

**New Cosmic Microwave Background measurements
with the Degree Angular Scale Interferometer (DASI)
at the Amundsen-Scott South Pole Station**

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Office of Polar Programs

National Science Foundation



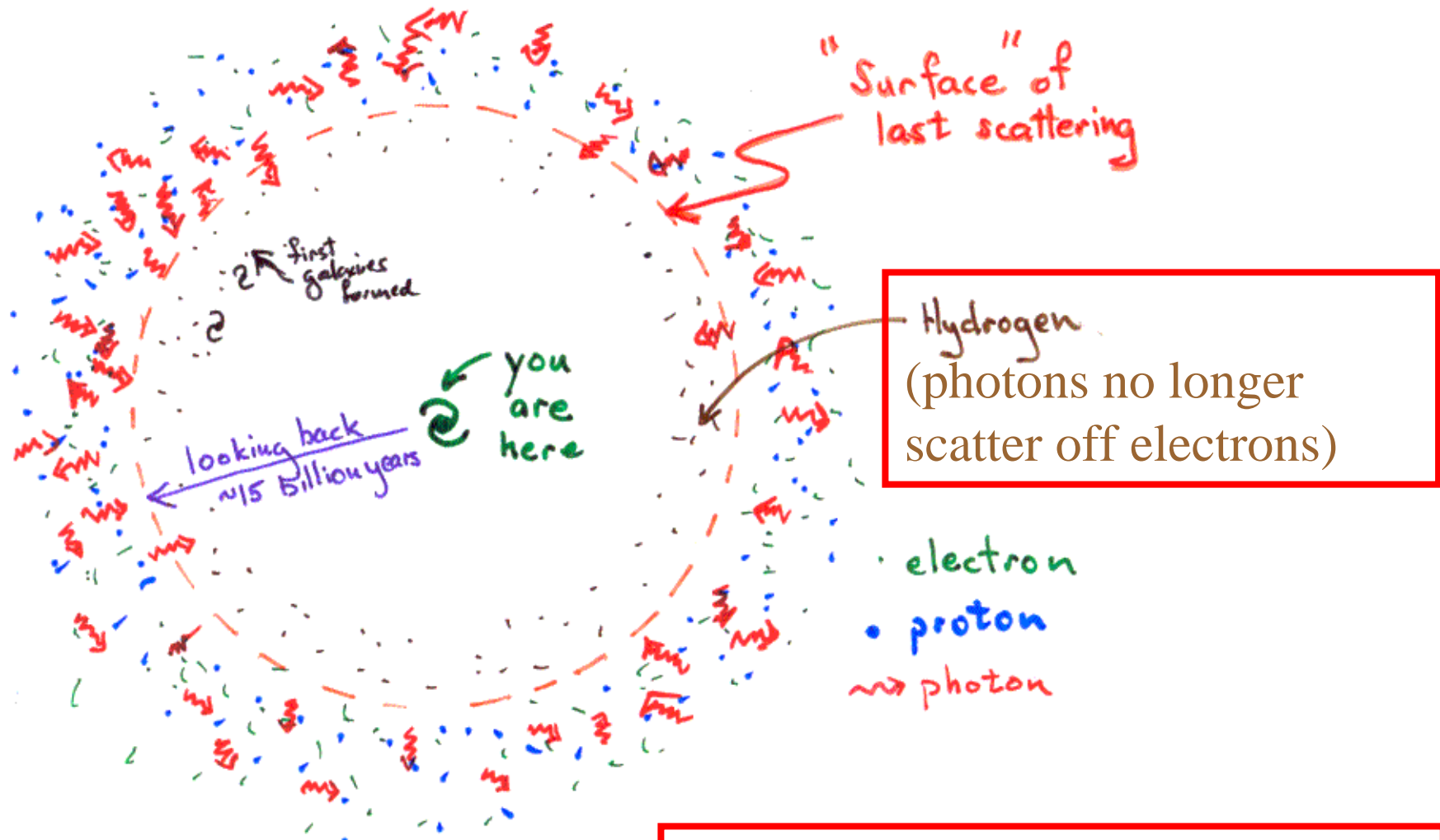
Exploring the early universe with Cosmic Microwave Background

