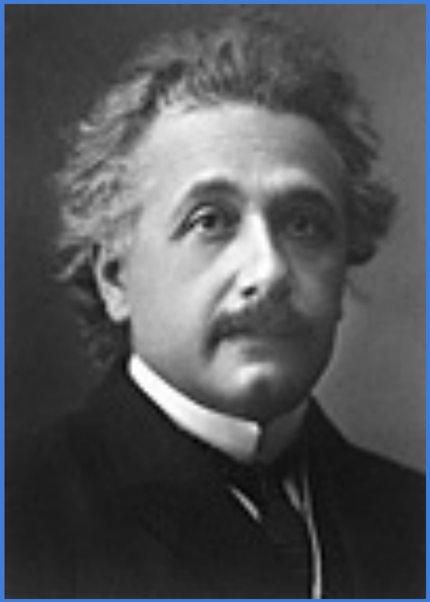
Come mai da millenni stiamo tutti col naso all' insù?

Emanuele Salerno

21/03/2005

• La storia inizierebbe circa tredici miliardi e mezzo di anni fa

• Ma partiamo dal 1915 (con qualche breve flashback)



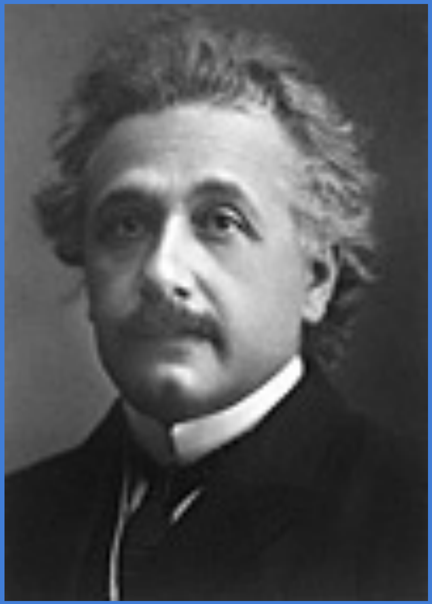
Albert Einstein introduce la costante cosmologica nelle equazioni della relatività generale che descrivono la nuova gravitazione universale (in qualche modo questo universo bisognerà tenerlo fermo)

Lo studio dell'universo nel suo insieme è da millenni materia per filosofi speculativi, e lo rimarrà ancora per qualche decennio

1929

- Edwin Hubble scopre che l’universo è in espansione

Ho trovato una costante anch’io!

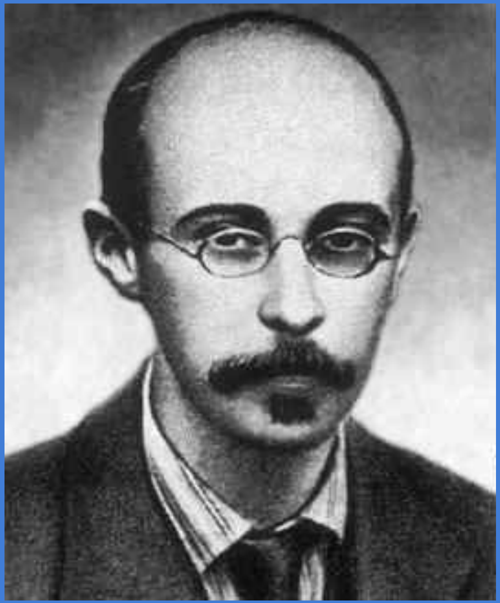


Il più grave errore della mia vita

1927

- Georges Lemaître propone la teoria del Big Bang

C’è stato un giorno senza ieri



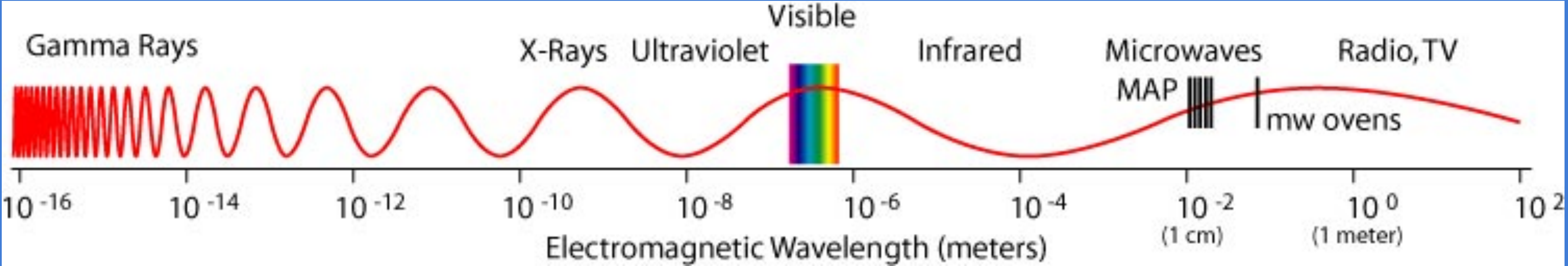
Anche Alexander Friedman lo aveva ipotizzato cinque anni prima

1948

• George Gamow prevede l'esistenza della radiazione cosmica di fondo

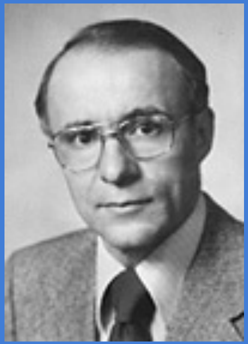
Un botto tale deve pure aver fatto qualche danno

Se c'è stato il Big Bang dovremmo essere immersi in una radiazione di corpo nero perfettamente isotropa alla temperatura di circa 3K



1964

- Arno Penzias e Robert Wilson scoprono la radiazione cosmica di fondo a microonde



Ma cos'ha quest'antenna?

