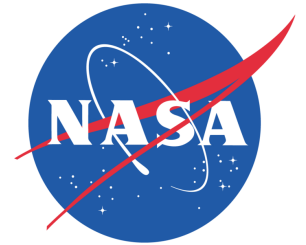


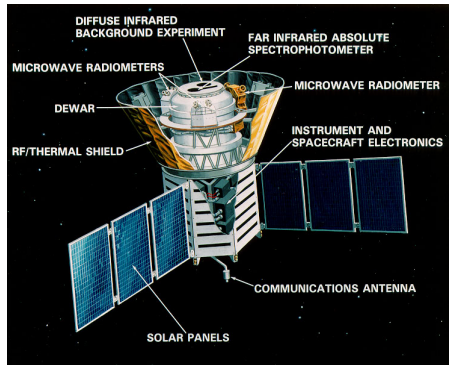
The Planck Satellite: Early results and more to come



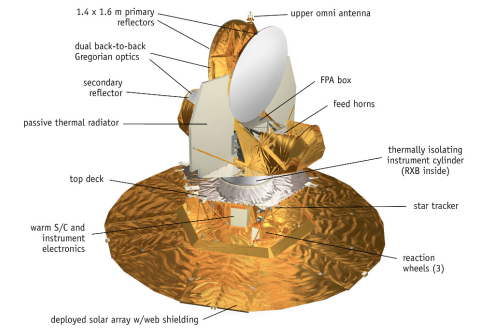
Kevin Huffenberger, *University of Miami*



