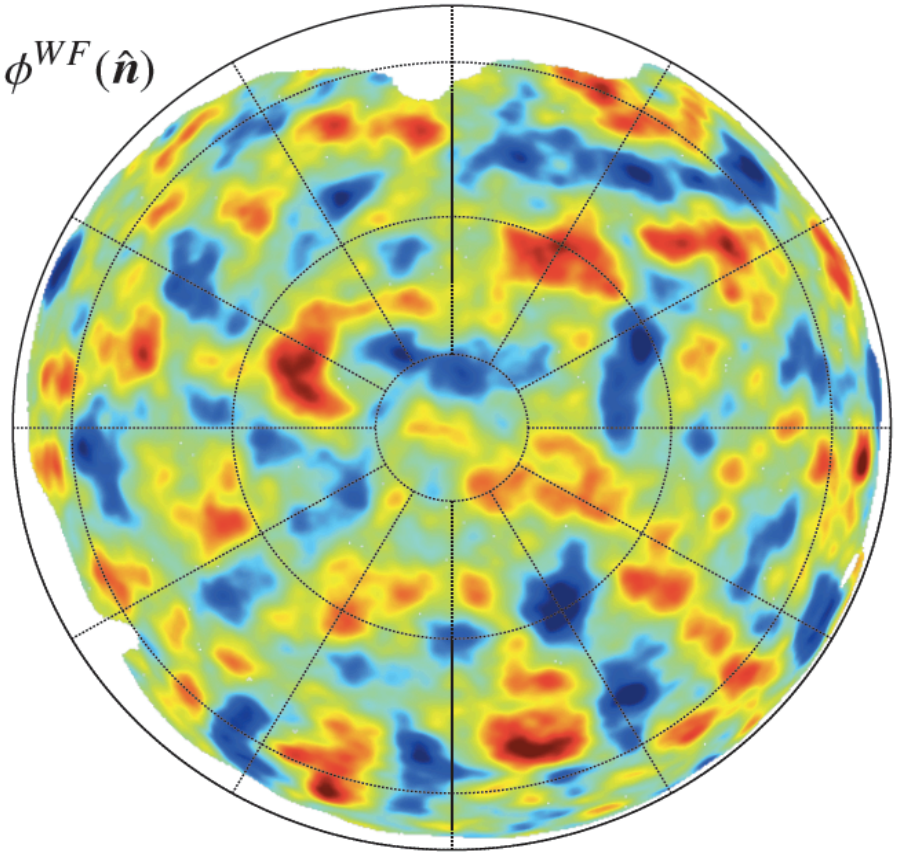
cosmology:
fixed

?

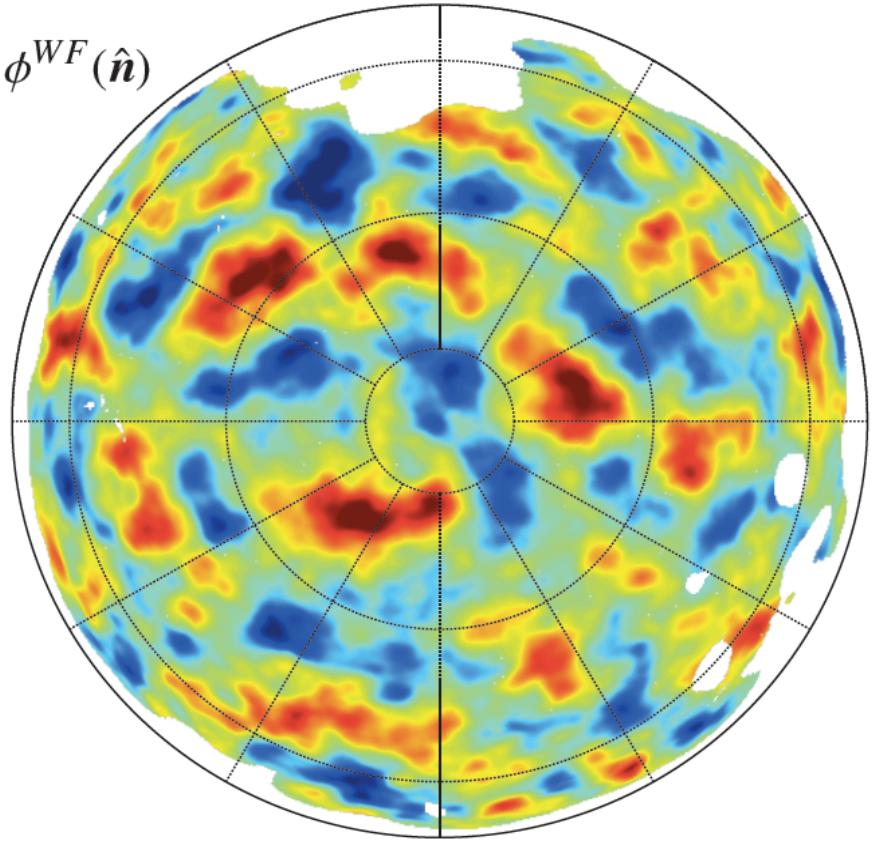
inhomogeneous, structured
universe

structure
formation

Planck all-sky map of the dark matter



Galactic North



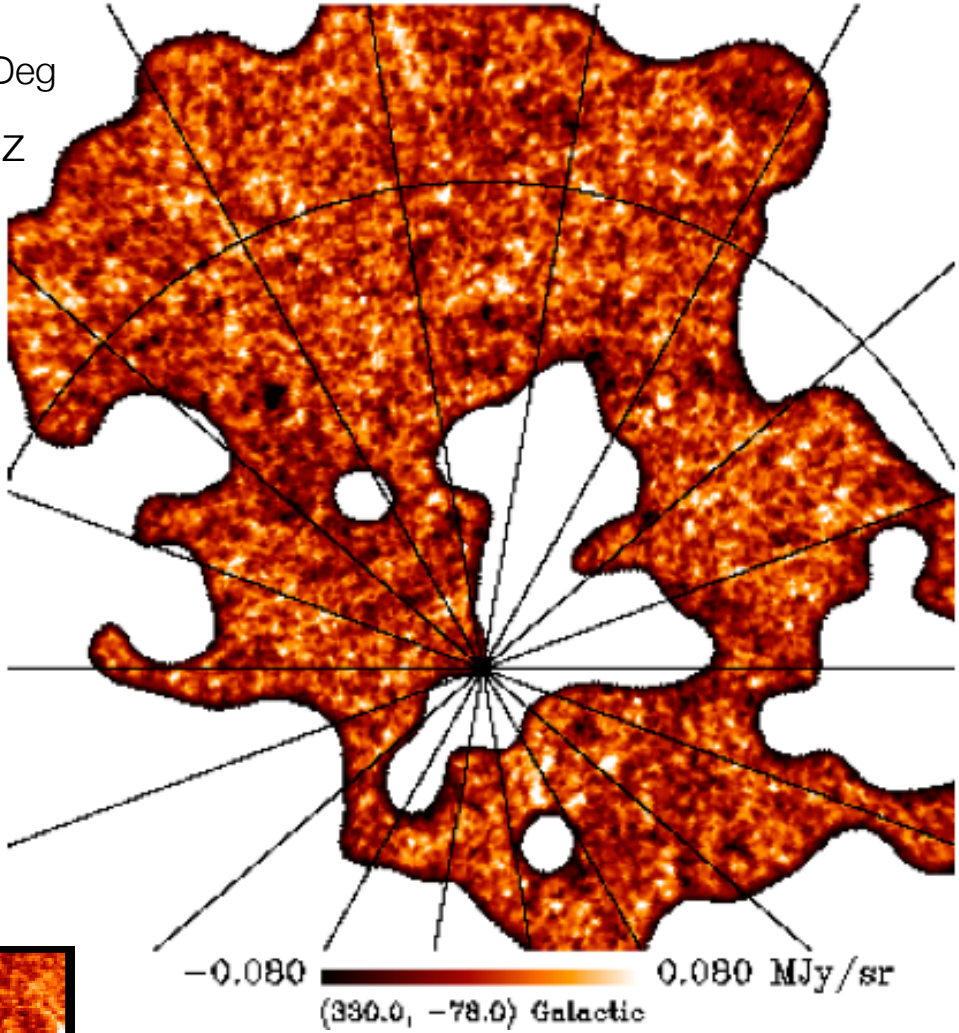
Galactic South

Planck 15 months
Planck Collaboration, 2013, 17

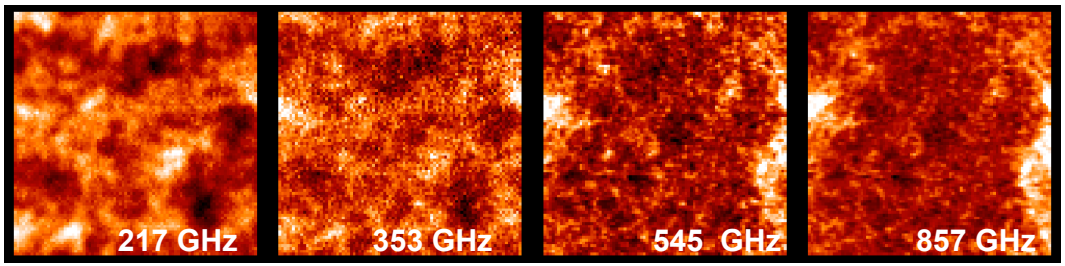
Cosmic IR Background maps probe high-z SFR

