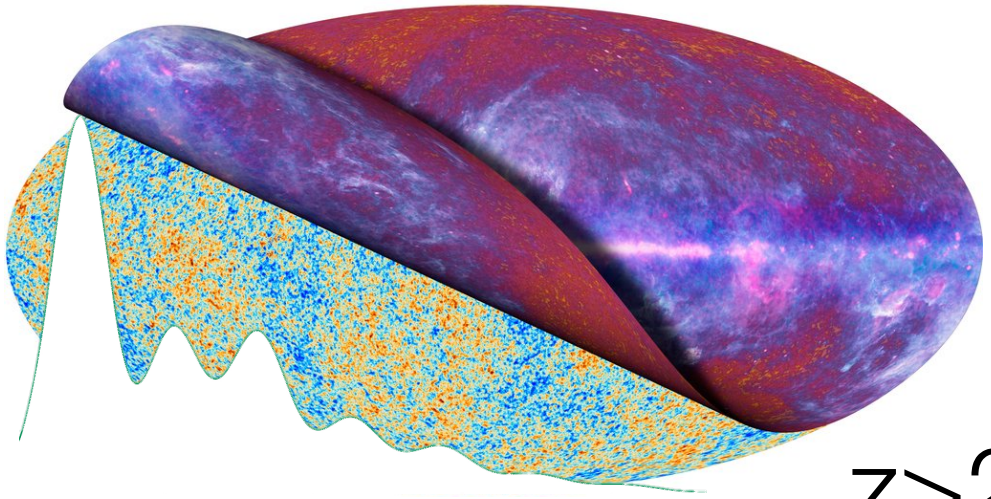

Planck, Herschel & Spitzer unveil z>2 cluster candidates. Prospects for JWST, Euclid

introduction 1.
digging into the Planck CIB 2.
Planck & Herschel outcome 3.
Spitzer towards JWST 4.
conclusions 5.

Hervé Dole

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

IAS Institut d'Astrophysique Spatiale Orsay

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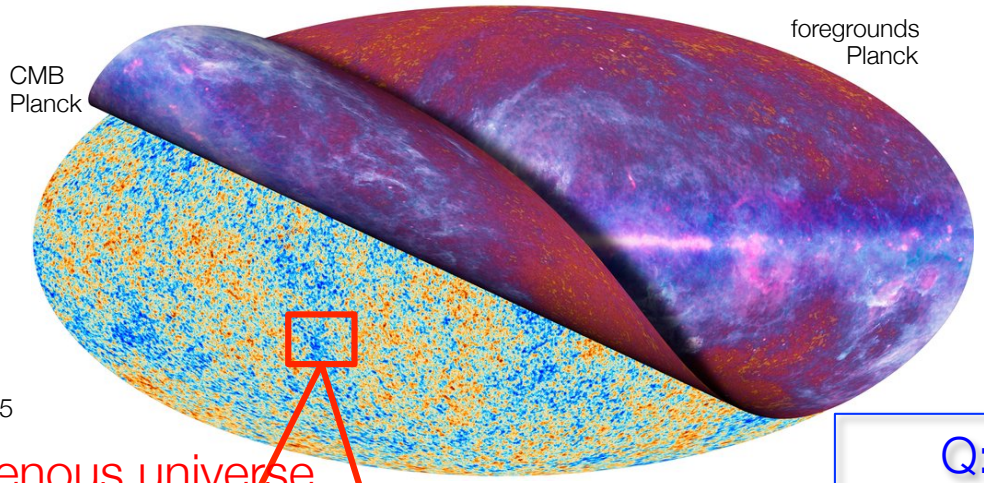
DÉPARTEMENT Sciences de la Planète et de l'Univers

1. some of the challenges in cosmology



$\Delta\rho/\rho \sim 10^{-5}$
homegenous universe
z=1090

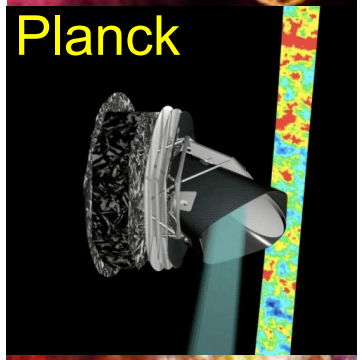
?

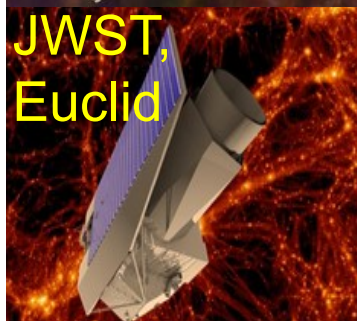
cosmological model ΛCDM

Q: processes of structure formation, esp. first clusters, mass assembly, gas cooling, star formation, galaxies ?

