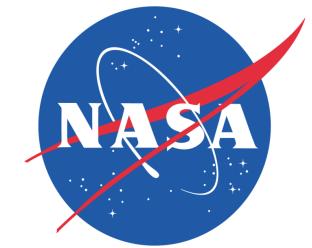


# The Planck Satellite: Early results and more to come

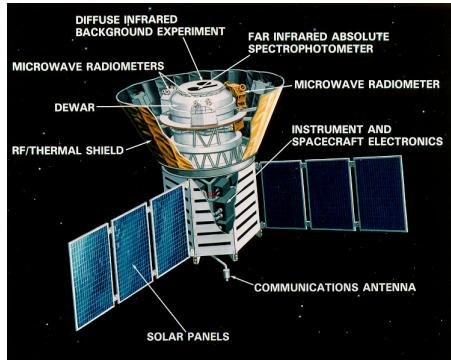


esa

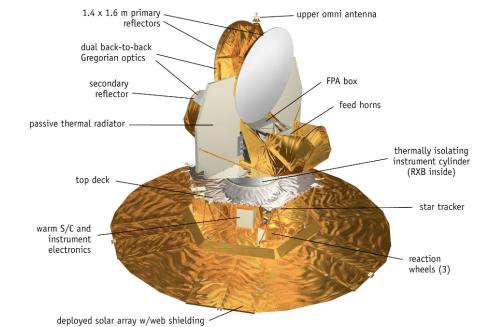


Kevin Huffenberger, *University of Miami*  The University of Miami logo, consisting of a green 'U' with an orange 'M' inside it.

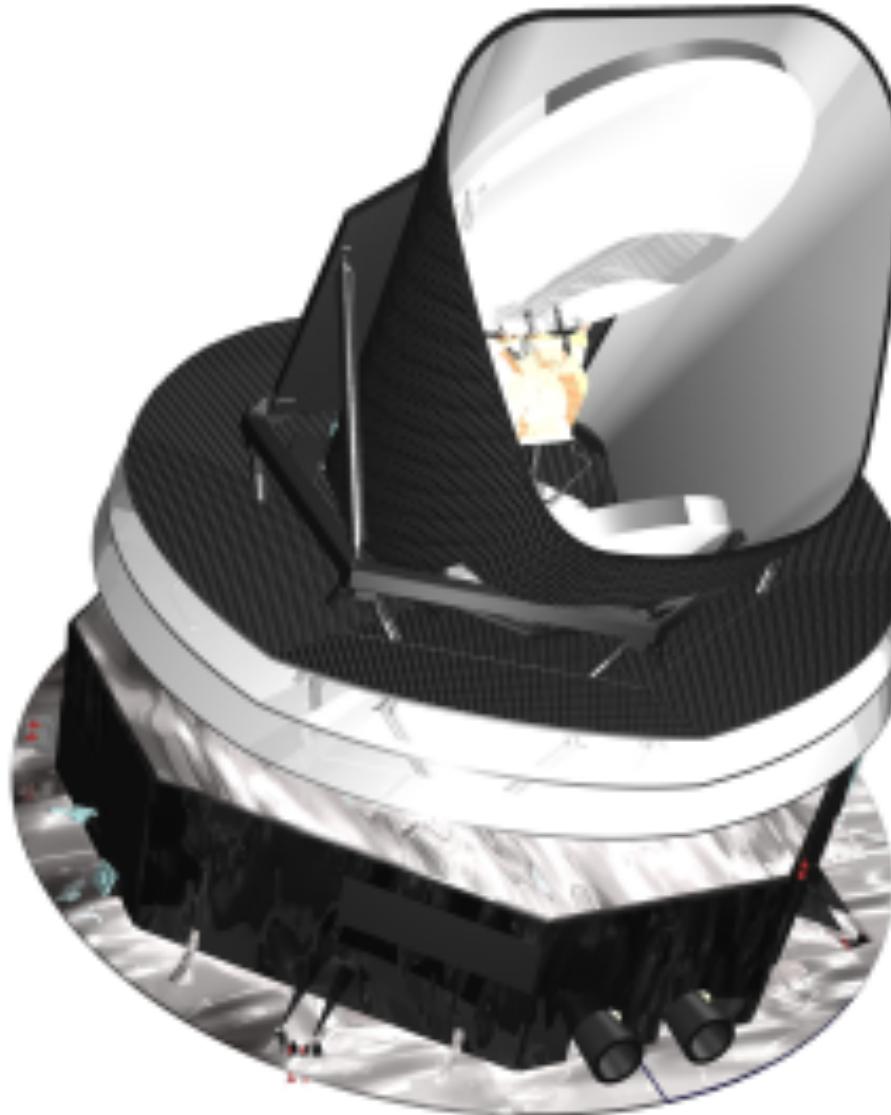
# 3 Generations of CMB Satellites



COBE



WMAP



Planck

# **Science Goals**

Map temp. and pol. of CMB... measure cosmology

Map galactic emission & magnetic field

Measure bright extragalactic AGN and DSFGs

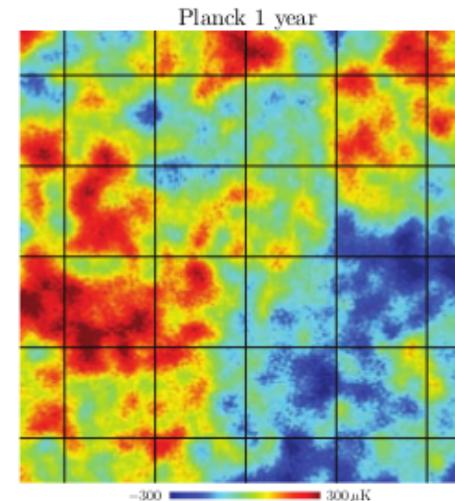
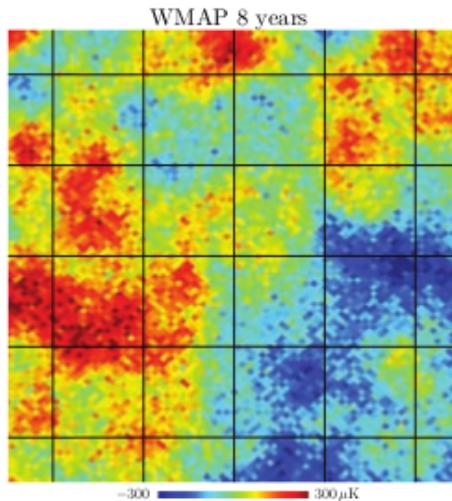
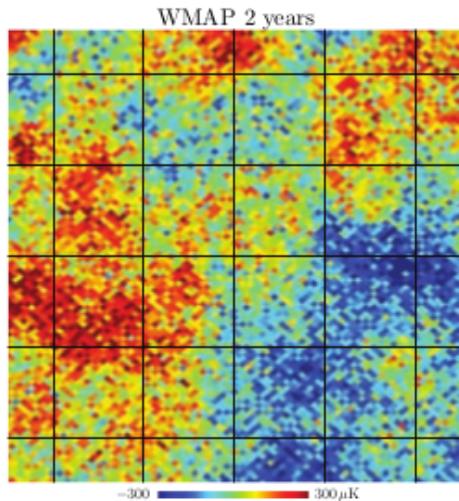
Find galaxy clusters

# Capabilities

"3 times better resolution

&

10 times lower noise than WMAP"