~2000 Sq. Deg

545 GHz



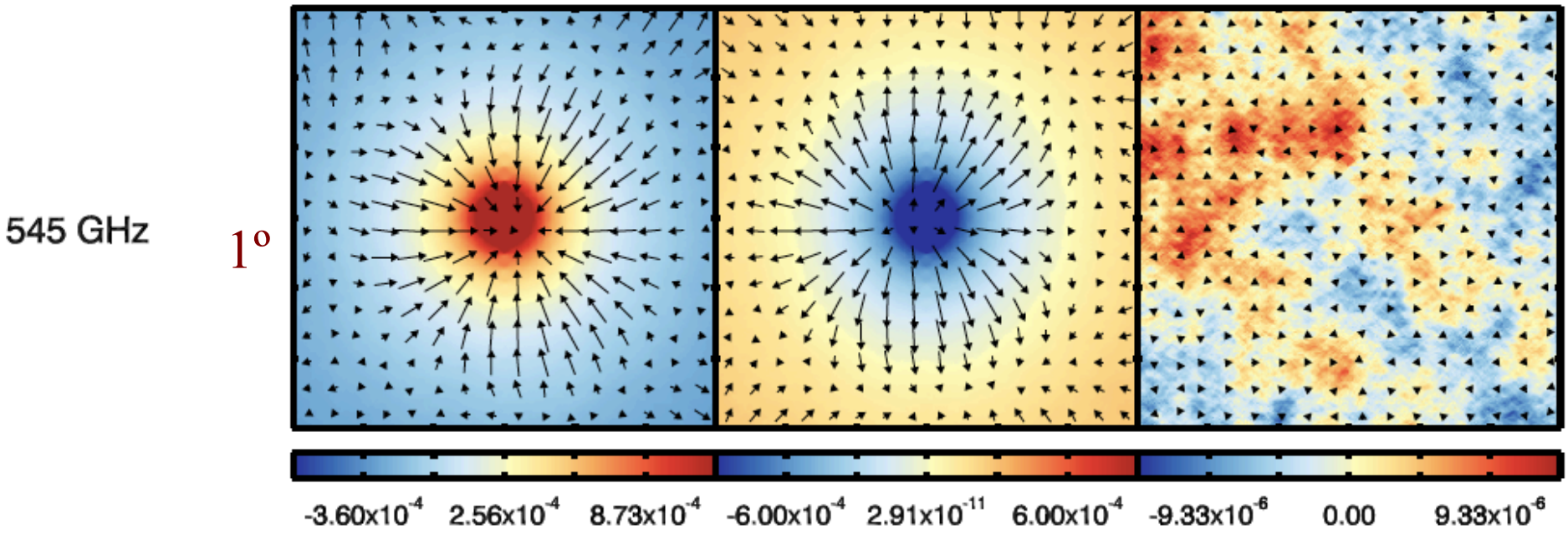
Planck Collab., 2013, 30



few 10 Sq Deg fields in 2011

CIB peaks correspond to mass peaks

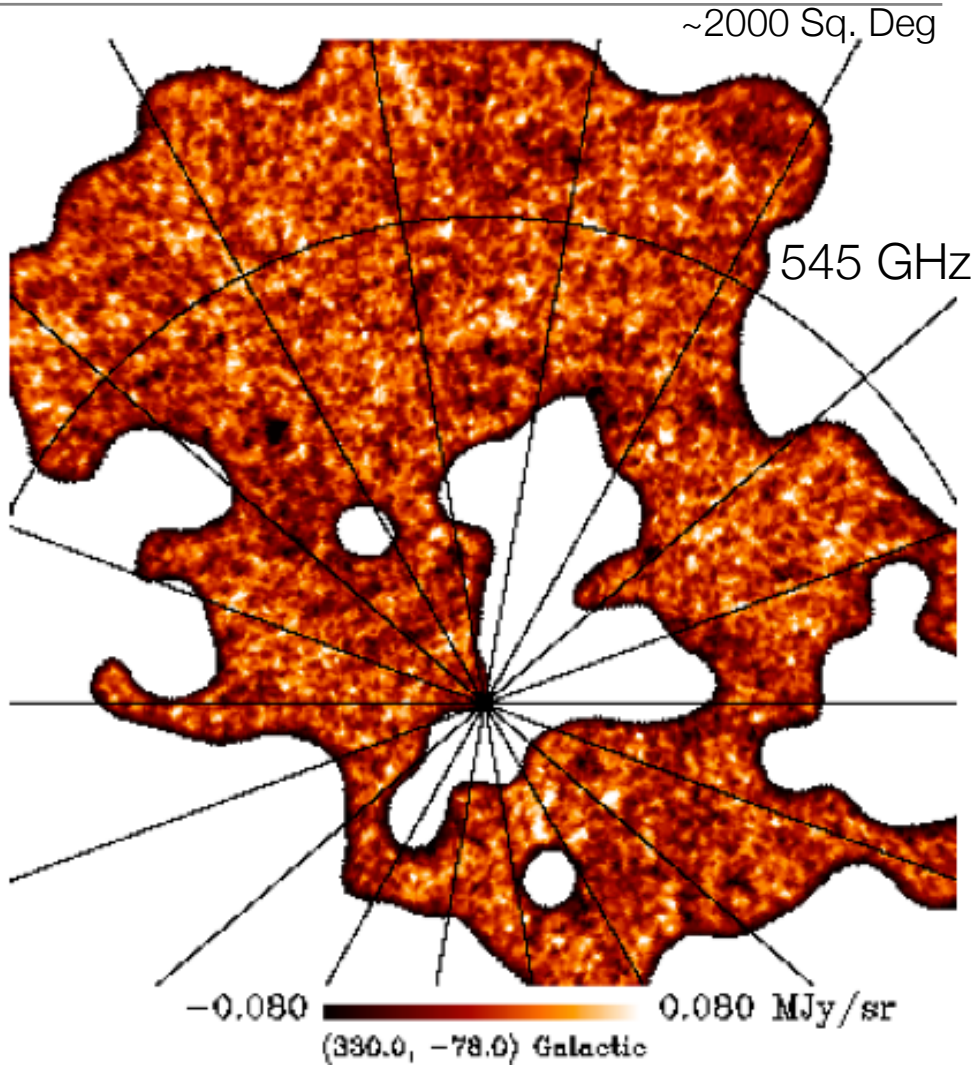
Stacking the Planck mass maps at the positions of peaks and troughs of Cosmic Infrared Background leads to a strong detection of the mass associated with these distant star forming galaxies. This is mostly Dark Matter.



see also Hanson et al., 2013 about lensing induced B-modes (NOT primordial B-modes !)

Planck 15 months
Planck Collaboration, 2013, 18

2. digging into the Cosmic IR Background

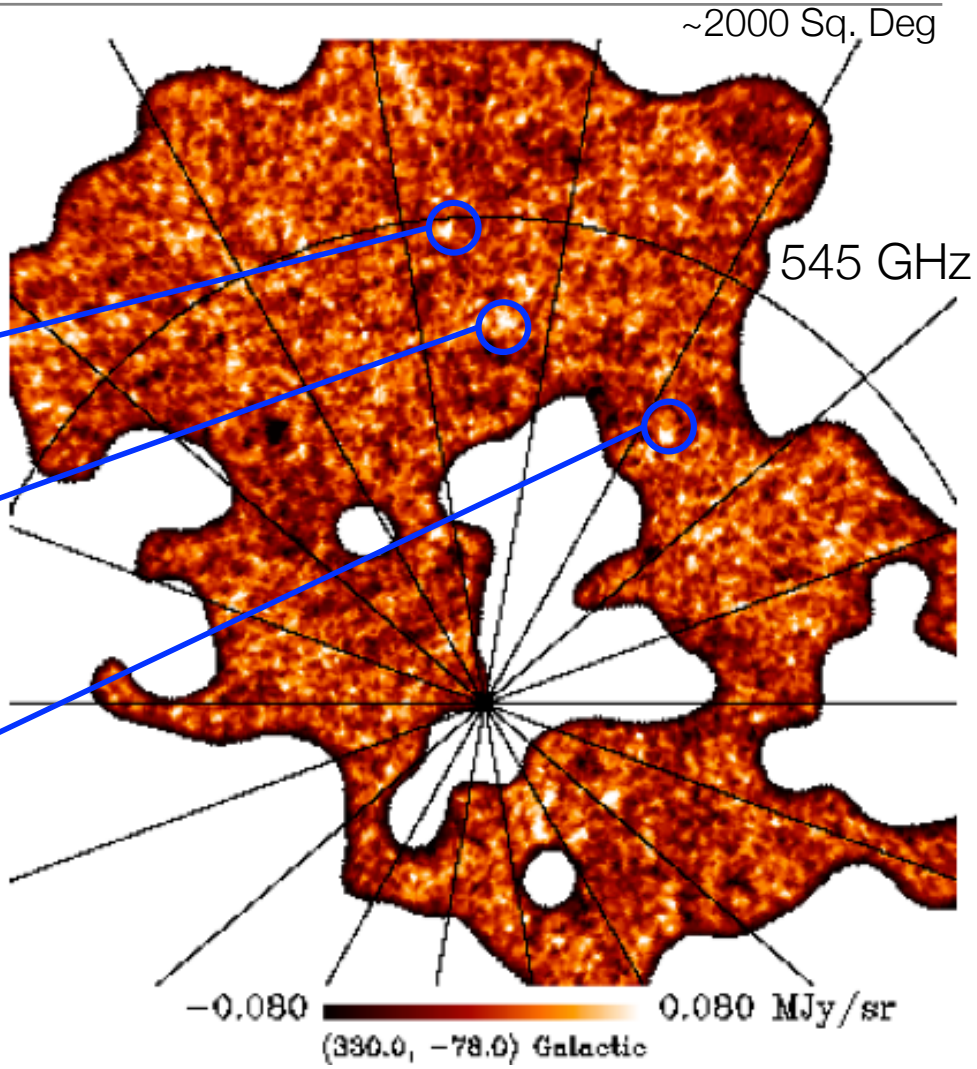


Planck Collab., 2013, 30

2. digging into the Cosmic IR Background

« cold sources » of the CIB
in Planck data (4.5’ beam)

- z >1.5 overdensities of intensely star forming galaxies ?
- z >1.5 extremely bright lensed sources ?
- large scale structure alignments ?
- residual cirrus ?

