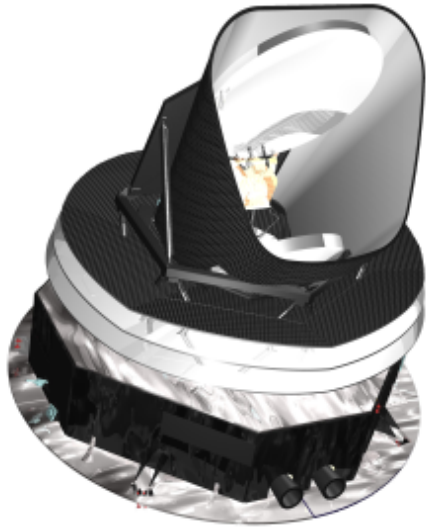
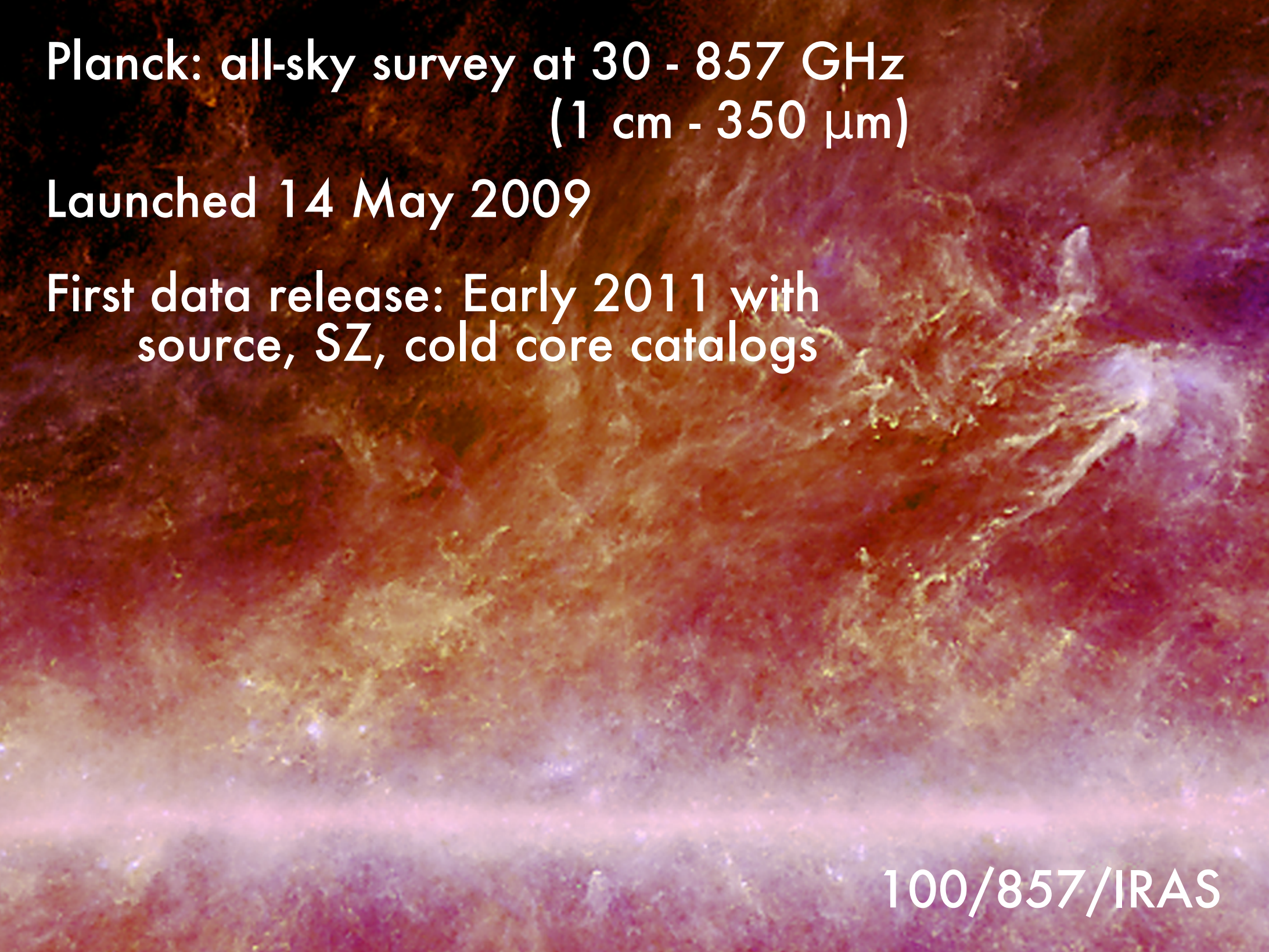
Measuring Planck beams with planets