Planck: 9 channels

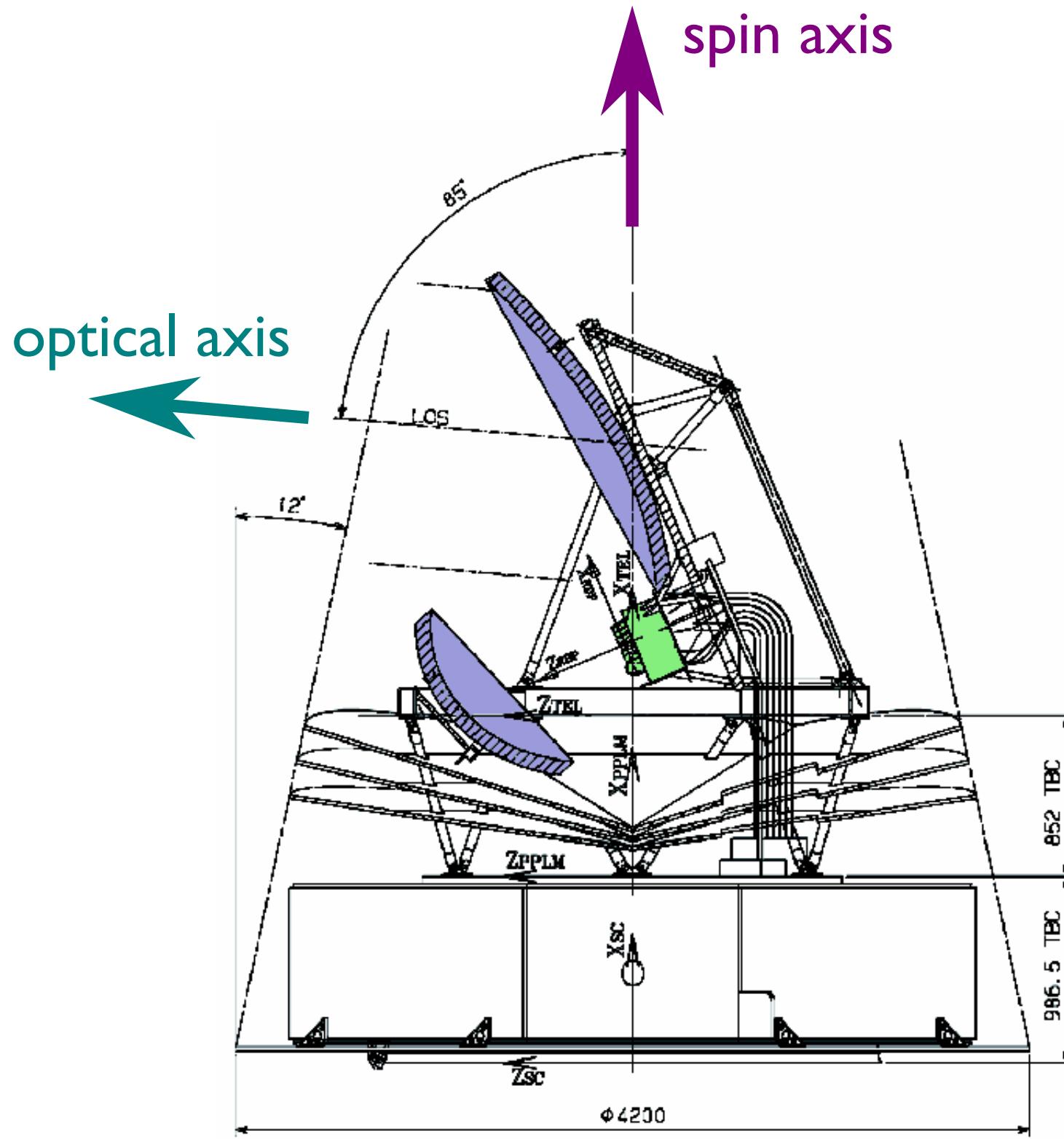
30 44 70

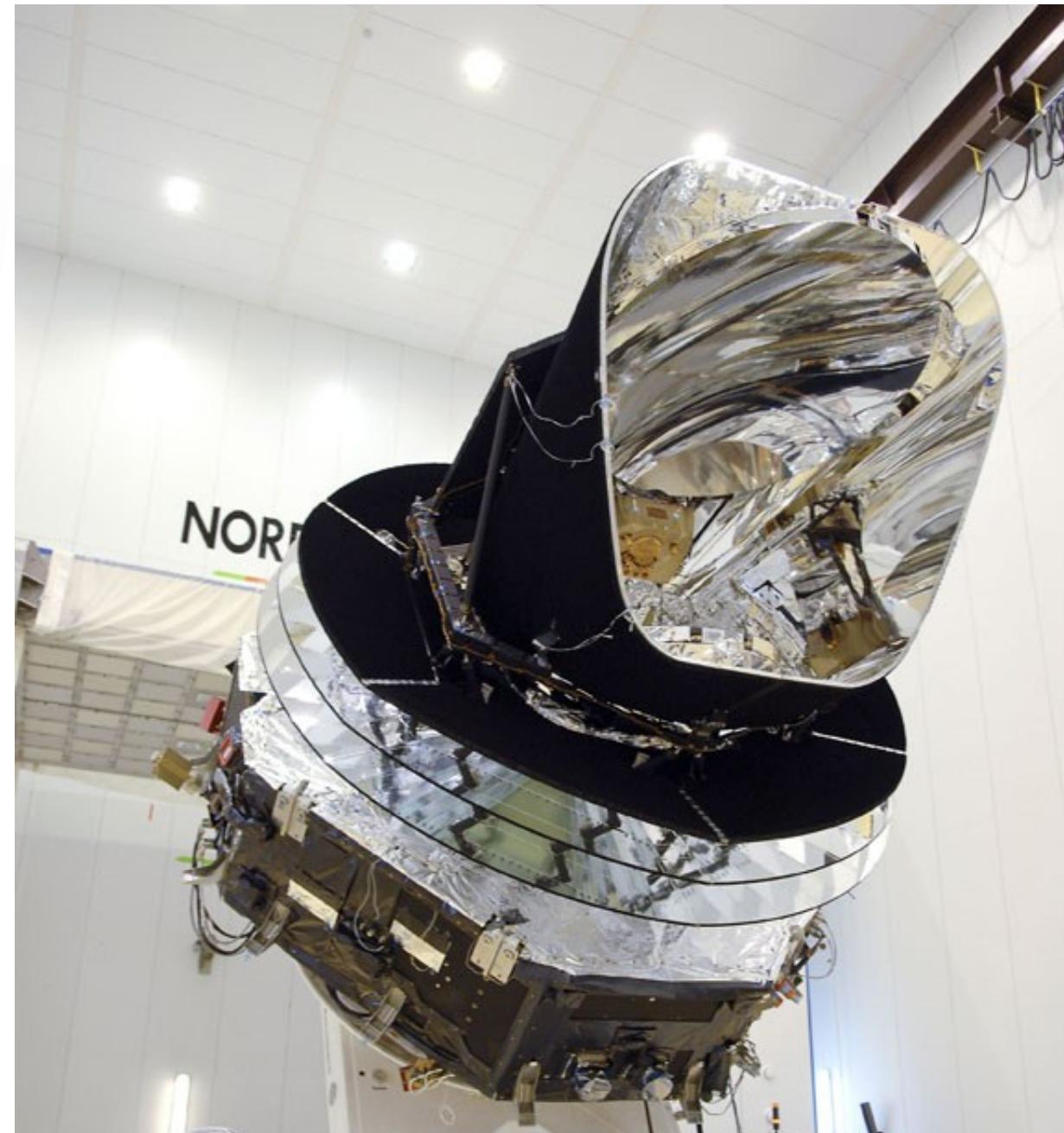
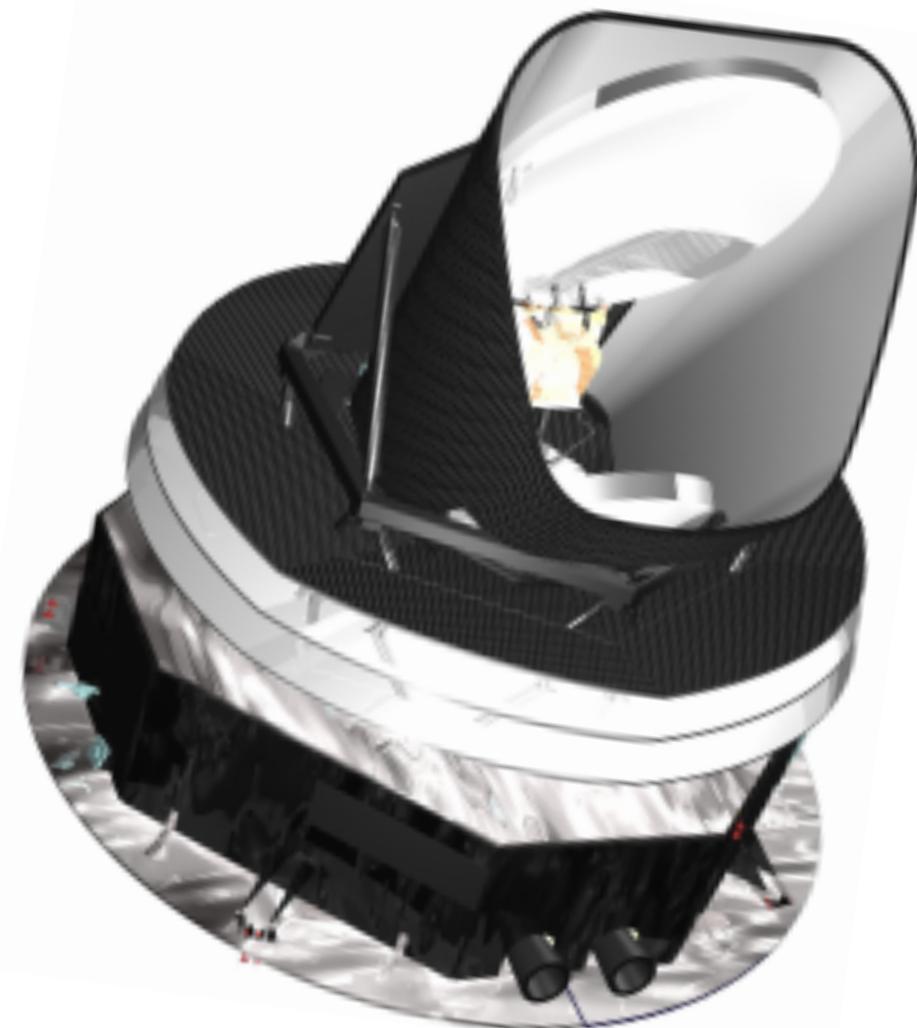
100 143 217

HFI

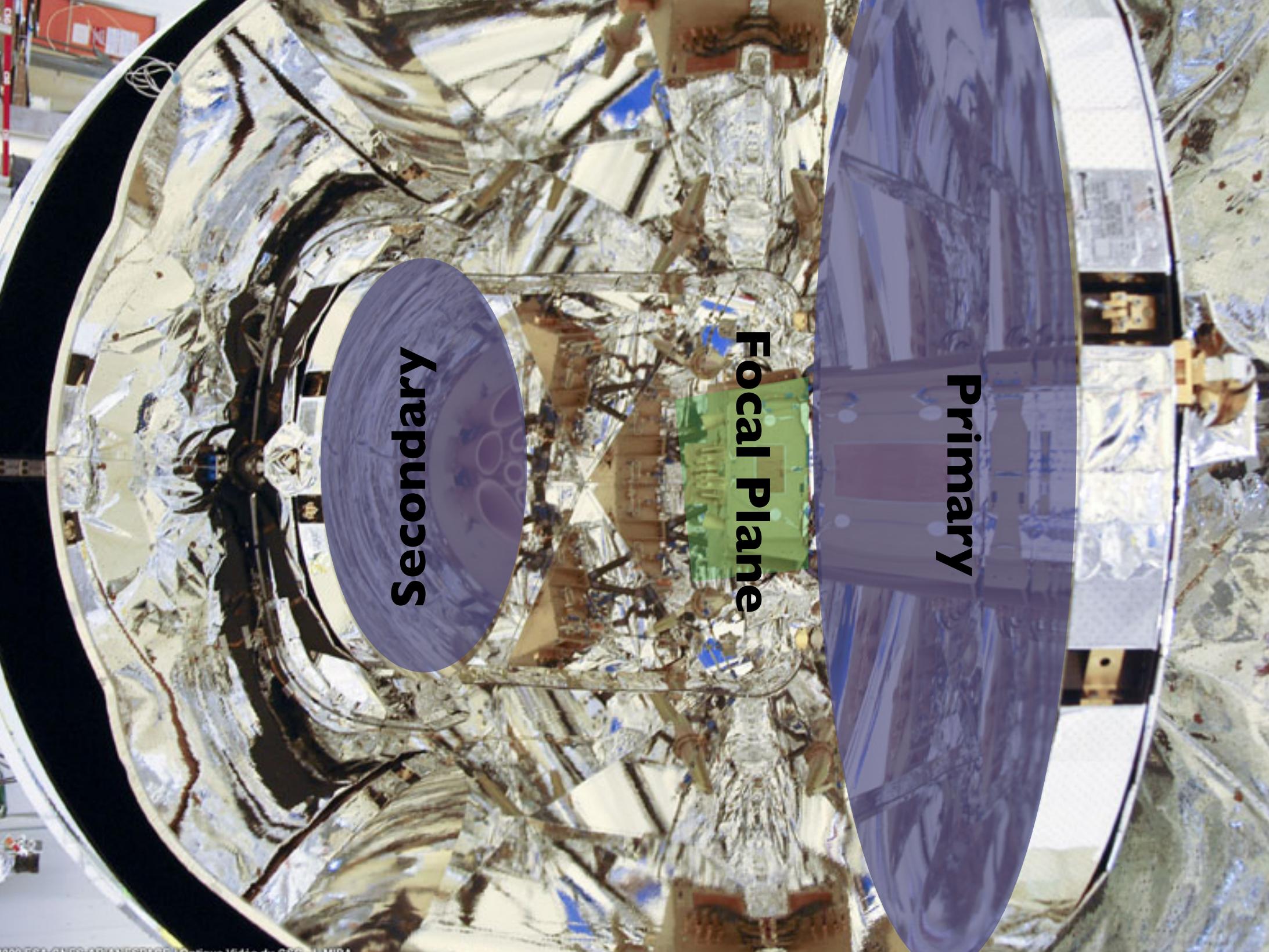
LFI

(20-30% bandwidth)





