From Planck to the future of CMB

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From Planck to the future of CMB

A workshop to discuss future challenges of Cosmic Microwave Background observations and data analysis

The story begins in 1992/1993

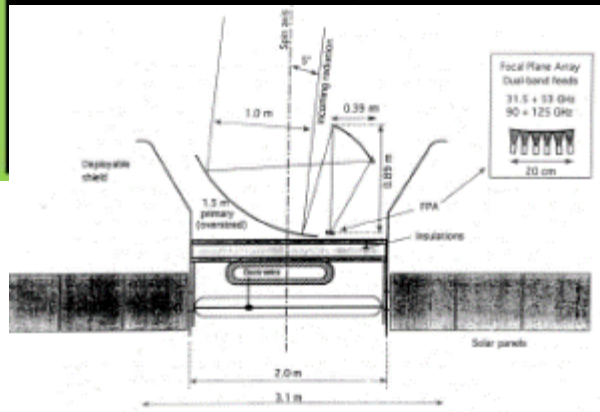
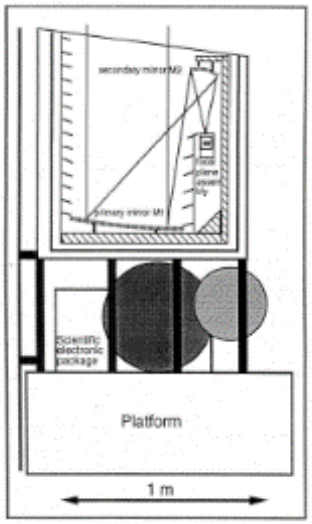


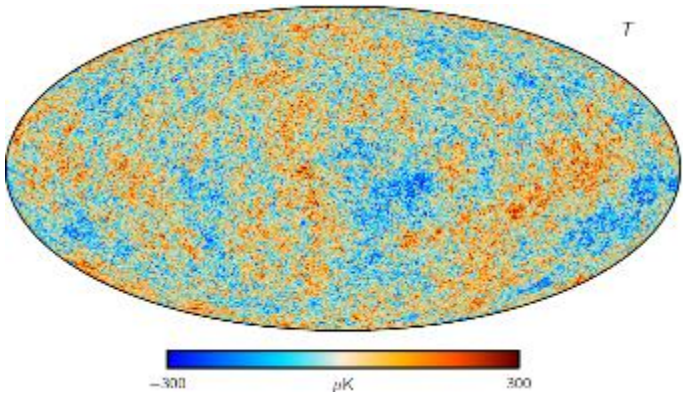
Figure 6 - Schematic COBRAS payload concept. The Gregorian optical system assumed in our preliminary simulation study is represented in scale. The pointing offset from the spin axis (here assumed to be 8°) will be optimized during the assessment study together with the details of the scan strategy. The ground screens will flare out at an appropriate angle to optimize sidelobe pickup and cooling efficiency. The inset shows a schematic of the focal plane array of dual-band feeds. Placing their apertures on a spherical surface (~ 0.7 m radius) optimizes beam symmetry.



Spectrum : Collaboration at White Mtn.

Even earlier
1981/1984

Instrument complexity growing
+
Data complexity growing
=
Number of people growing
a lot



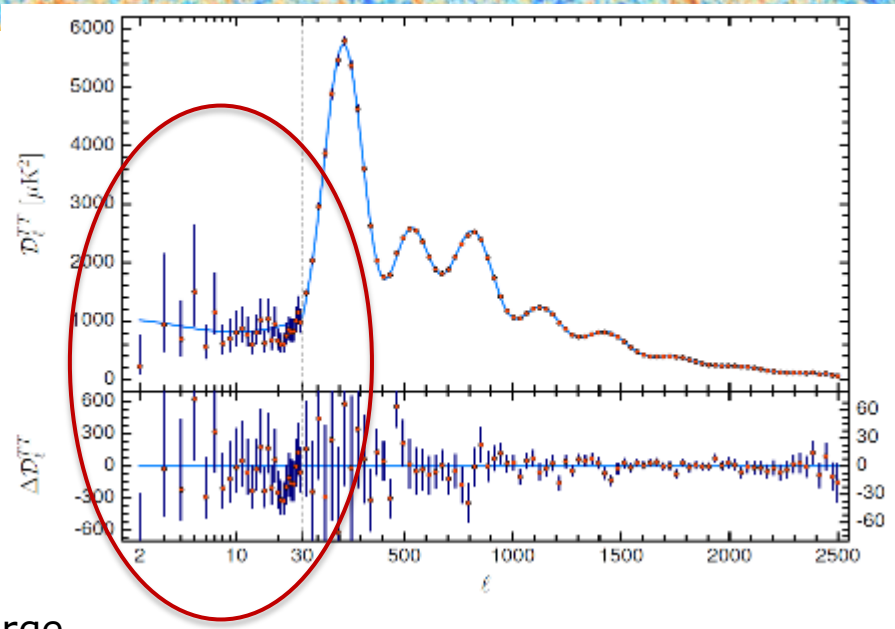
PLANCK

- Third generation of CMB satellites
- 74 detectors (radiometers and bolometers) in 9 frequency bands from 30 to 857 GHz
- angular resolution between 30’ and 5’, DT/T ~ 2 x 10^{-6}