Direct view of the universe ~14 billion years ago
(400,000 years after big bang)

- *Map the seeds of the magnificent structures in the universe today*
- *Provide stringent tests of cosmological models for the origin of the universe*
- *Determine the values of the cosmological parameters that describe our universe*

1992 – 1st CMB anisotropy measurements (NASA COBE DMR)

Universe expanded, cooled
=> electrons & protons form Hydrogen



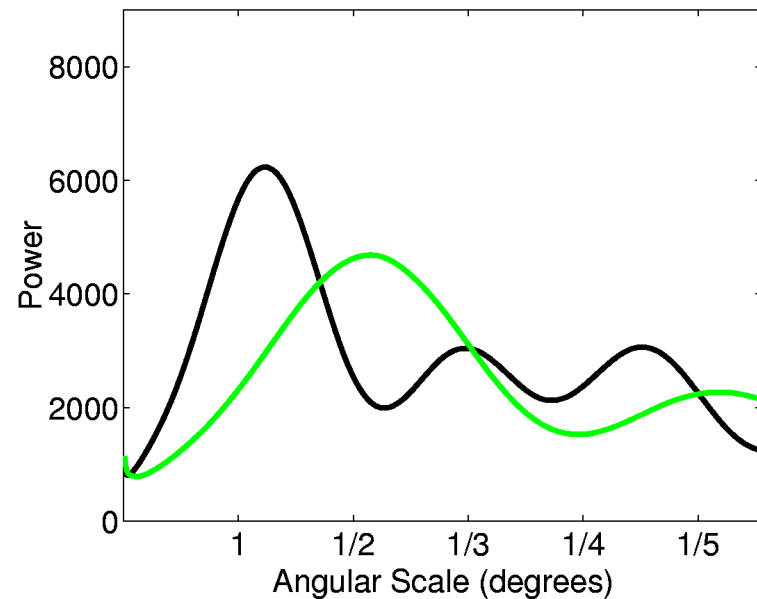
CMB telescopes are time machines

Testing the inflationary model for origin of our universe

Is the universe flat?

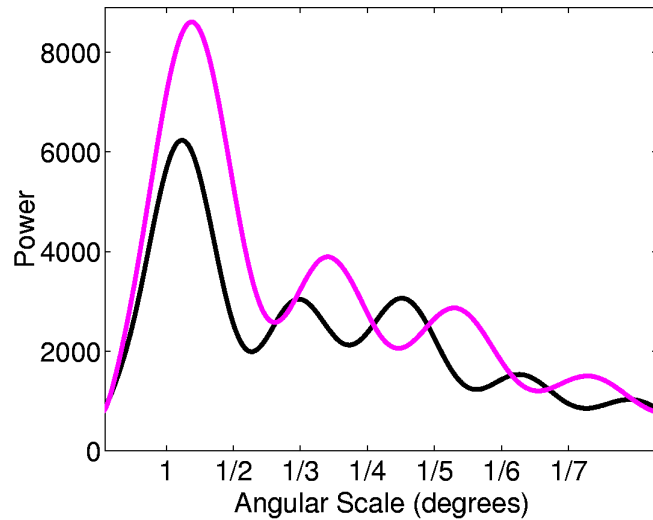
**Do the second and higher
peaks in the CMB power
spectrum exist?**

*(i.e., were the initial
structures coherent?)*



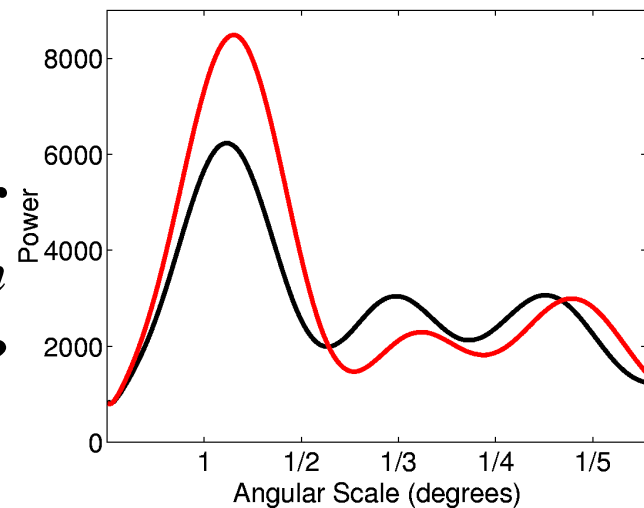
Is the initial underlying power spectrum flat?