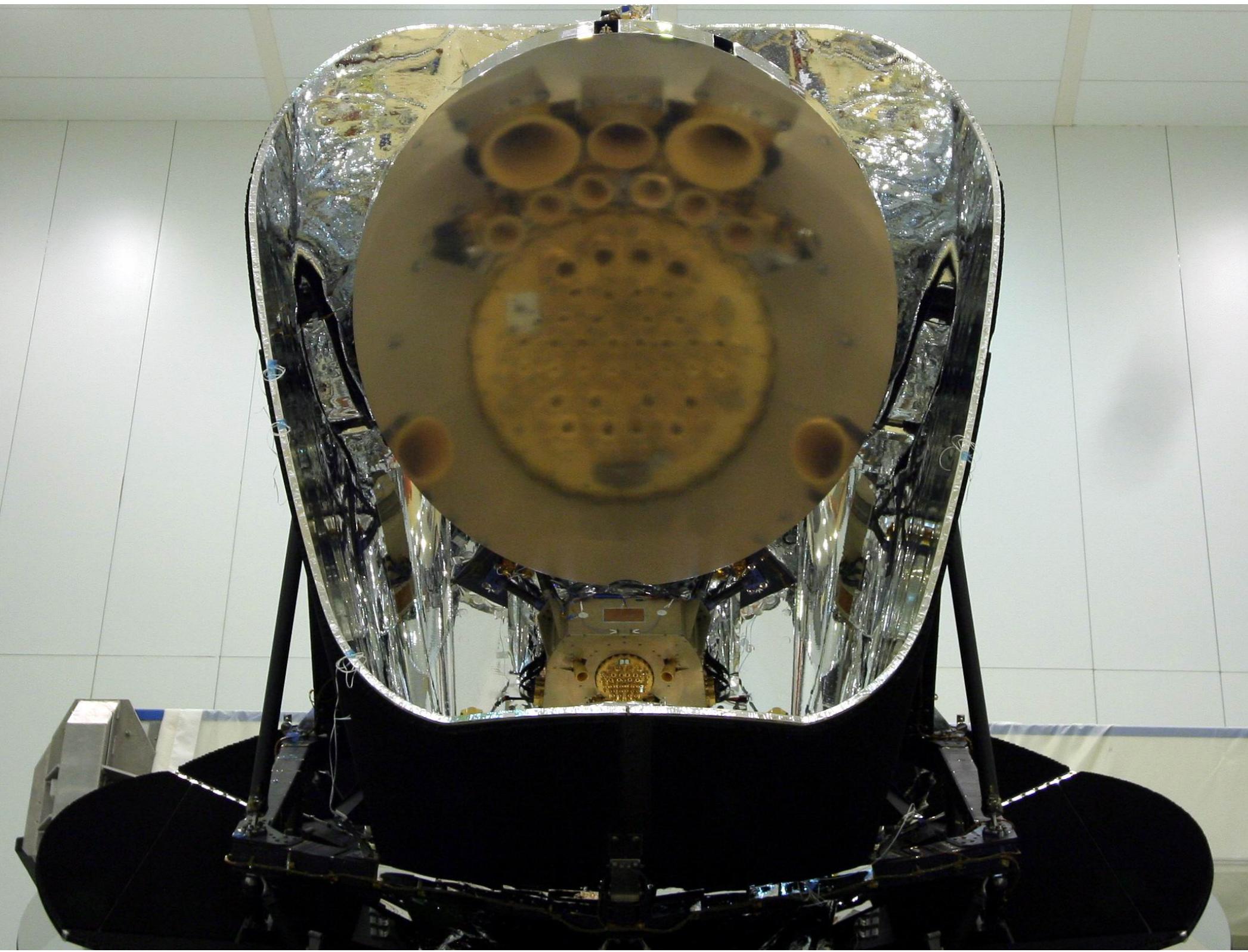




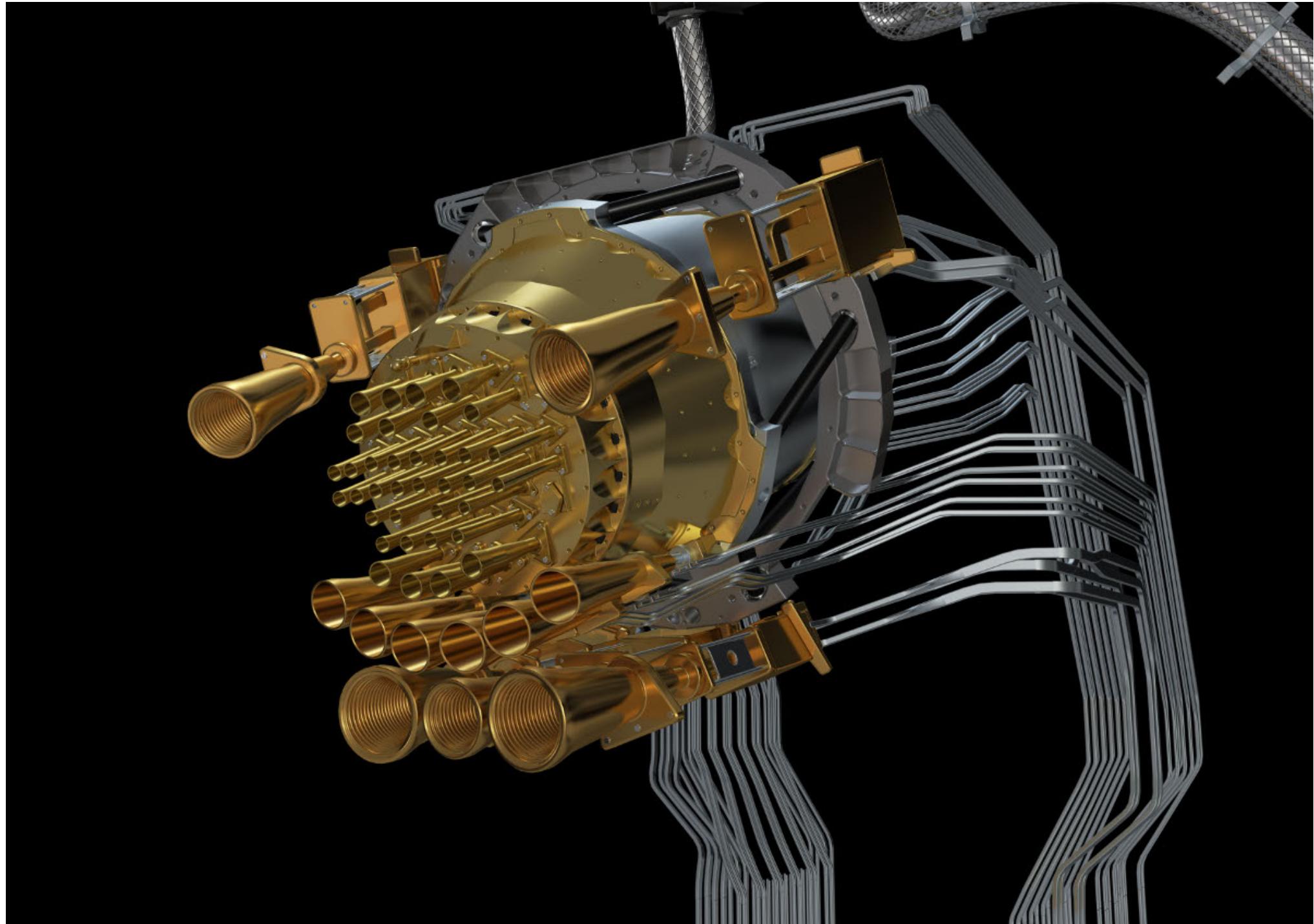
Secondary

Focal Plane

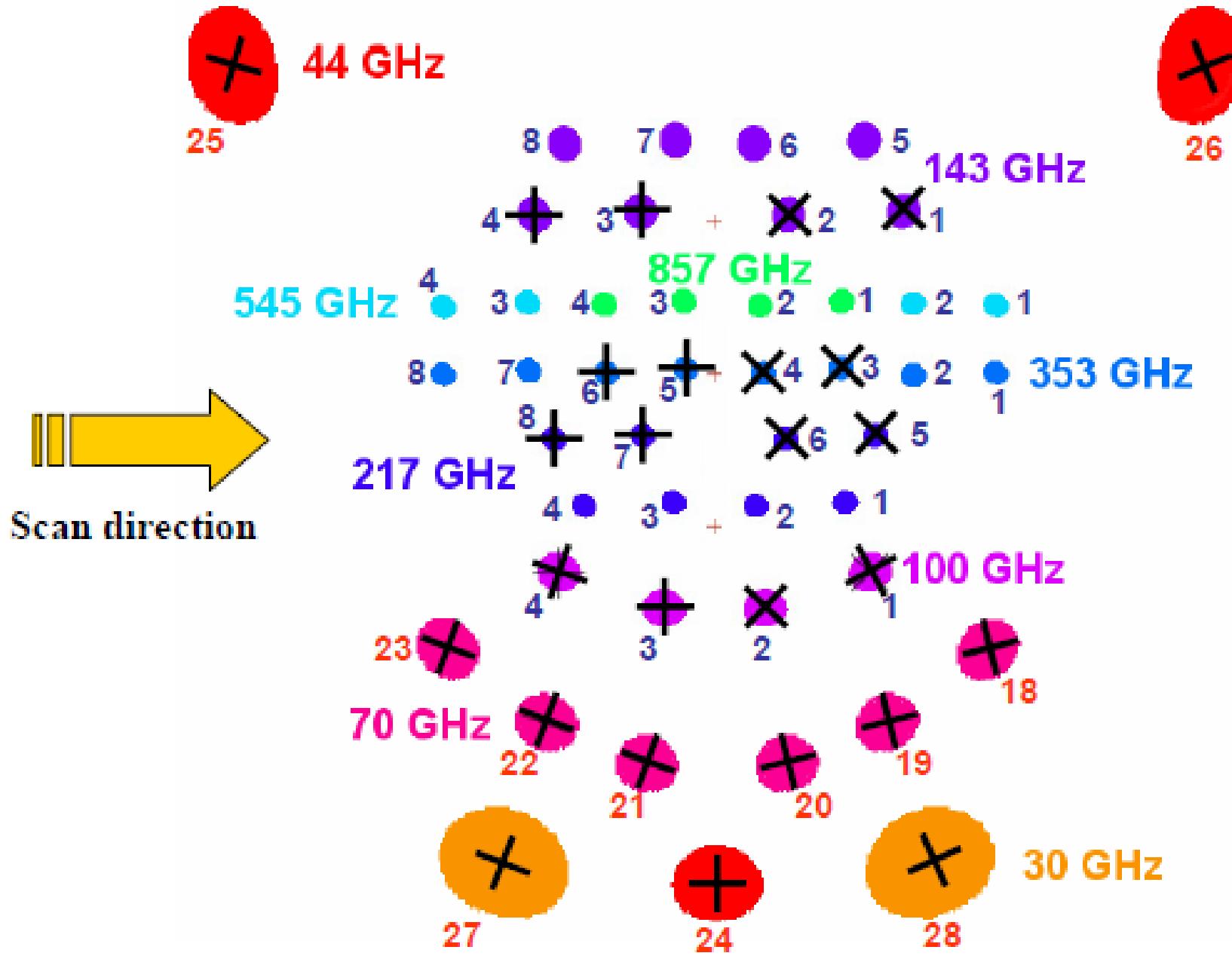
Primary



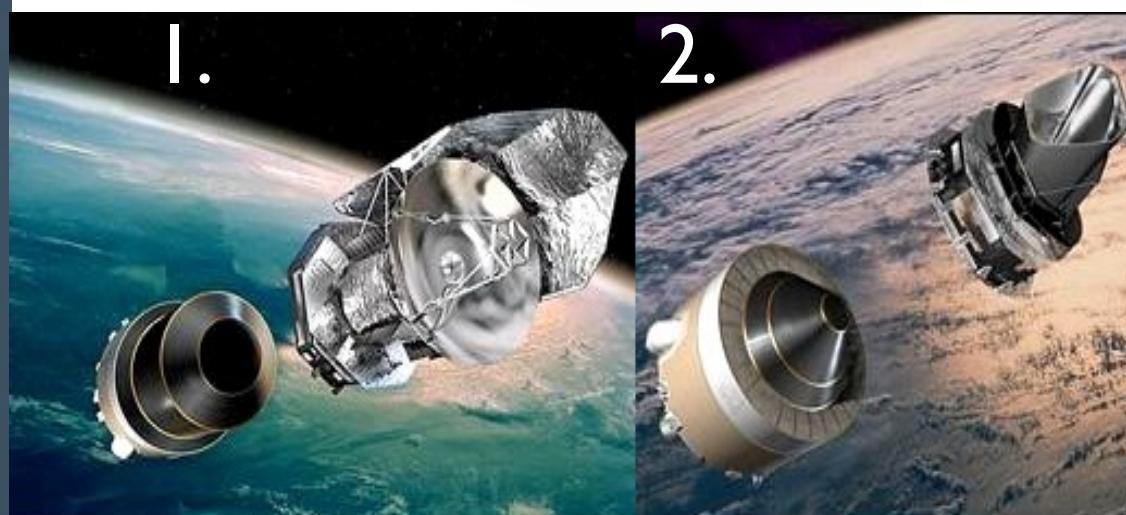
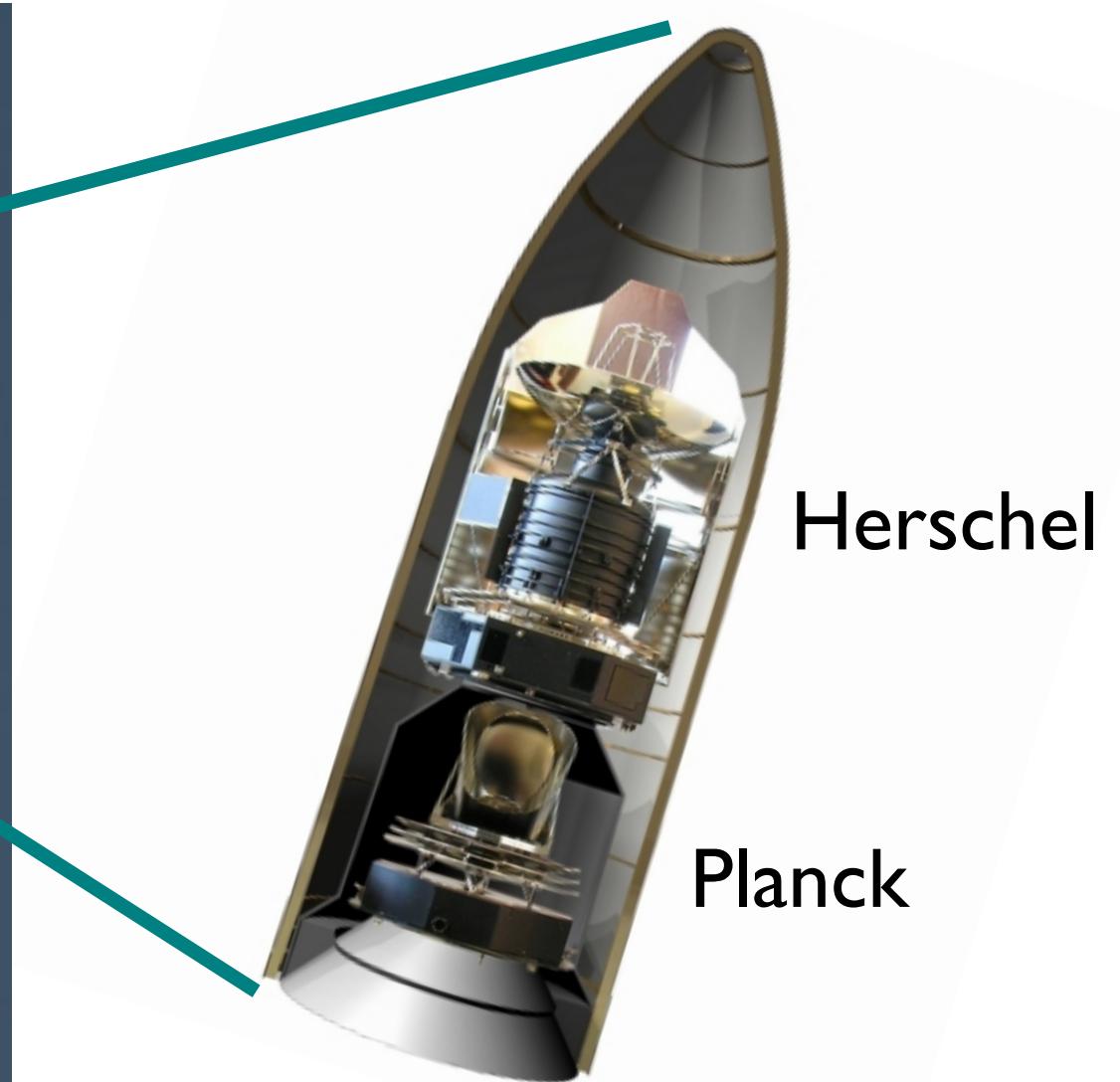
# Focal plane