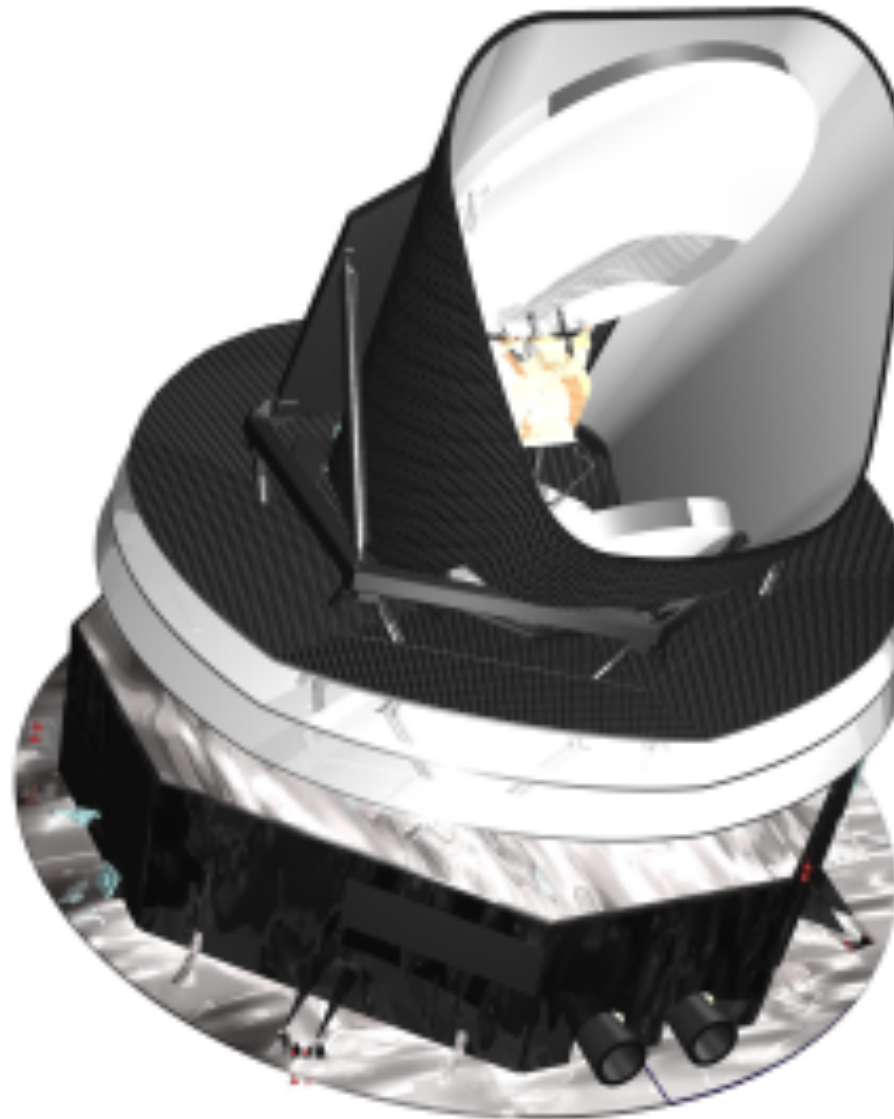
3 Generations of CMB Satellites



COBE



WMAP



Planck

Science Goals

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

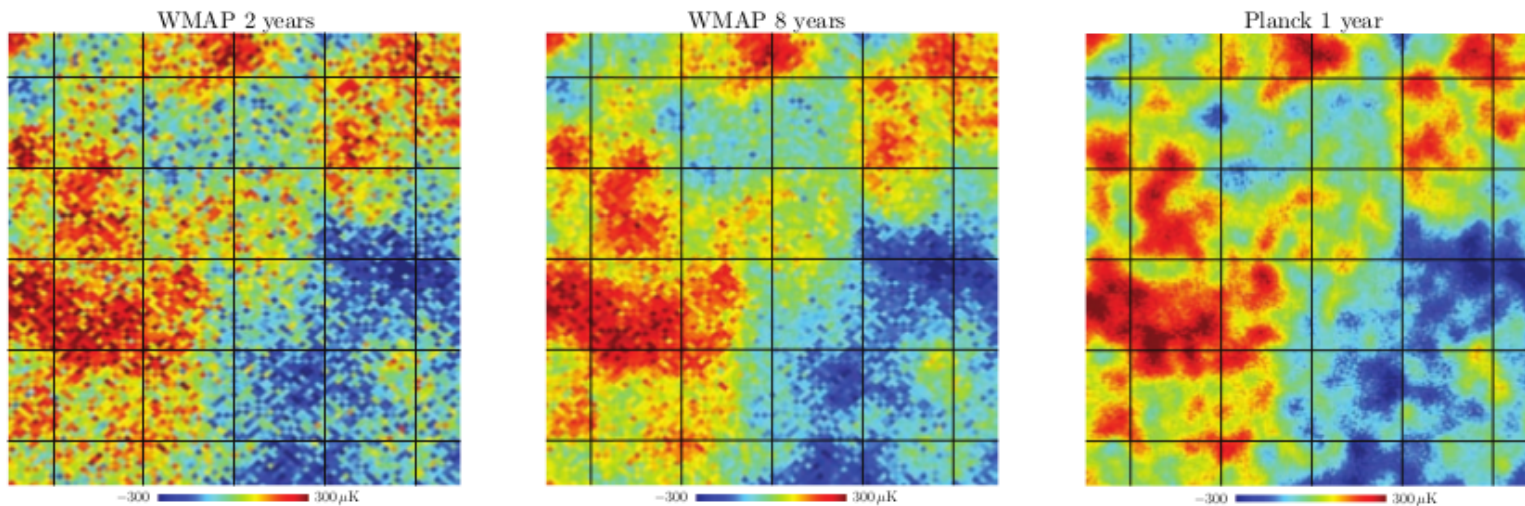
Map galactic emission & magnetic field

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

LFI

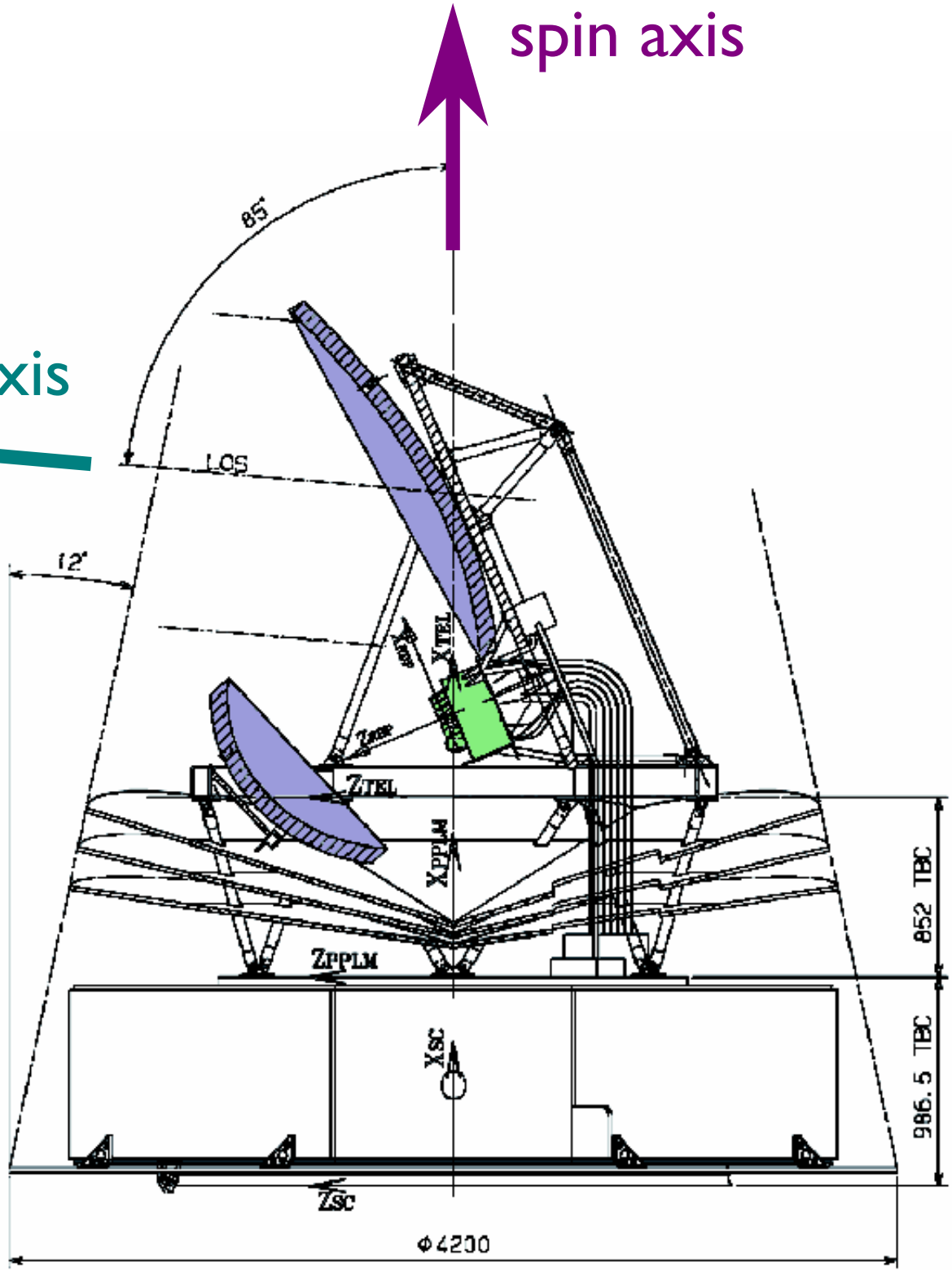
100 143 217 353 545(I) 857(I) GHz

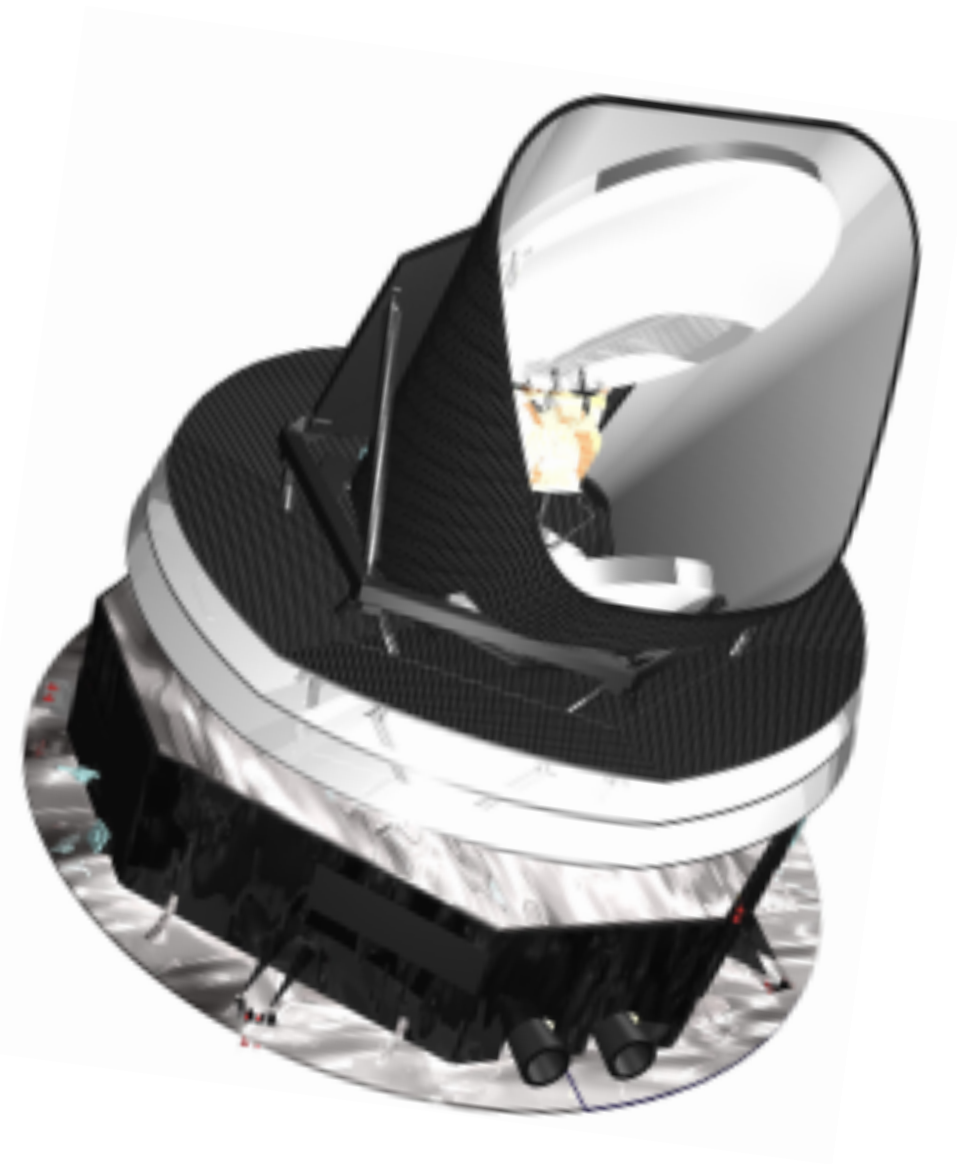
HFI

(20-30% bandwidth)