$\Delta\rho/\rho > 10^{20}$
inhomogeneous structured, universe
z=0

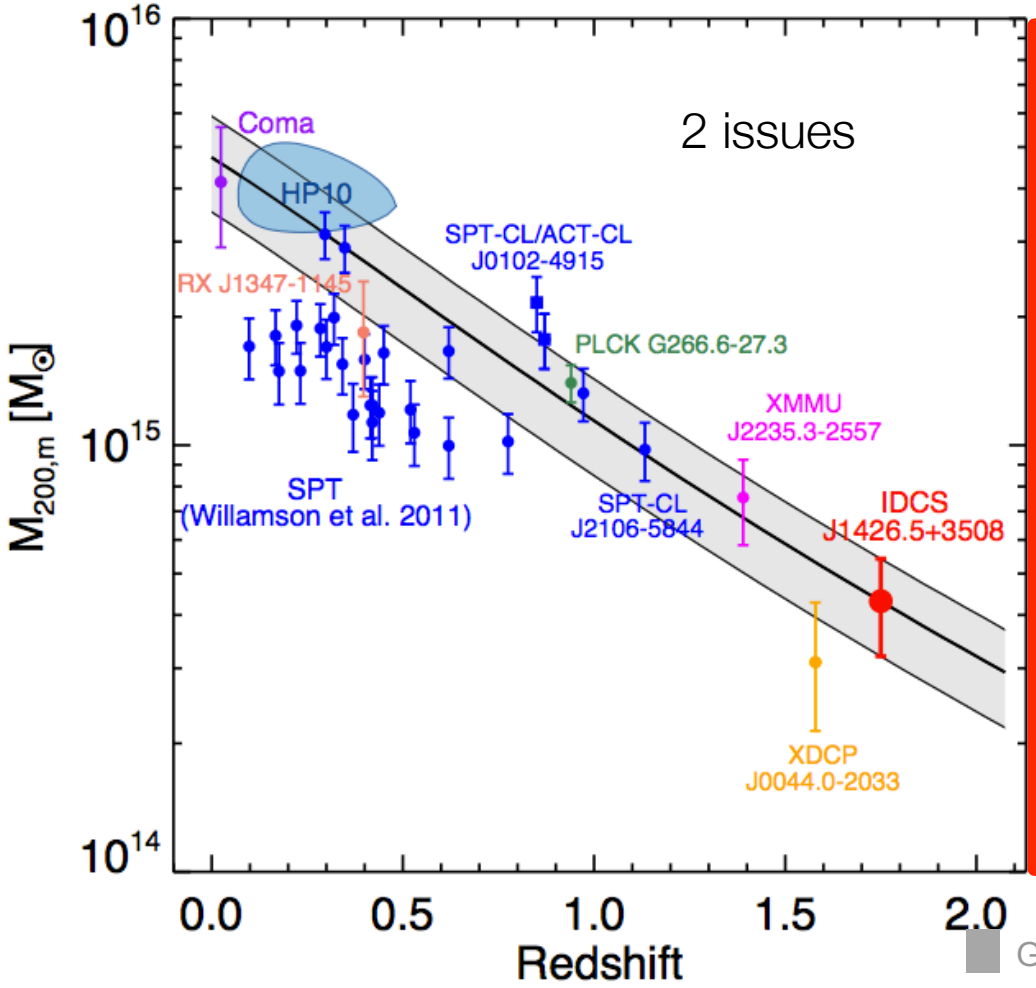
processes implying :
- fundamental forces
- dark components
- baryon physics
- cosmological parameters





searching for high-z massive structures: link DM-baryons

Predictions / mesurements: massive clusters vs redshift



Q: processes of cluster
- stellar mass assembly
- star formation ?
--> can we find a new way to select **highly star-forming clusters** ?

z > 2

Planck

Herschel, ALMA

then Euclid, WFIRST, JWST

Brodwin et al, 2012 – Mortonson et al., 2011

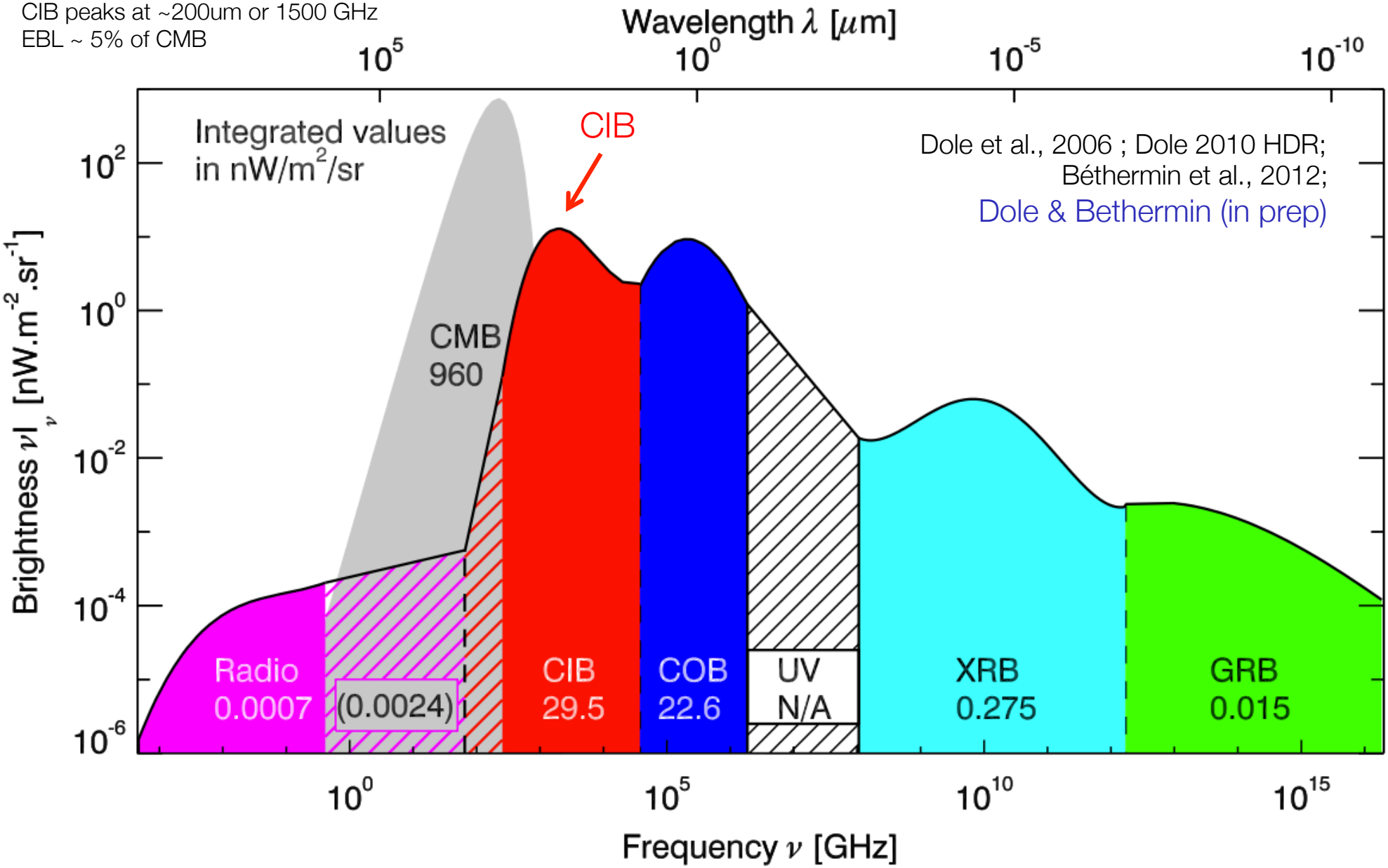
Gobat Cl.