Nasce la cosmologia come scienza sperimentale

Ma la prima luce non è stata emessa all'istante del big bang

Quando è stata emessa l'universo aveva già cominciato a differenziarsi. La temperatura vista da un'antenna non sarà esattamente la stessa in tutte le direzioni

Conoscere la mappa delle temperature su tutta la sfera celeste sarebbe utilissimo per provare (o smentire) la fondatezza delle nostre teorie sull'universo

Prima teoria: $\Delta T/T \cong 10^{-2}$

Nulla

Seconda teoria: $\Delta T/T \cong 10^{-3}$

Nulla

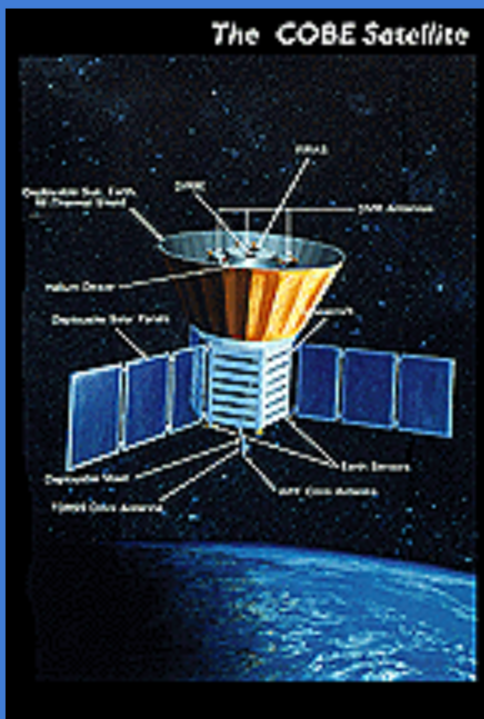
Terza teoria: ....

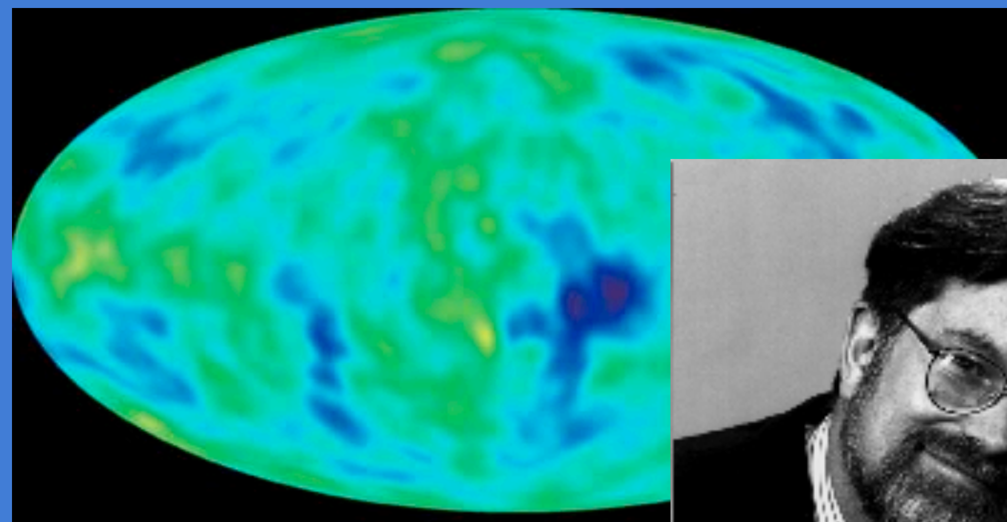
Nulla! ......

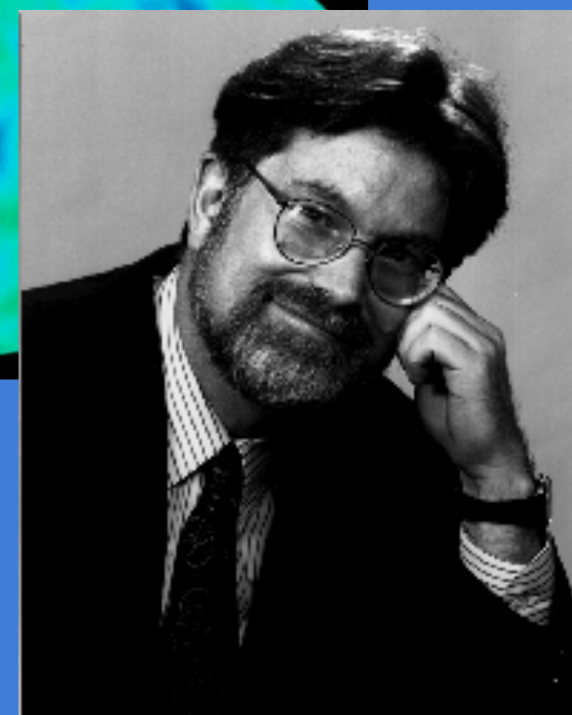
1992

COBE!