Kevin M. Huffenberger

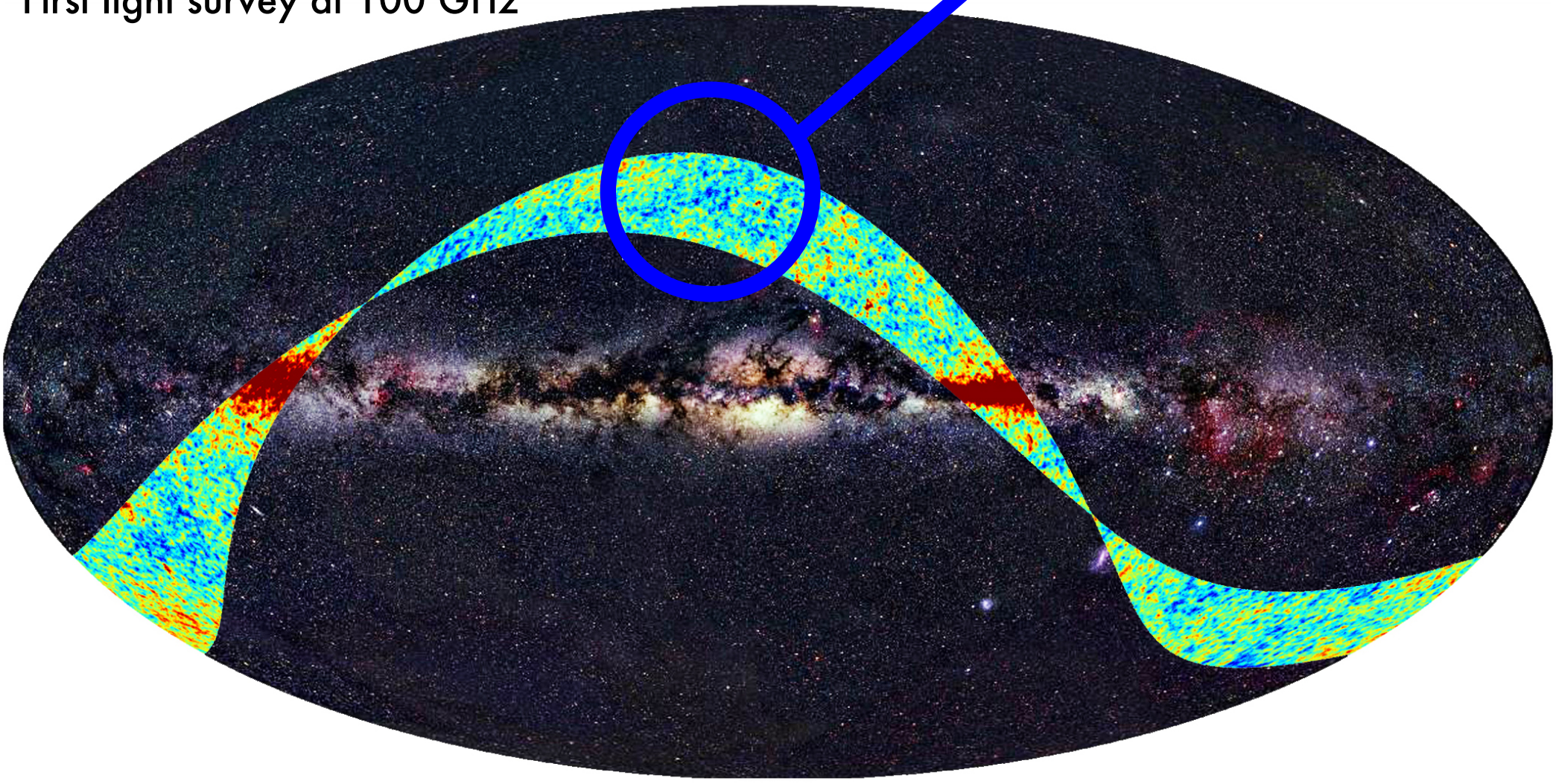
UNIVERSITY OF MIAMI

T. Matsumura, B.P. Crill, A.E. Lange, K.M. Gorski, C.R. Lawrence


Planck: all-sky survey at 30 - 857 GHz