# Planck focal plane



14 May 2009

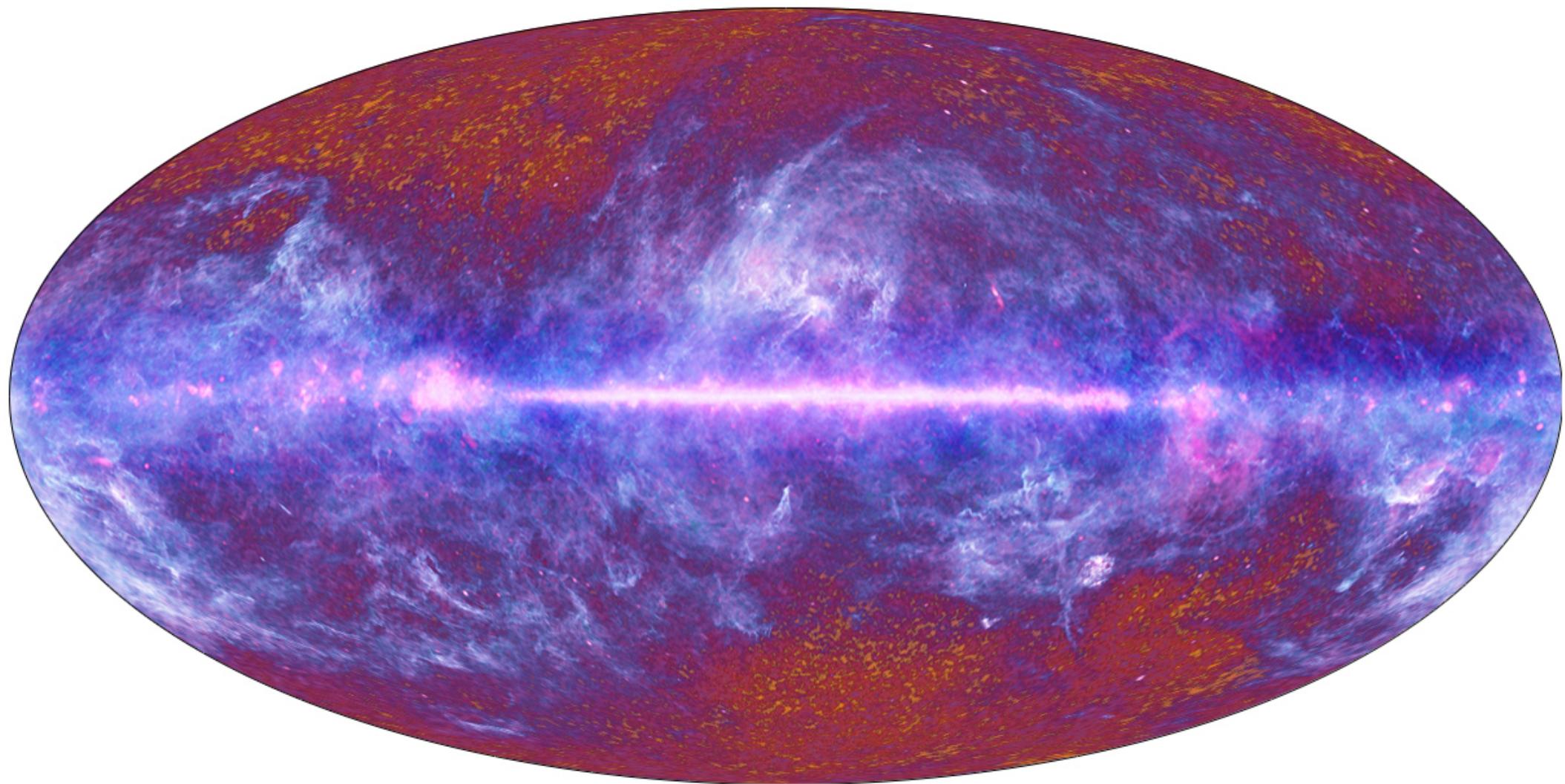


# 1.5 million km away at L2



(movies)

# Planck's first full-sky image



Goal: map galactic emission...

# **Planck papers released so far:**

25 "Early Results" papers (Jan 2011)

11 "Intermediate Results" papers (from Dec 2011)

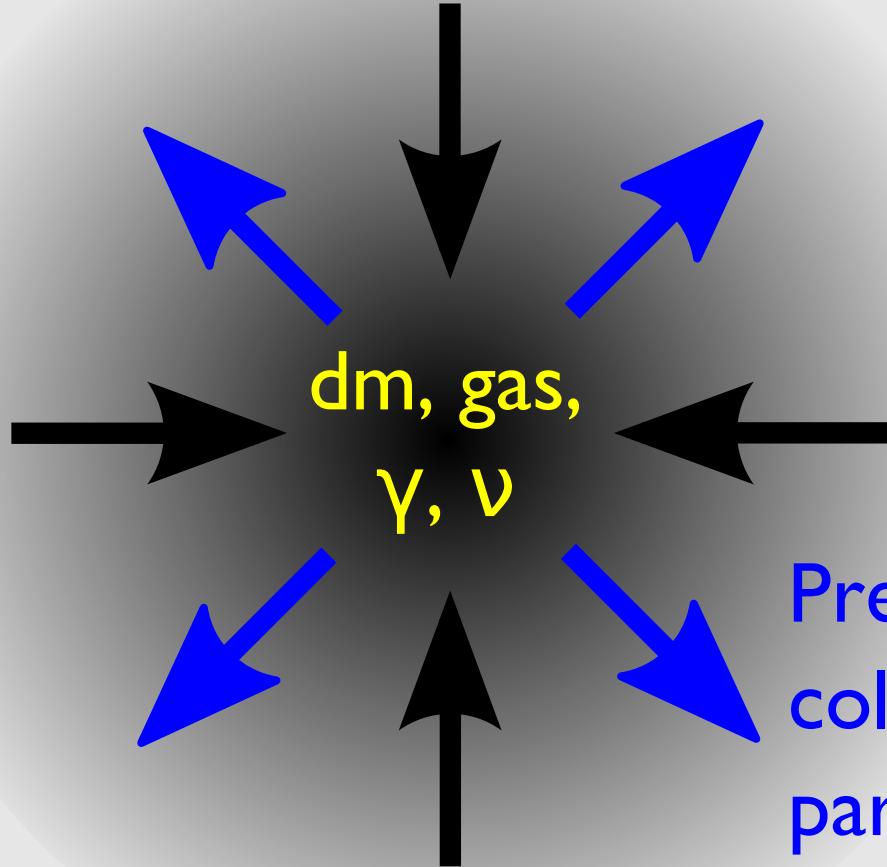
N>20 "Cosmology and product" papers (coming soon!)