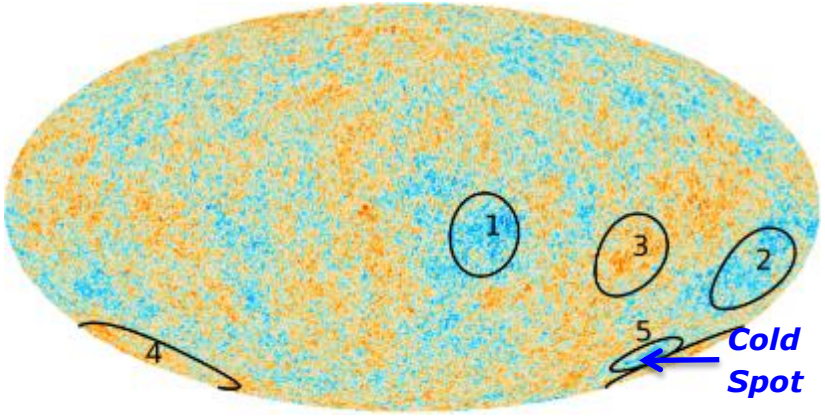
DEFINITIVE CHARACTERIZATION OF TEMPERATURE ANISOTROPIES but still….

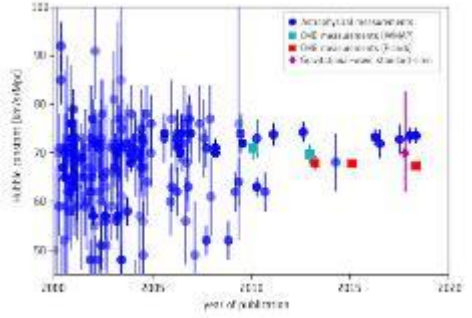
LARGE SCALE ANOMALIES

- Lack of power
- Hemispherical asymmetry
- Even-odd asymmetry
- etc..



The *Cold Spot* is an anomalous CMB feature of large area, very negative amplitude, and a large kurtosis at scales of around 5 deg.
Besides the *Cold Spot* it's interesting *to* investigate the multipolar profiles of four more large-scale peaks, which have been previously identified as anomalous features at very large scales (at 10 deg).





SMALL SCALE CURIOSITIES

- Lensing amplitude?
- Curvature?
- Early and late universe tensions?
- others?

THE NEXT CMB FRONTIER IS POLARIZATION

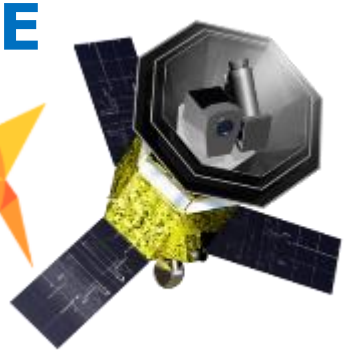
Sensitivity, frequency range for foreground subtraction, knowledge of the systematics and perfect **CALIBRATION** are required for accurate polarization measurements

But its worth the effort:

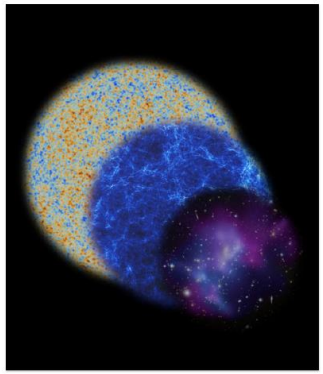
INFLATION, FUNDAMENTAL PHYSICS IN THE EARLY UNIVERSE, REIONIZATION, NEUTRINOS, ANOMALIES, COSMOLOGICAL BIRIFRINGENCE, EXOTIC PHYSICS ETC.

SPACE

LiteBIRD



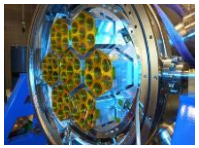
MICROWAVE SPECTRO-POLARIMETRY OF MATTER AND RADIATION ACROSS SPACE AND TIME



GROUND

BALLOON

- LSPE-SWIPE
- PIPER
- …



- LSPE-STRIP
- GroundBIRD
- QUBIC
- ….

NEW FRONTIERS REQUIRE NEW DATA

NEW DATA REQUIRES NEW IDEAS

NEW IDEAS WILL BREAK THROUGH NEW FRONTIERS

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NEW IDEAS WILL BREAK THROUGH NEW FRONTIERS

Think for example of modified gravity theories as Jordans Brans Dicke and the eternal discussion between Jordan Frame and Einstein frame (being not mappable one in the other in the equation of motions)...
Searching for canonical transformations you may end up with a new Frame where the gravitational strength goes to infinity while the speed of light approaches zero (similar to a concept called "Carollian gravity")...


THINK
OUTSIDE
THE BOX

THANK YOU