$\Delta T/T \cong 10^{-5}$





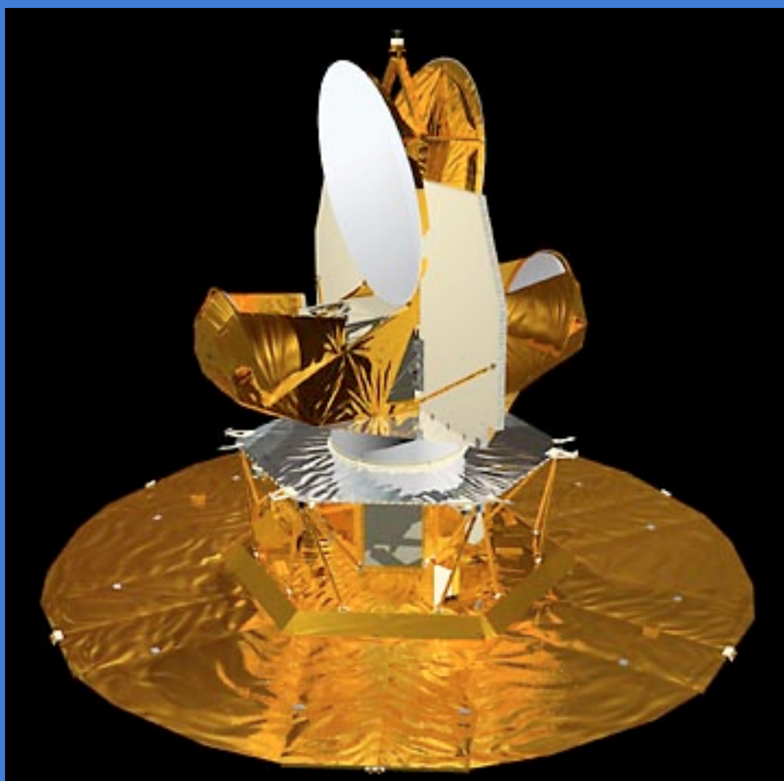


George Smoot

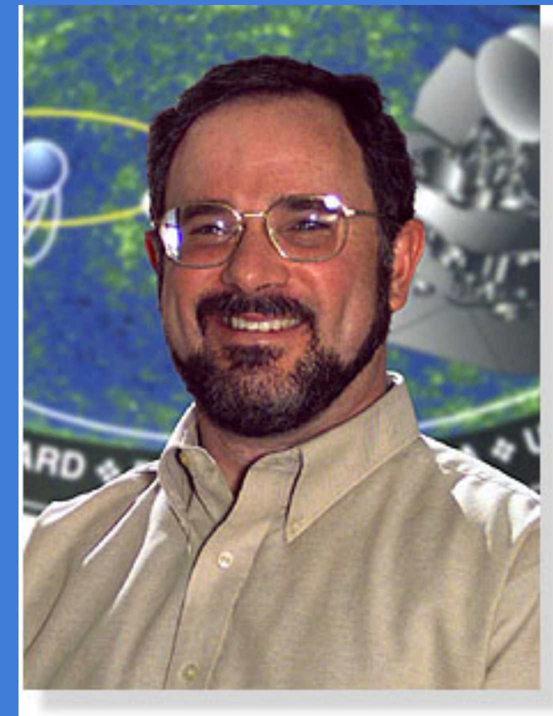
2002

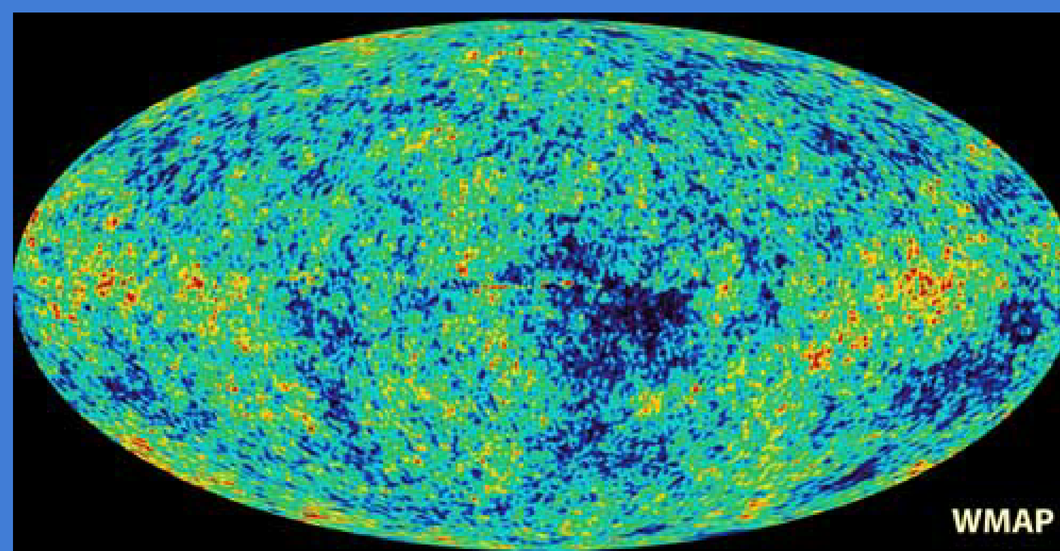
WMAP

Wilkinson Microwave Anisotropy Probe

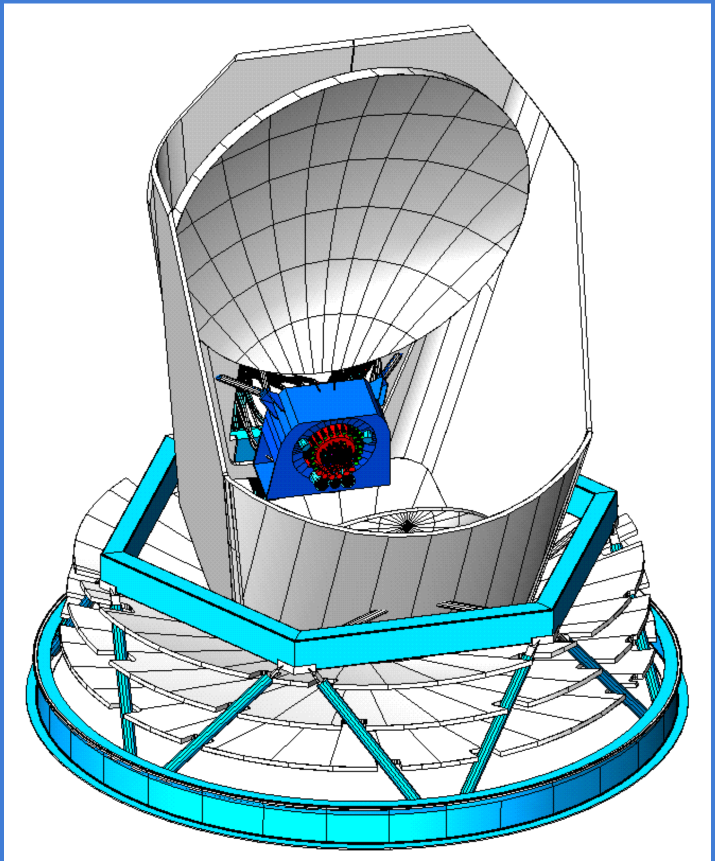


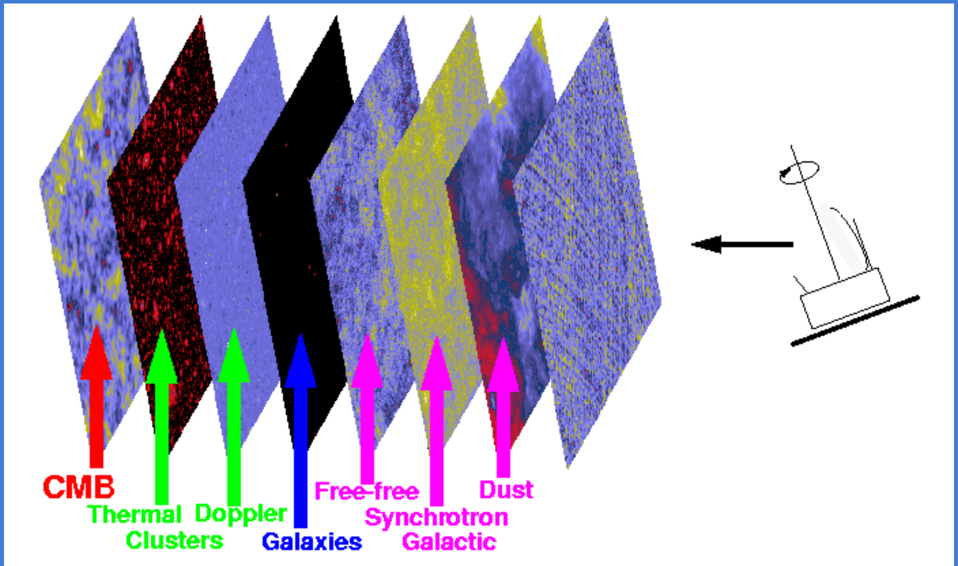
Charles Bennett