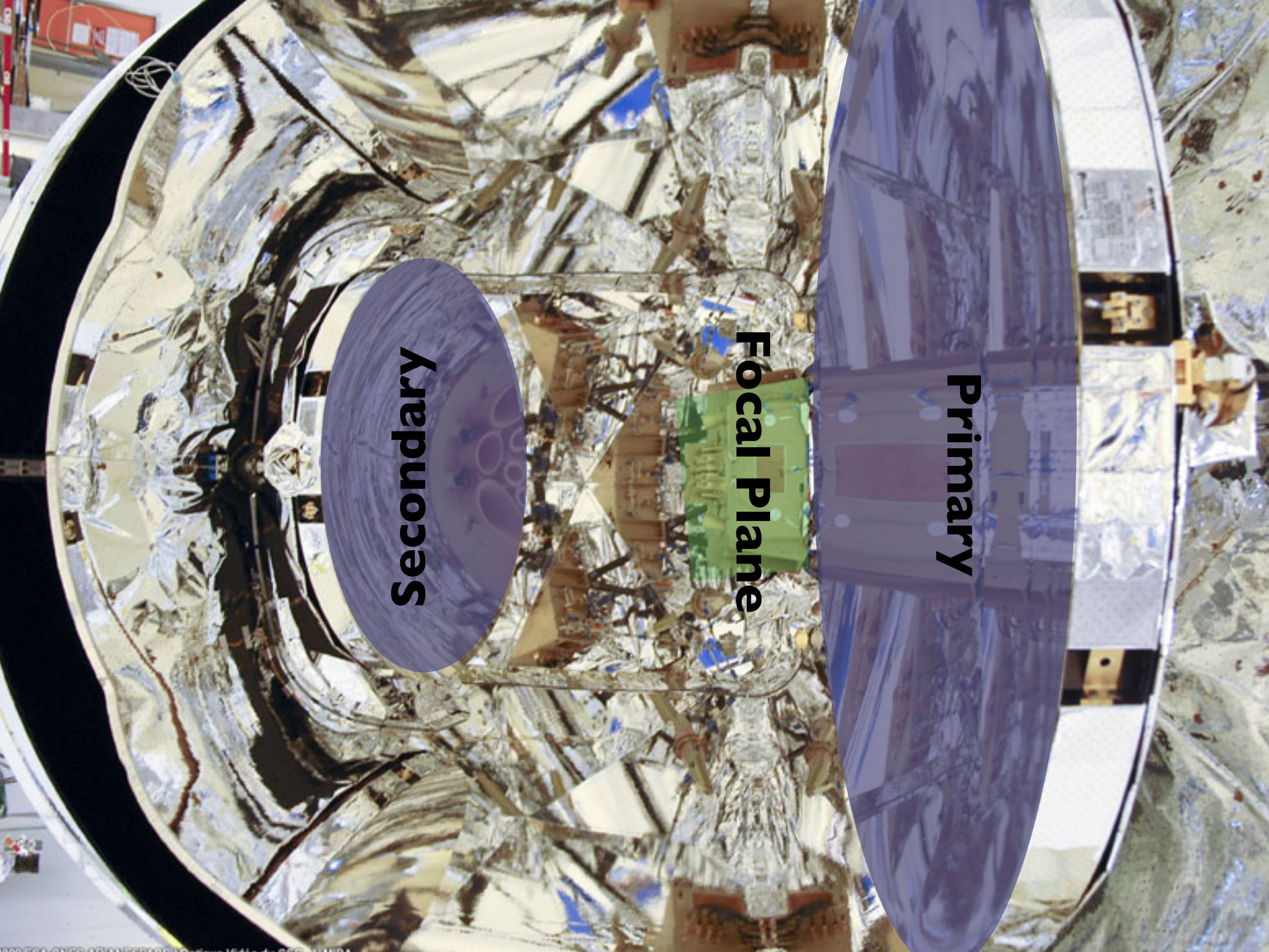
optical axis

spin axis





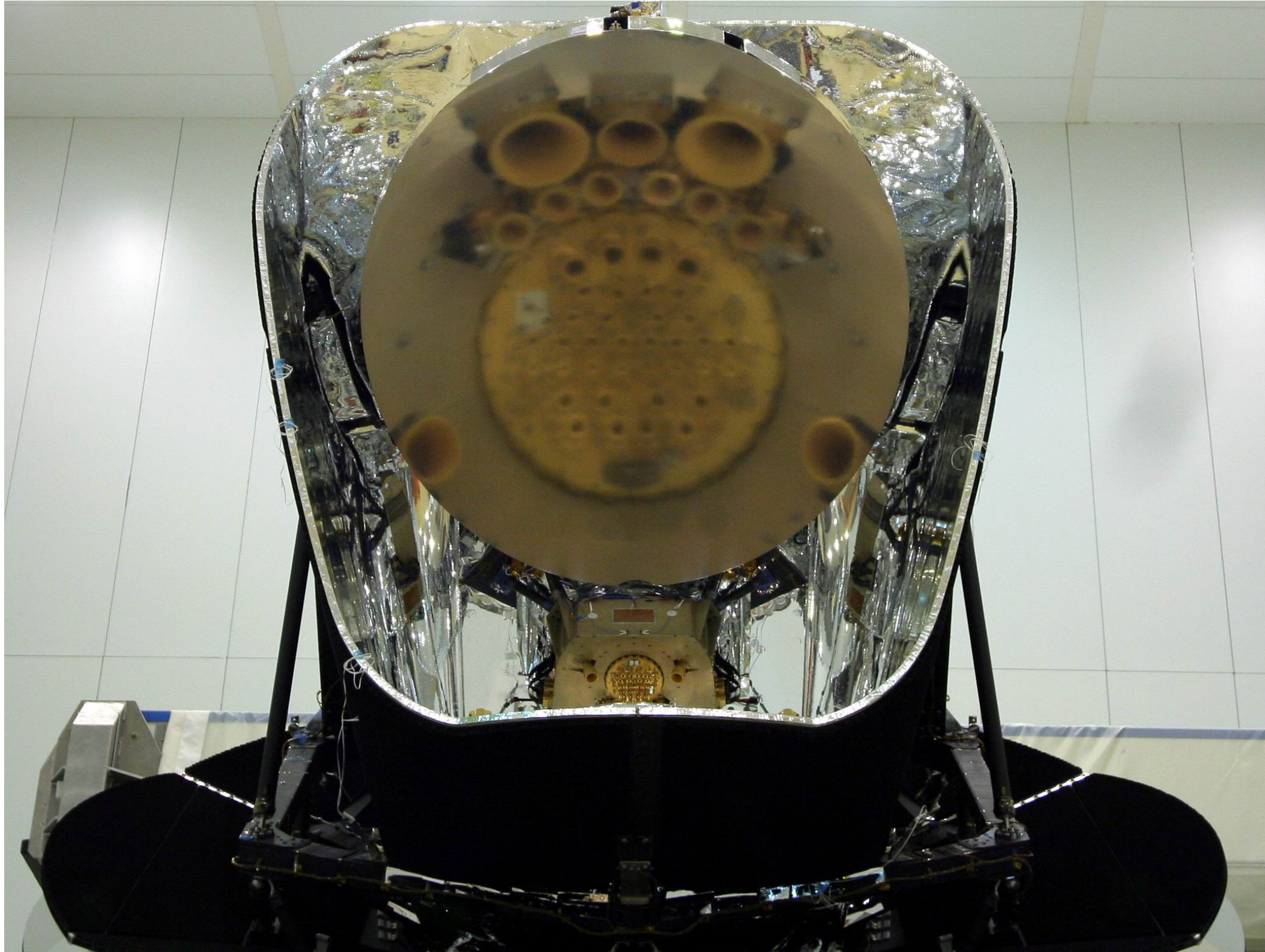




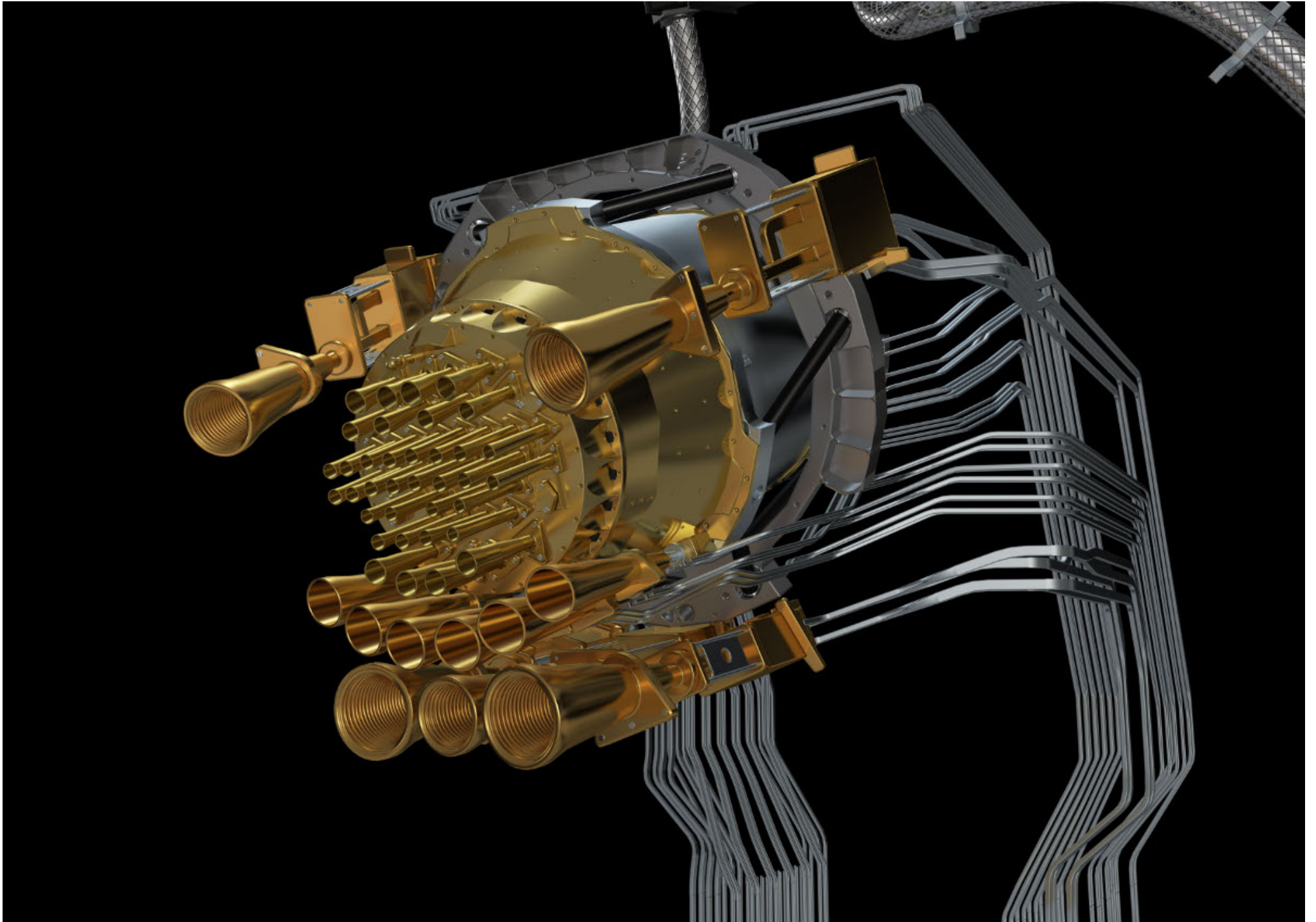
Primary

Focal Plane

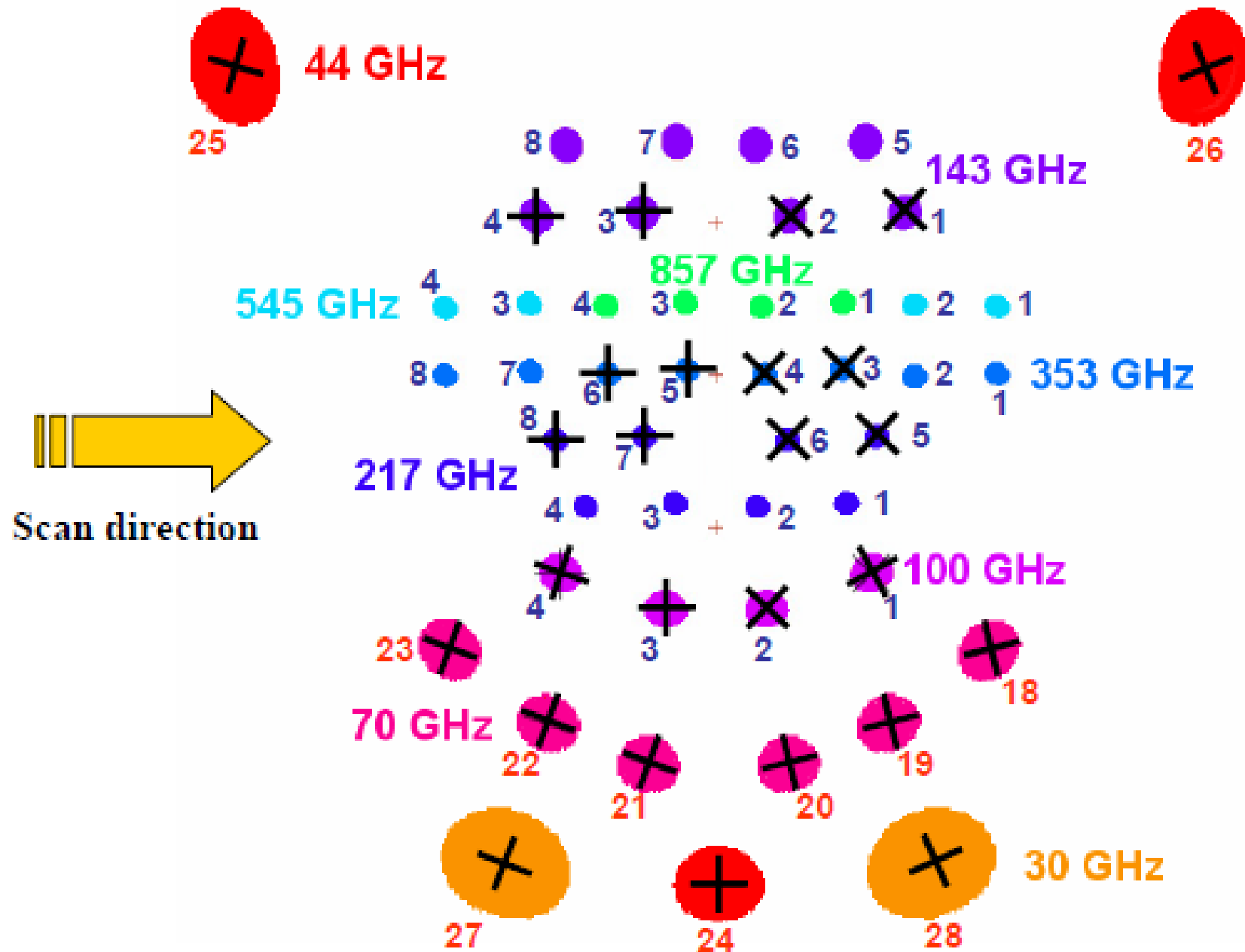
Secondary



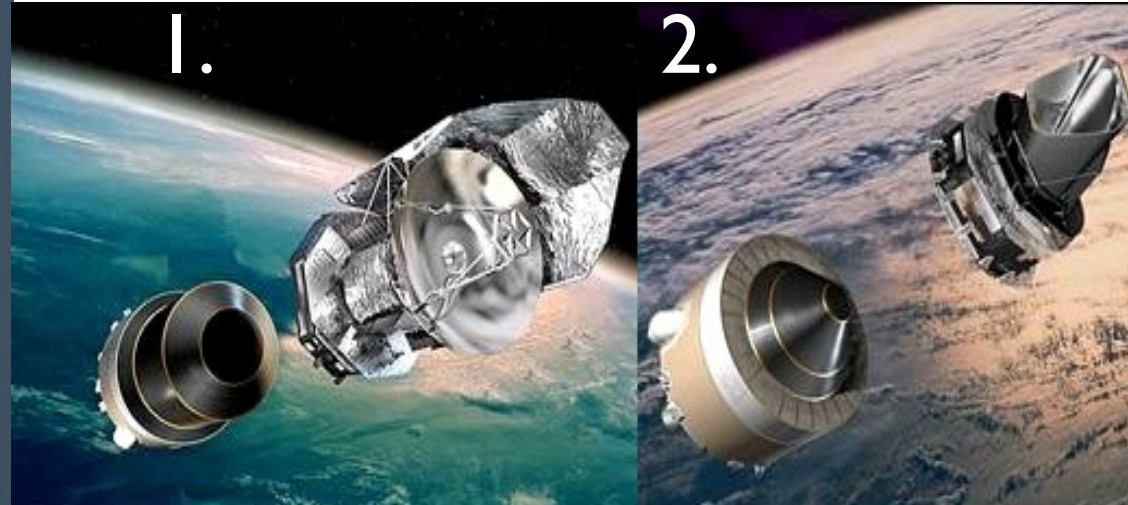
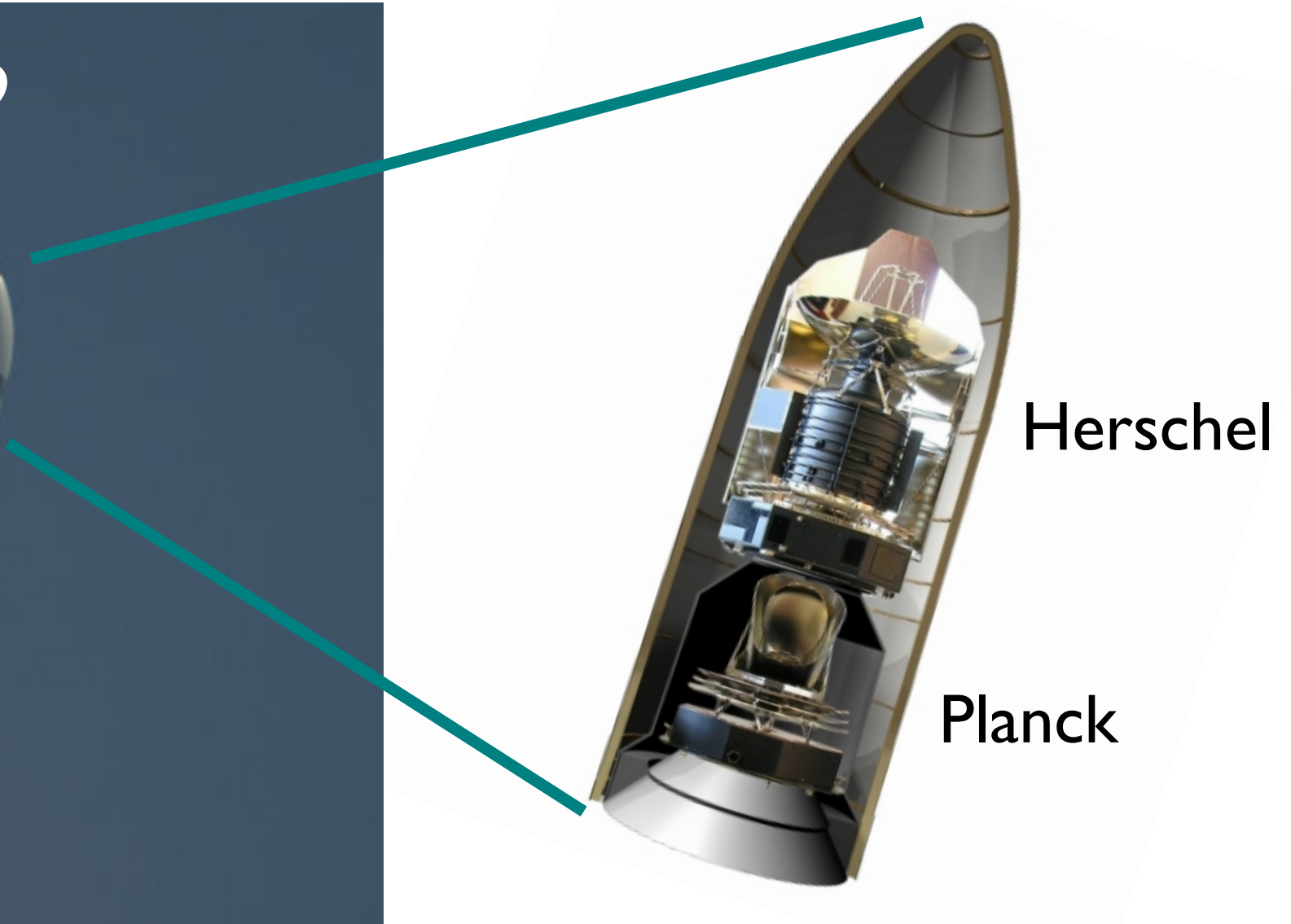
Focal plane