how to find z>2 clusters ?
(observationnally) rare objects can be unveiled using all-sky surveys: Planck, Euclid, and further studied with JWST, WFIRST

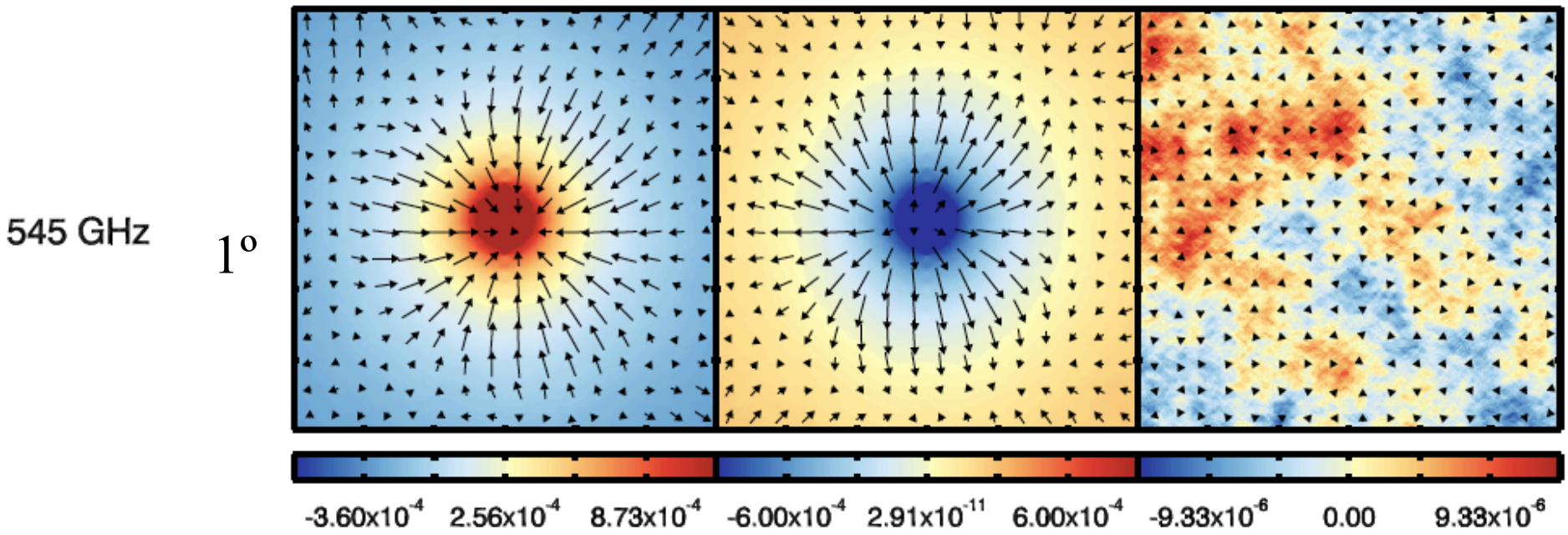
Galaxy clusters are proxies for massive DM halos