(1 cm - 350 μm)
Launched 14 May 2009
First data release: Early 2011 with
source, SZ, cold core catalogs
100/857/IRAS

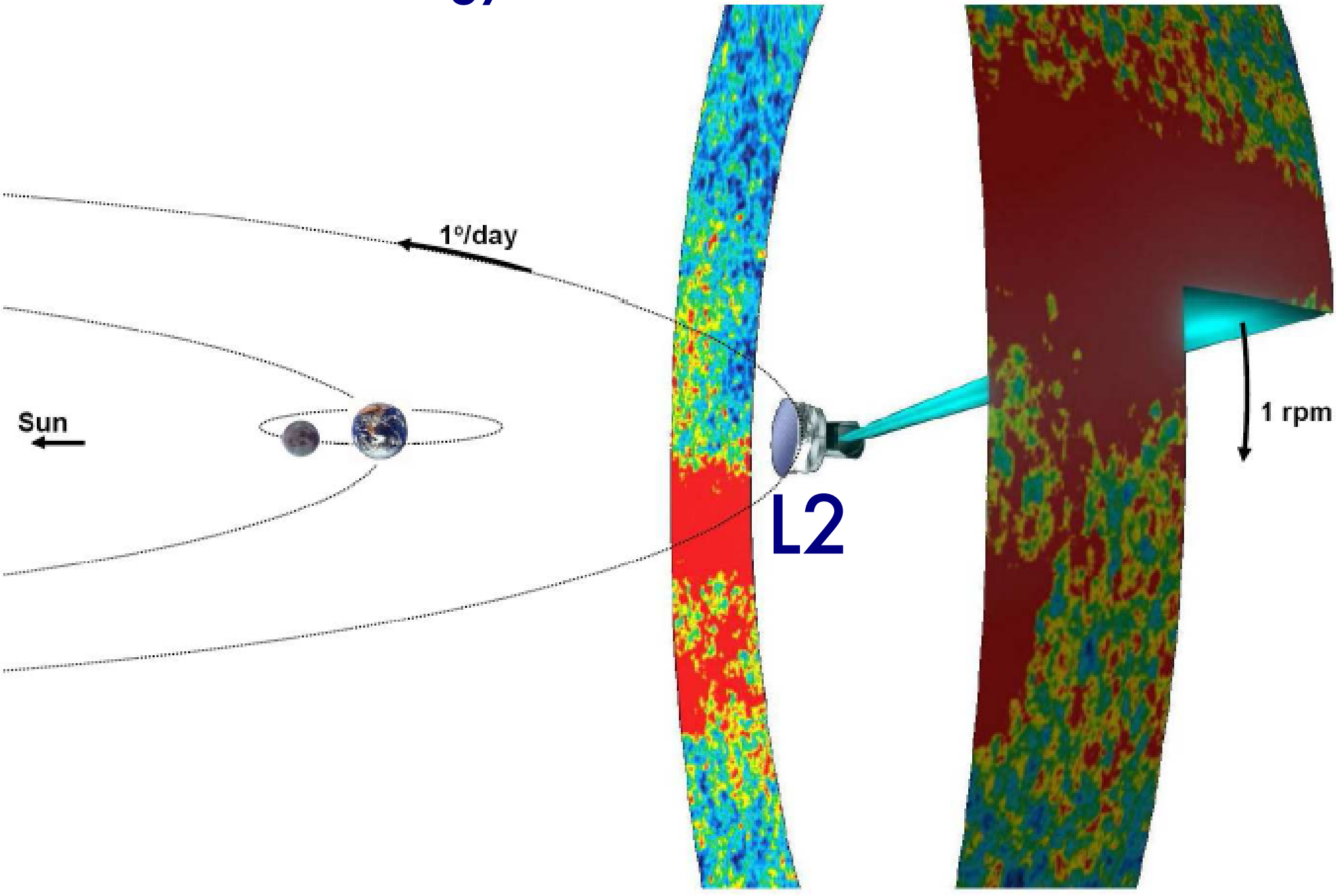
Primary goal: map Cosmic Microwave Background