Planck focal plane



14 May 2009

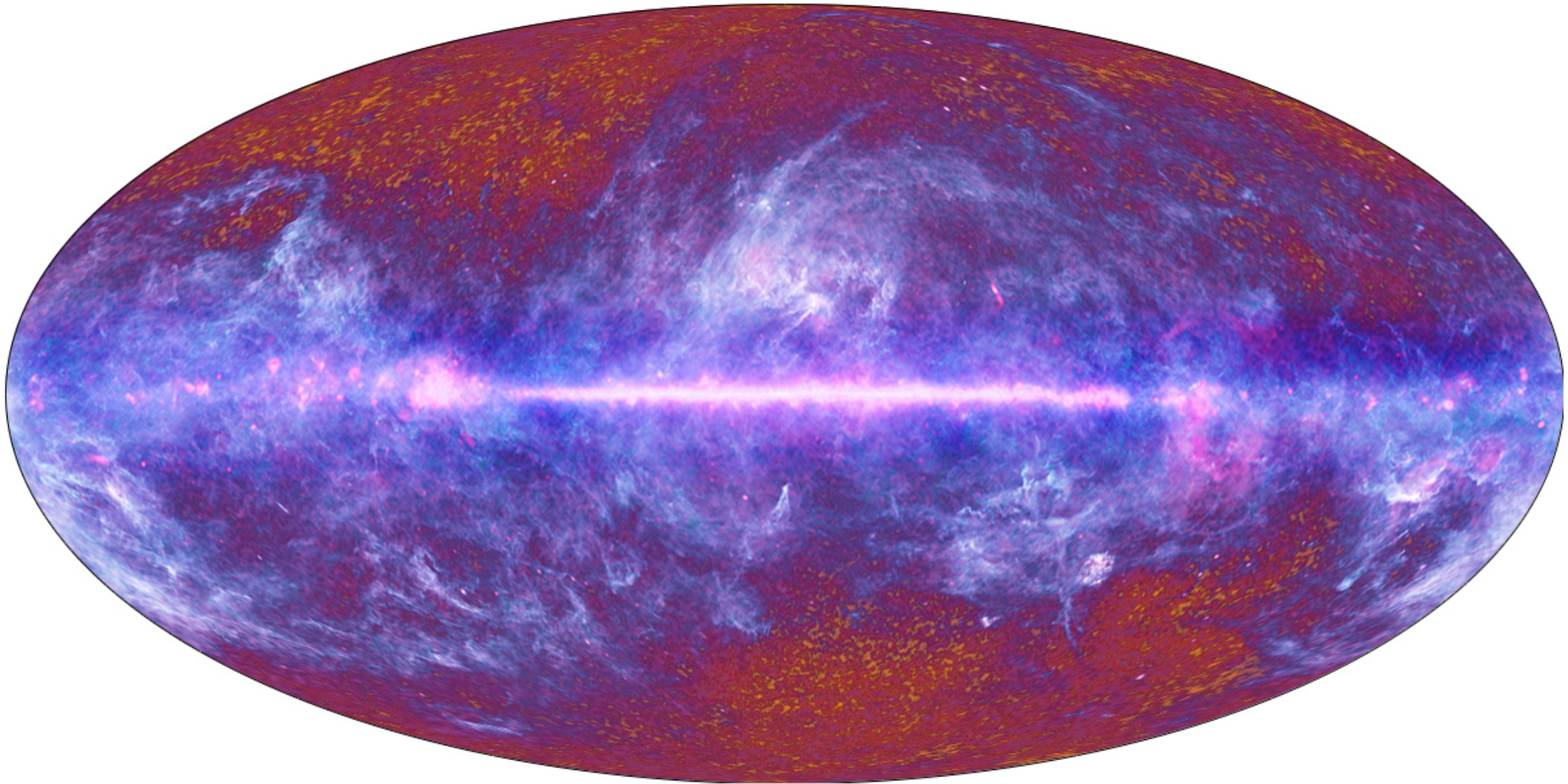


1.5 million km away at L2



(movies)

Planck's first full-sky image



Goal: map galactic emission...

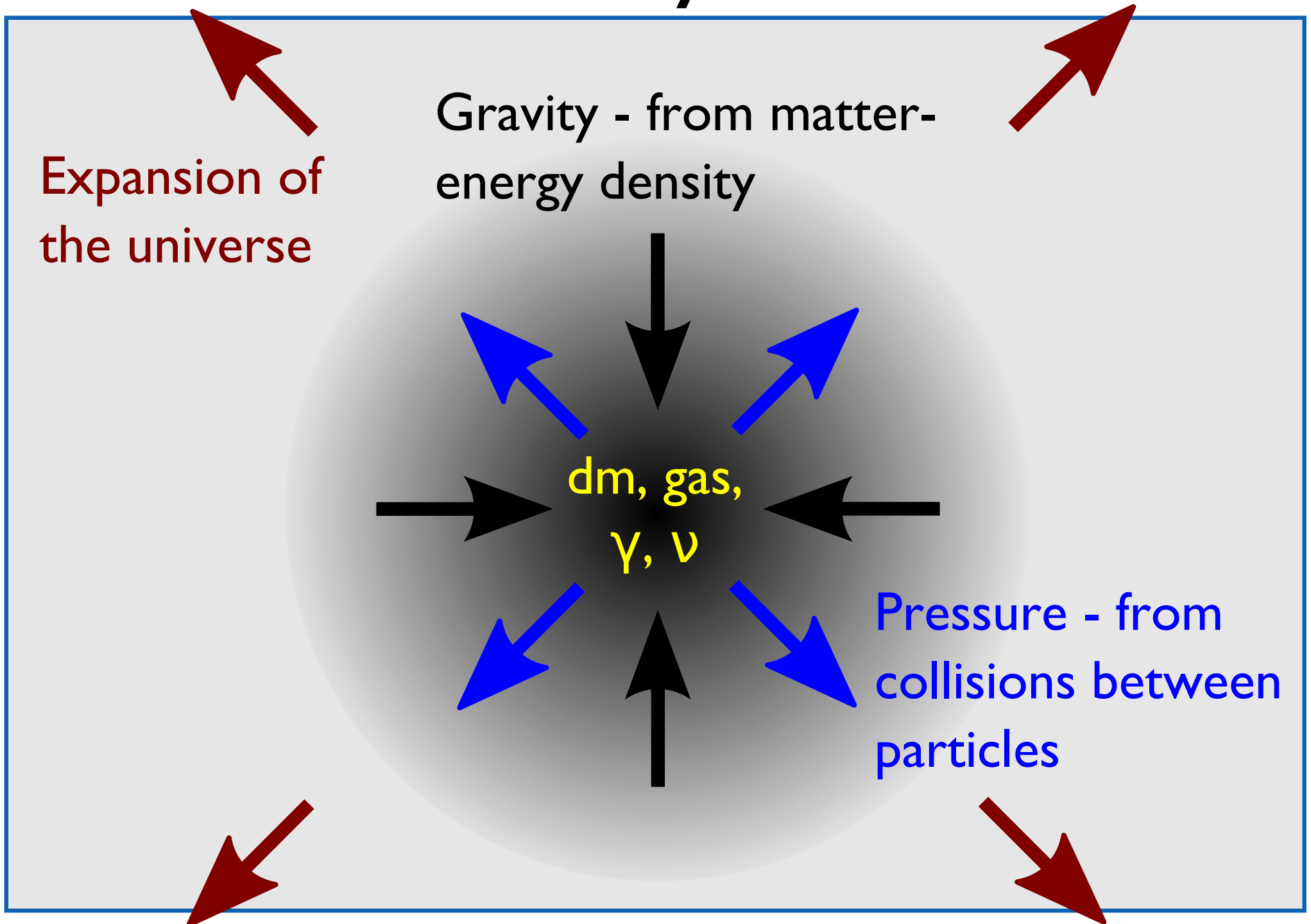
Planck papers released so far:

25 "Early Results" papers (Jan 2011)

11 "Intermediate Results" papers (from Dec 2011)

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

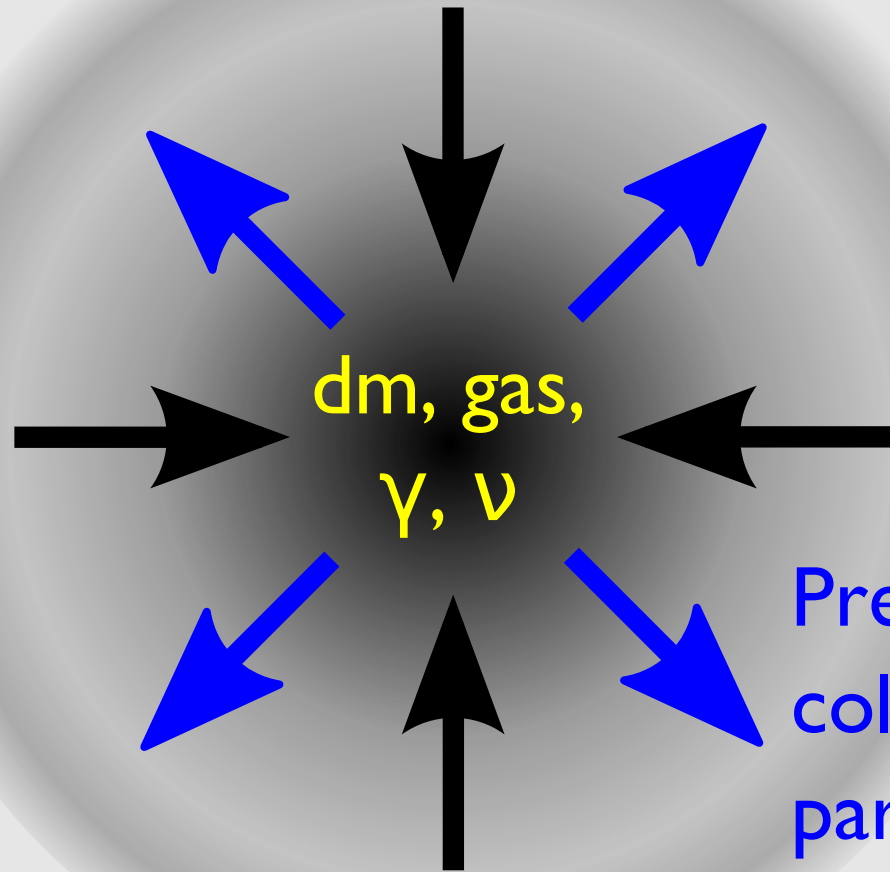
Forces on an overdensity



Forces on an overdensity

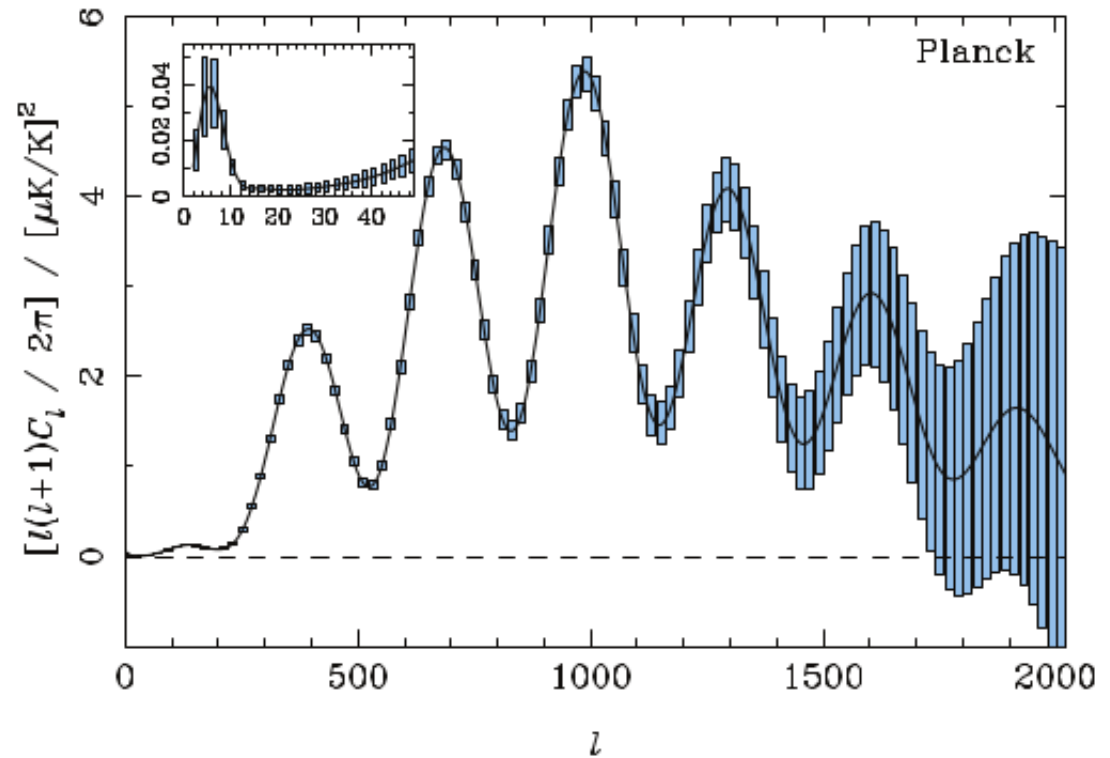
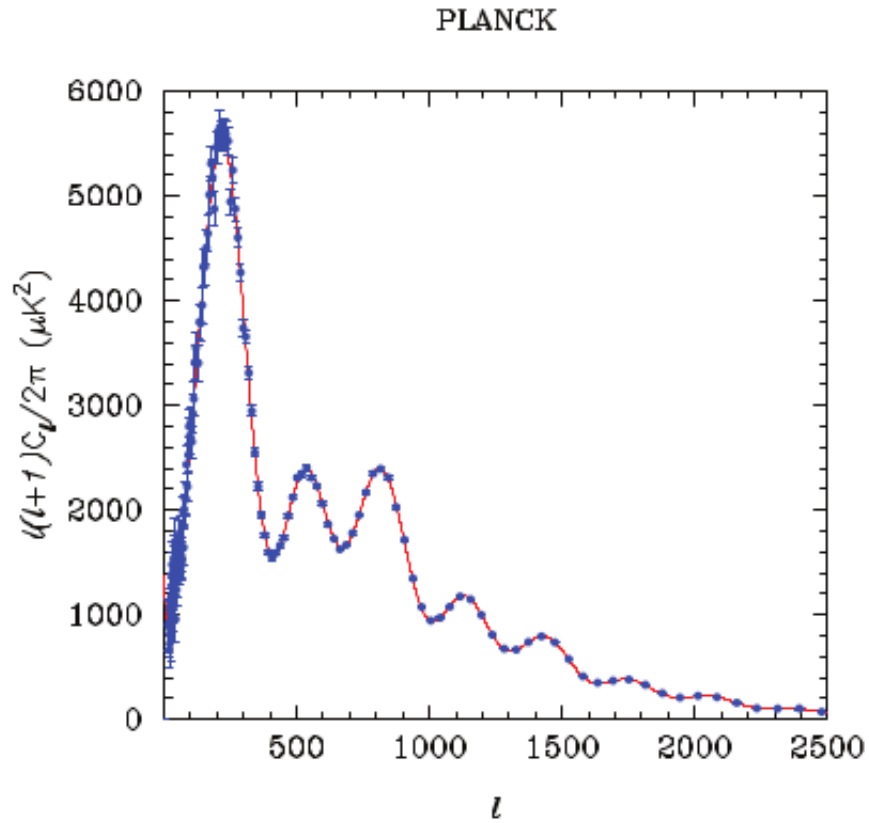
Expansion of
the universe