2. Extragalactic Bkg Light SED

CIB > COB
CIB peaks at ~200um or 1500 GHz
EBL ~ 5% of CMB



CIB peaks correspond to mass peaks…

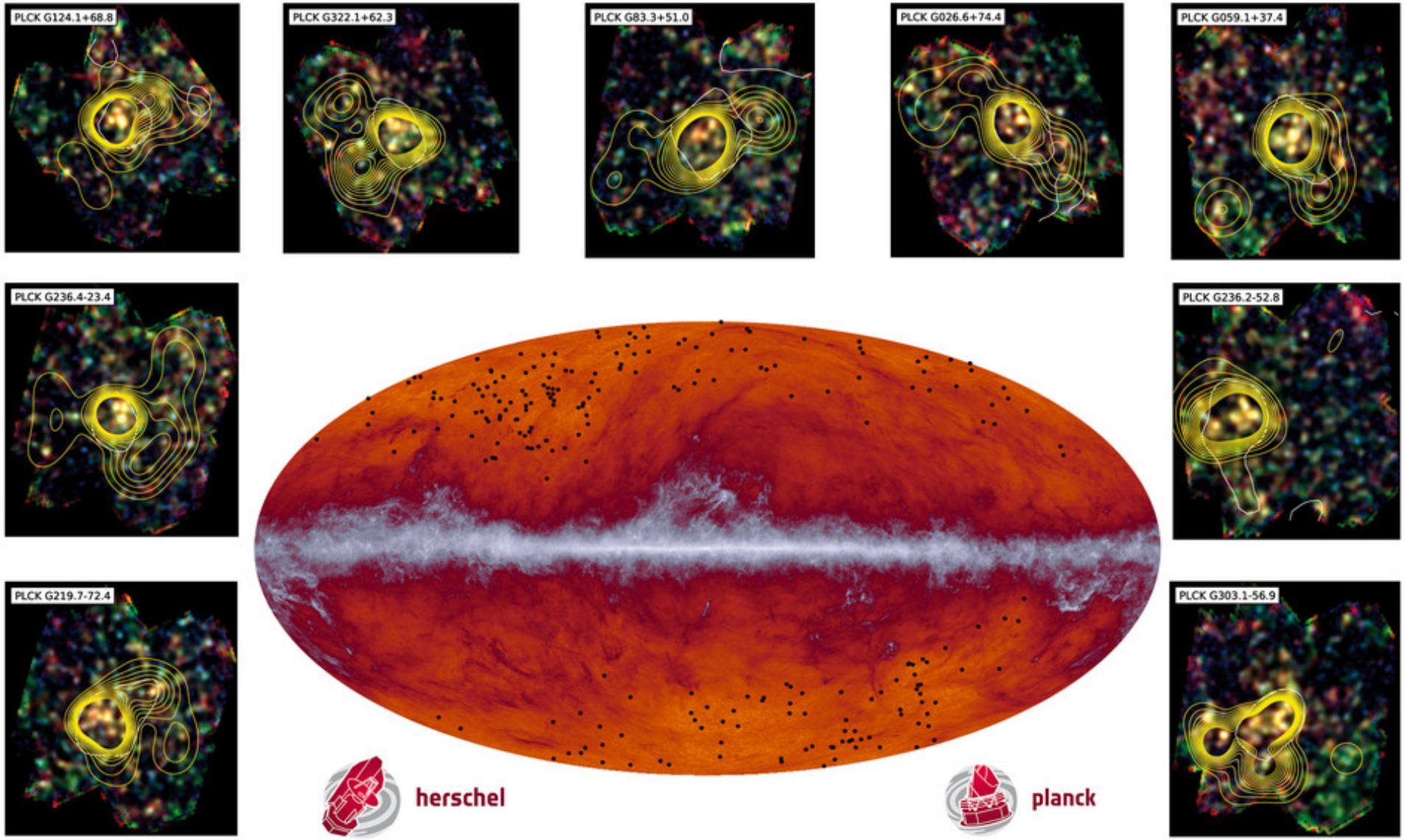


… and the CIB probes also high-z SFR

-> a novel method to search for high-z clusters in formation
(CIB > high SFR > massive high-z clusters)

Planck 15 months
Planck Collaboration, 2013, 18

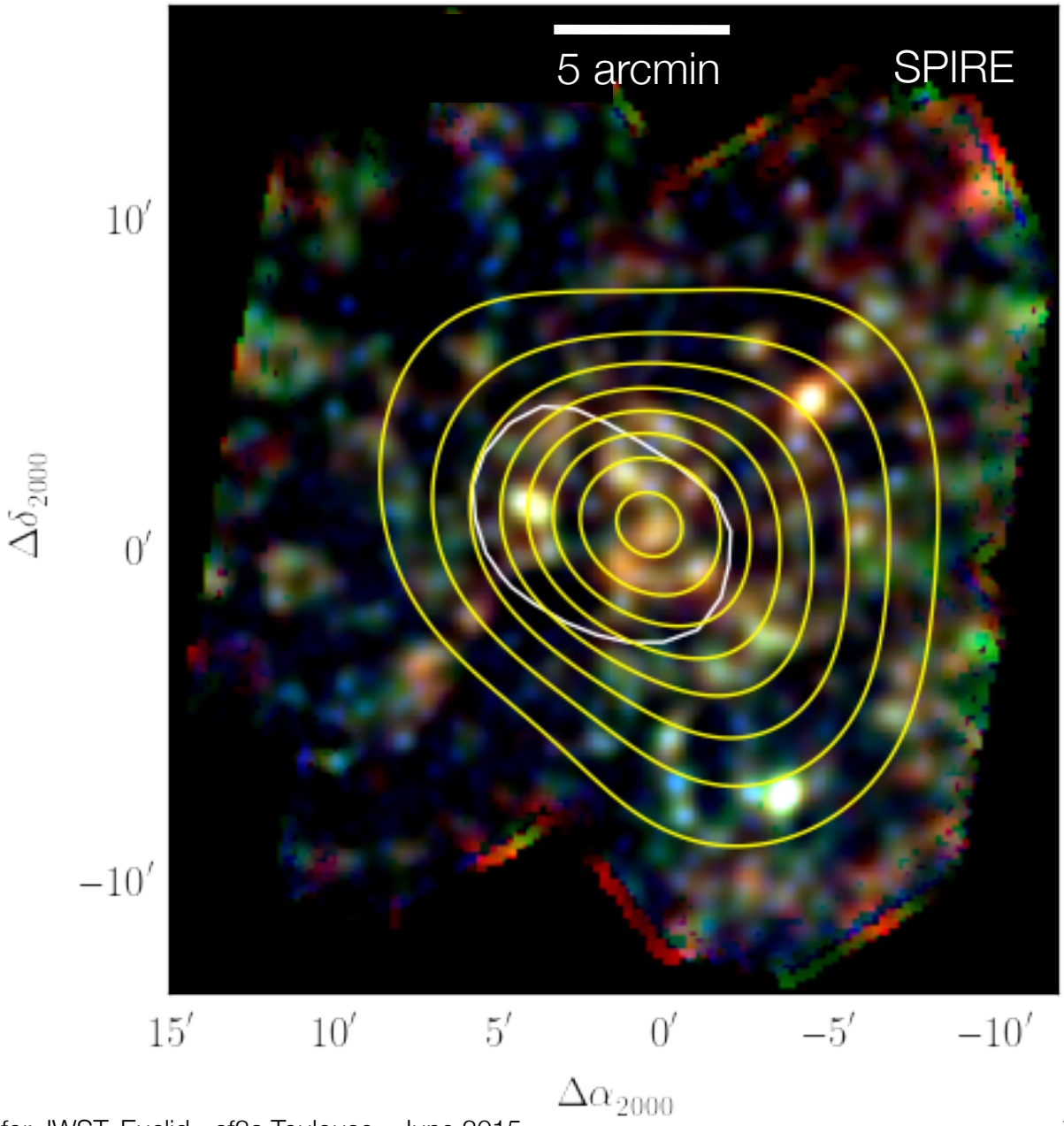
3 Herschel and Planck proto-cluster candidates