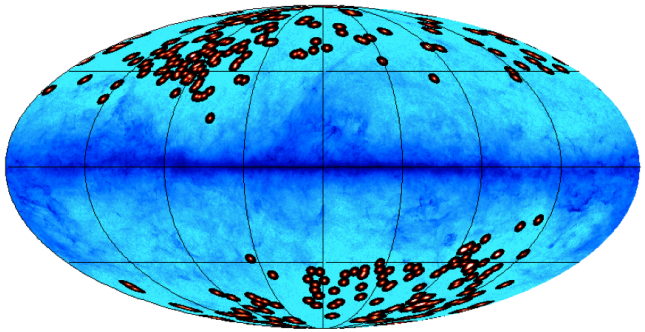


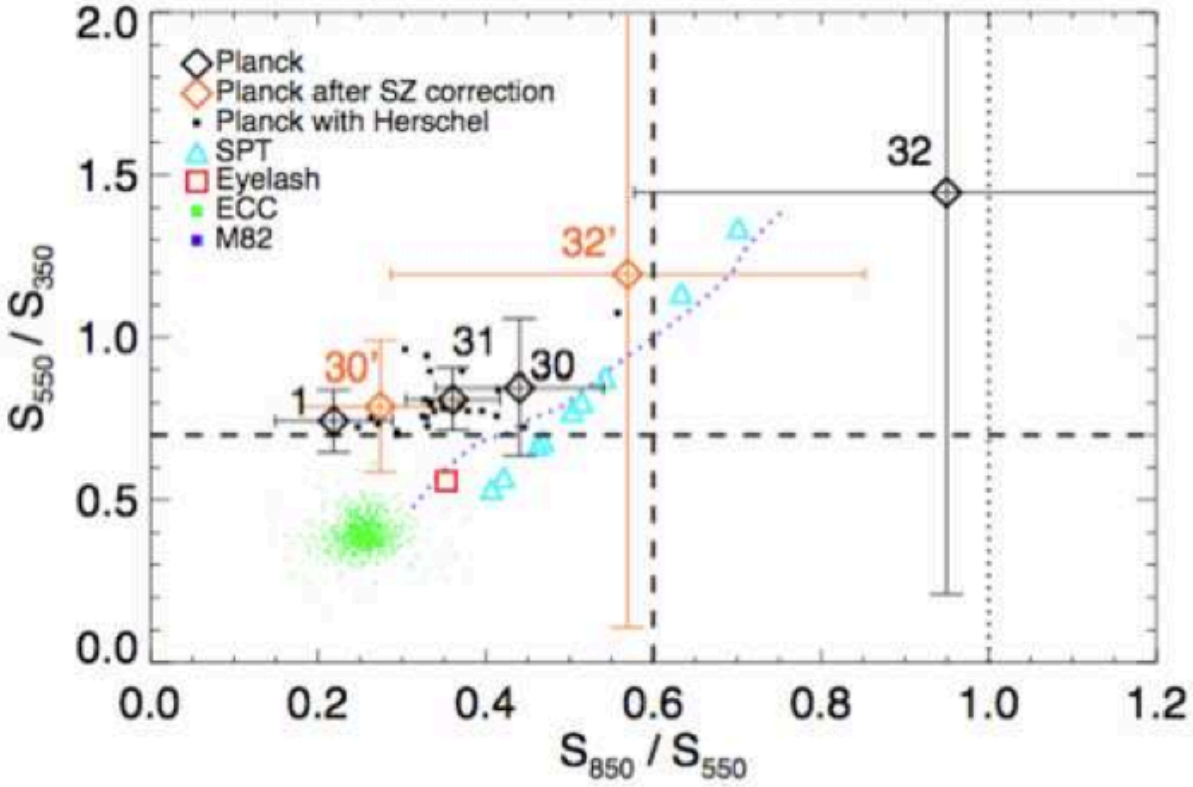
Planck Collab., 2013, 30

predicted number of extragalactic objects :
100 – 1000 (Negrello+2005)

Planck selection – several hundred

- best 35% of the sky
- several hundred Planck high-z candidates
- PCCS sources (a la Negrello+2010)
- or CIB fluctuations (a la Montier+2010)
- color-color selection

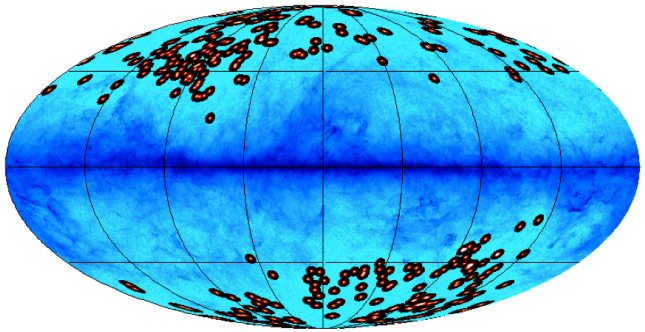


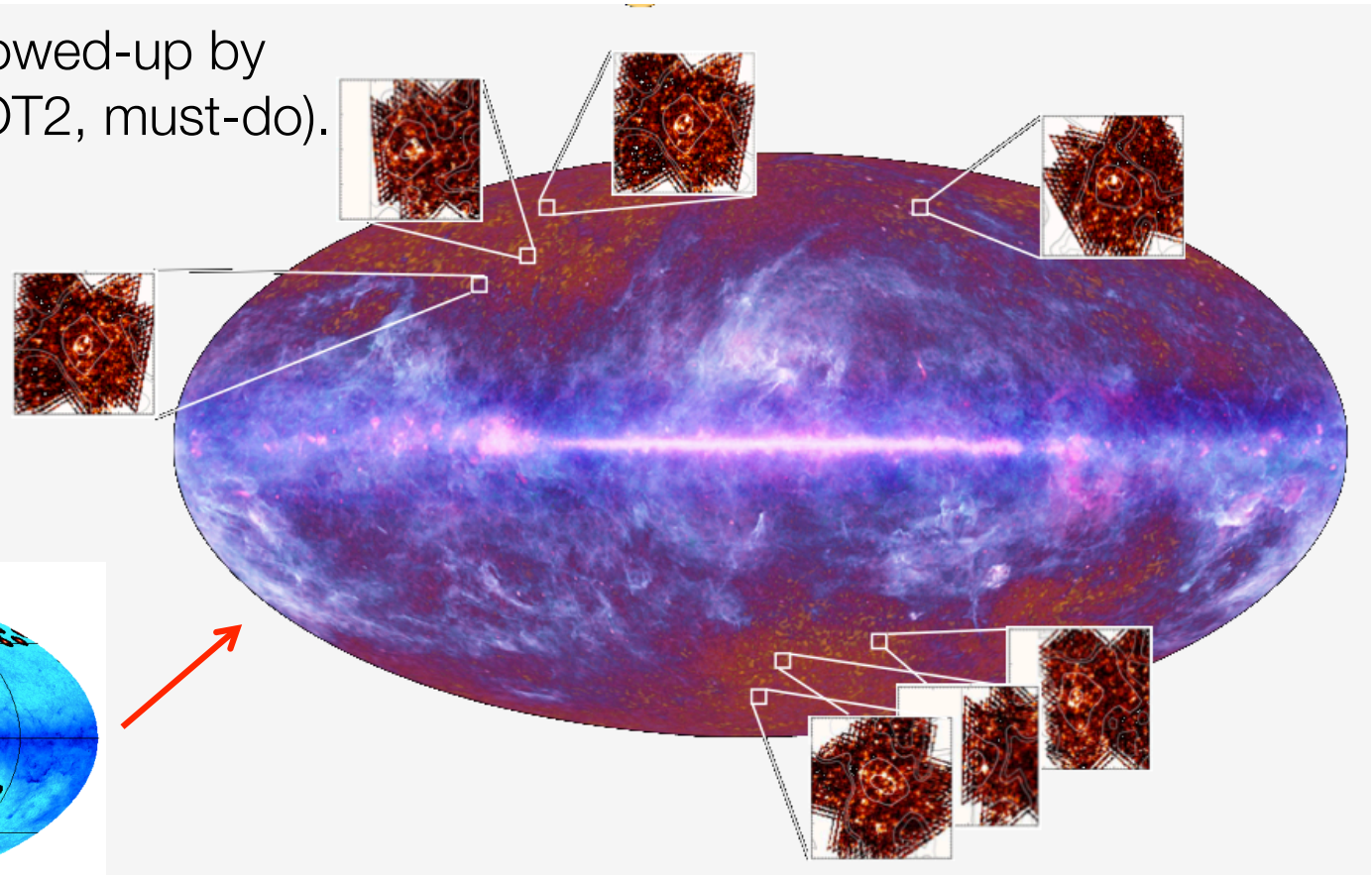


Courtesy Ludovic Montier

several hundred Planck high-z candidates

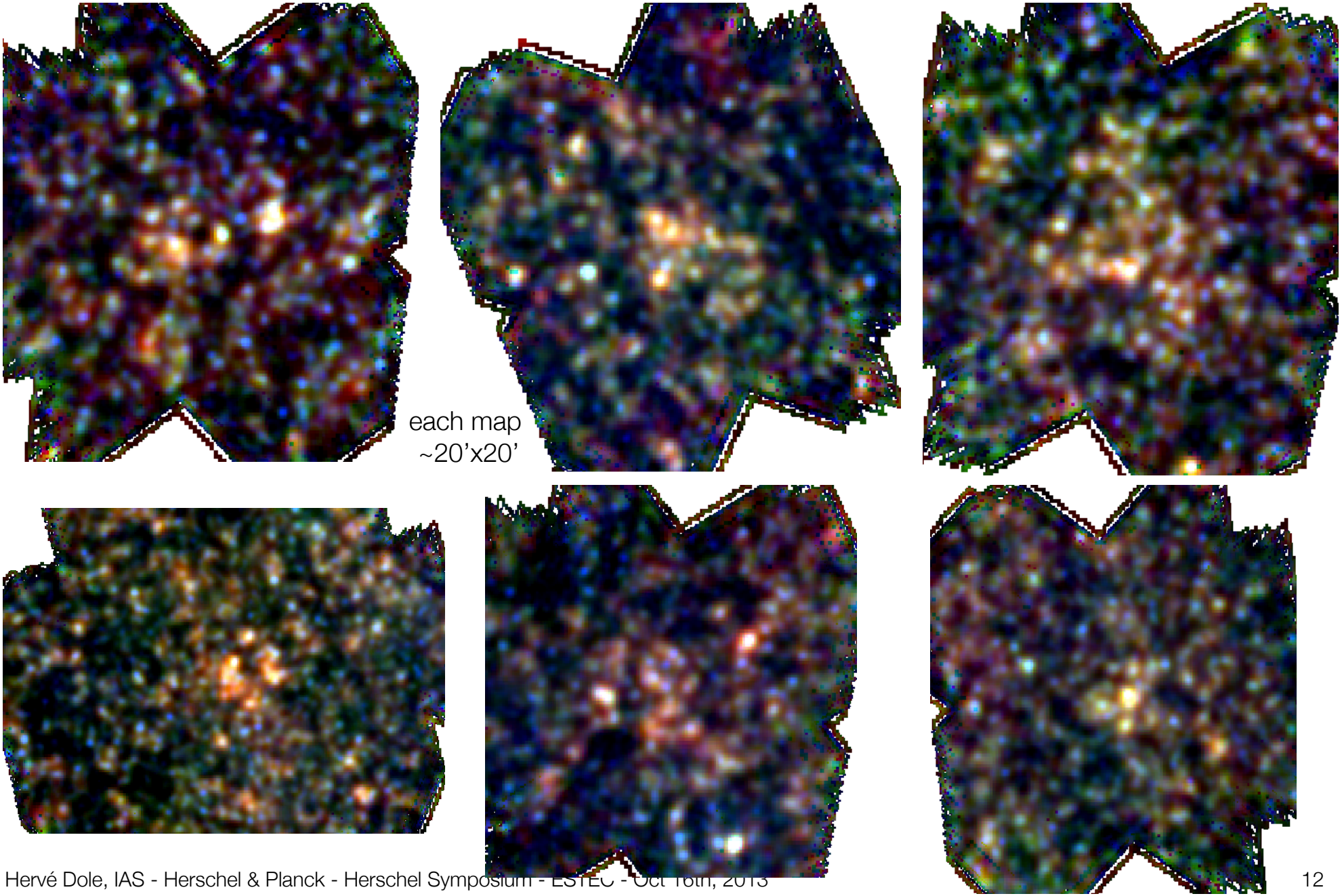
226 Planck sources followed-up by Herschel/SPIRE (OT1, OT2, must-do).