Determining what stuff makes up the universe



**Do we need dark matter?
How much?**

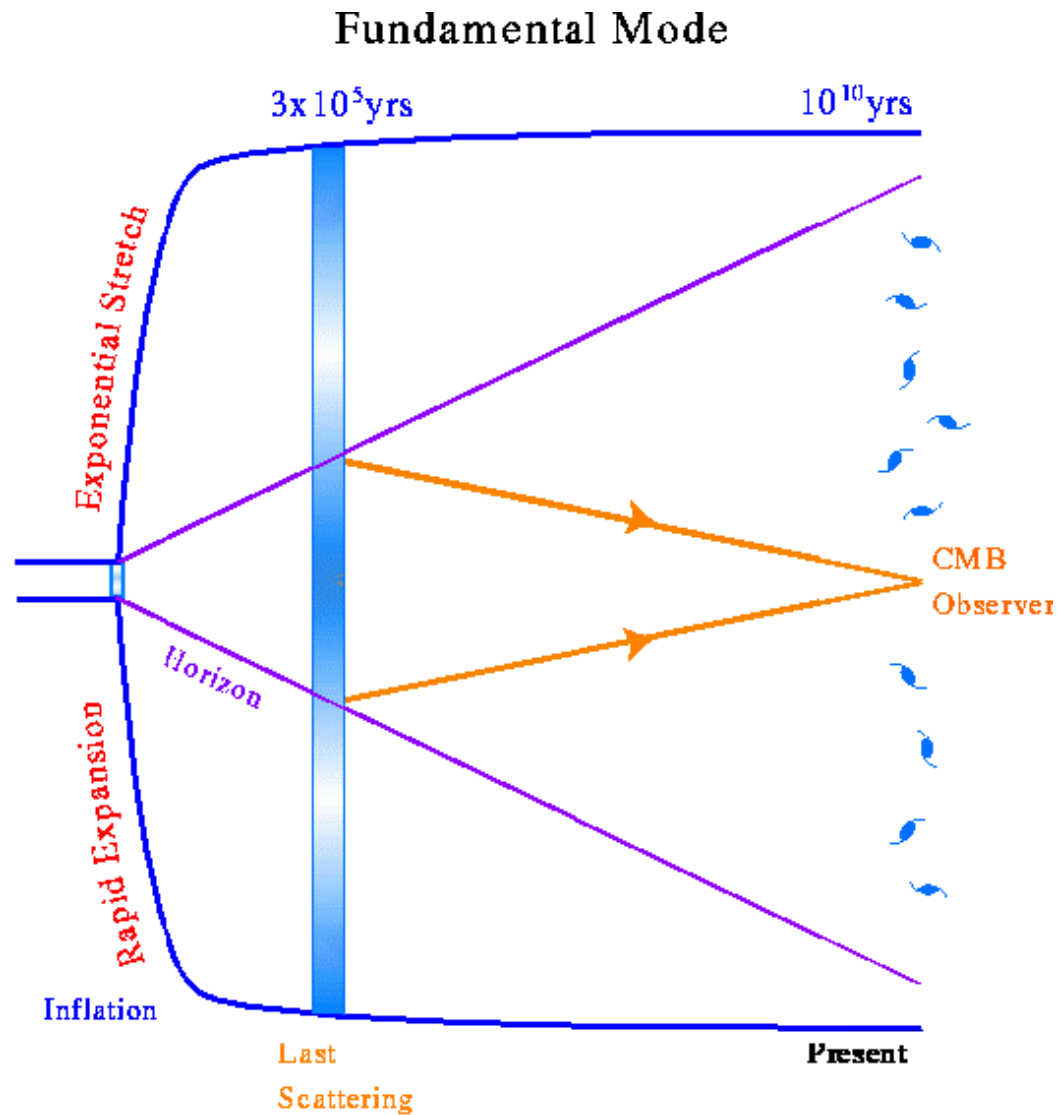
Amount of 'ordinary' matter
*Do CMB measurements agree with
Big Bang Nucleosynthesis?*



Do we need dark energy component?