Planck Collab., 2015, Int XXVII
Press Releases: ESA, NASA, INSU, A&A

the case of one field: Spitzer and VLT

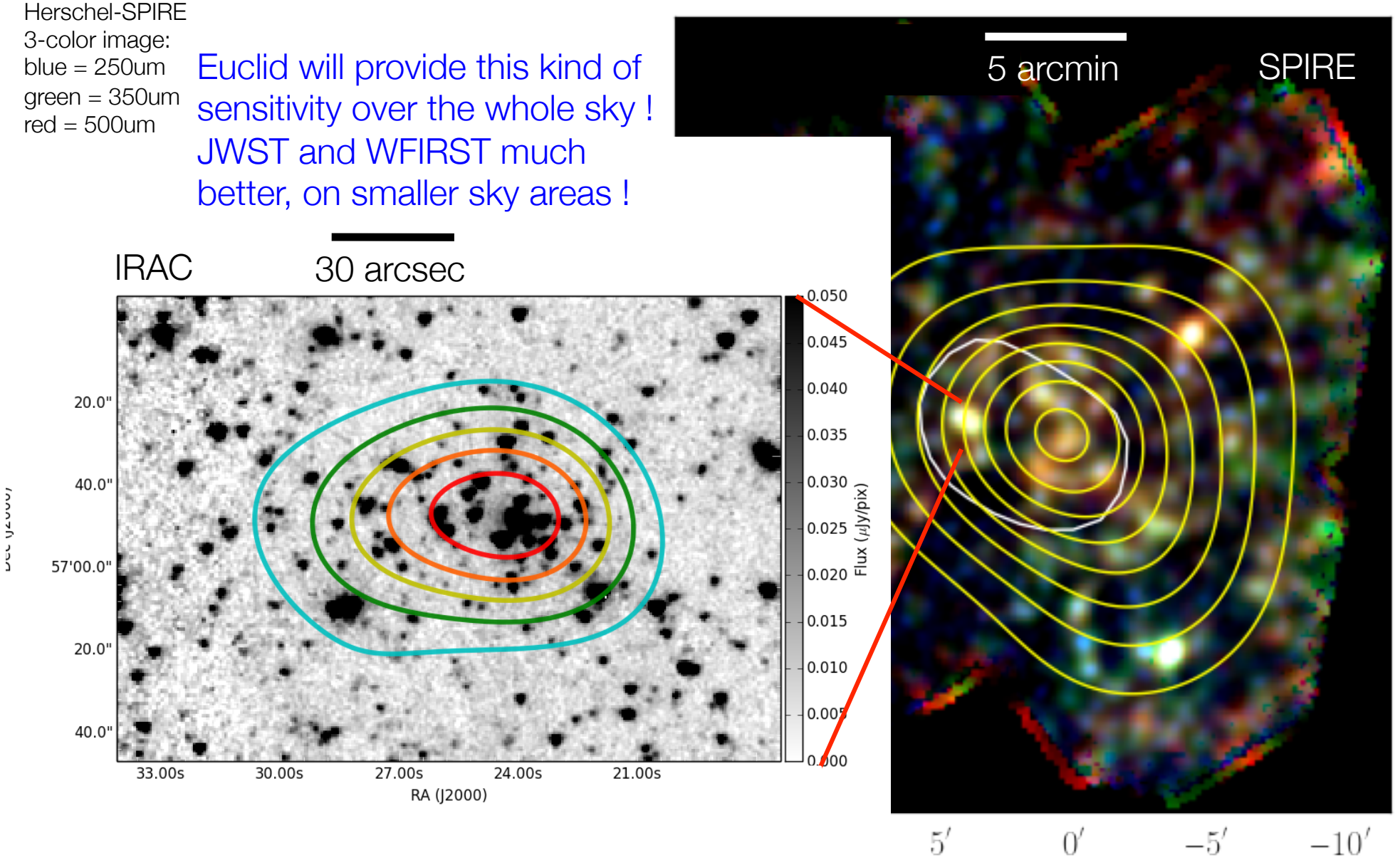
Herschel-SPIRE
3-color image:
blue = 250um
green = 350um
red = 500um