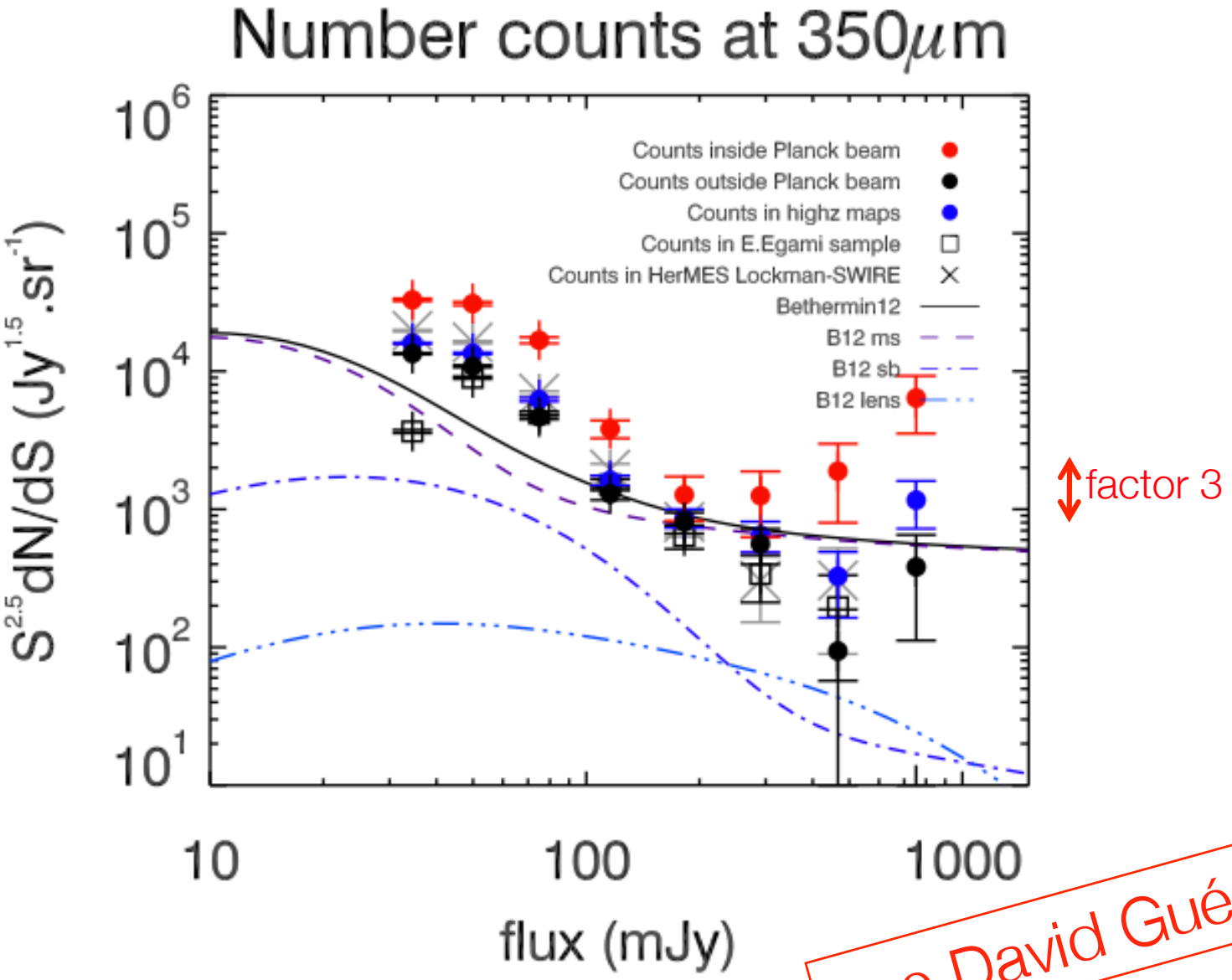


98% success
- either bright lensed candidates
- or overdensities of red galaxies
- 1.4% of the fields were cirrus