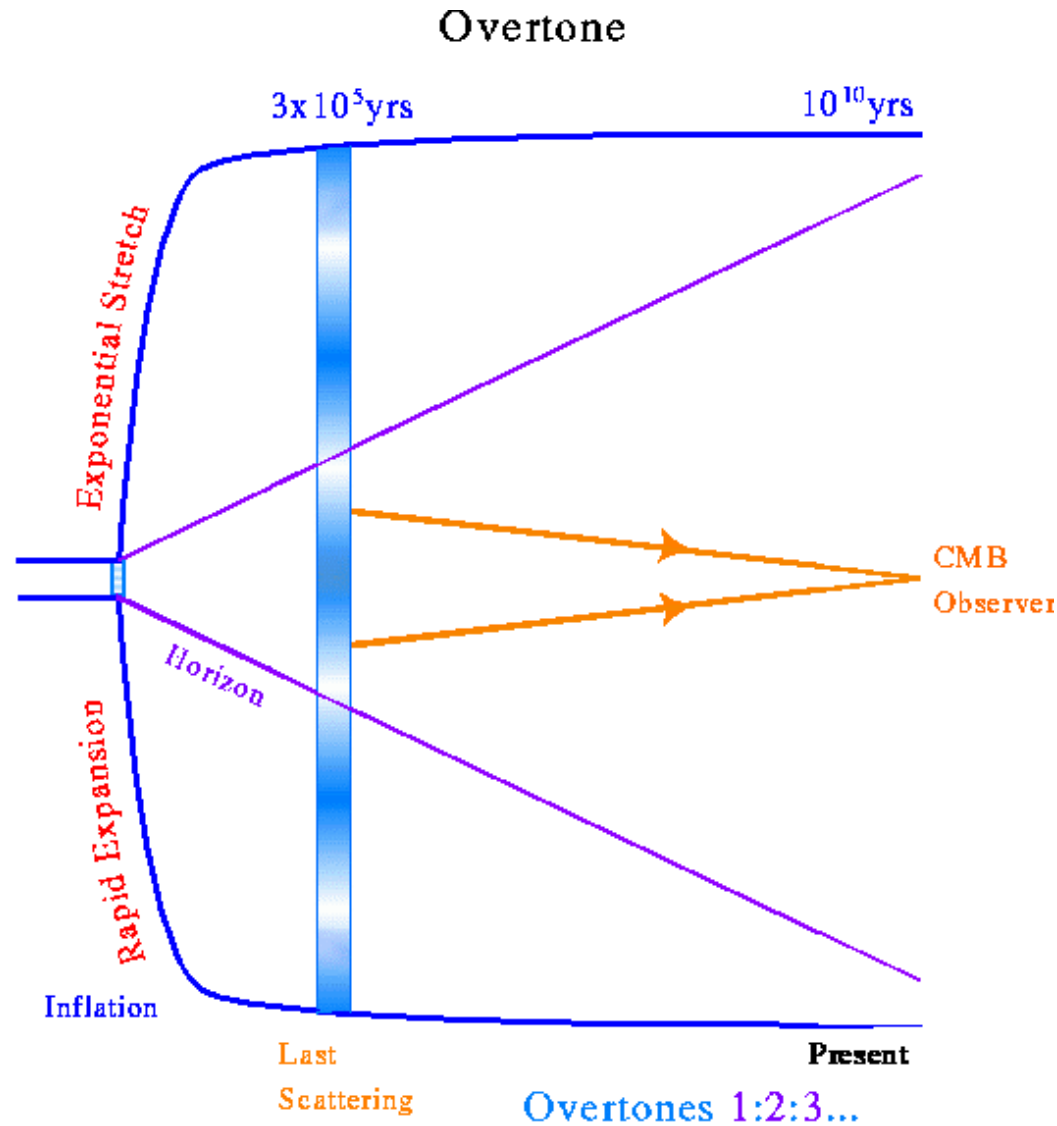
If the matter components don't add up to provide enough matter to make the universe flat (a la Einstein) then we need a dark energy component!