First light survey at 100 GHz

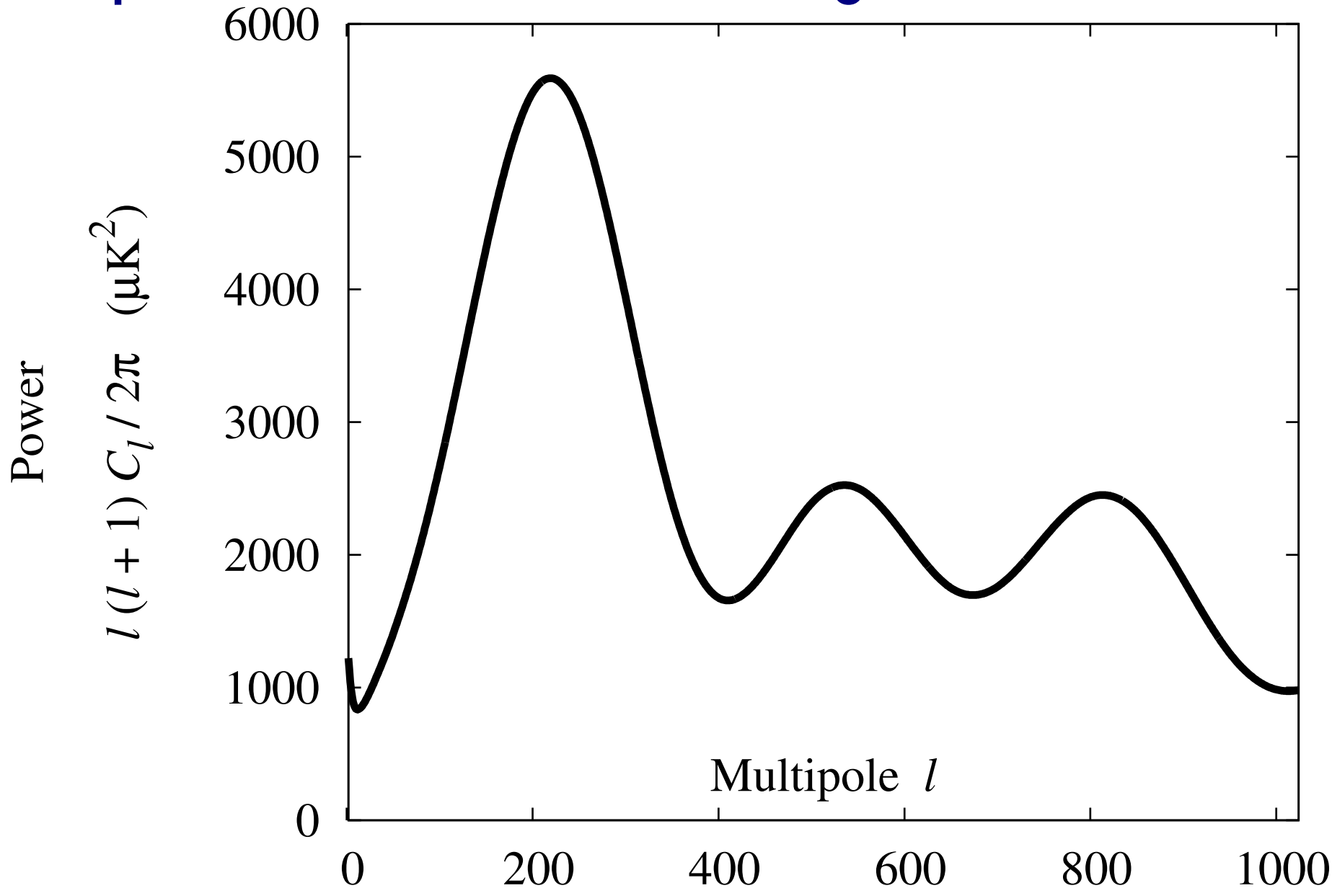


Better resolution, sensitivity, frequency coverage vs. WMAP

Planck scan strategy

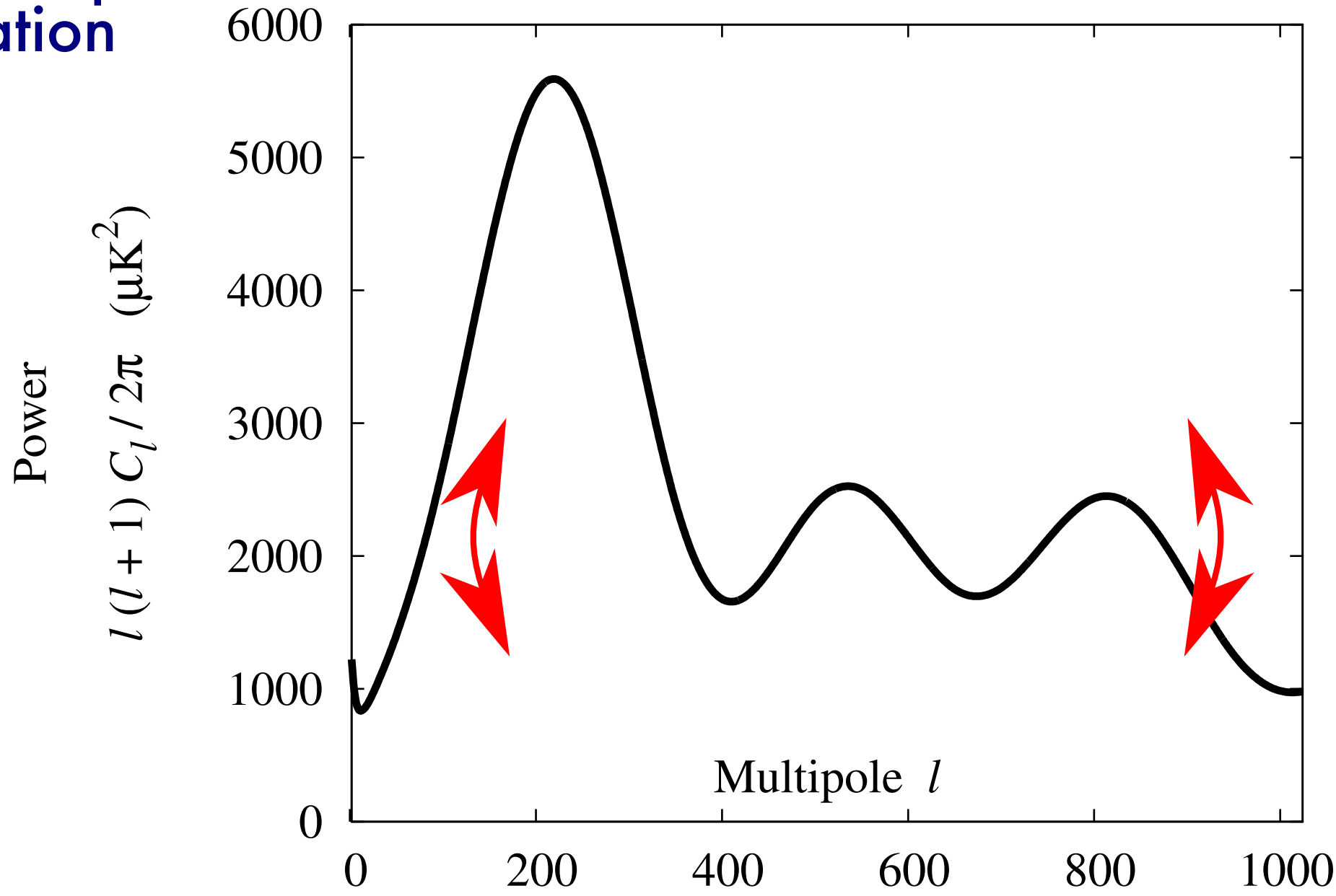


Power spectrum encodes cosmological information



Initial perturbations processed by gravity, pressure, photon streaming, etc.