a remarkable dataset



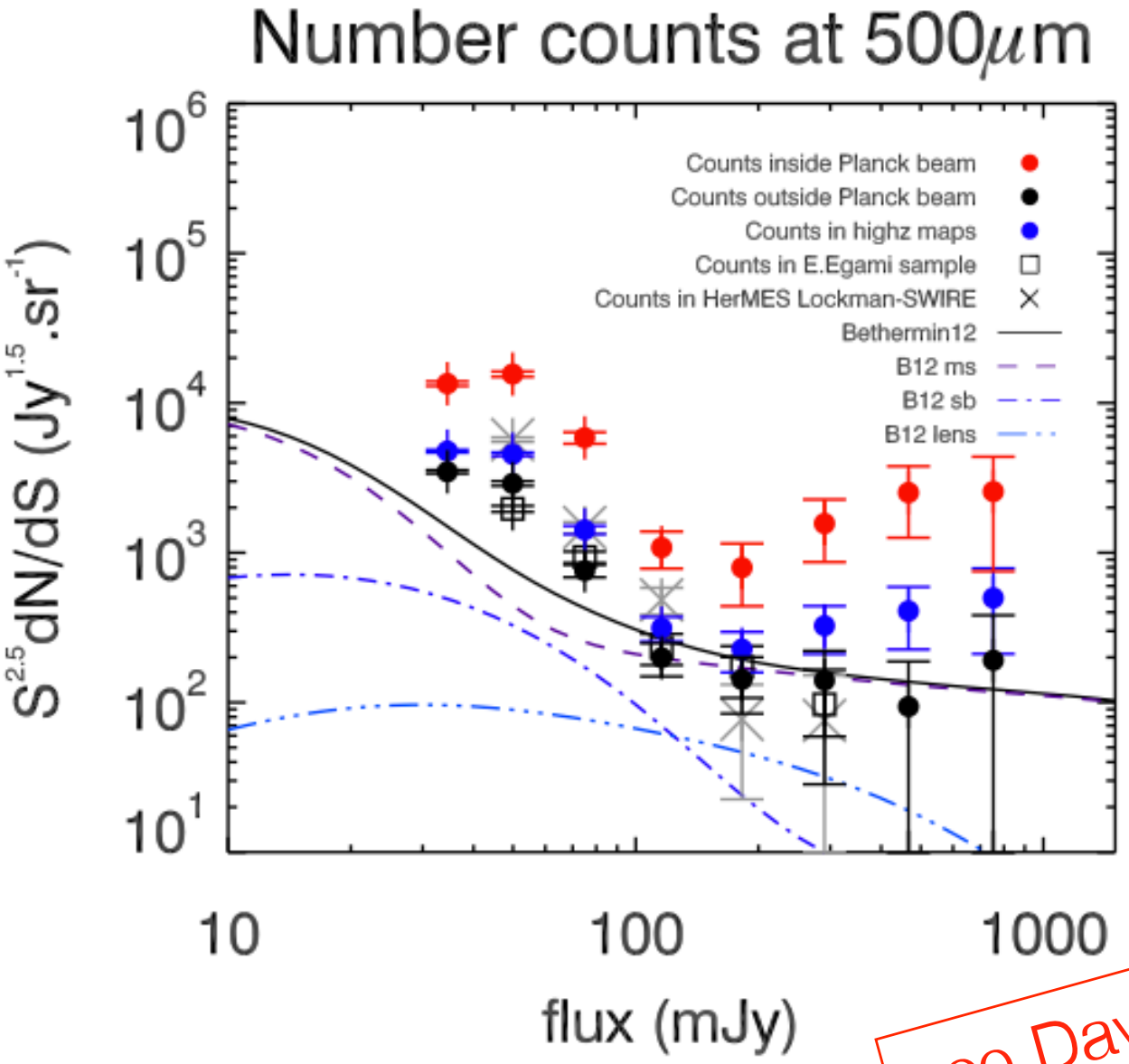
excess of red sources



factor 3

see David Guéry's poster

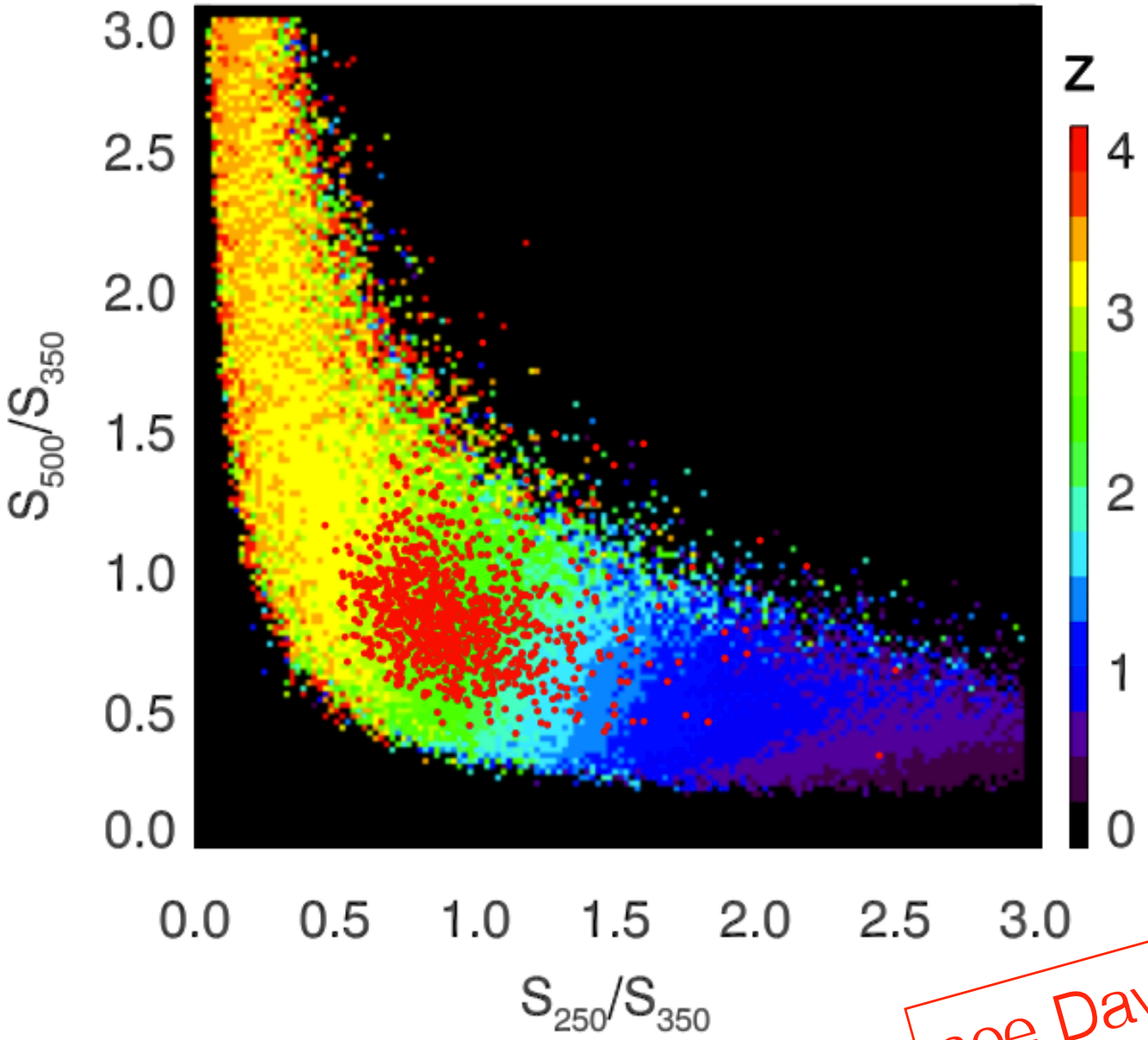
excess of red sources



factor 3

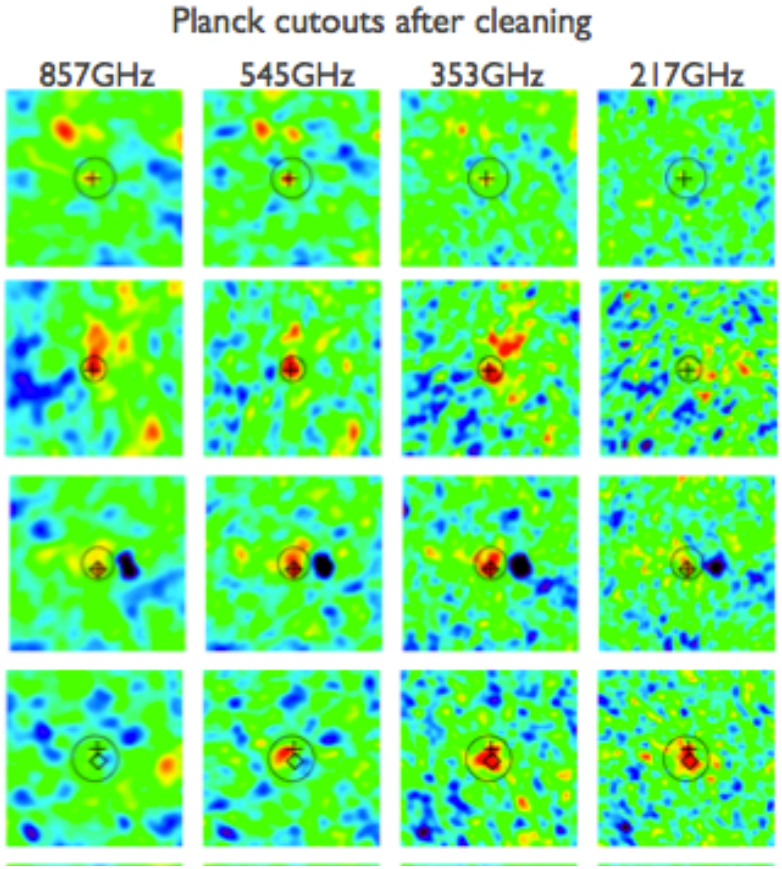
see David Guéry's poster

most of the SPIRE sources look z~2.



see David Guéry's poster

3. first identifications: all at z>1.5



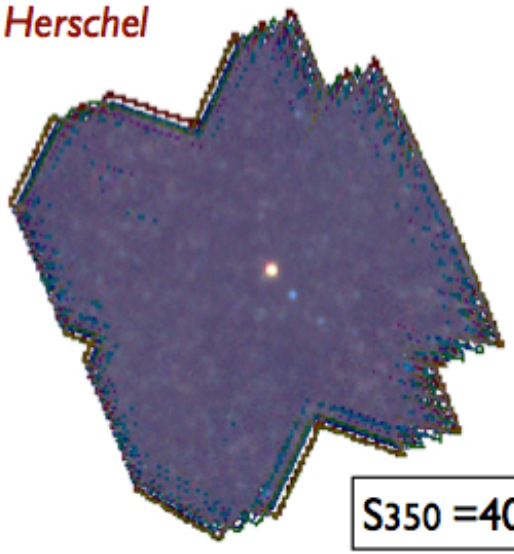
Confirmation	Redshift	Nature
SPT (1)	2.783	Lensed Dusty Galaxy (Greve et al. 2012) (Marrone et al. in prep)
Herschel ATLAS	3.26	Lensed Dusty Galaxy (Herranz et al.2012) (Fu et al. 2012)
SPT (2)	2.738	Lensed Dusty Galaxy behind a Galaxy Cluster (Greve et al. 2012) (Vieira et al. in prep)
Herschel Lensing Survey	5.2	Lensed Dusty Galaxy behind a Galaxy Cluster (Combes et al. 2012)

Courtesy Ludovic Montier

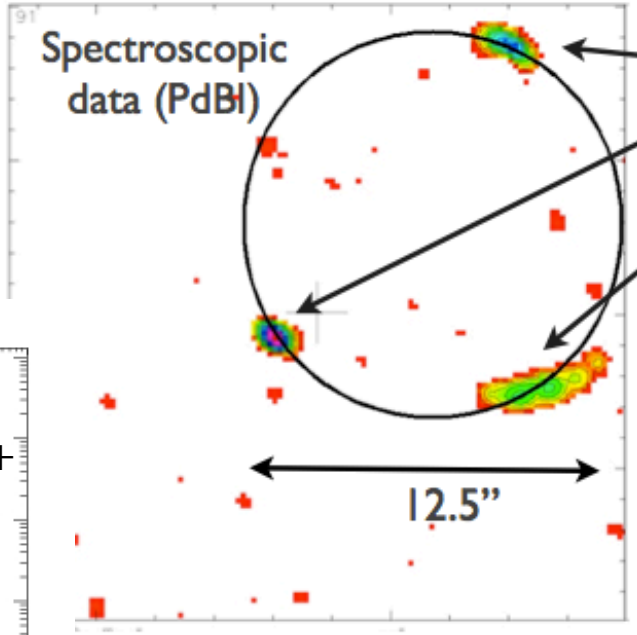
a bright gravitational lens candidate


Herschel confirmation of the first *Planck* lensed Galaxy

see Nicole Nesvadba's poster



Spectroscopic data (PdBI) CO(3-2) interferometery → z = 2.59

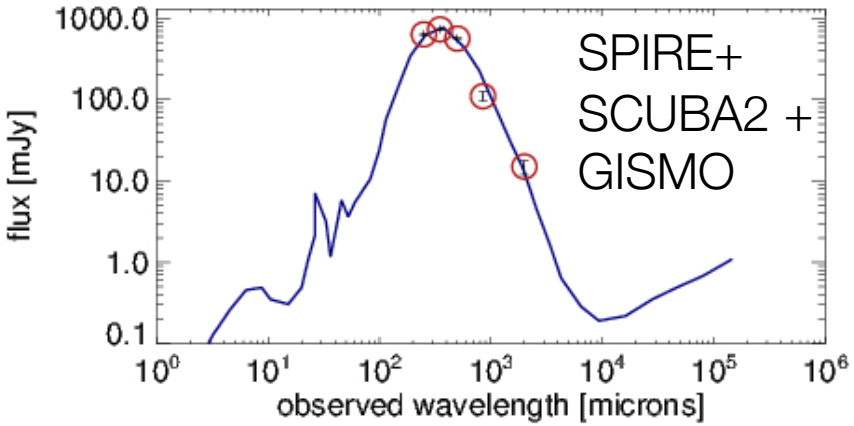


2 images of interacting galaxies

2 merging images of other or same galaxies

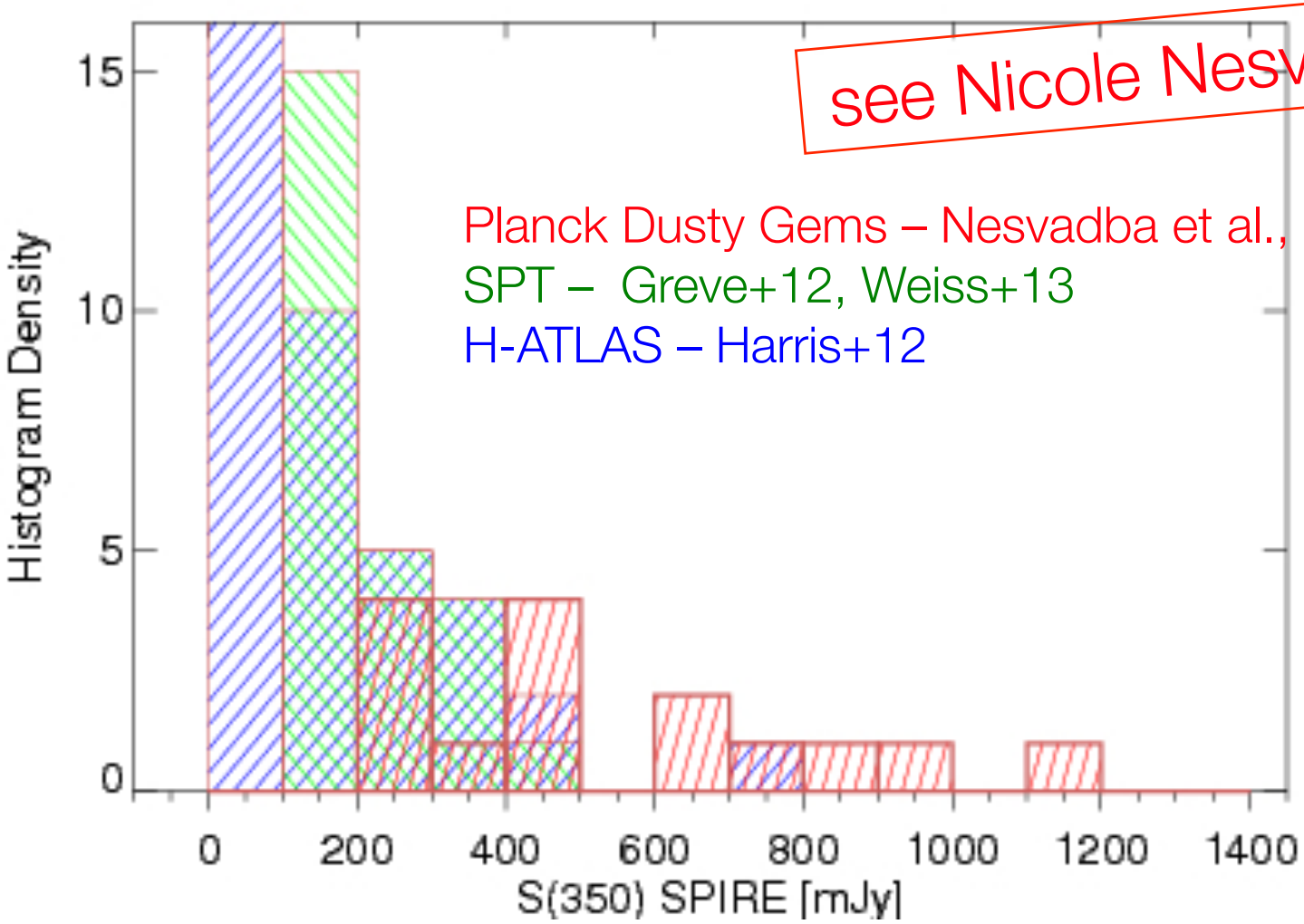
Highly magnified (>>10)