CMB allows us to 'see' sound in the early universe



See Wayne Hu's fantastic web pages at <http://background.uchicago.edu/~whu/>

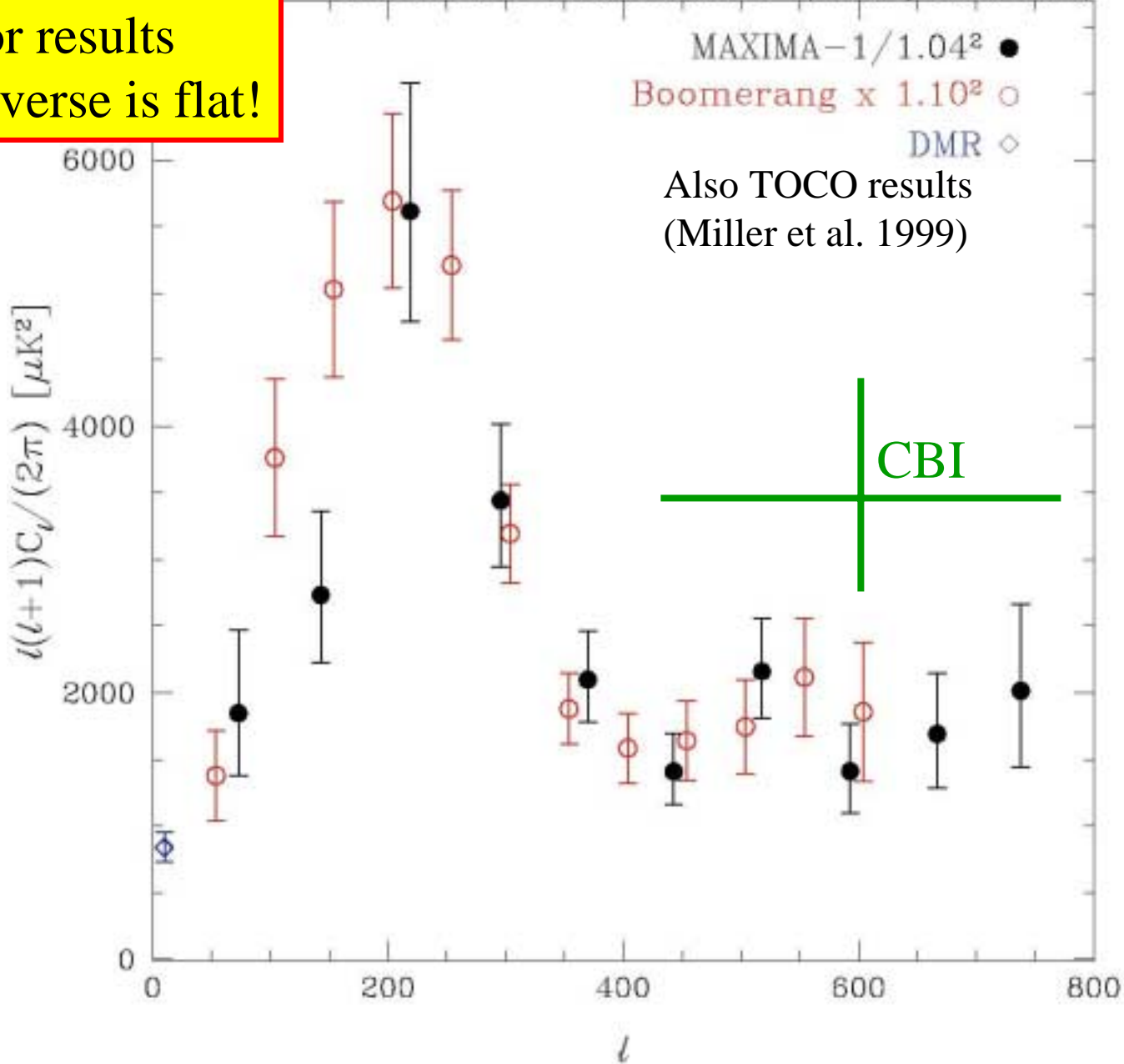
CMB allows us to ‘see’ sound in the early universe Overtones reveal the nature of the instrument being played