Gravity - from matter-
energy density



Pressure - from
collisions between
particles

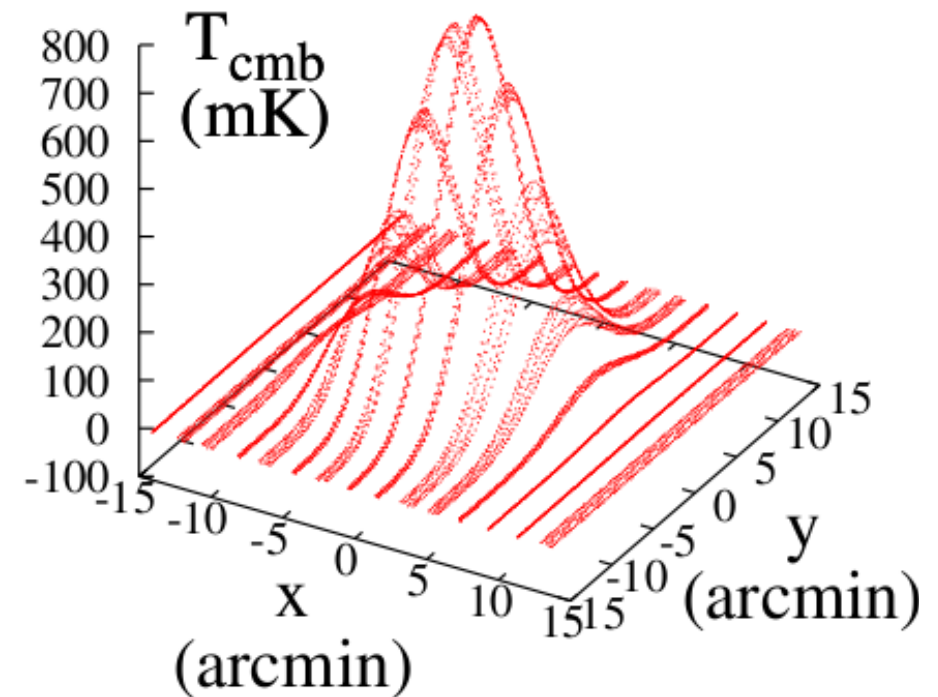
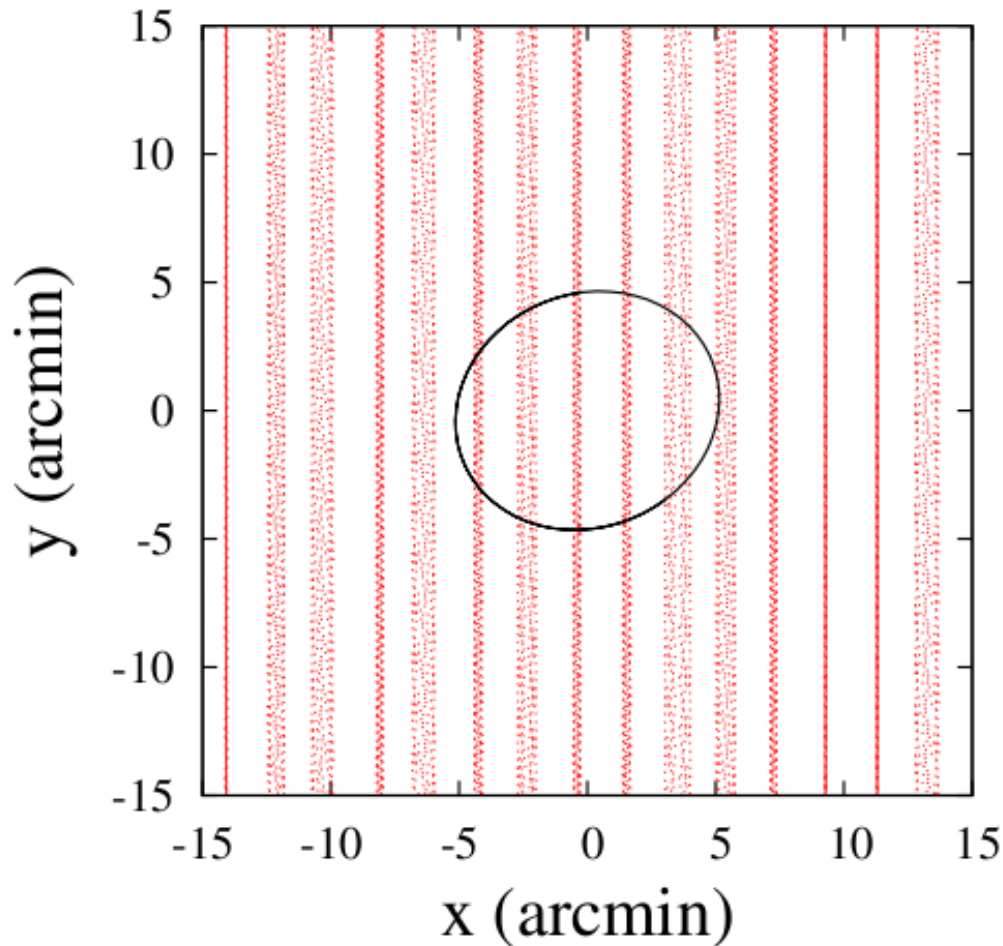
Expected power spectra



Goal: CMB for cosmology...

Real spectra soon!

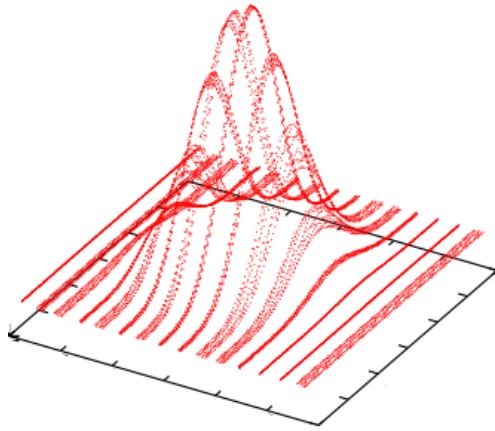
Planets are the brightest objects, compact & well-suited to probing the beam.



Simulated Jupiter at 100 GHz

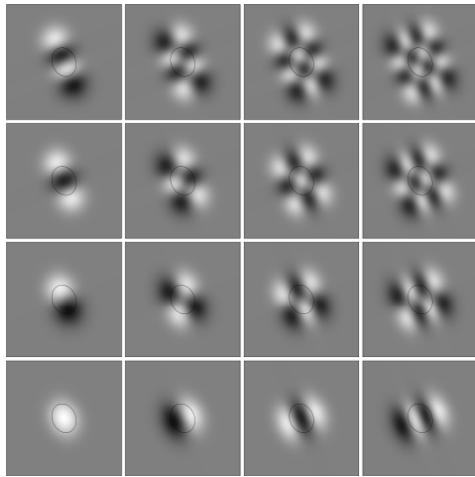
Monte Carlo pipeline to probe reconstruction error

1.



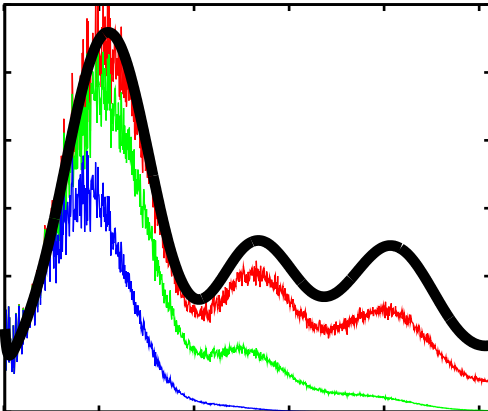
simulate signal, noise,
electronics, etc.

2.



reconstruct beam

3.