Initial spectrum of fluctuations tells about the end of inflation

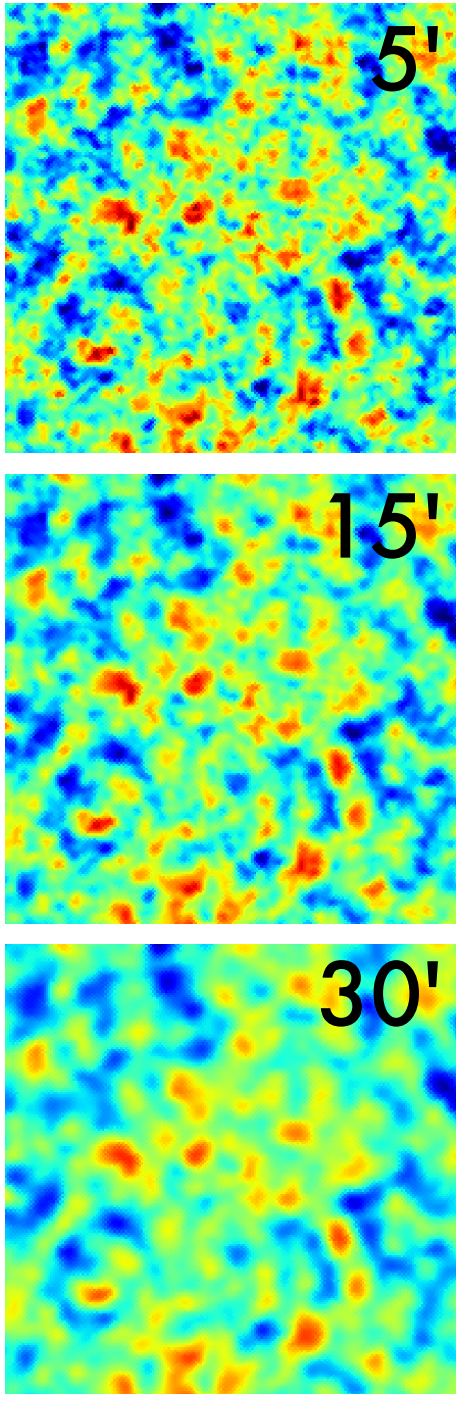


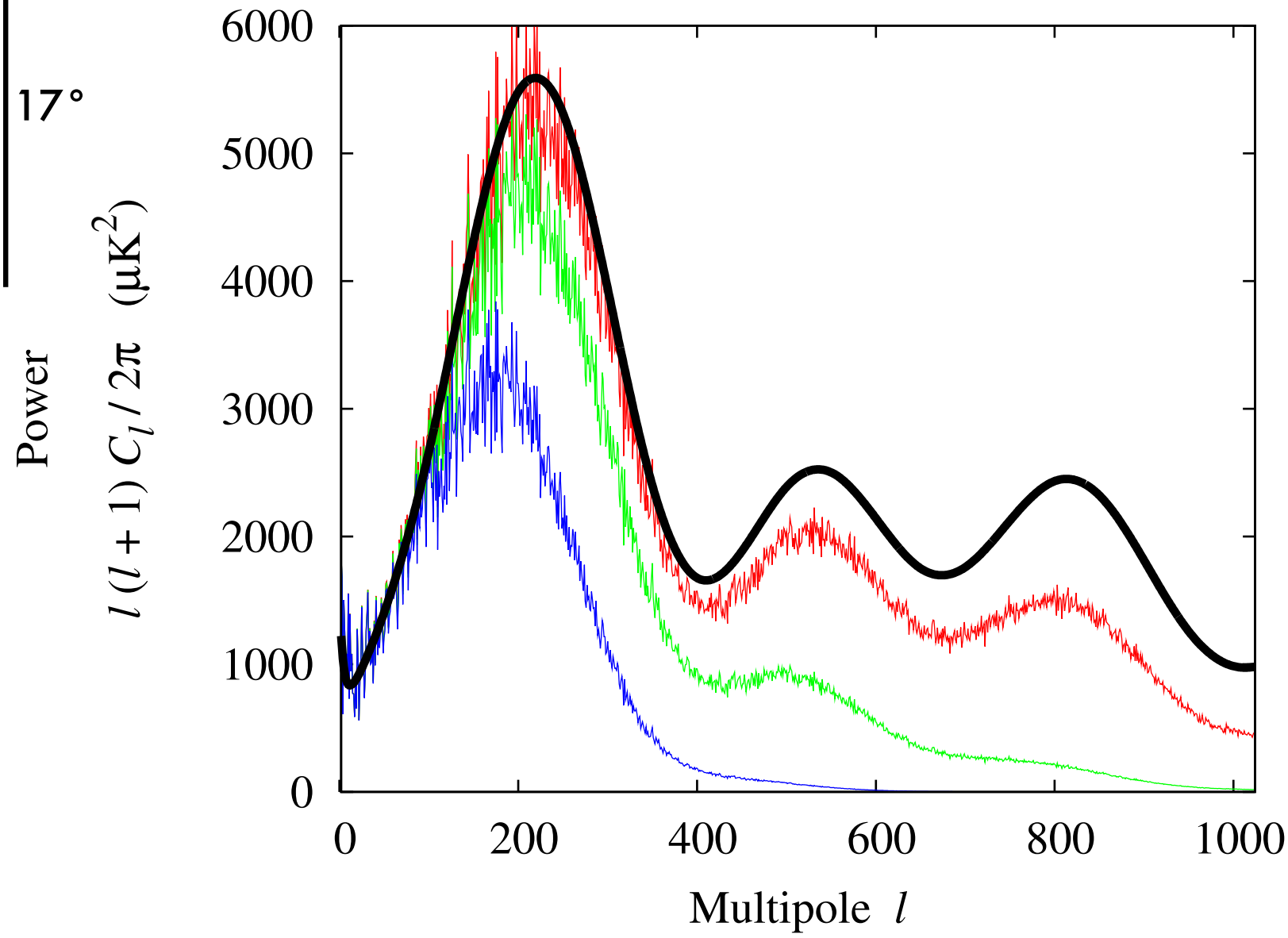