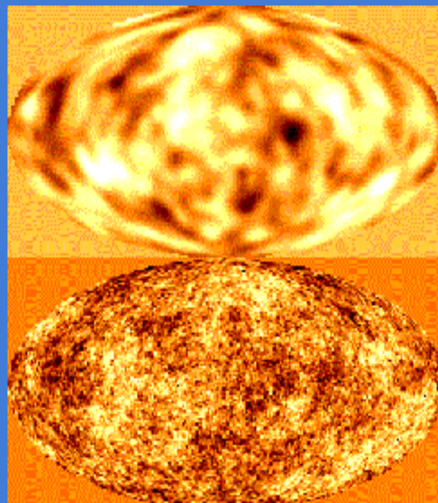


2007: PLANCK



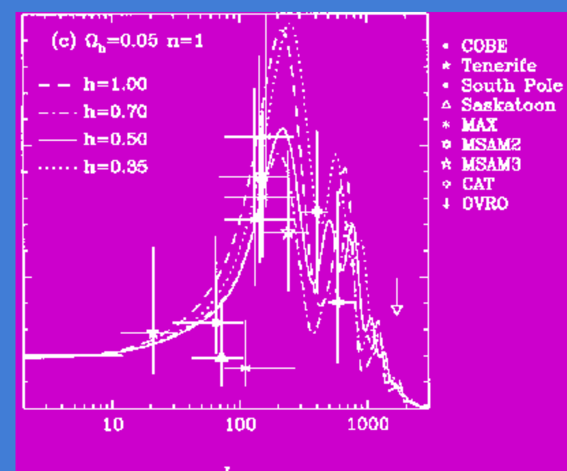


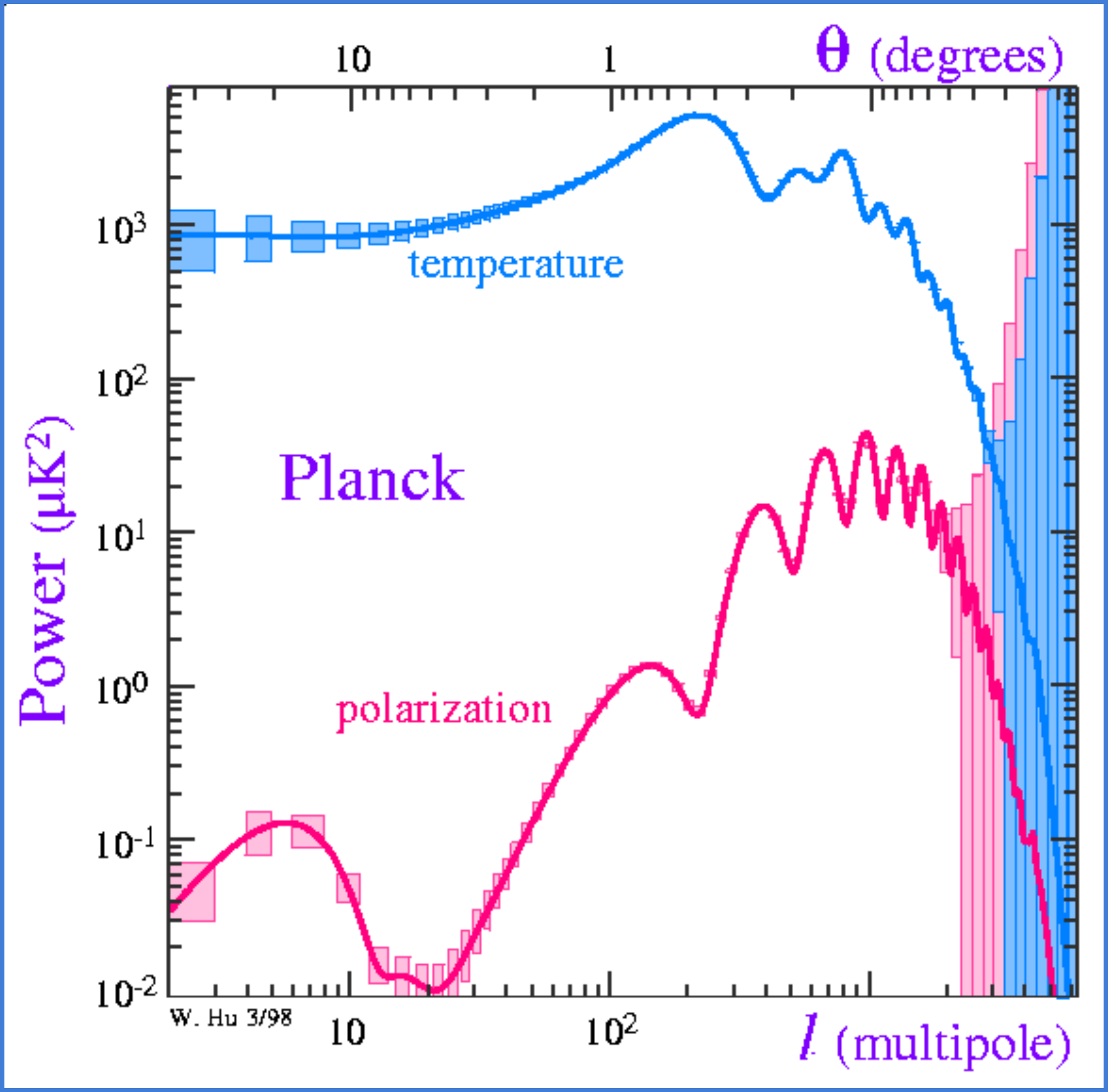
Guardare nel passato con un dettaglio mai raggiunto



Comparison between CMB maps for COBE (above) and Planck (below, simulated from a cold-dark matter inflationary model). Temperature differences across the sky are