the case of one field: Spitzer and VLT

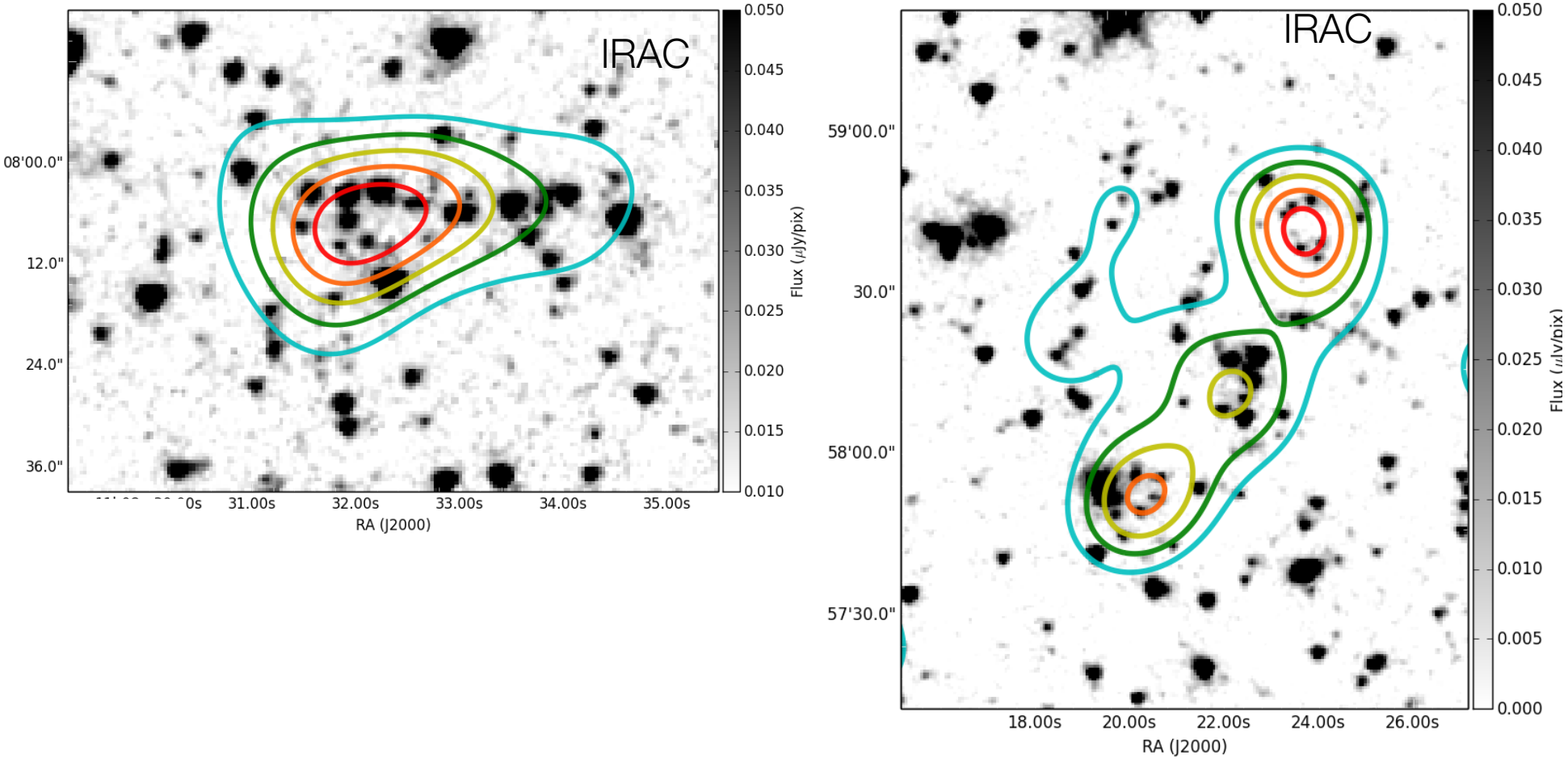
Herschel-SPIRE
3-color image:
blue = 250um
green = 350um
red = 500um

Euclid will provide this kind of sensitivity over the whole sky !
JWST and WFIRST much better, on smaller sky areas !