repair spectrum

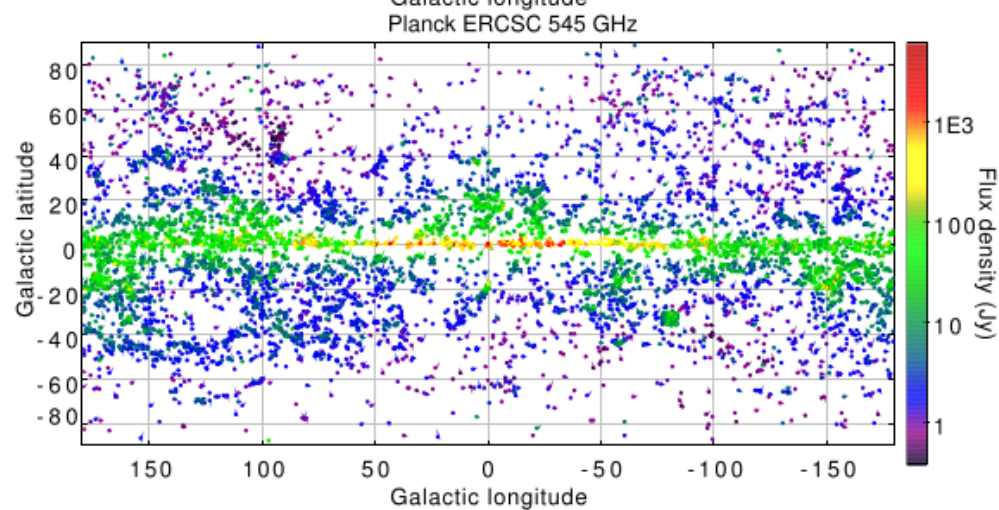
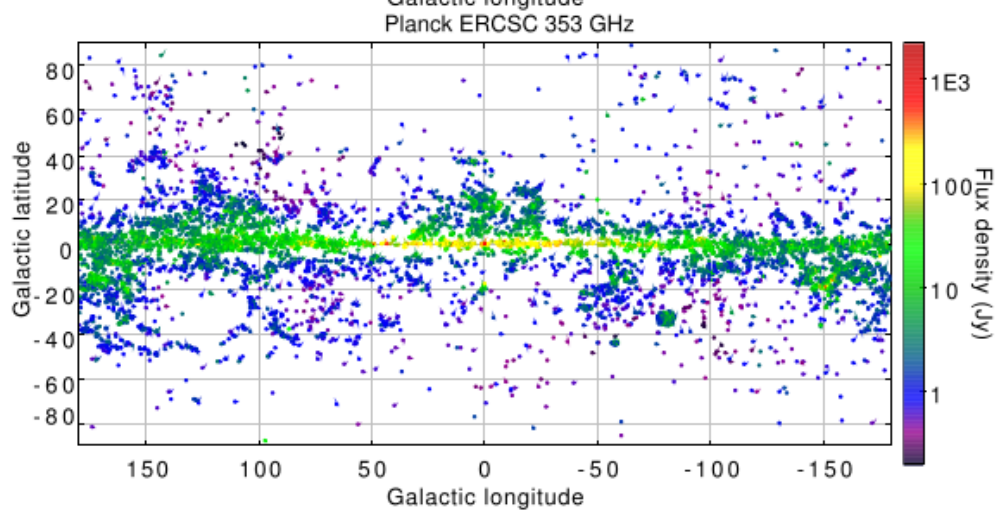
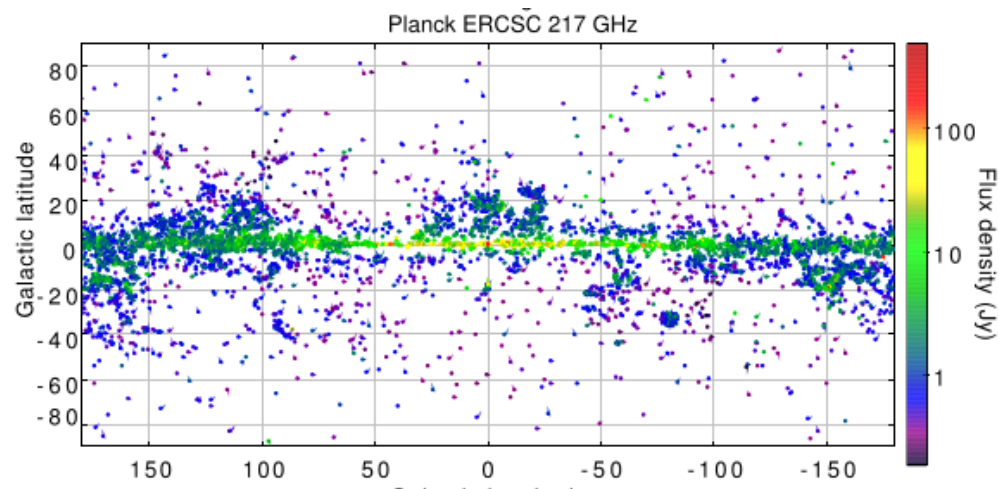
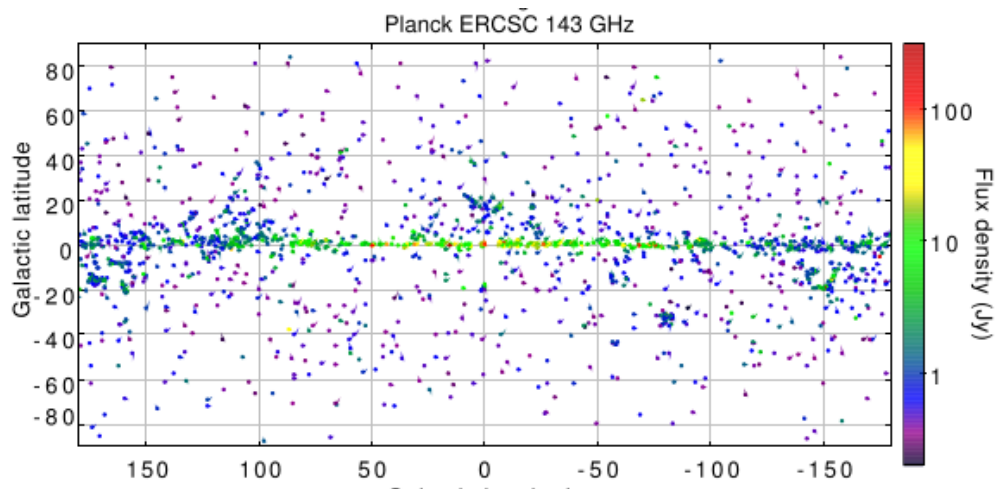
Huffenberger et al., A&A 510 (2010)

Compact source catalog

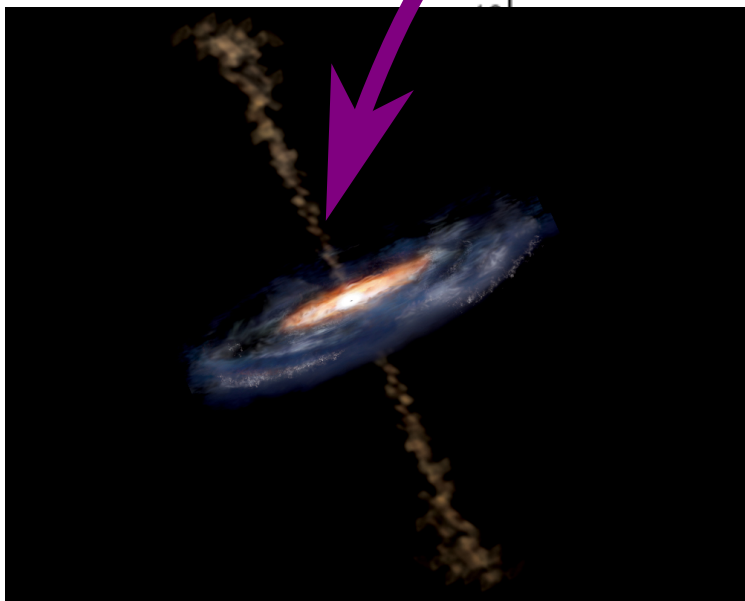
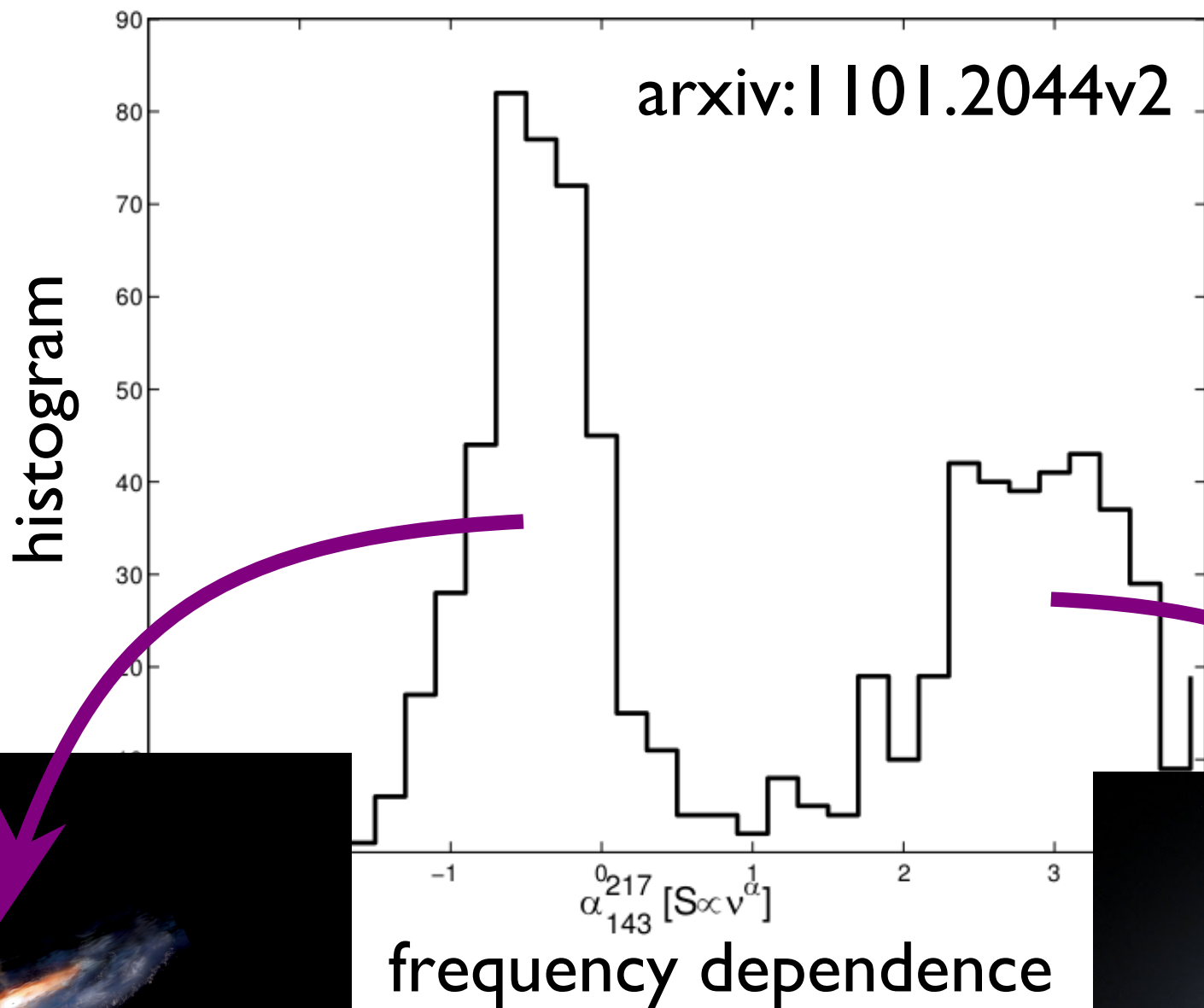
The screenshot shows a Mozilla Firefox browser window titled "Single Wavelength (All-Sky) - Mozilla Firefox". The address bar contains the URL irsa.ipac.caltech.edu/applications/planck/#id=Hydra_planck_planck_1&pr. The page header features the IRSA logo and the text "NASA / IPAC Infrared Science Archive". Navigation links include "IRSA", "Mission", "Archive Search", "Related Data Archives", "Tools & Services", and "Help". A "Guest Sign In ?" link is also present. Below the header, there are logos for "PLANCK", "esa", and "NASA". A search bar contains the text "Searches | Catalogs | Preferences". The breadcrumb trail shows "Home > Single Wavelength (All-Sky)" and a link to "Background Monitor". The main content area is titled "Planck" and includes a "Search By ..." section with three options: "Single Wavelength (All-Sky)", "Multiple Wavelength (Name/Position)", and "Download Planck Products". The "Single Wavelength (All-Sky)" option is selected. To the right, there is a "Band:" dropdown menu set to "30 GHz". Below this, there are links for "Set Column Selections and Filters" and "Remove Selections and Filters", with the text "Number of Column Filters: 0" underneath. At the bottom of the search area, there are "Search", "Clear", and "?" buttons. The browser's status bar at the bottom shows the address bar, a close button, and a refresh button.

9-band photometry, 10000s of sources

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

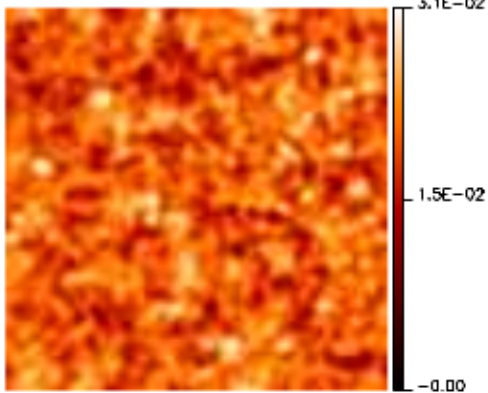


Goal: Measure AGN and DSFG...