measured by Planck with a precision of two parts in a million and an angular resolution of 10'

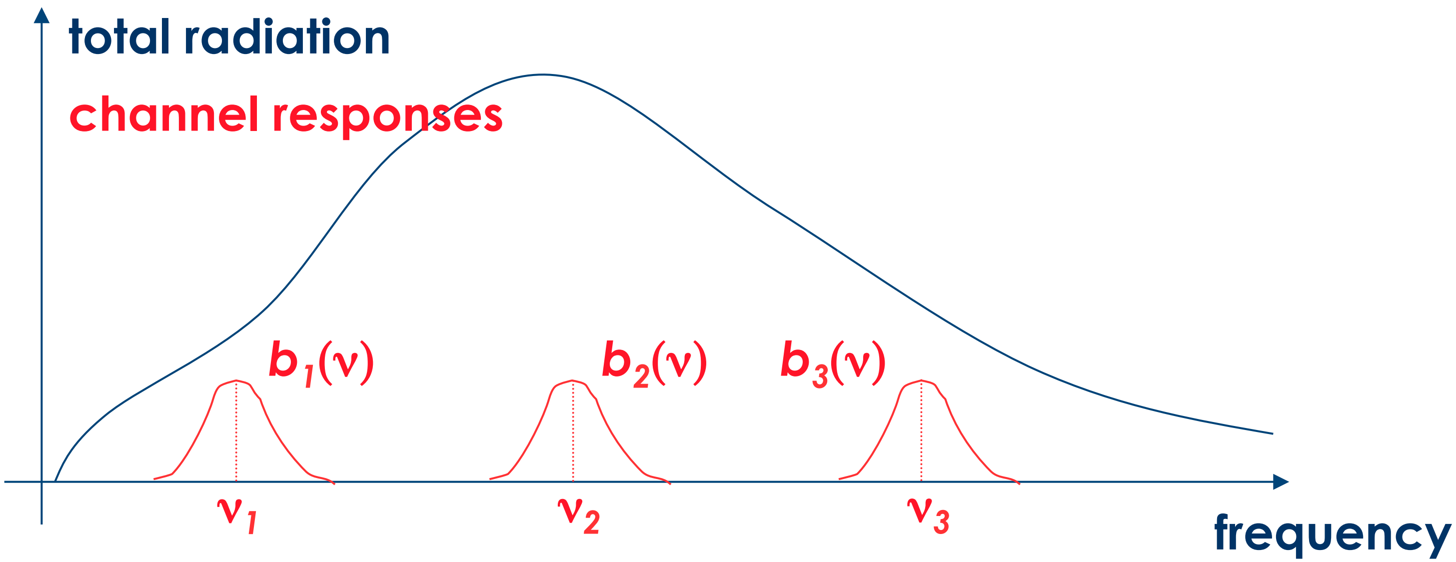
Values of cosmological parameters can be determined by comparing model and observed temperature power spectra - for instance, the influence of the Hubble constant on the power spectrum is shown here.