WMAP constraint: $n_s = 0.963 \pm 0.014$

rules out some models

(Larson et al 2009)

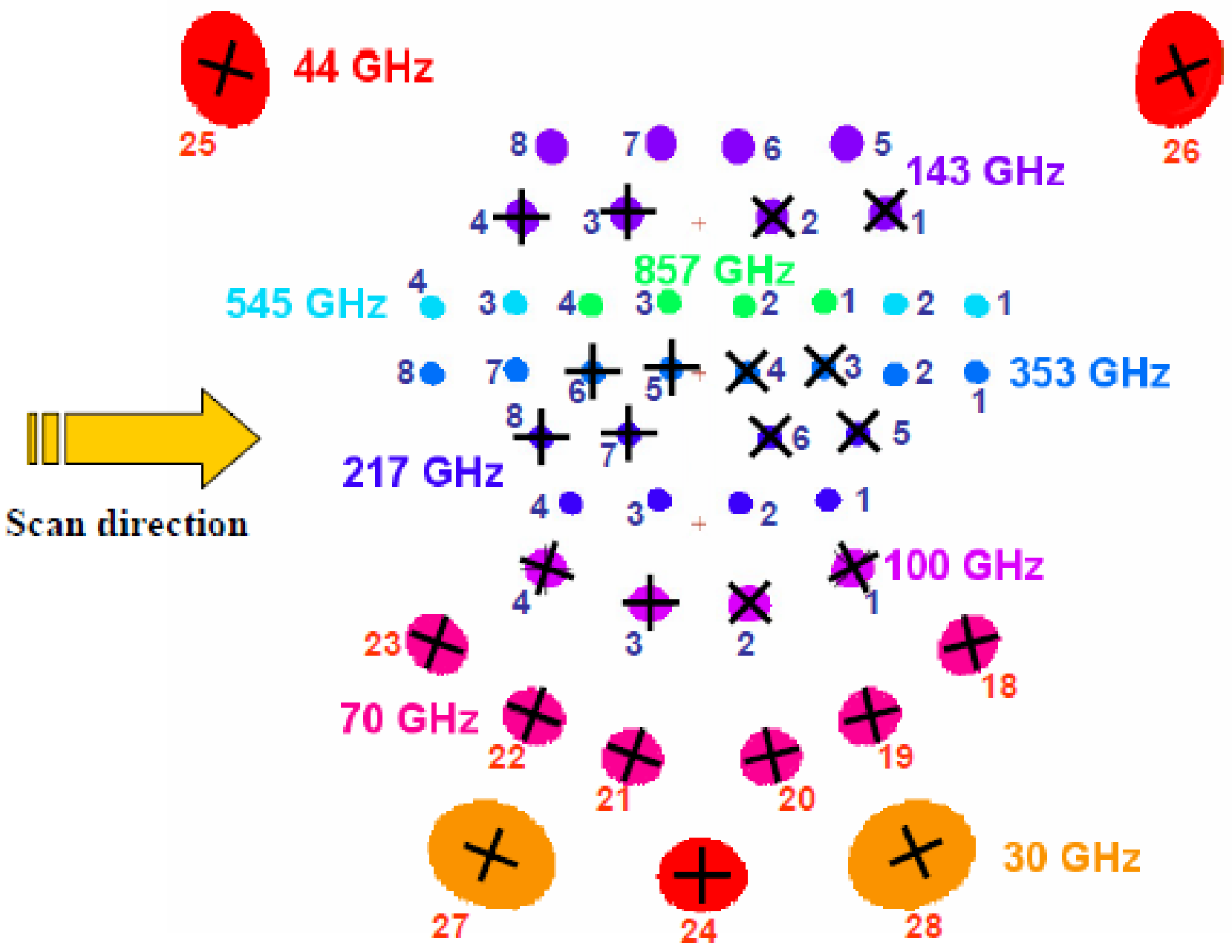
Finite resolution damps small scale power