Waiting for lens model



Canameras et al., in prep
Nesvadba et al., in prep

many bright high-z lensed sources



see Nicole Nesvadba's poster

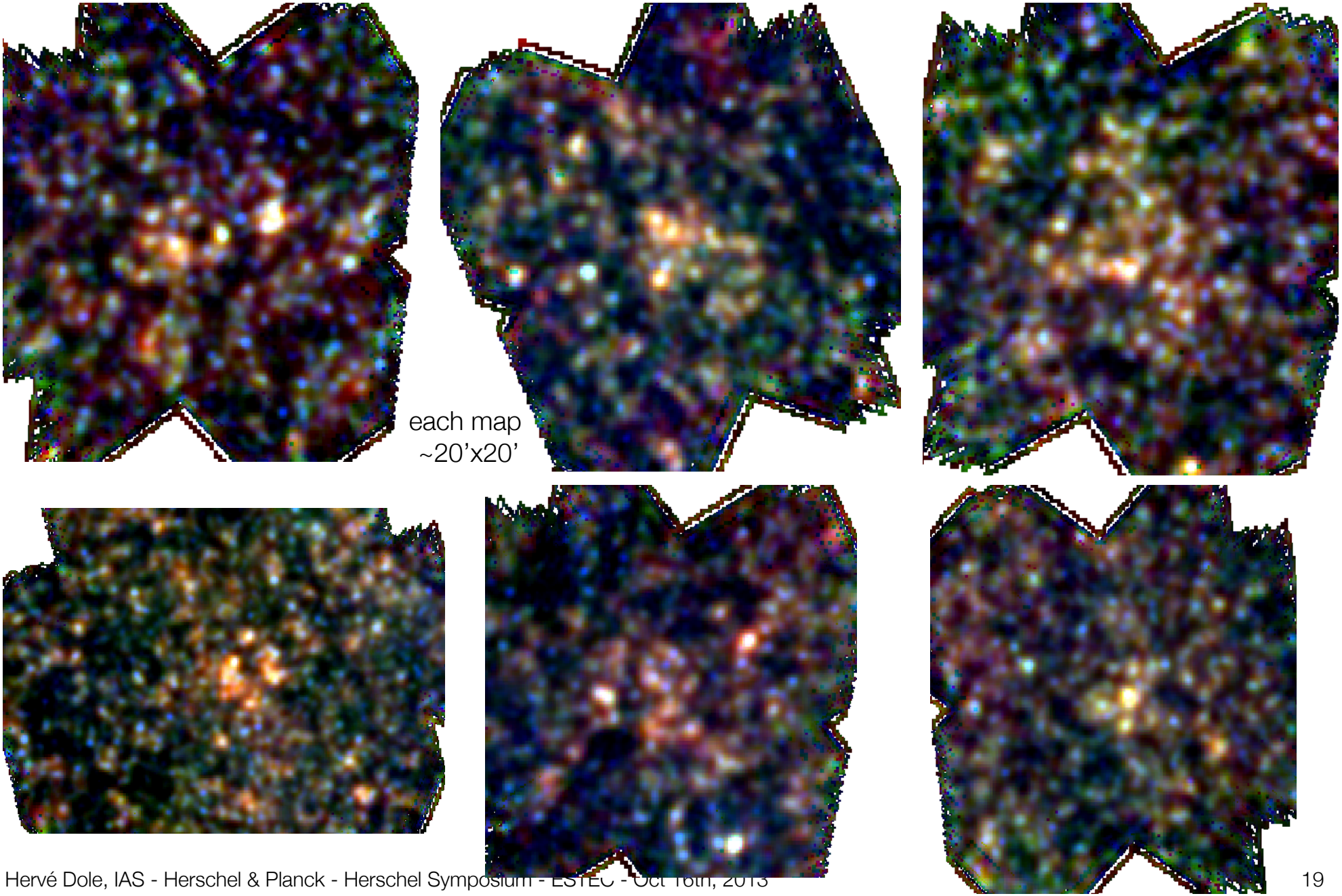
Planck Dusty Gems – Nesvadba et al., in prep
SPT – Greve+12, Weiss+13
H-ATLAS – Harris+12

all measured redshifts at IRAM:
z: 2.2 – 3.6

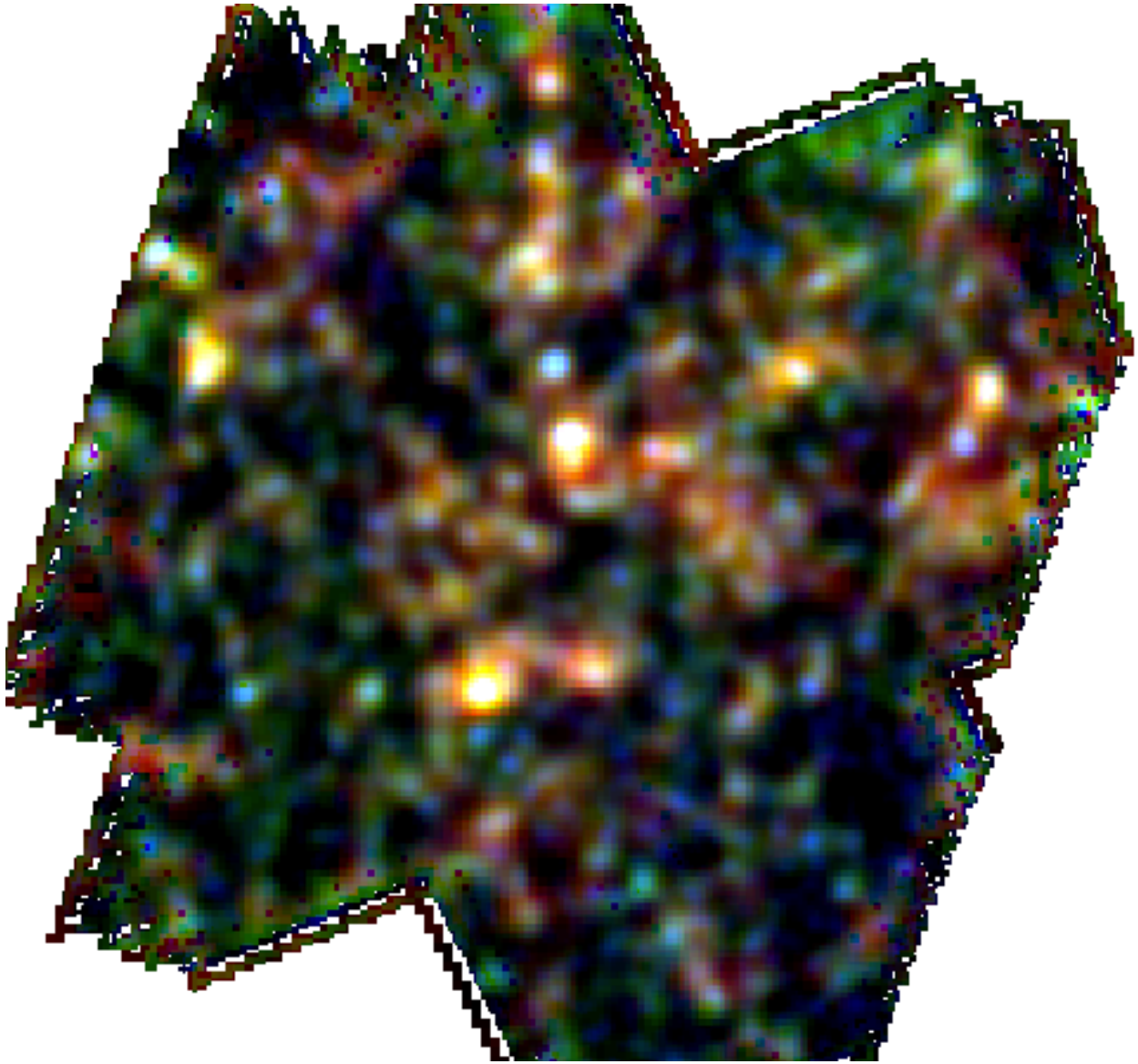
major contribution from ground-based mm img/spec