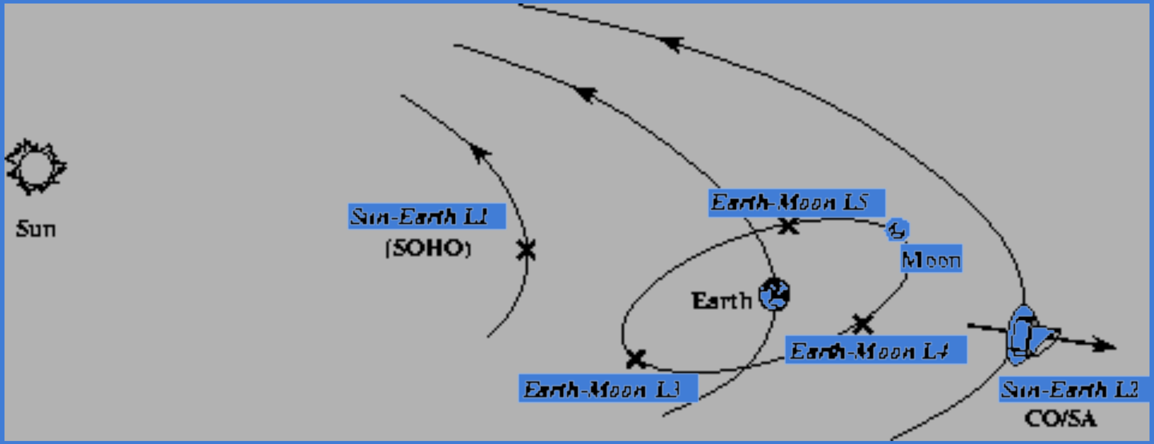


10
1
θ (degrees)
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
Power (μK^2)
temperature
Planck
polarization
W. Hu 3/98
10
10^2
l (multipole)

A number of radiometers with frequency responses $b_d(\nu)$ on M different channels measure the total radiation, giving M different noisy outputs