Martinache et al., in prep

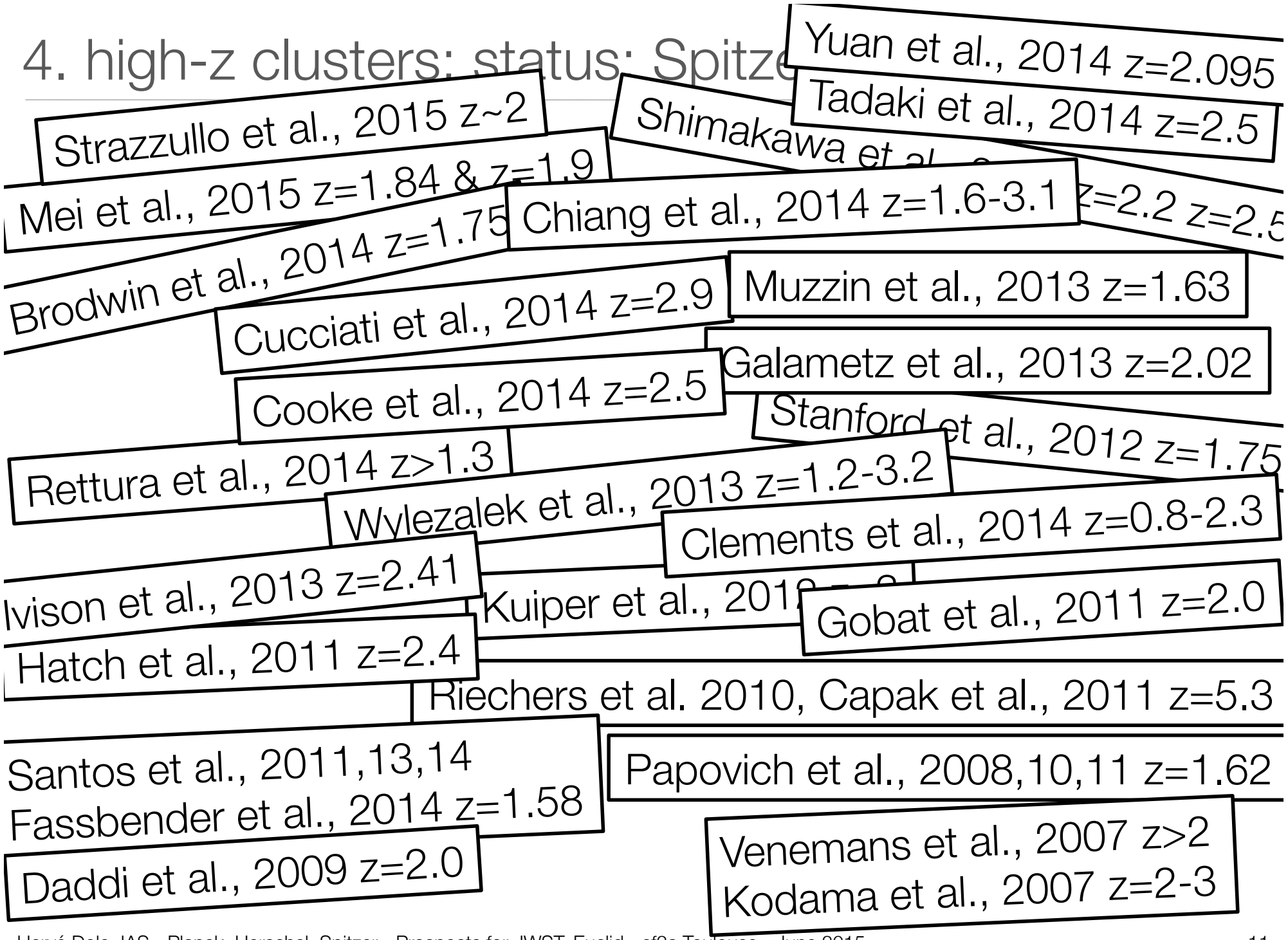
many more Spitzer examples



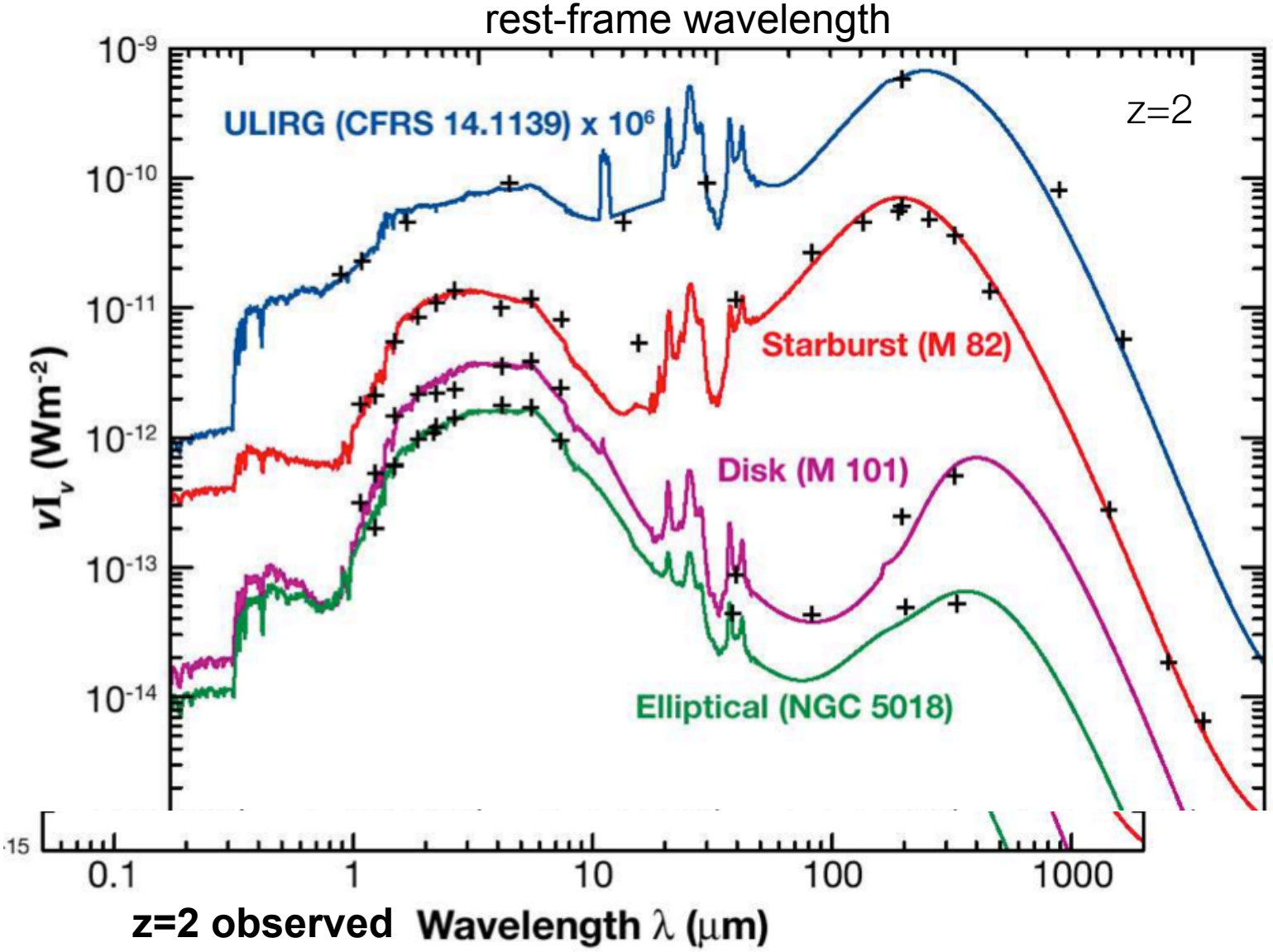
Martinache et al., in prep

4. high-z clusters: status; Spitzer towards JWST

4. high-z clusters: status: Spitze

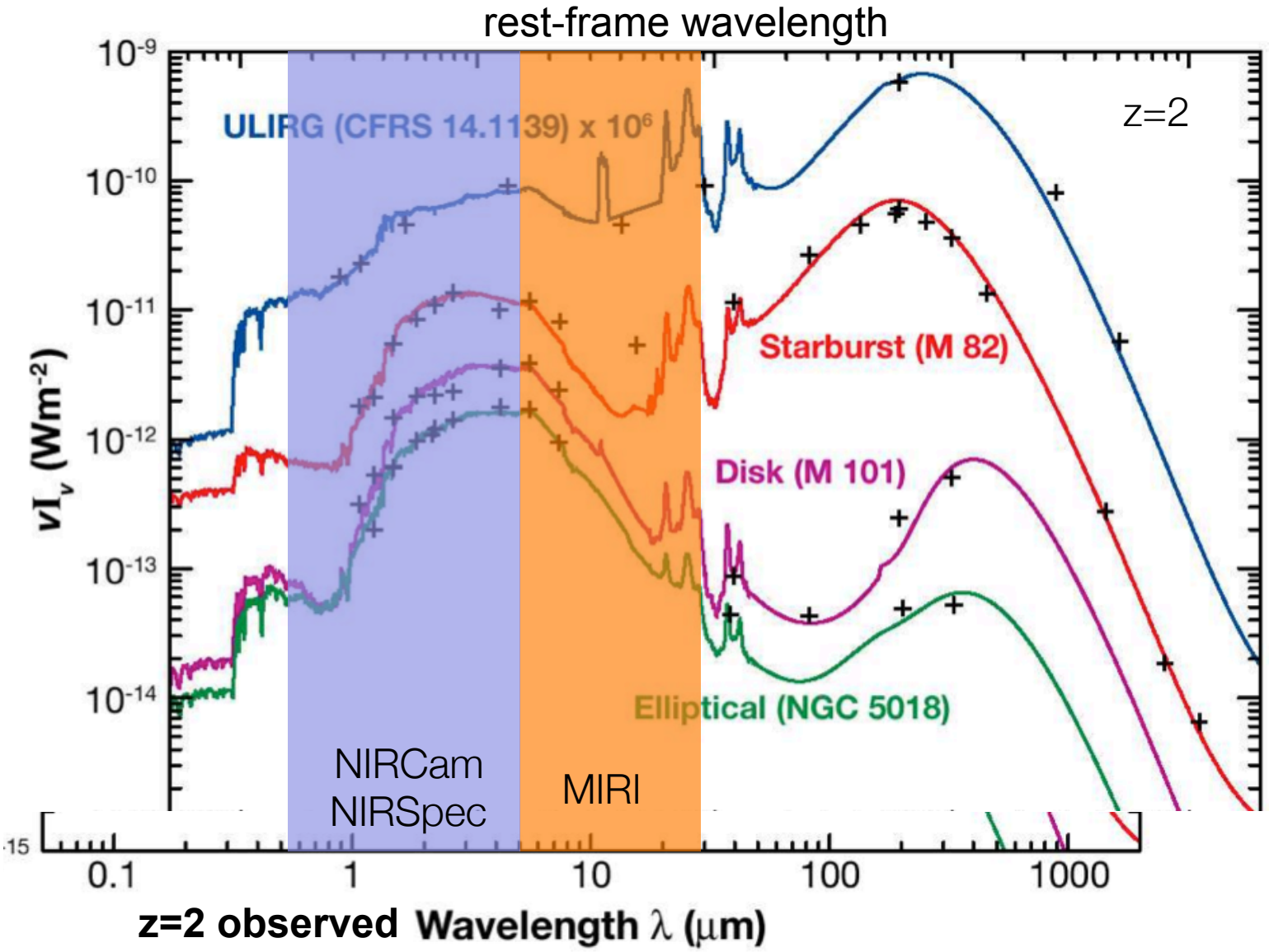


MIRI: a key range for z>1 structures



Lagache, Dole, Puget, 2005, ARAA
from Galliano 2004

MIRI: a key range for z>1 structures



In the redshift range
~1 < z < ~3
MIRI probes
unique spectral
features,
even at low spectral
resolution

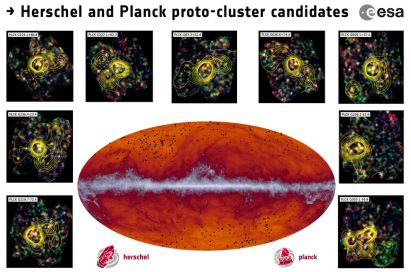
Lagache, Dole, Puget, 2005, ARAA
from Galliano 2004

GO proposal project: high-z clusters w. MIRI

- federation / coordination of interested parties
- taking benefit of
  - different selections of high-z clusters
    - Stellar masses; radiogalaxies; submm emission; LAE; LBG
  - extended expertise
- submission of a well-coordinated GO proposal, covering key questions w/ key samples
- cluster formation / bias baryons/DM / star formation/AGN is dense environements w/ z
- Science goals
  - Galaxies and cluster dynamics w/ galaxy MIR lines
  - Gas dynamics with IGM MIR emission lines
  - Mass, z, SF vs AGN
  - (complementary to ALMA)

5. summary & conclusions: high-z clusters

- High-z clusters are exciting
  - Cosmology, LSS
  - Galaxy evolution
  - e.g. Planck/Herschel



- Many samples of z>2 cluster (confirmed or candidates) exist: targets are already identified
- Different selections

- Coordination for a high-z cluster MIRI proposal
  - Imaging and IFU
  - Details TBD
  - Census of galaxies, their gas and IGM in densest environments and halos
- Synergies w/ Euclid