See Wayne Hu's fantastic web pages at <http://background.uchicago.edu/~whu/>

The MAXIMA Collaboration (Hanany et al 2000)

prior results
Universe is flat!





PEOPLE

DASI Team

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November 1999 – January 2000
Deployment of DASI at South Pole



DASI and Martin A. Pomerantz Laboratory at Amundsen-Scott South Pole Station



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Inside DASI



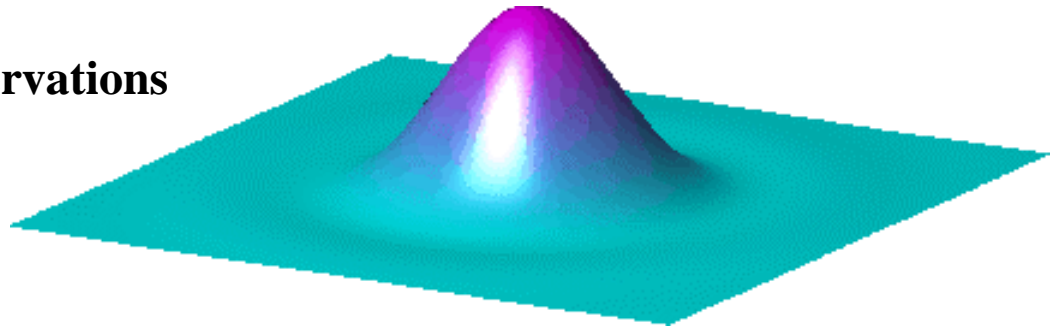
DASI at sunset March 2000
CMB observations made from May – November 2000



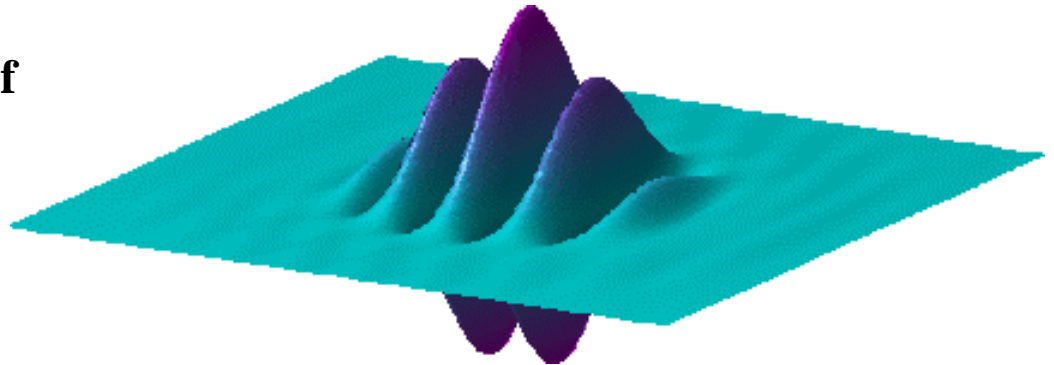
DASI is a ripple machine!