# Forces on an overdensity

Expansion of  
the universe

Gravity - from matter-  
energy density

Pressure - from  
collisions between  
particles

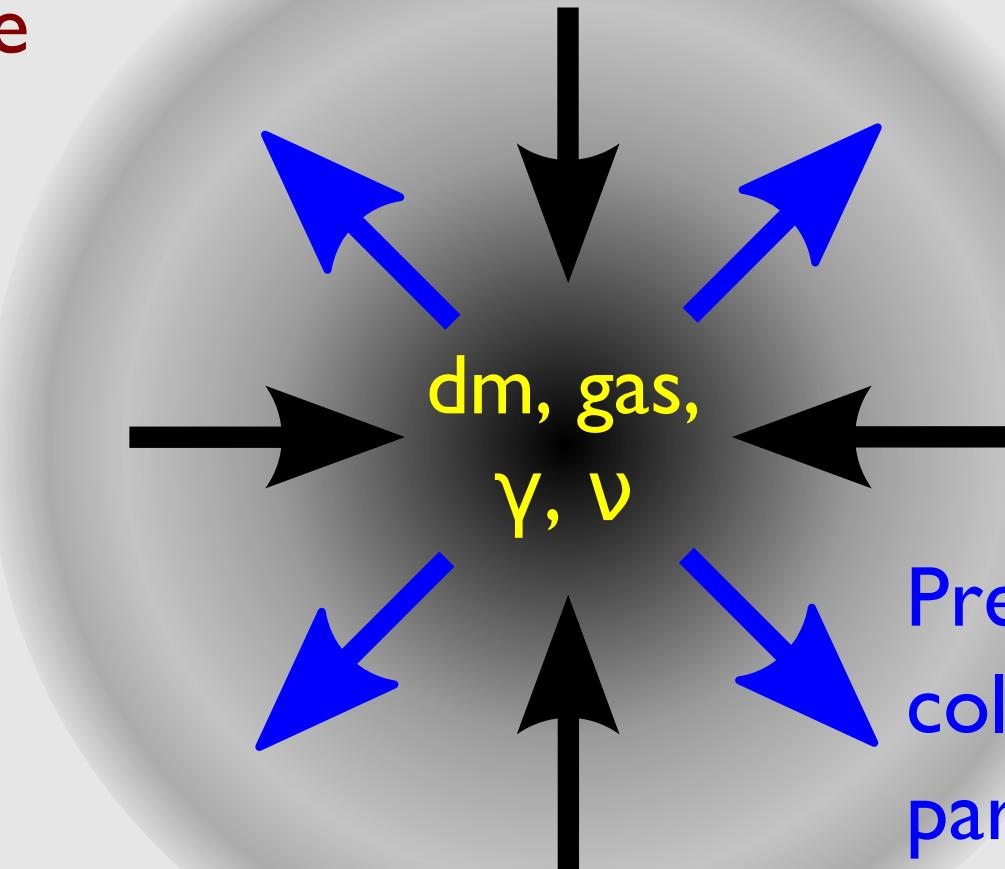


# Forces on an overdensity

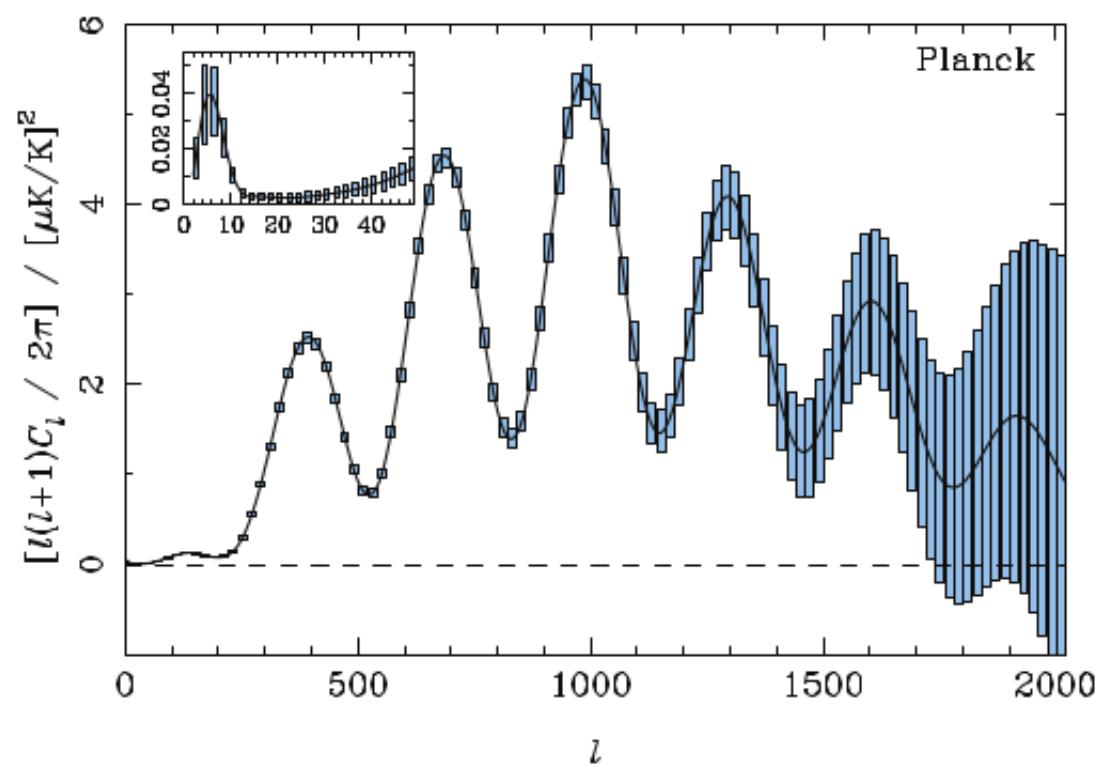
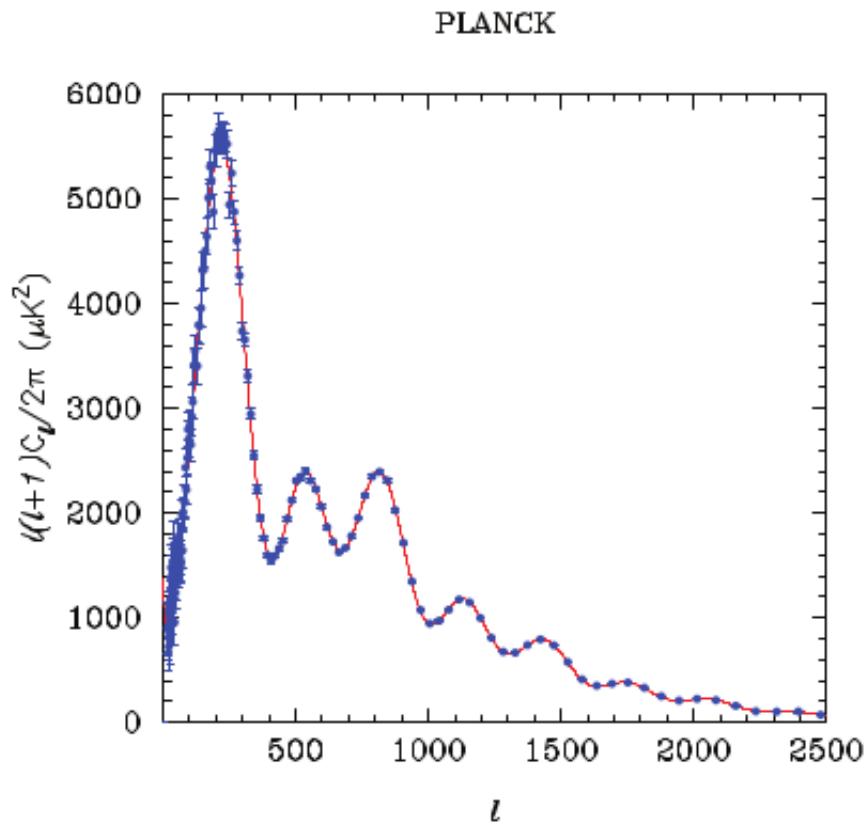
Expansion of  
the universe

Gravity - from matter-  
energy density

Pressure - from  
collisions between  
particles



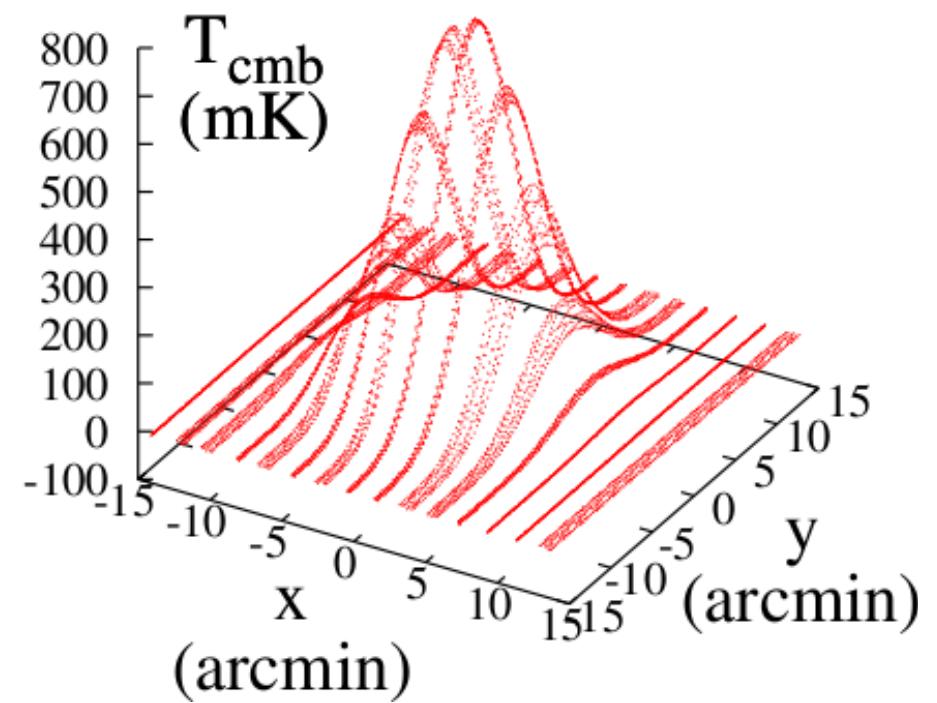
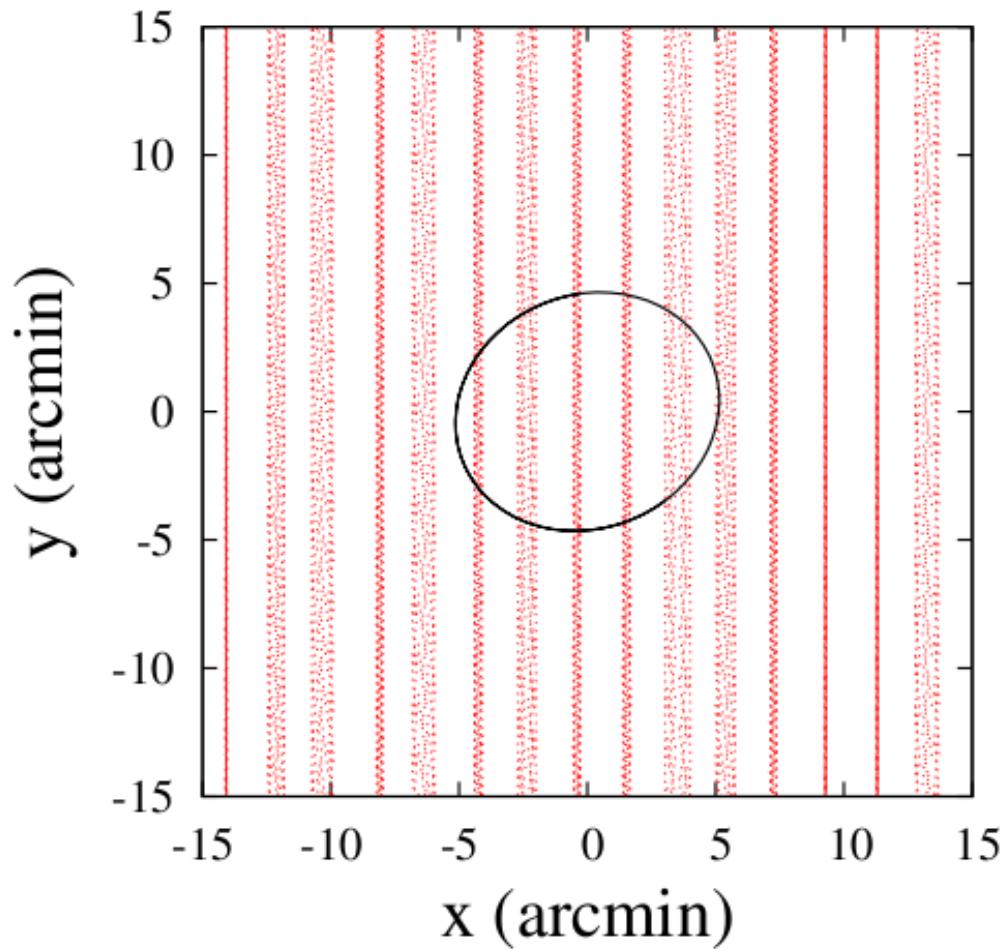
# Expected power spectra



Goal: CMB for cosmology...

Real spectra soon!

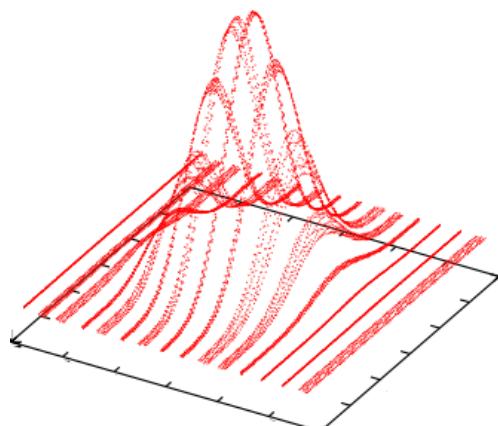
Planets are the brightest objects, compact & well-suited to probing the beam.



Simulated Jupiter at 100 GHz

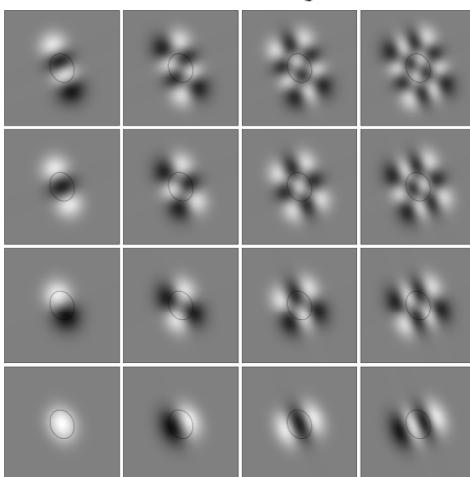
# Monte Carlo pipeline to probe reconstruction error

1.



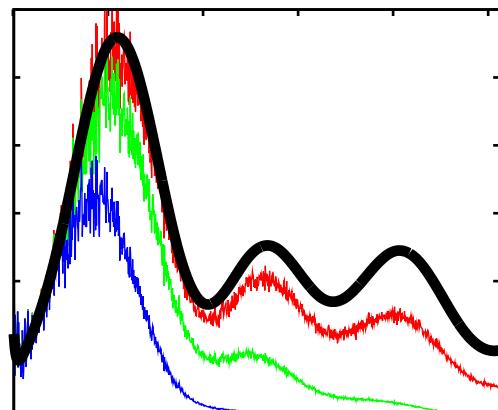
simulate signal, noise,  
electronics, etc.

2.



reconstruct beam

3.



repair spectrum

# Compact source catalog

Single Wavelength (All-Sky) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

irsa.ipac.caltech.edu/applications/planck/#id=Hydra\_planck\_planck\_1&pr

Single Wavelength (All-Sky)

**IRSA** NASA / IPAC Infrared Science Archive Guest Sign In ?

IRSA Mission Archive Search Related Data Archives Tools & Services Help

**PLANCK** Searches Catalogs Preferences

Home > Single Wavelength (All-Sky) Background Monitor

esa NASA

Planck

Search By ...