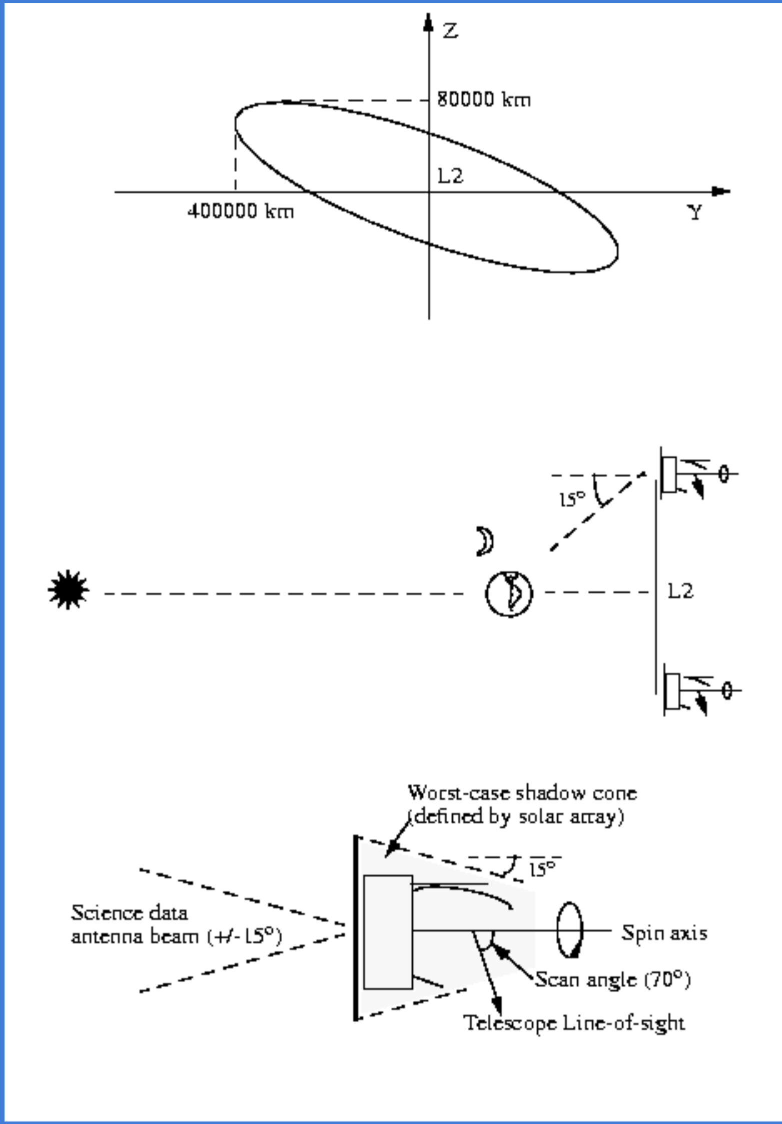


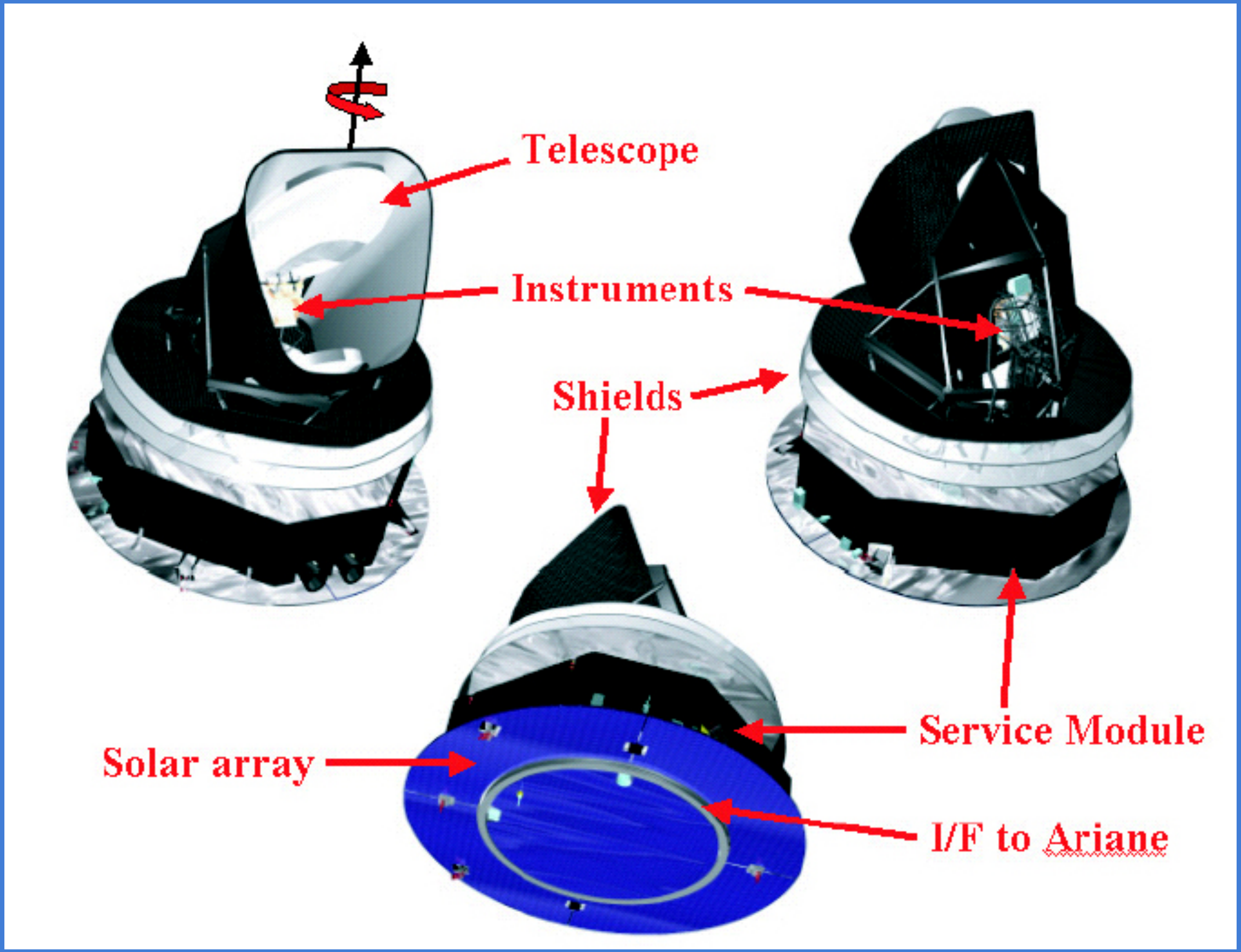
Each output is the integral of the product between the total radiation spectrum and one of the frequency responses of the instrument, corrupted by instrumental noise



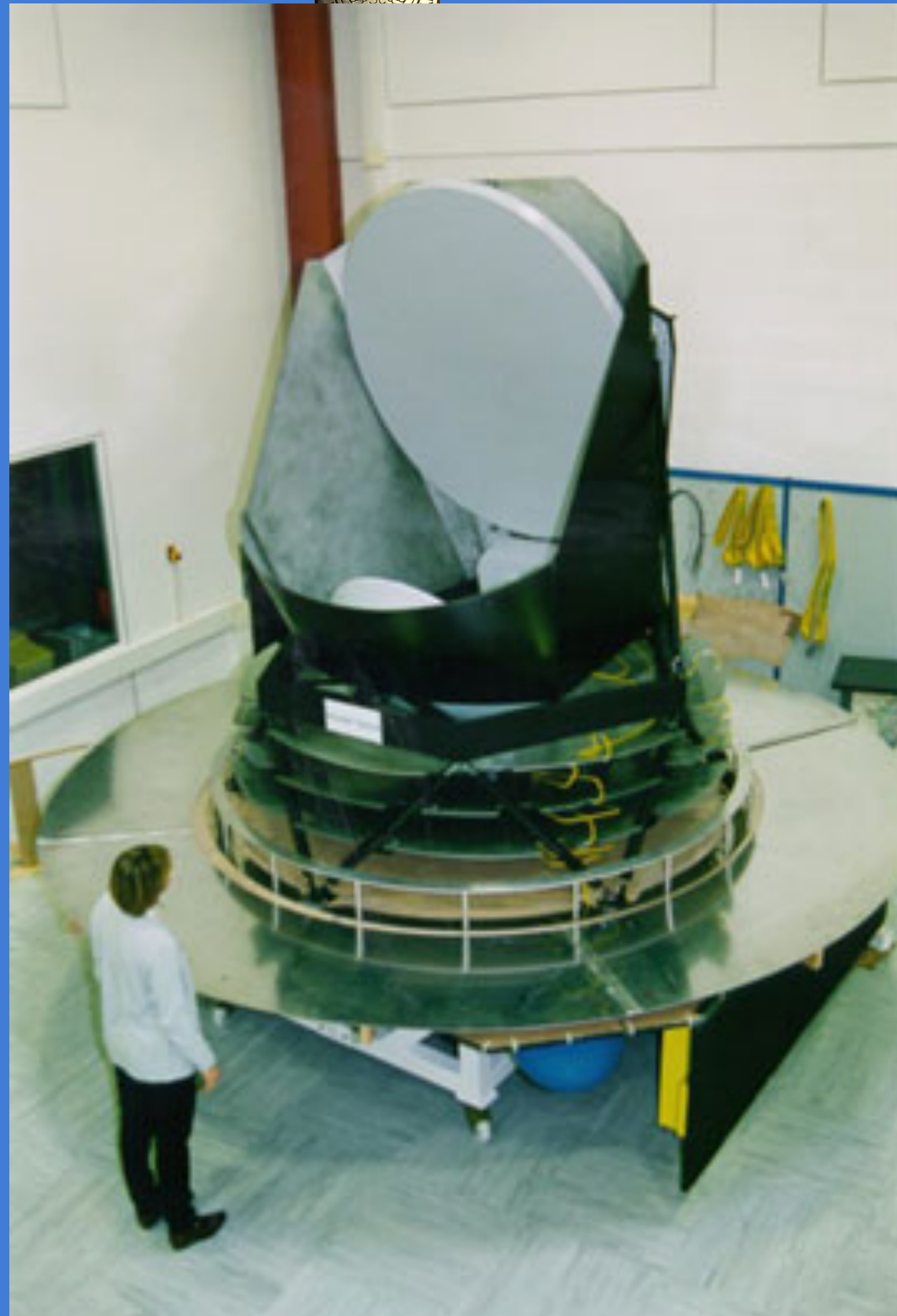
Il secondo punto lagrangiano del sistema Terra Sole (L2) si trova a 1.500.000 chilometri dalla Terra, ed è costantemente allineato con la congiungente Terra-Sole