Nesvadba et al., in prep

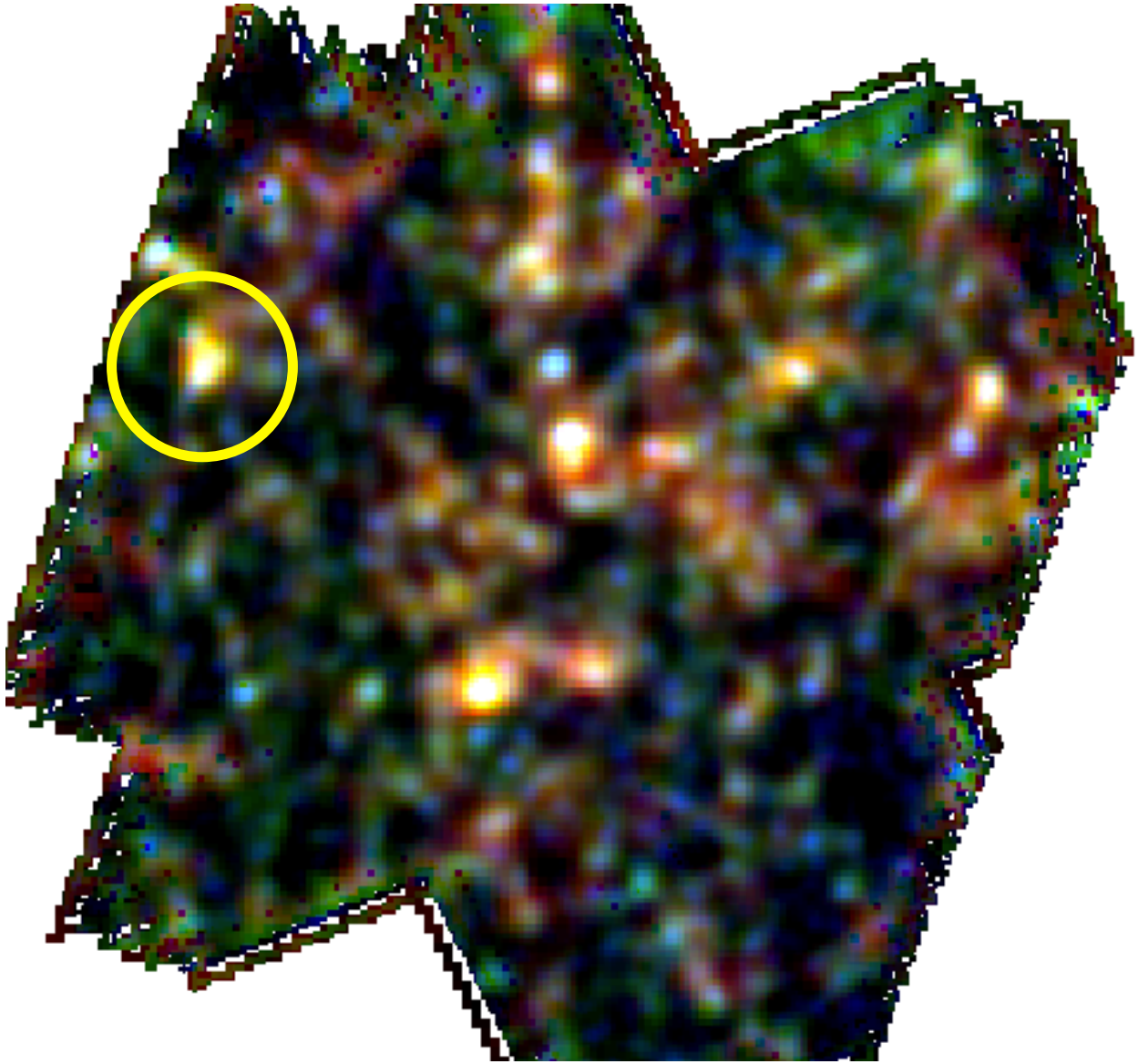
4. overdensities ?



the case of XMMU J0044.0-2033 @z=1.58



the case of XMMU J0044.0-2033 @z=1.58



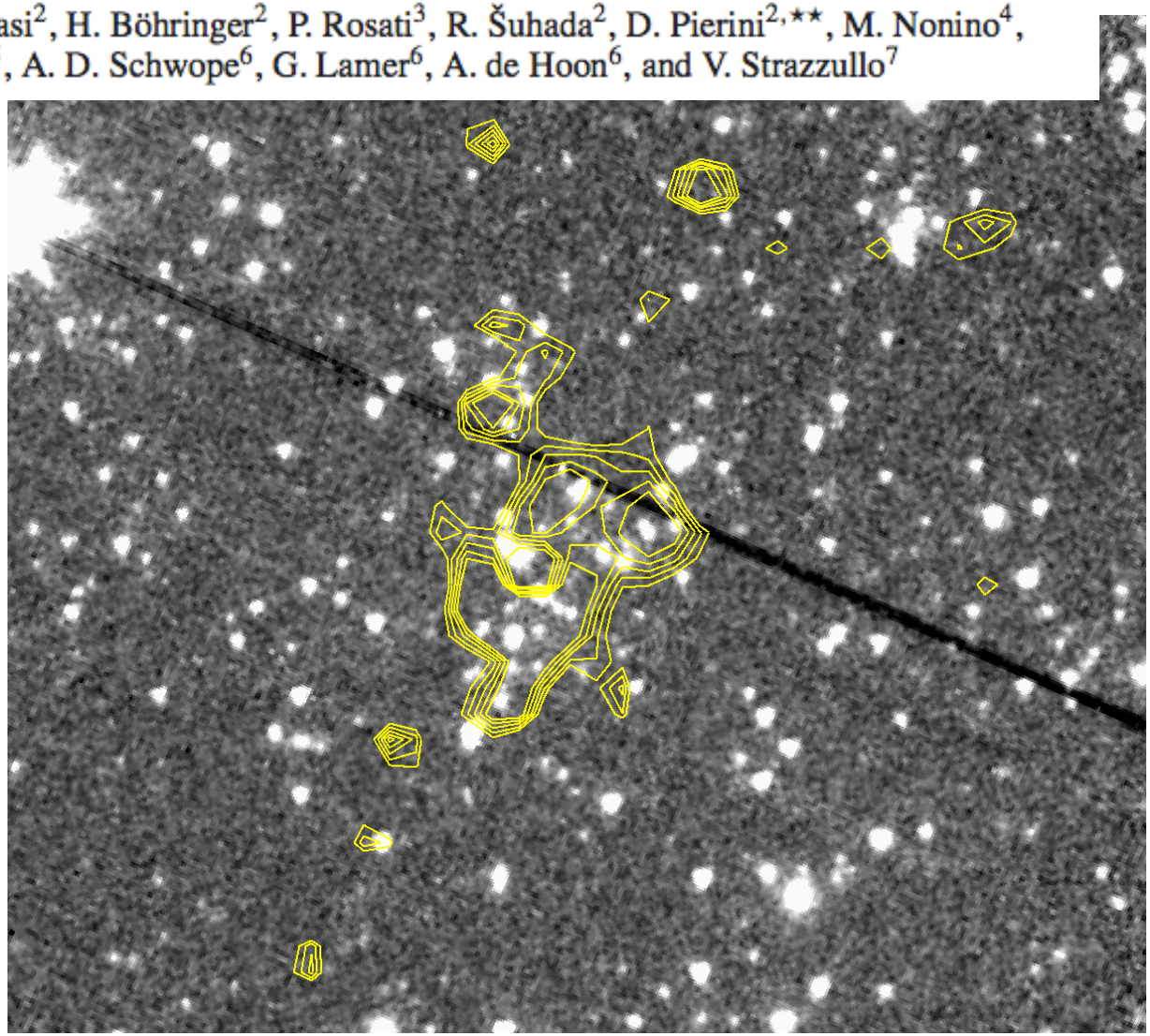
the case of XMMU J0044.0-2033 @z=1.58

Discovery of a massive X-ray luminous galaxy cluster at $z = 1.579^{\star}$

J. S. Santos[1], R. Fassbender[2], A. Nastasi[2], H. Böhringer[2], P. Rosati[3], R. Šuhada[2], D. Pierini[2,⋆⋆], M. Nonino[4], M. Mühlegger[2], H. Quintana[5], A. D. Schwope[6], G. Lamer[6], A. de Hoon[6], and V. Strazzullo[7]

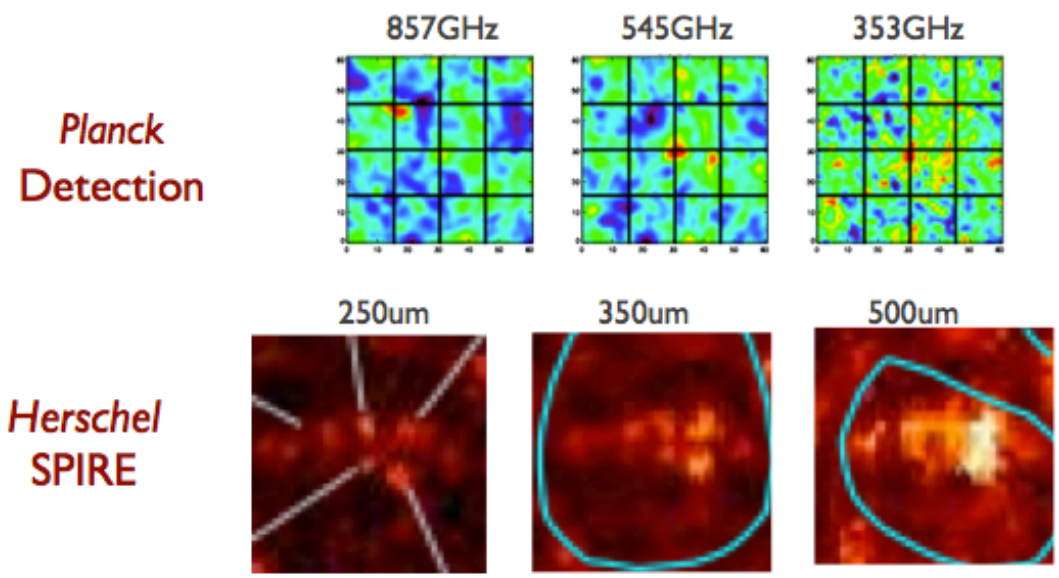
We report on the discovery of a very distant galaxy cluster serendipitously detected in the archive of the *XMM-Newton* mission, within the scope of the *XMM-Newton* Distant Cluster Project (XDCP). XMMUJ0044.0-2033 was detected at a high significance level (5σ) as a compact, but significantly extended source in the X-ray data, with a soft-band flux $f(r < 40'') = (1.5 \pm 0.3) \times 10^{-14}$ erg s^{-1} cm^{-2}. Optical/NIR follow-up observations confirmed the presence of an overdensity of red galaxies matching the X-ray emission. The cluster was spectroscopically confirmed to be at $z = 1.579$ using ground-based VLT/FORS2 spectroscopy. The analysis of the $I-H$ colour–magnitude diagram shows a sequence of red galaxies with a colour range $[3.7 < I-H < 4.6]$ within 1′ from the cluster X-ray emission peak. However, the three spectroscopic members (all with complex morphology) have significantly bluer colours relative to the observed red-sequence. In addition, two of the three cluster members have [OII] emission, indicative of on-going star formation. Using the spectroscopic redshift we estimated the X-ray bolometric luminosity, $L_{\rm bol,40''} \sim 5.8 \times 10^{44}$ erg s^{-1}, implying a massive galaxy cluster. This places XMMU J0044.0-2033 at the forefront of massive distant clusters, closing the gap between lower redshift systems and recently discovered proto- and low-mass clusters at $z > 1.6$.