- [Single Wavelength \(All-Sky\)](#)
- [Multiple Wavelength \(Name/Position\)](#)
- [Download Planck Products](#)

Band: 30 GHz

[Set Column Selections and Filters](#) [Remove Selections and Filters](#)

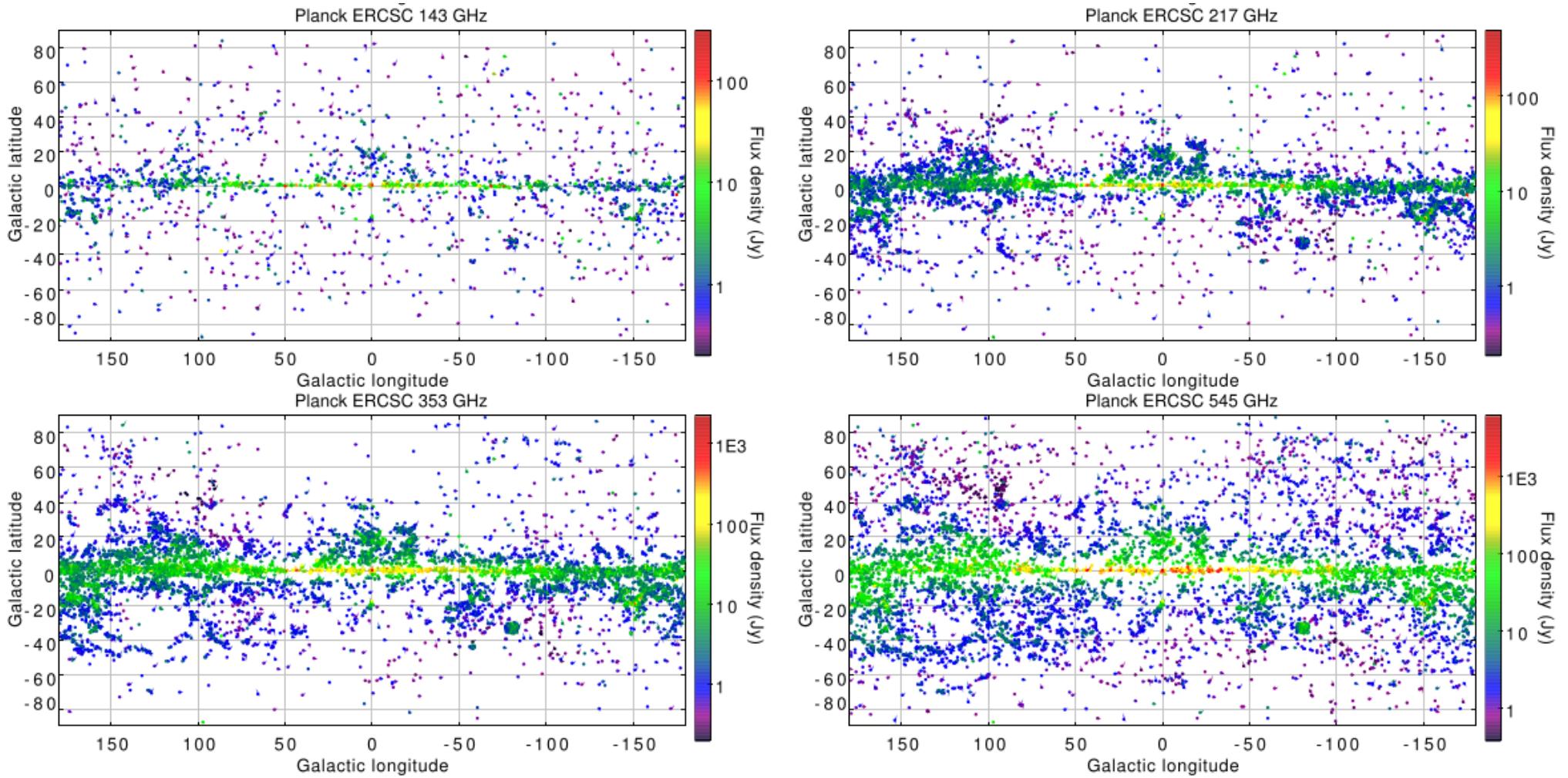
Number of Column Filters: 0

Search Clear ?