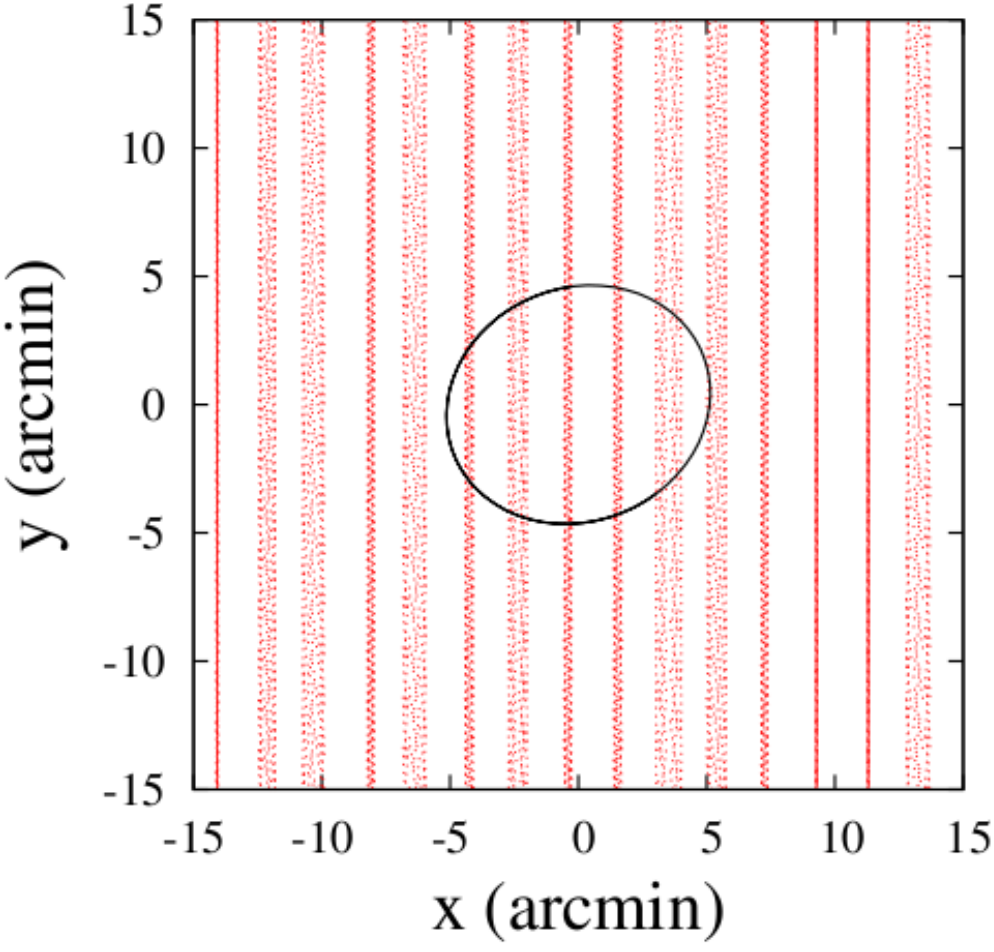


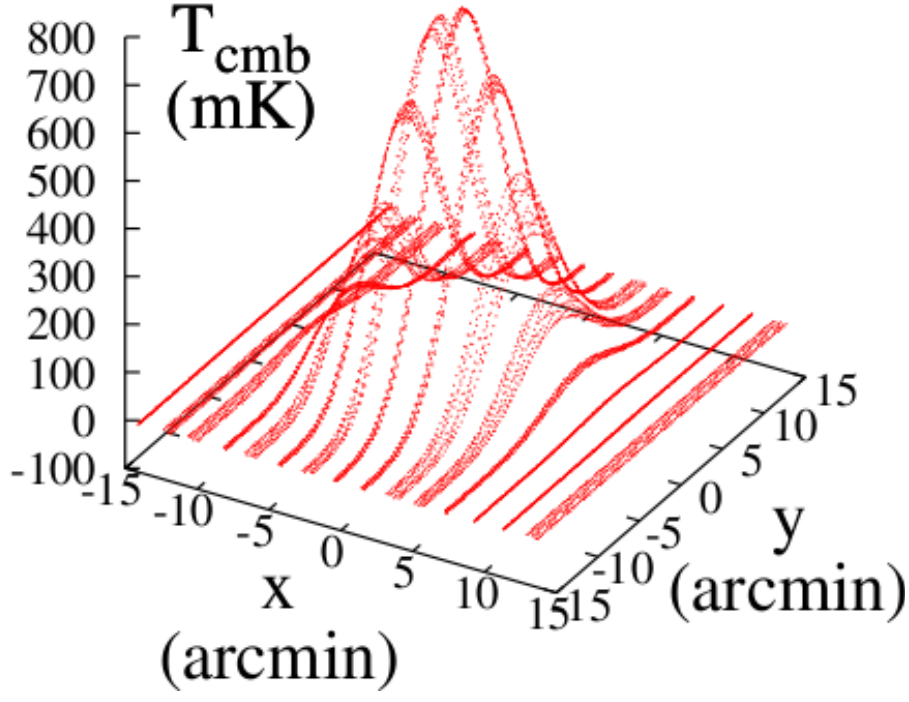
Must know beam well to unbias spectrum.

Planck focal plane



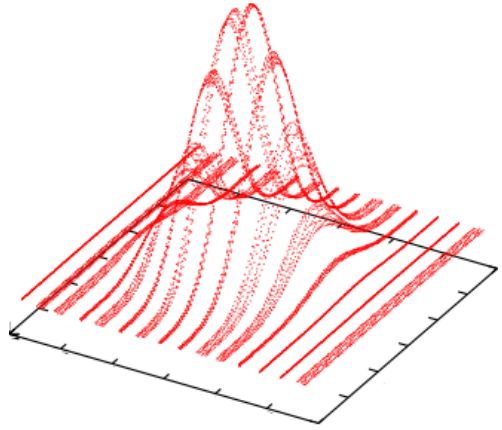
Planets are the brightest objects, compact & well-suited to probing the beam.



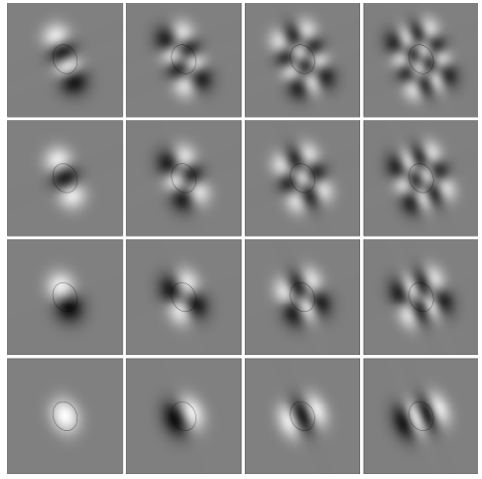


Simulated Jupiter at 100 GHz

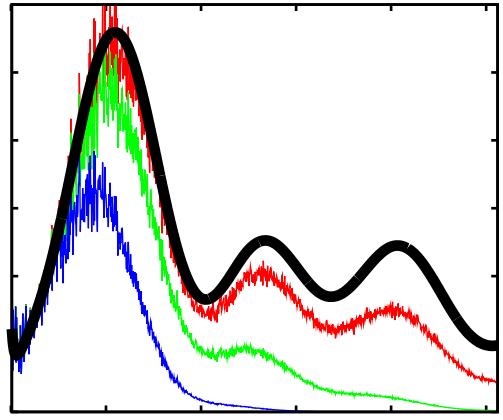
Monte Carlo pipeline to probe reconstruction error

1. 

simulate signal, noise, electronics, etc.

2. 