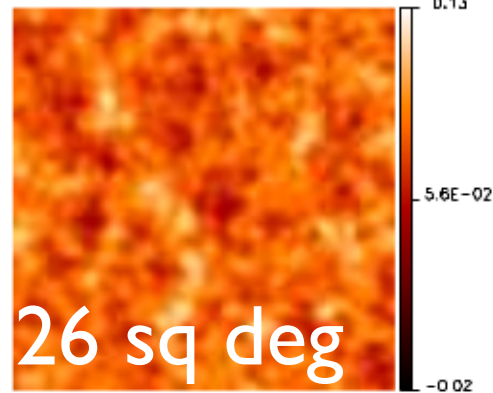


Cosmic Infrared Background

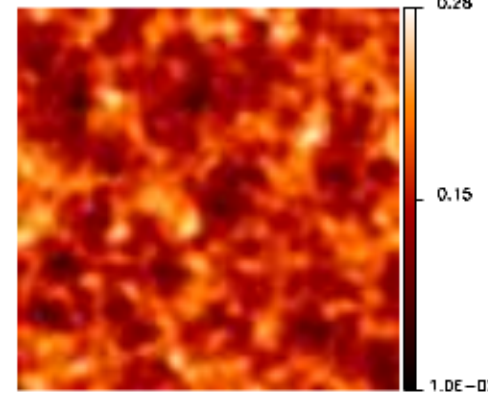
217 GHz



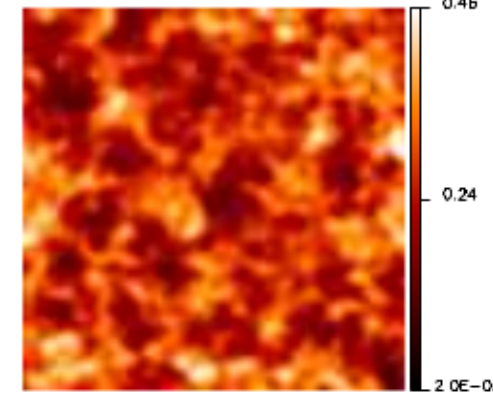
353 GHz



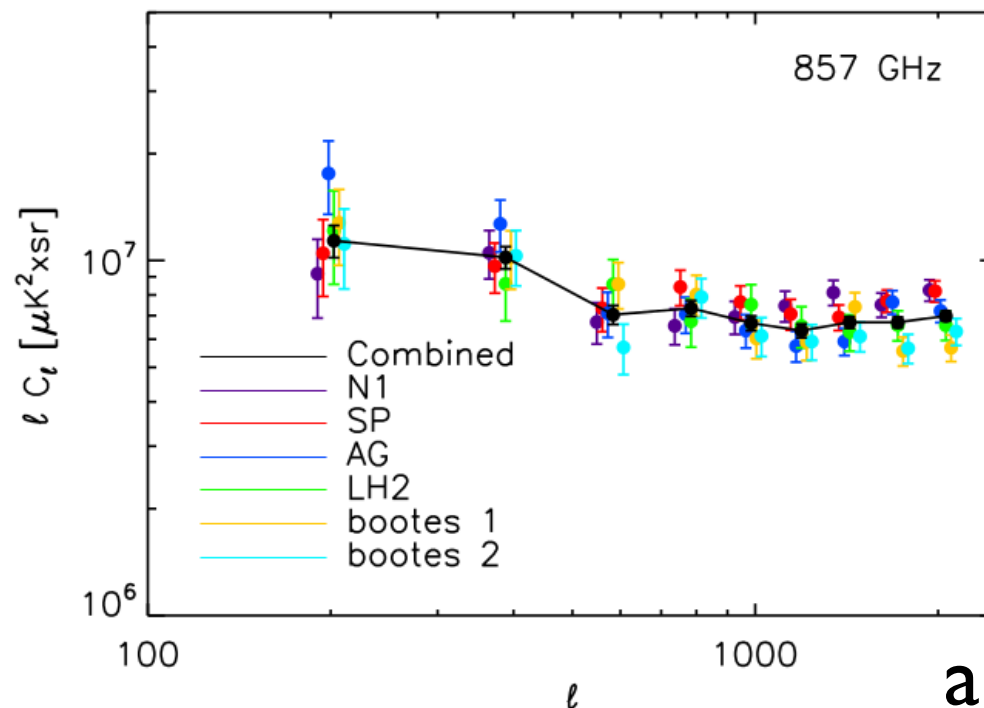
545 GHz



857 GHz

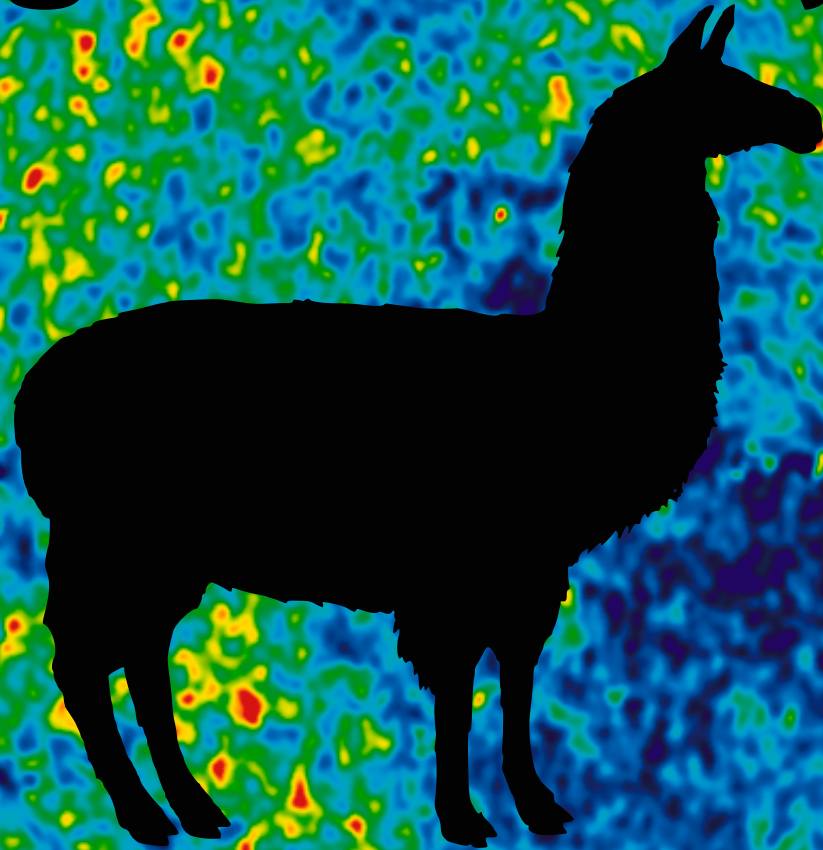


Residual after cleaning of CMB, galactic dust,
and identified point sources



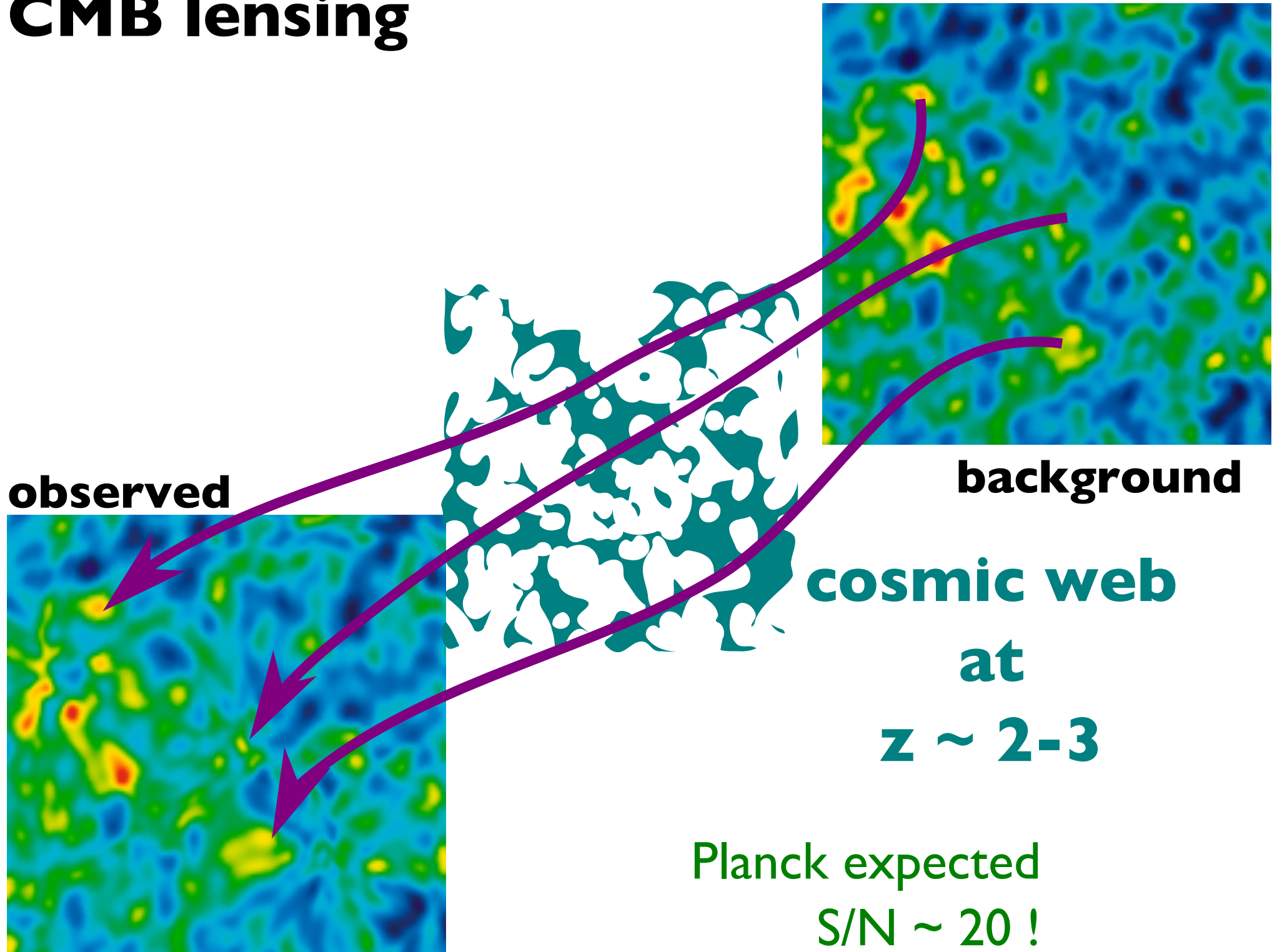
arxiv:1101.2028v3

**Use CMB to study
foreground objects**

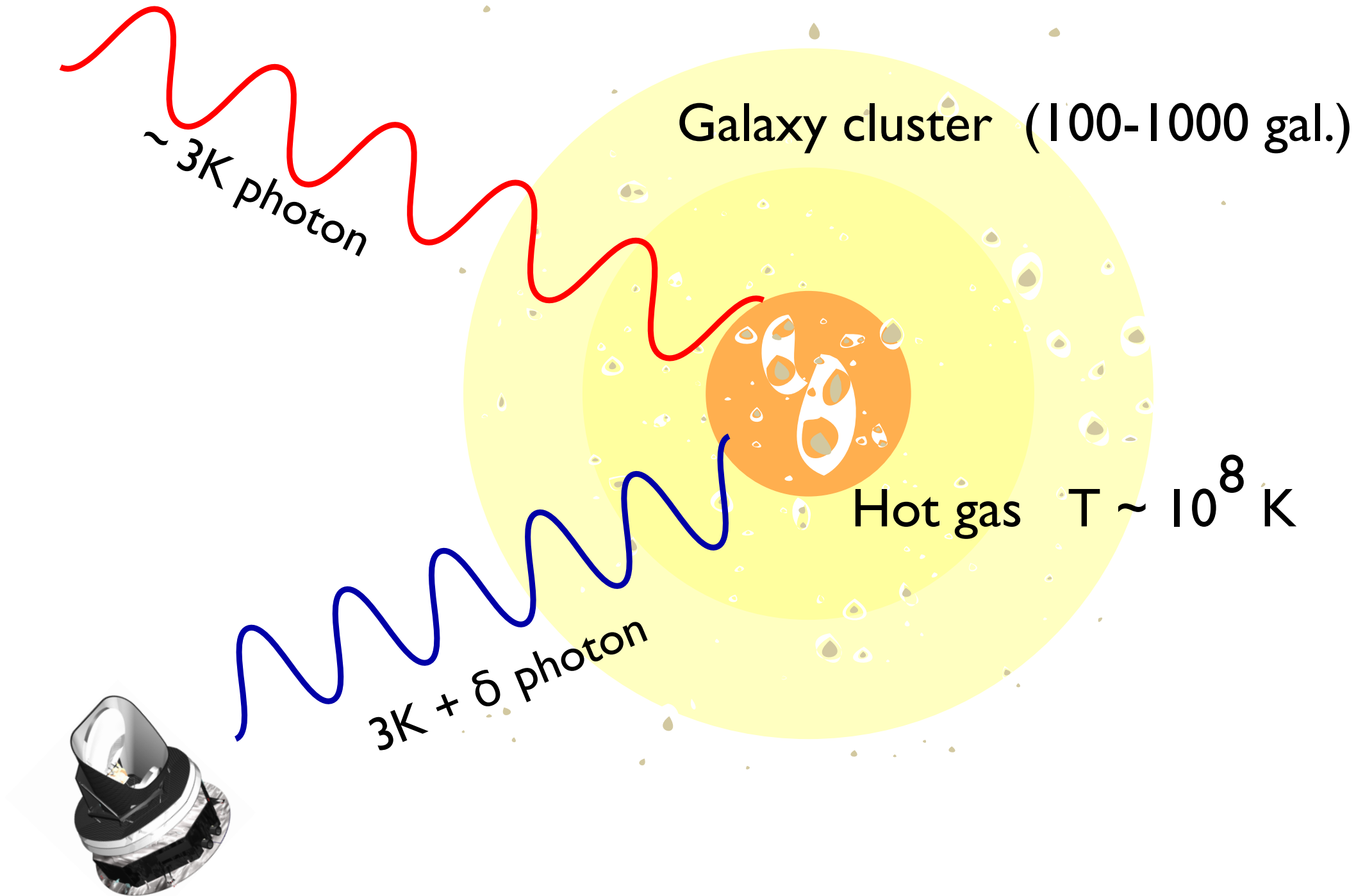


**Large Scale Structure
Clusters of Galaxies**

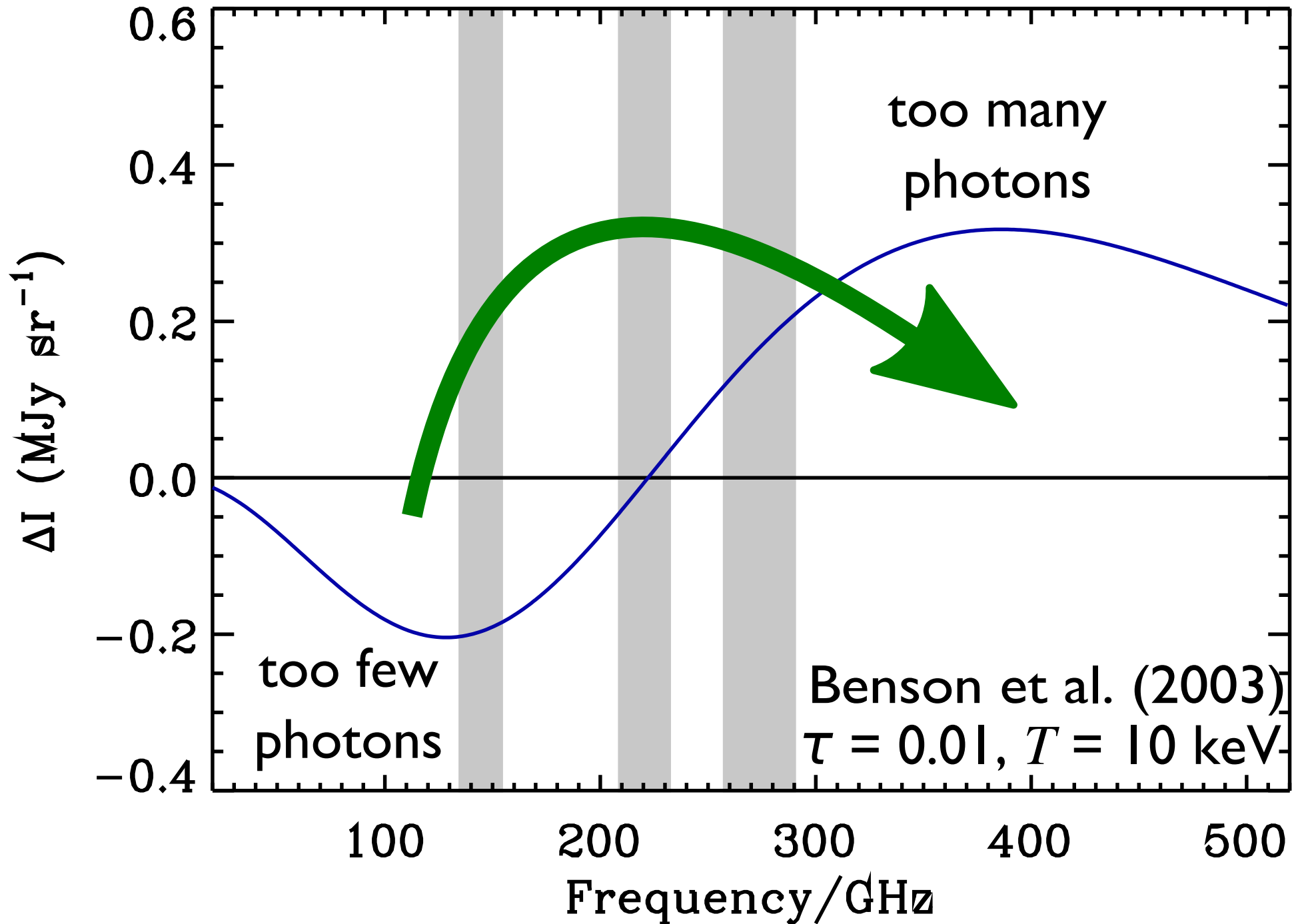
CMB lensing