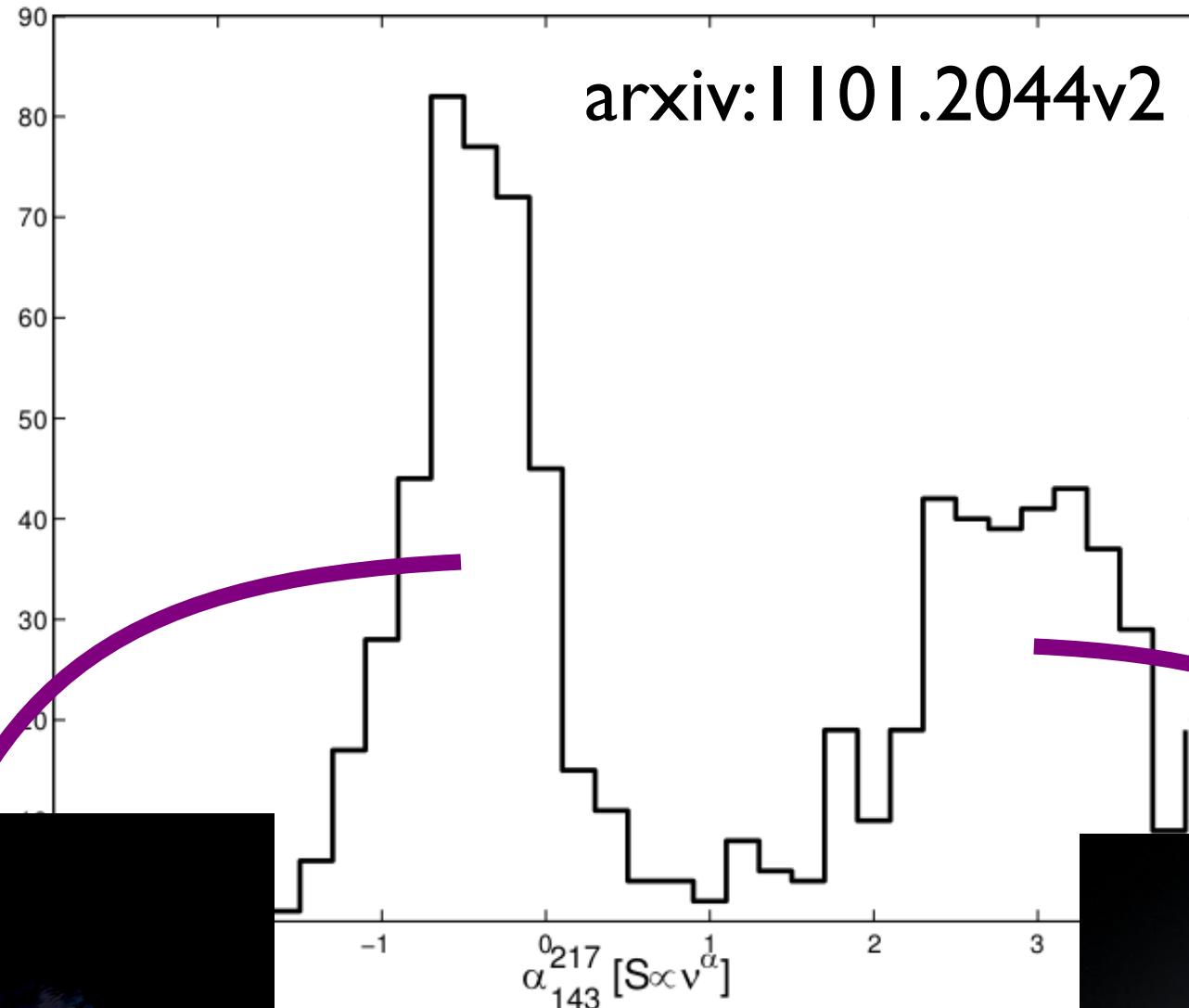
9-band photometry, 10000s of sources

ABP X

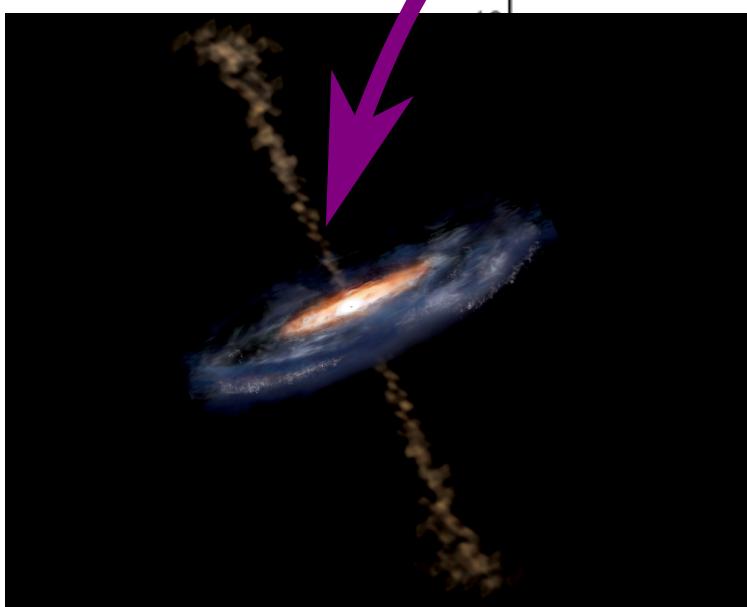
<http://irsa.ipac.caltech.edu>



# Goal: Measure AGN and DSFG...

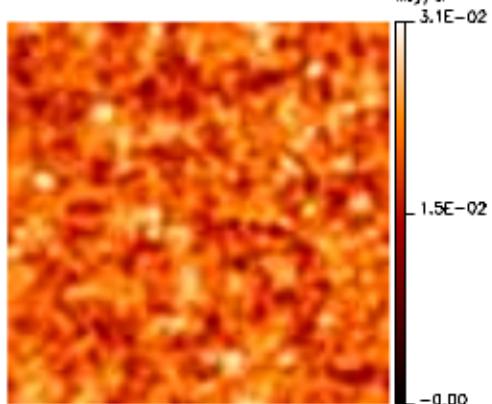


frequency dependence

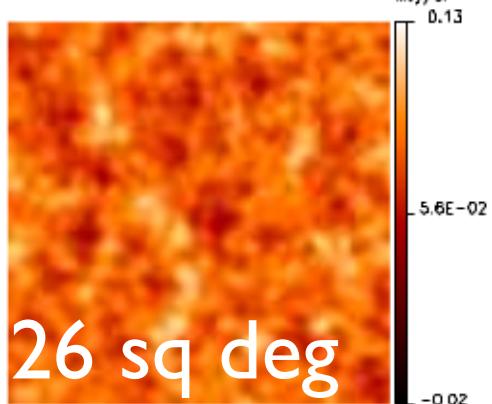


# Cosmic Infrared Background

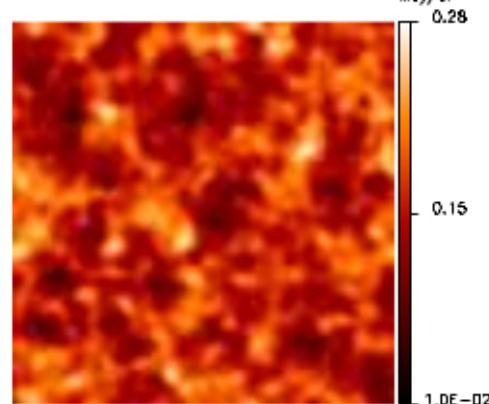
217 GHz



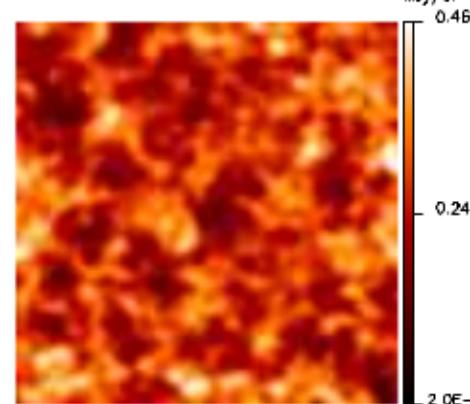
353 GHz



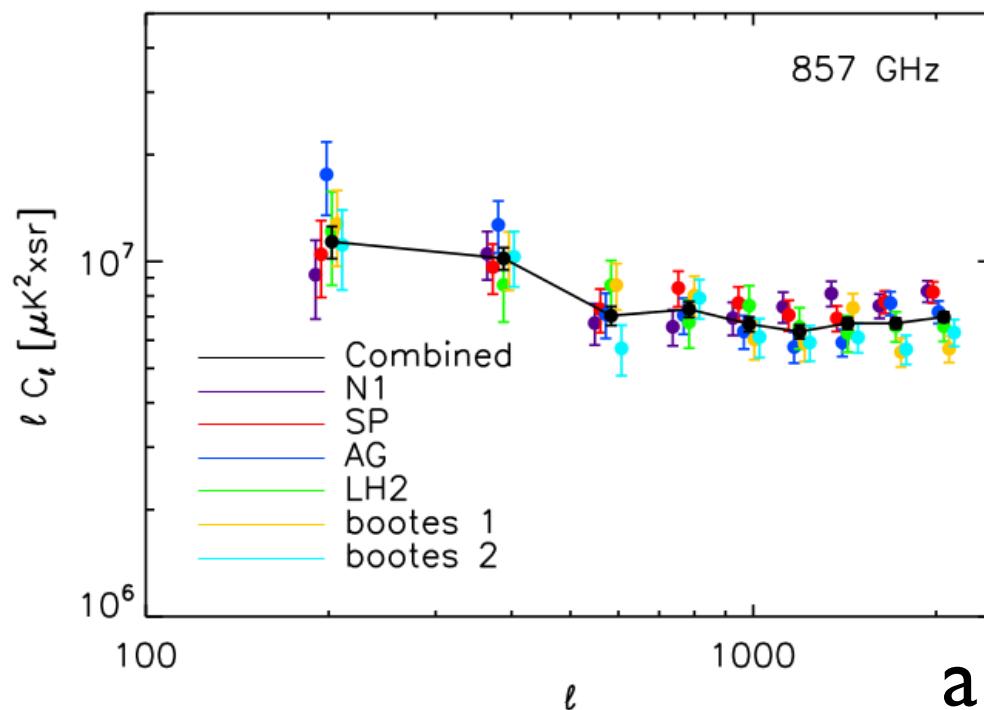
545 GHz

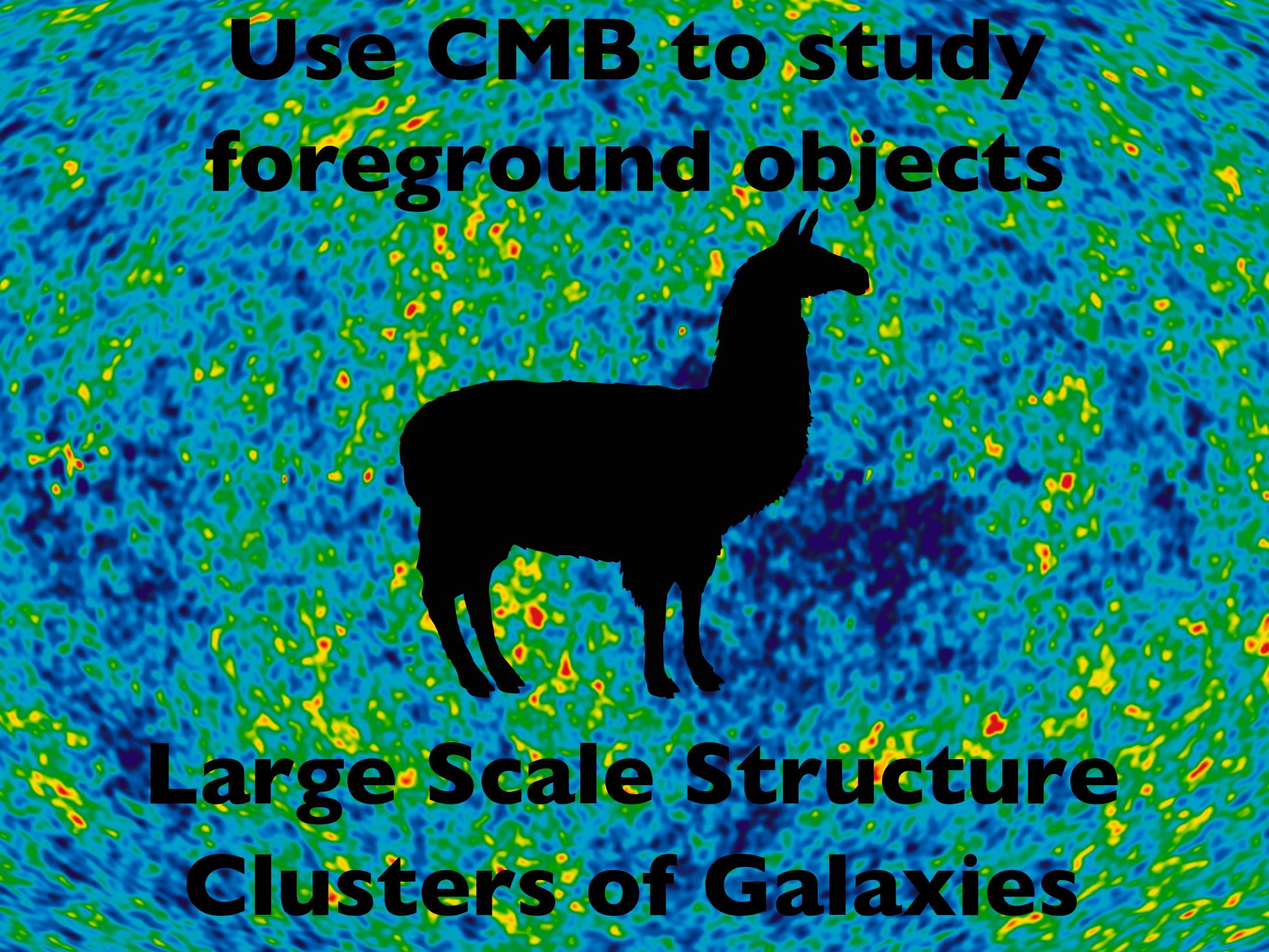


857 GHz



Residual after cleaning of CMB, galactic dust,  
and identified point sources

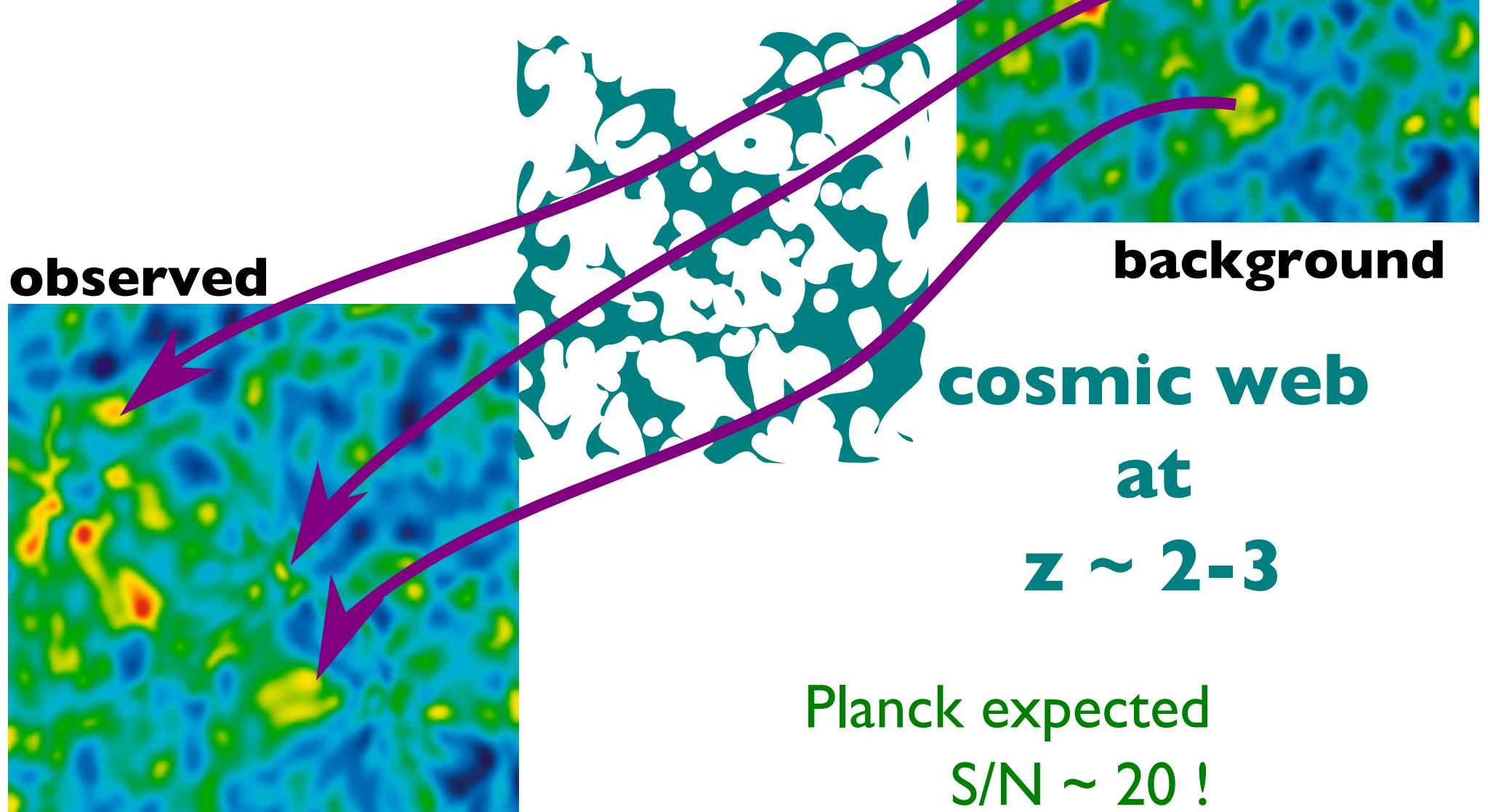




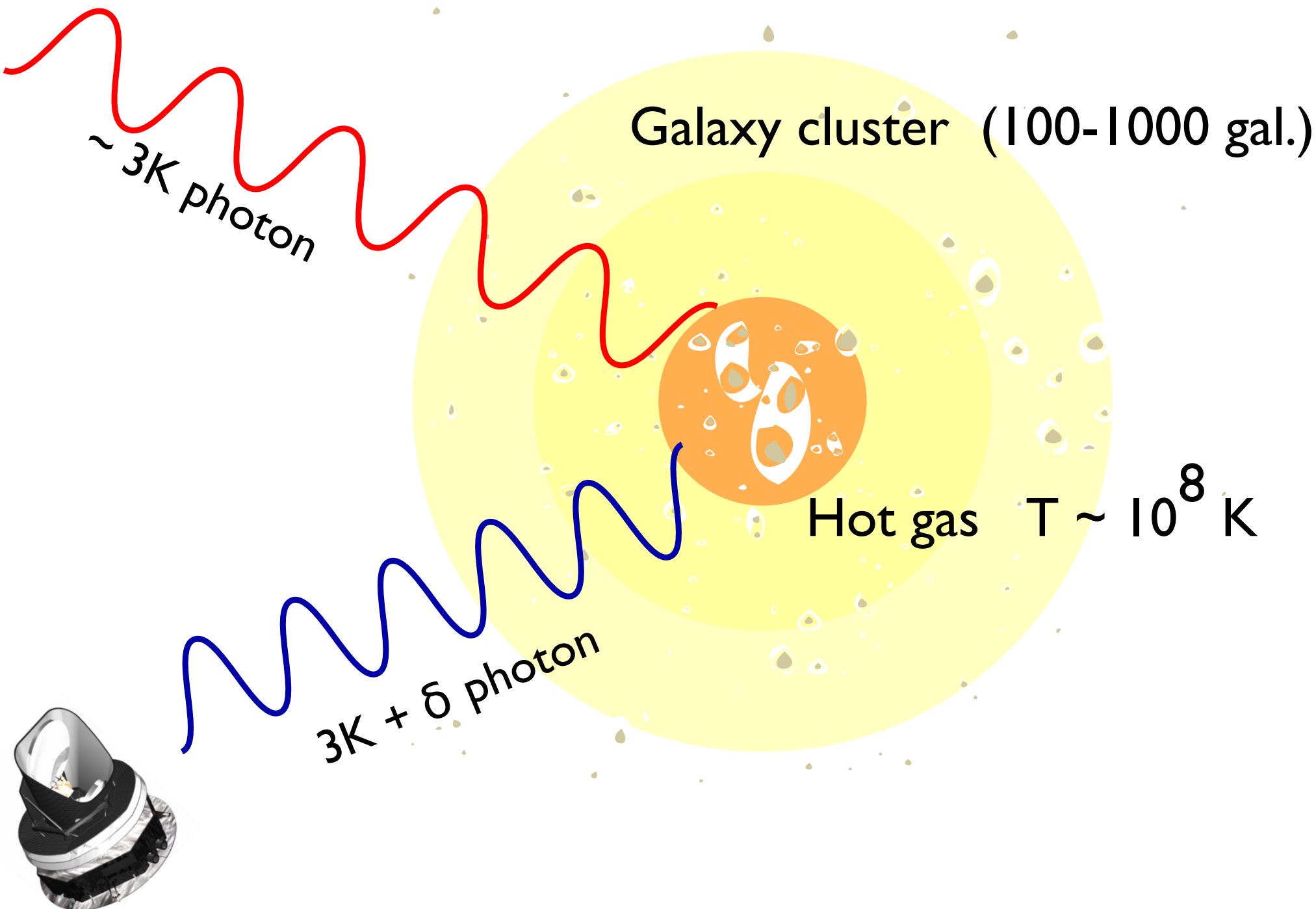
**Use CMB to study  
foreground objects**