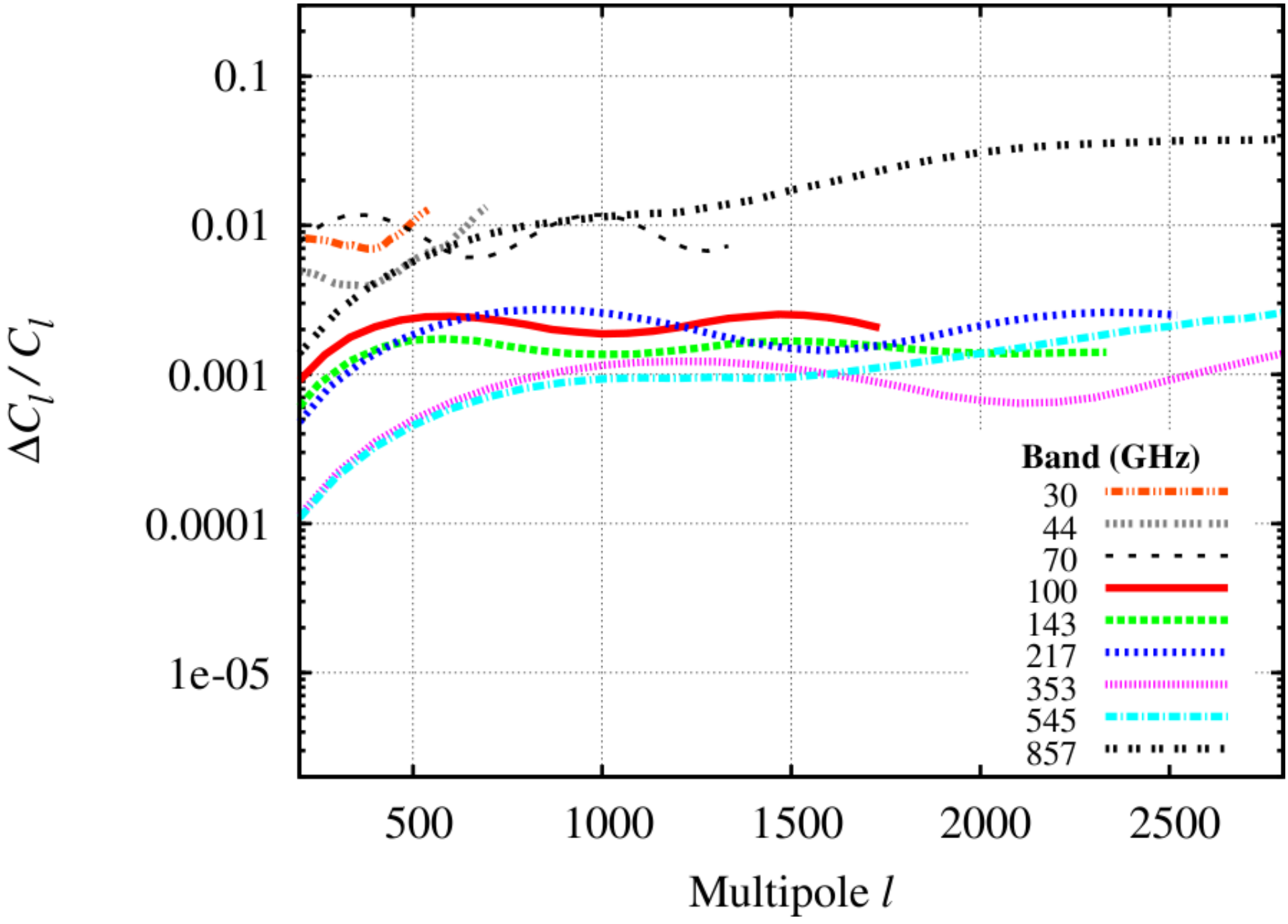
reconstruct beam

3. 

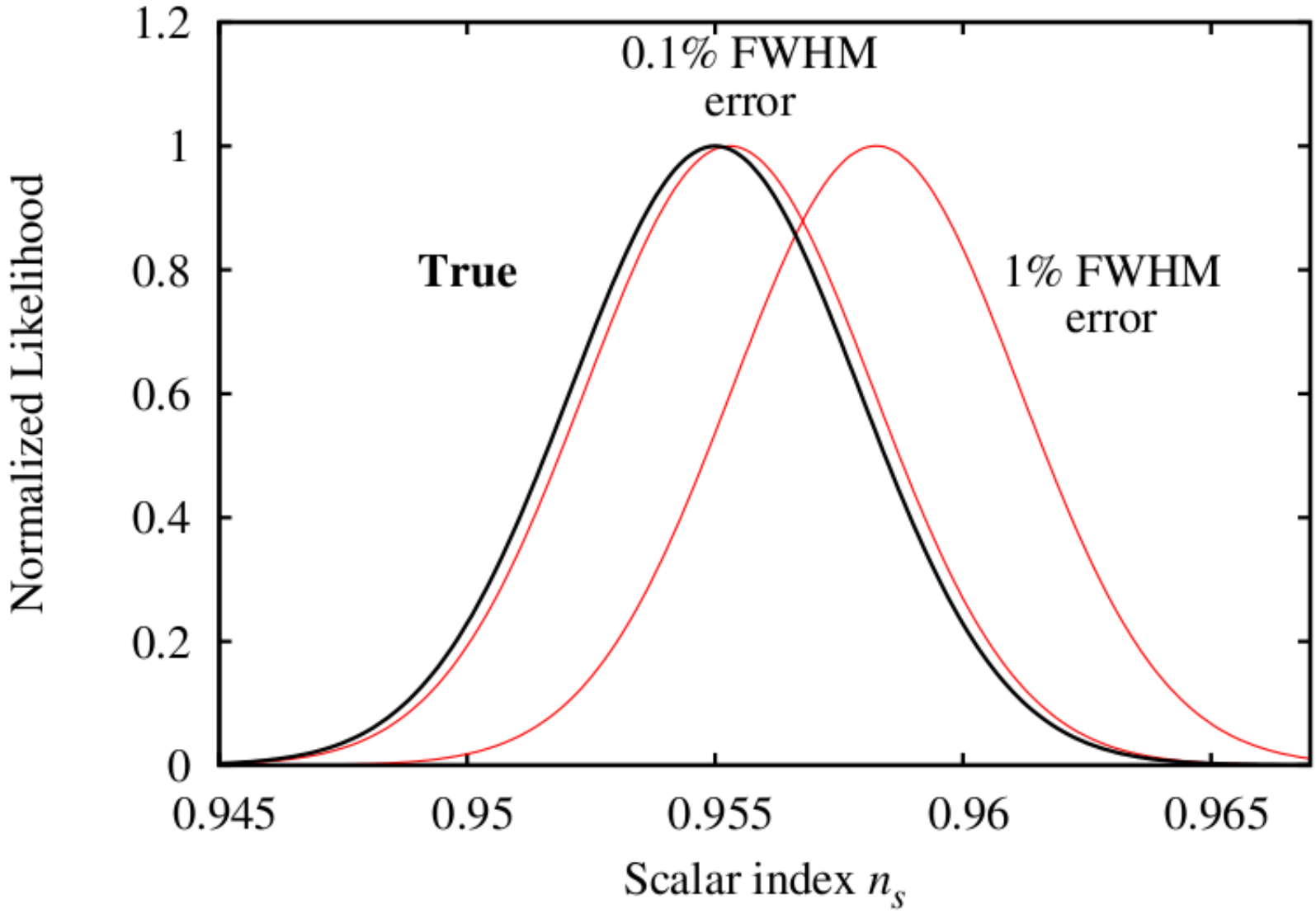
repair spectrum

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

Results: most sensitive bands better than 0.3%



But Planck is very sensitive!



Typical parameter bias 0.1 - 0.6σ

Conclusions

Interesting physics (constraints on inflation) depends on mundane details (beams of the instrument).

Fitting the beam to planet measurements is challenging.

Residuals in beam fitting will probably play a small but still significant role in cosmological parameters' final error budget.