M~3-5 10^{14} Ms



new structure at z>~1.7

Herschel confirmation of the *Planck* proto-cluster candidate



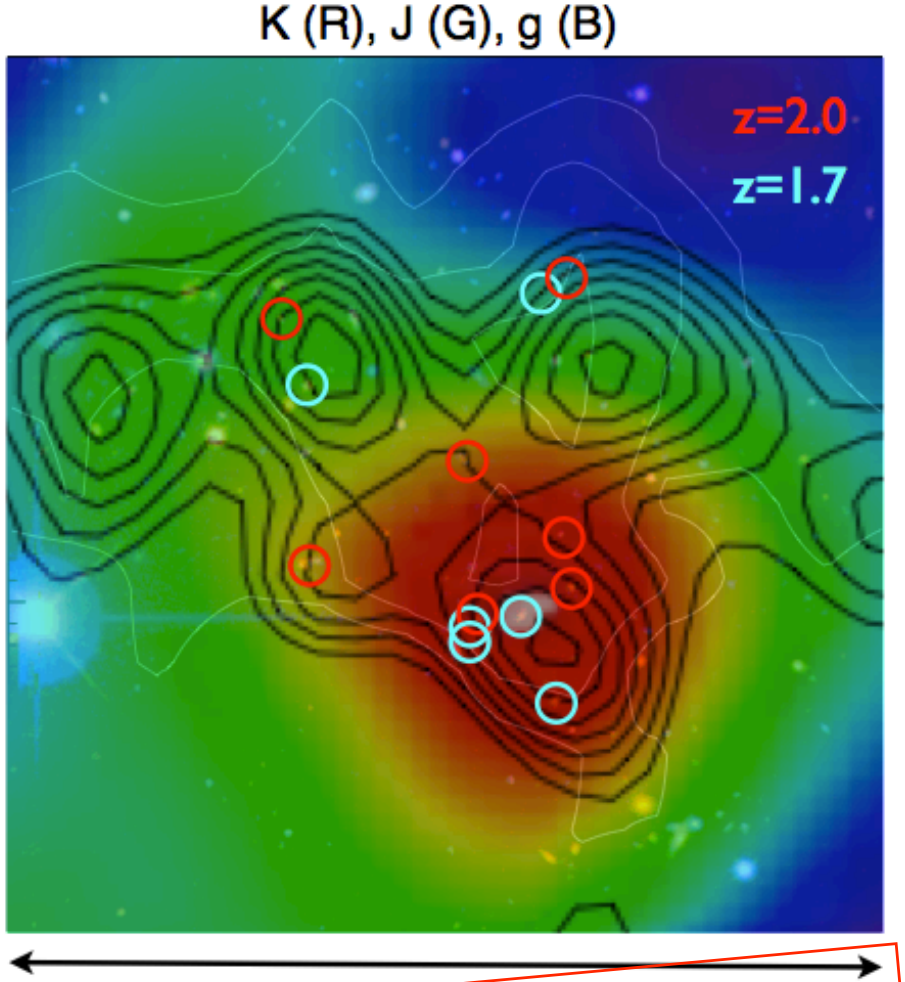
IR observation: CFHT + Spitzer

Overdensity of J-K galaxies

Spectroscopic redshifts (VLT)

2 groups of Galaxies: z=2.0 & z=1.7

(Flores-Cacho et al. in prep)



see Ines Flores-Cacho's poster

Courtesy Ludovic Montier

more identifications to go

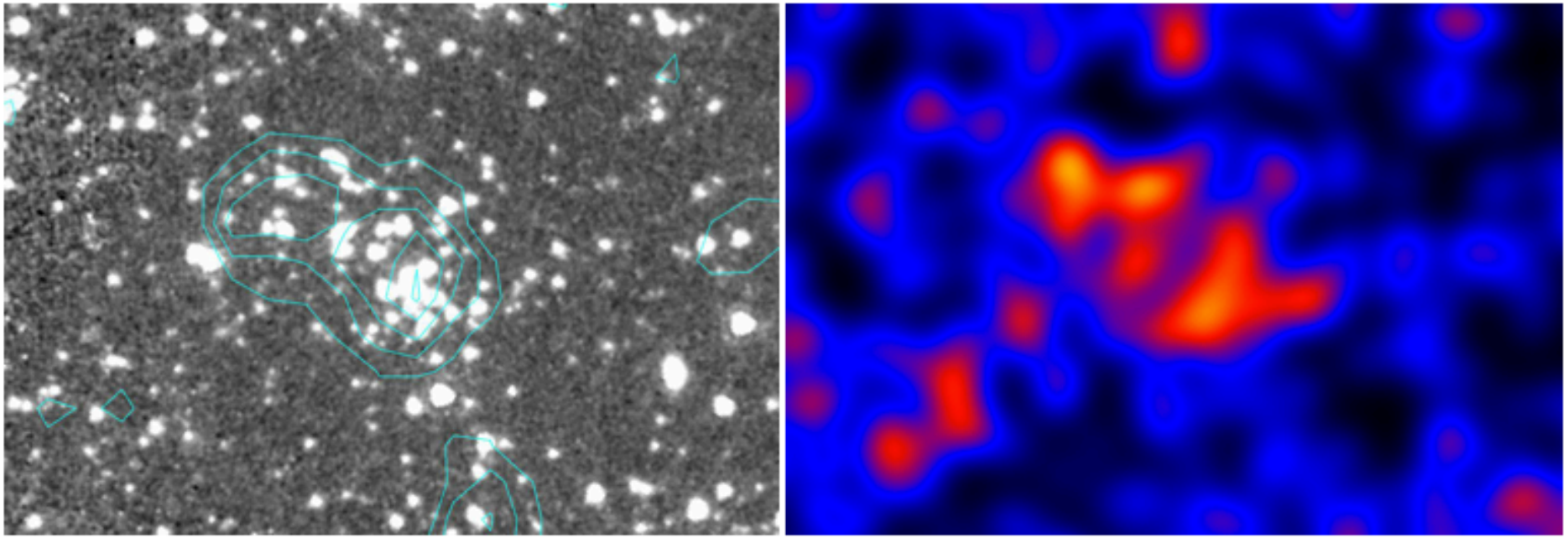


Figure 10. A high-z cluster candidate observed by *Planck*, Herschel, and here Spitzer-IRAC (3.5′ × 2.3′). Left: IRAC channel 2 (4.5 μm) with SPIRE 350 μm contour. Right: color image of the 4.5/3.6 color ratio, showing the red color of the sources within the cluster candidate.

clear need for imaging and spectroscopy in the NIR and mm;
work in progress

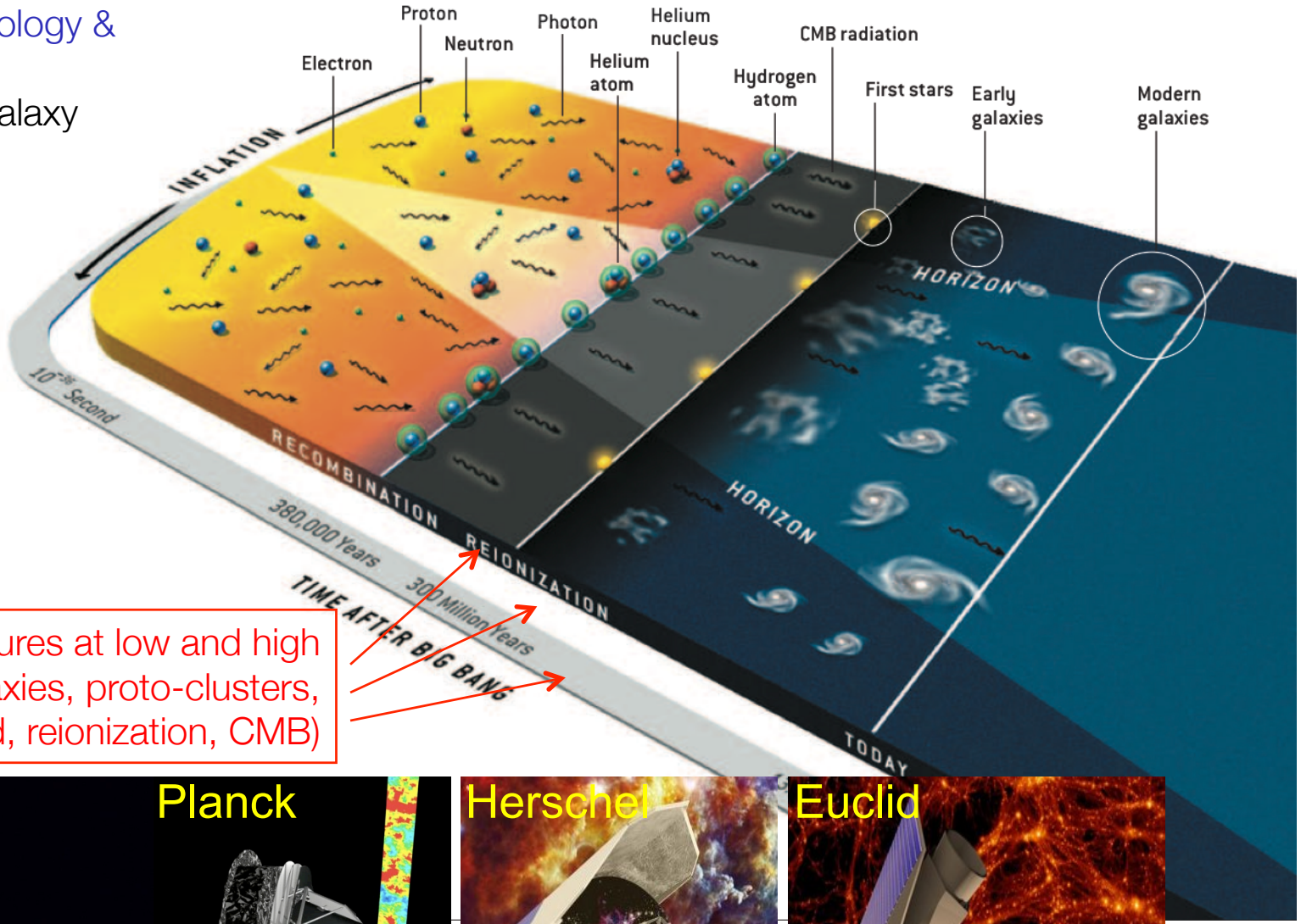
summary & conclusions

- Planck color selection of cold sources of the CIB (all sky):
  - PCCS red sources
  - and CIB fluctuations
- show SPIRE counterparts:
  - red (either 350um peaking or 500um risers)
  - bright lensed
  - overdensities
- all confirmed so far at z>1.7
  - and are promising samples for high-z studies
- synergy Herschel – Planck in action
  - thanks to the Herschel teams and ST
- extensive multi-wavelength follow-up on-going
  - NIR img/spectra – mm img/spectra

- See posters: David Guéry, Nicole Nesvadba, Ines Flores-Cacho

perspectives

nexus between cosmology & astrophysics:
structure formation, galaxy formation & evolution



Search for structures at low and high redshift (clusters, galaxies, proto-clusters, infrared background, reionization, CMB)