**Large Scale Structure  
Clusters of Galaxies**

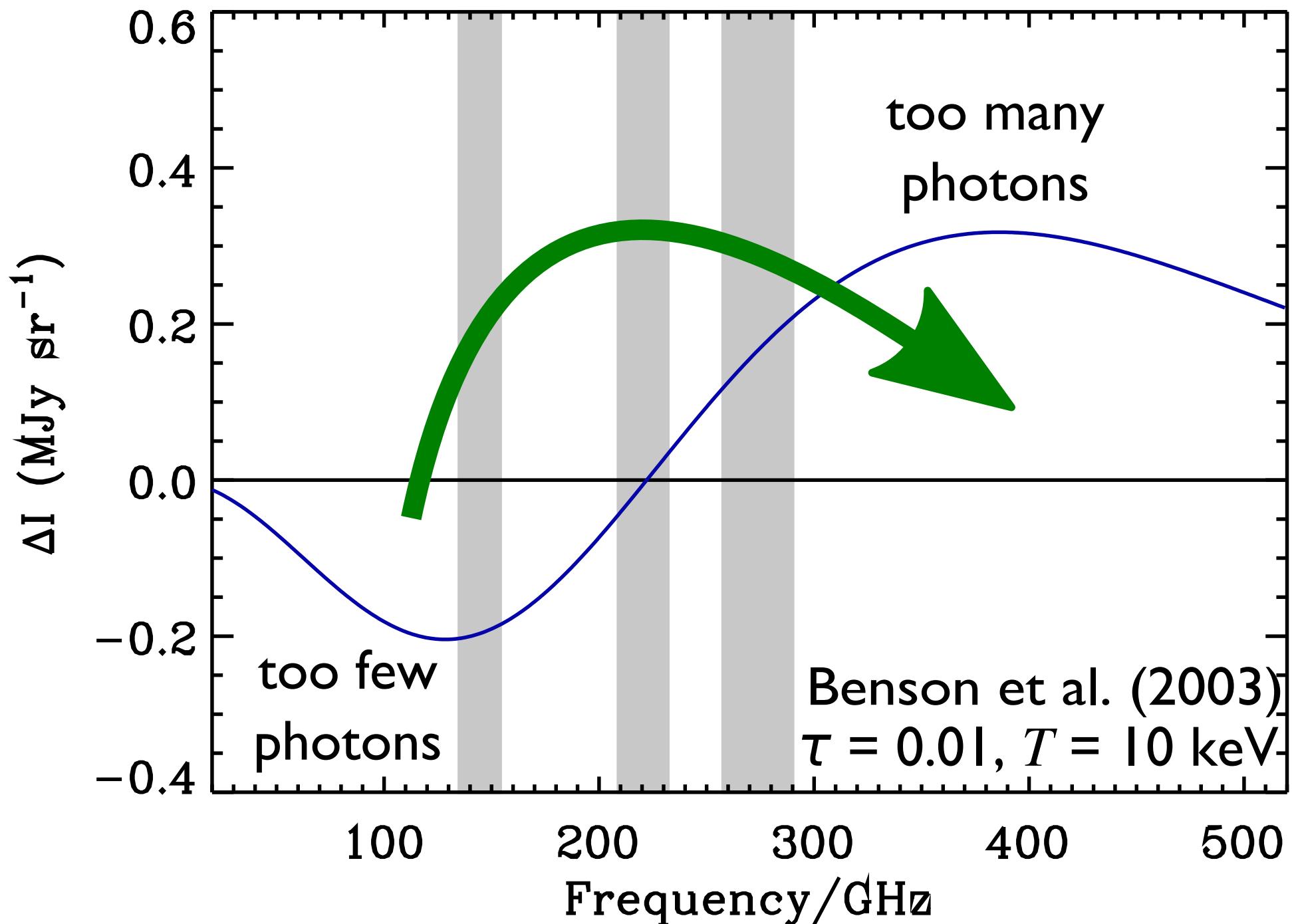
# CMB lensing



# Sunyaev-Zeldovich effect



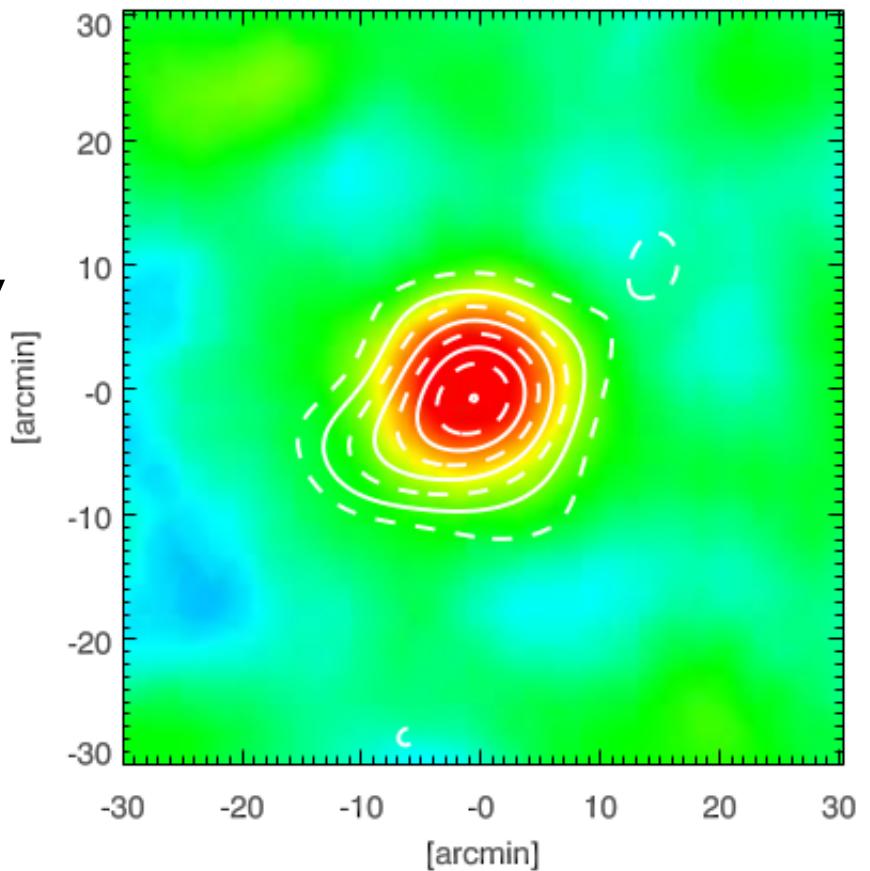
# SZ distorts CMB blackbody



# Early SZ cluster catalogue

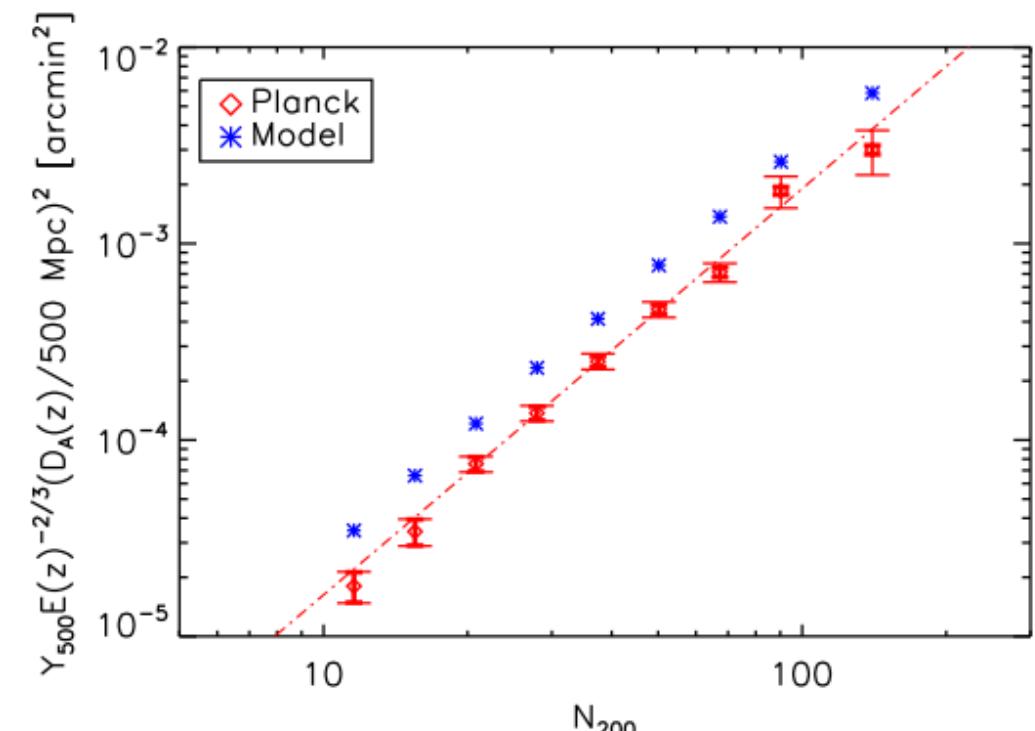
6 months of data:

189 cluster candidates, 30 new

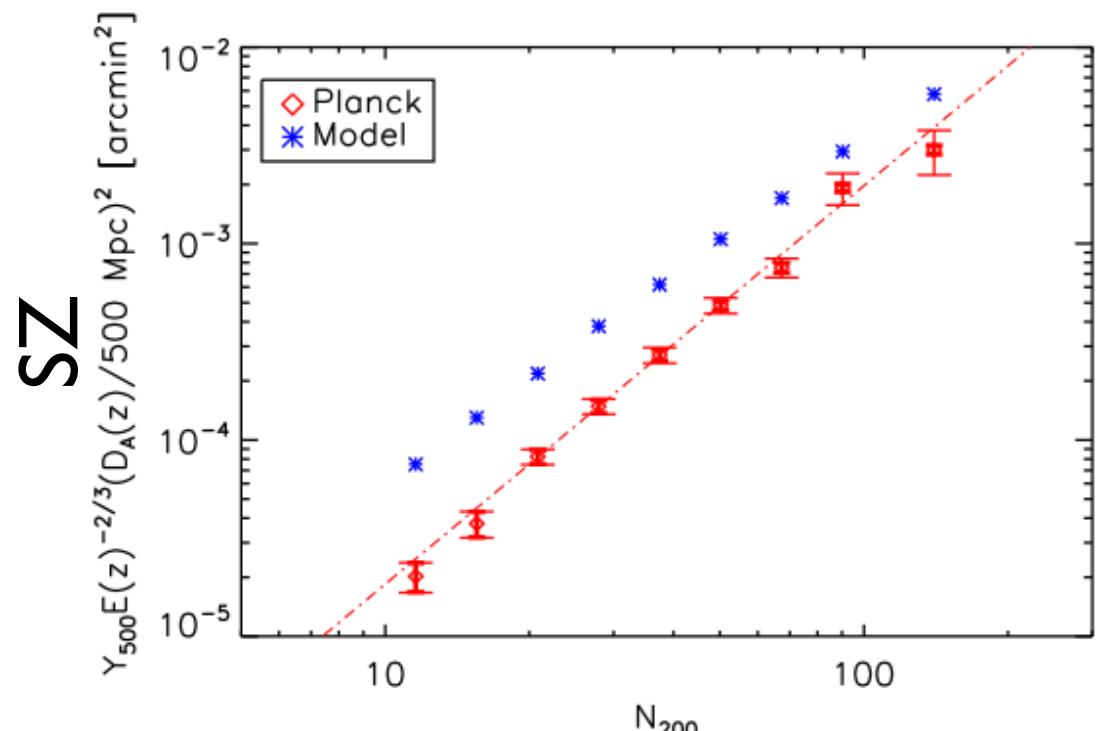


**Fig.4.**  $y$ -map of PLCKESZ G139.59+24.19 as observed by *Planck* (colour image) and AMI (contours) at a common resolution of 13 arcmin. The contours are from two to nine in S/N ratio.

# Planck forces re-evaluation of cluster gas models (normalization at least)



13,000 MaxBCG clusters



But SZ vs. X-ray models OK!

# Summary

Planck is a terrific instrument for cosmology and astrophysics.

Important results are out now on:

clusters

AGN

DSFG

cosmic infrared background

Important results and data products coming soon!