Sunyaev-Zeldovich effect



SZ distorts CMB blackbody



Early SZ cluster catalogue

6 months of data:

189 cluster candidates, 30 new

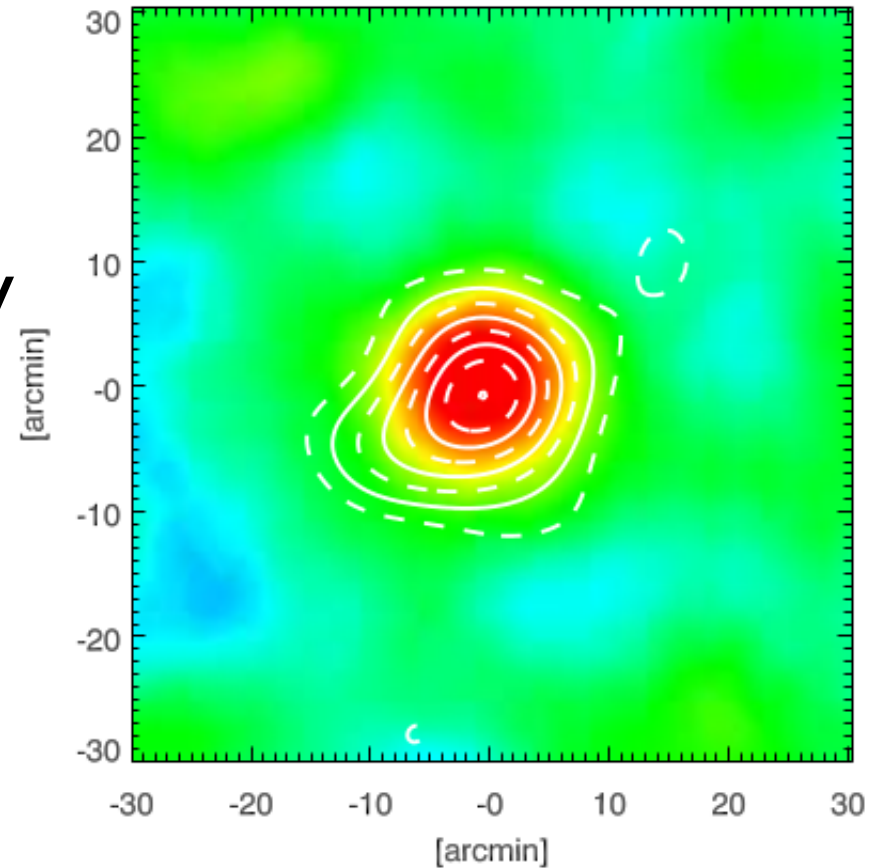
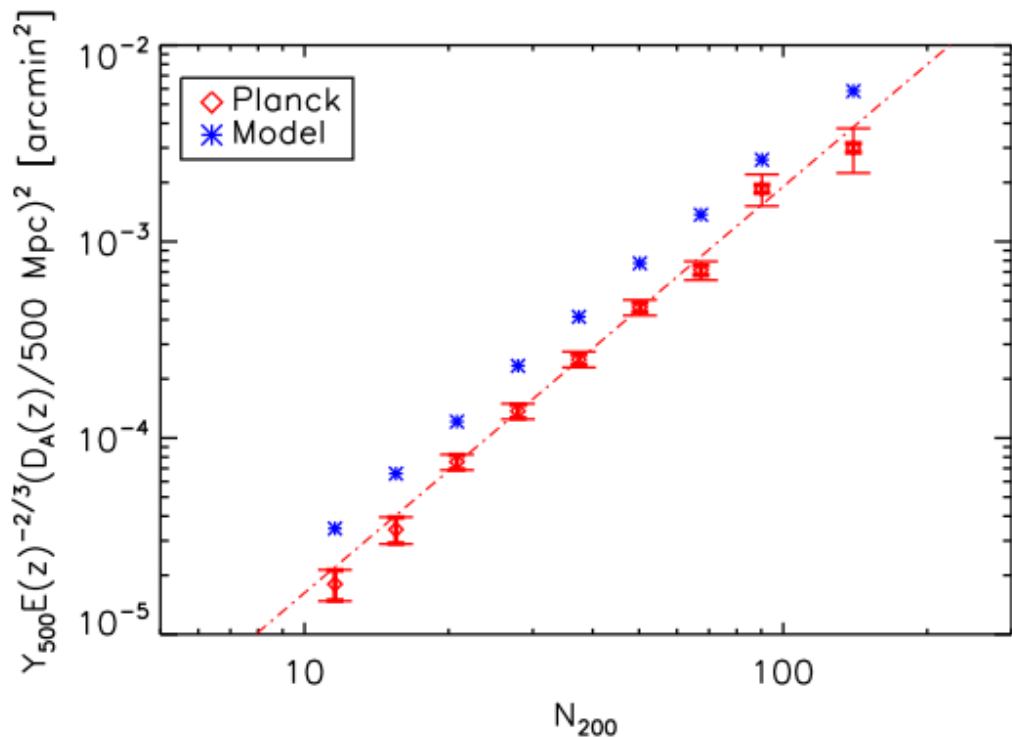
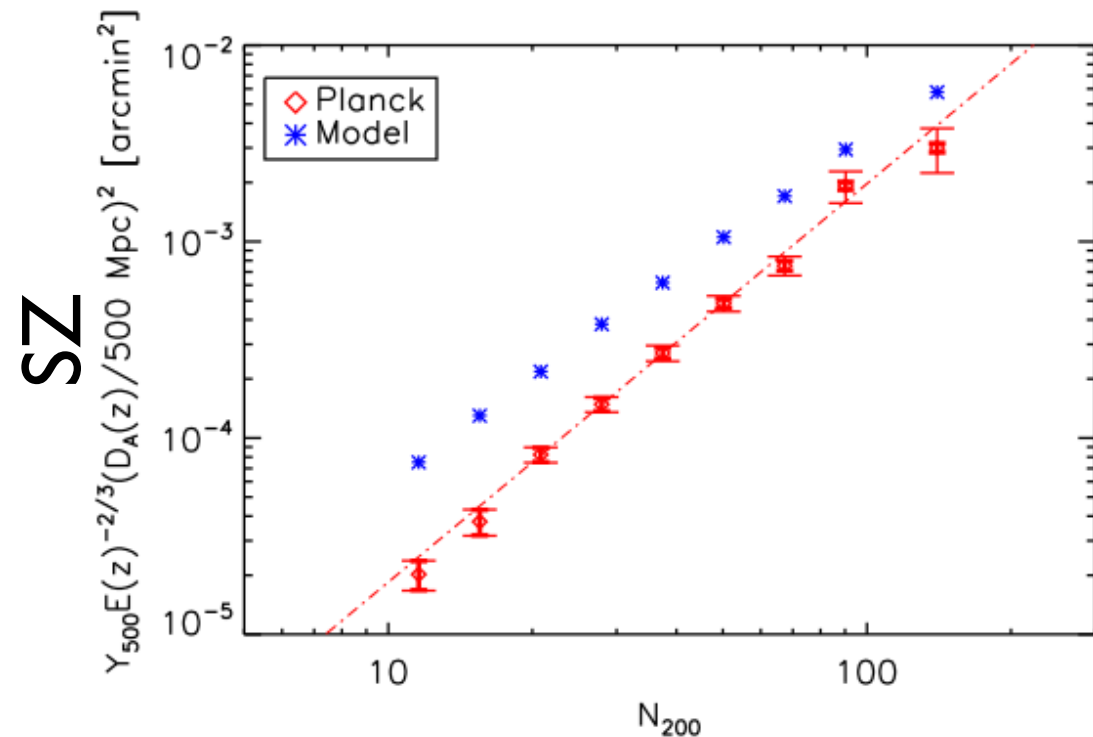


Fig.4. *y*-map of PLCKESZ G139.59+24.19 as observed by *Planck* (colour image) and AMI (contours) at a common resolution of 13 arcmin. The contours are from two to nine in S/N ratio.

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



13,000 MaxBCG clusters



Richness

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!