Directly measures the CMB power spectrum

‘beam’ for single dish observations

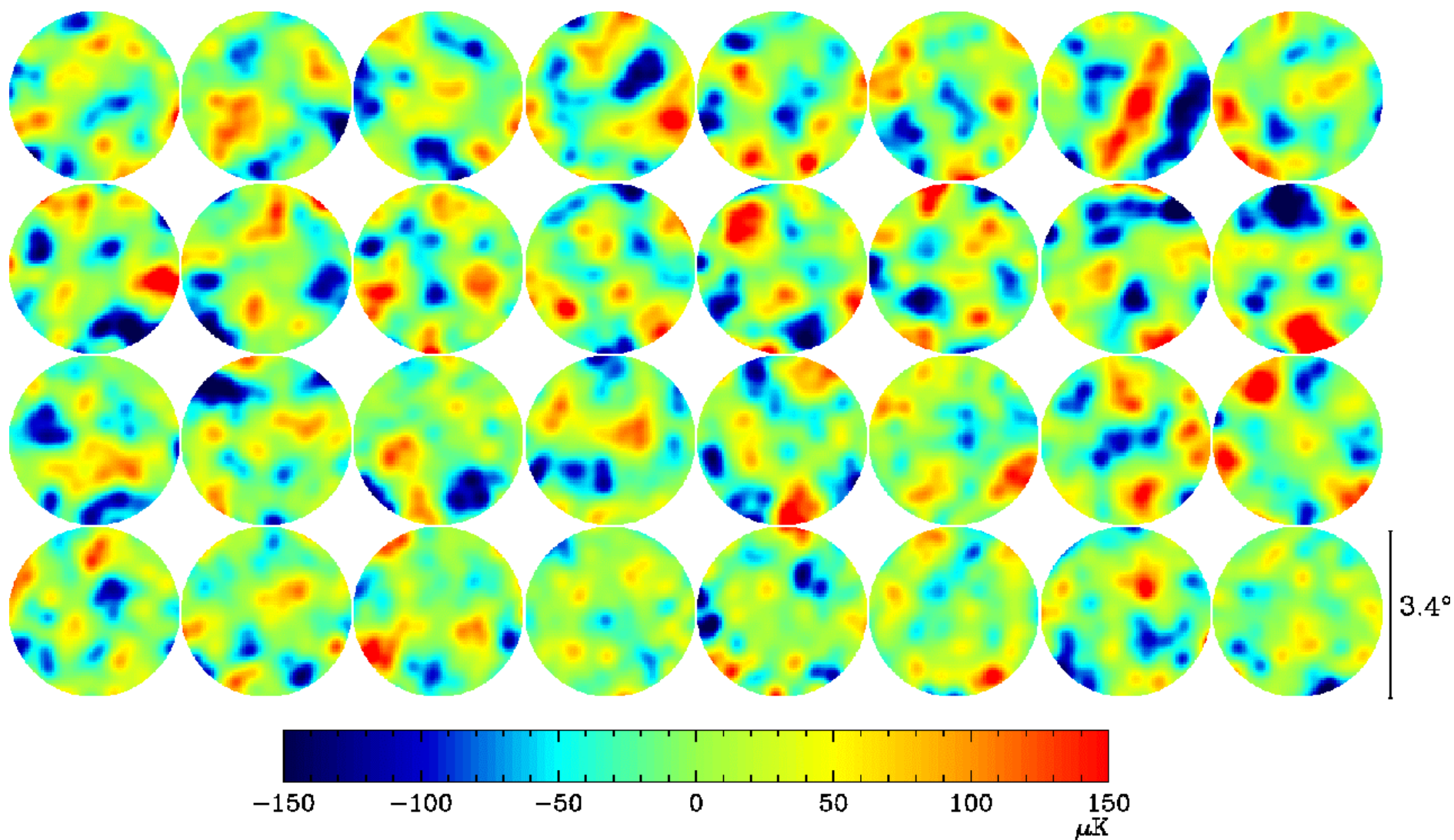


‘beam’ for two elements of interferometer array

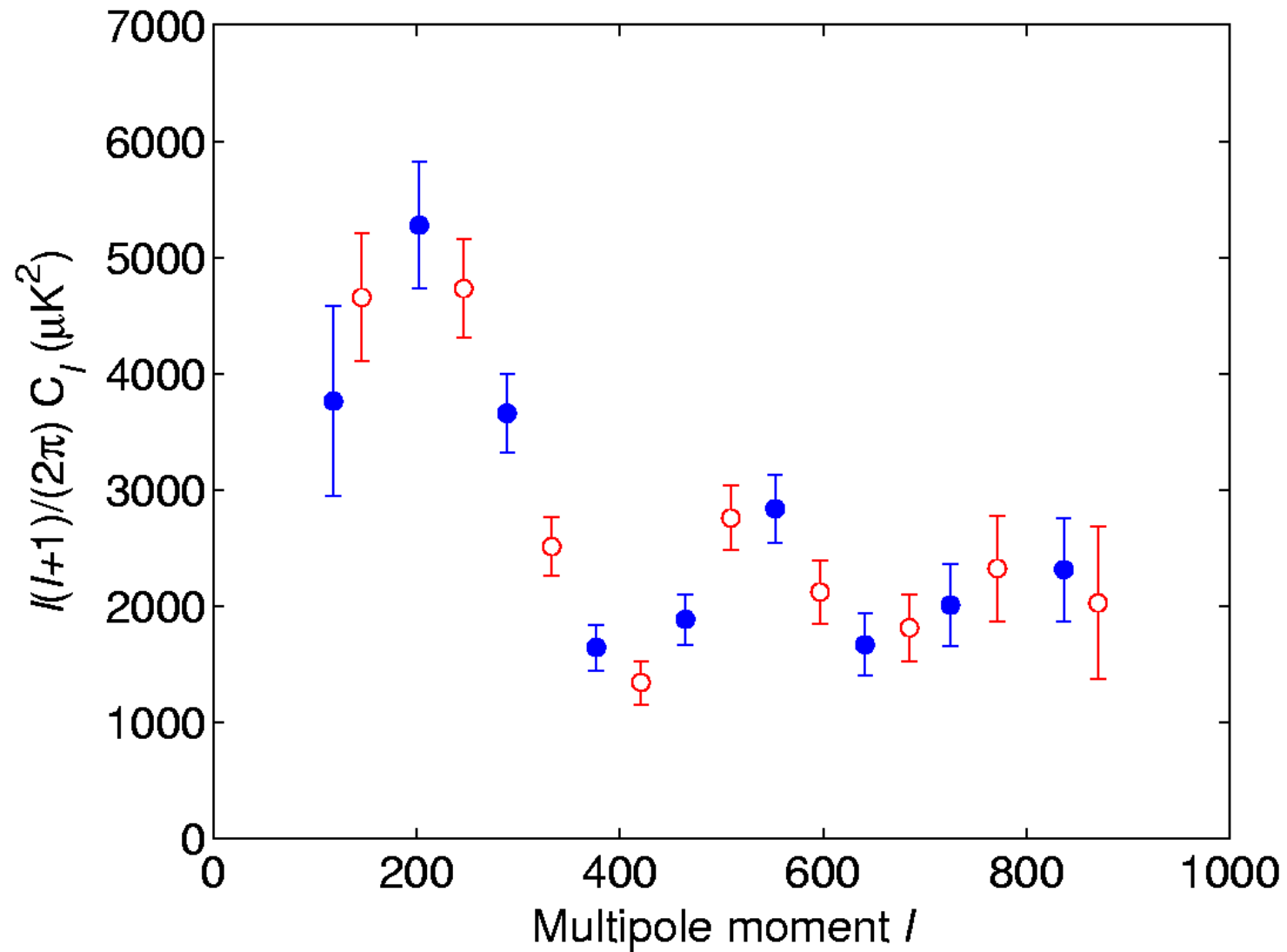


1. DASI's 13 elements provides 78 'ripple' measurements simultaneously
(not necessary to make maps)
2. Calibration of CMB power spectrum is essentially independent on angular scale
3. Completely different technique, systematics & foregrounds from bolometer obs.

DASI CMB images of 32 fields



DASI power spectrum



DASI CMB results

Inflation tests:

Further support for flat universe (1.04 ± 0.06)

1st and 2nd peaks clearly detected and

3rd peak strongly suggested

Scale invariant initial spectrum ($n_s = 1.01 \pm 0.07$)

What stuff makes up the universe:

5% Ordinary matter ($\Omega_b h^{-2} = 0.022 \pm 0.04$)

consistent with Big Bang Nucleosynthesis!

35% Dark matter

60% Dark energy

DASI power spectrum