Orbita di *Planck* attorno a L2

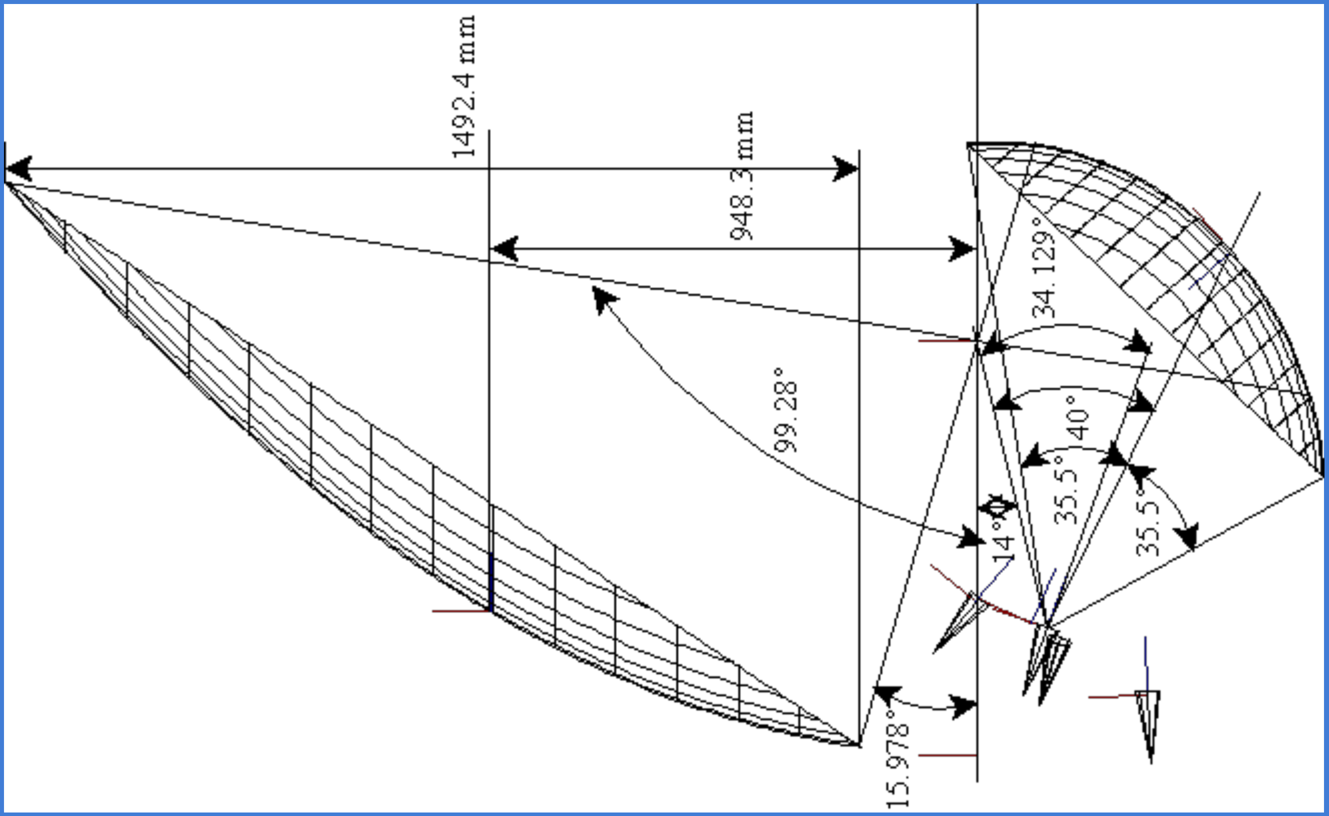


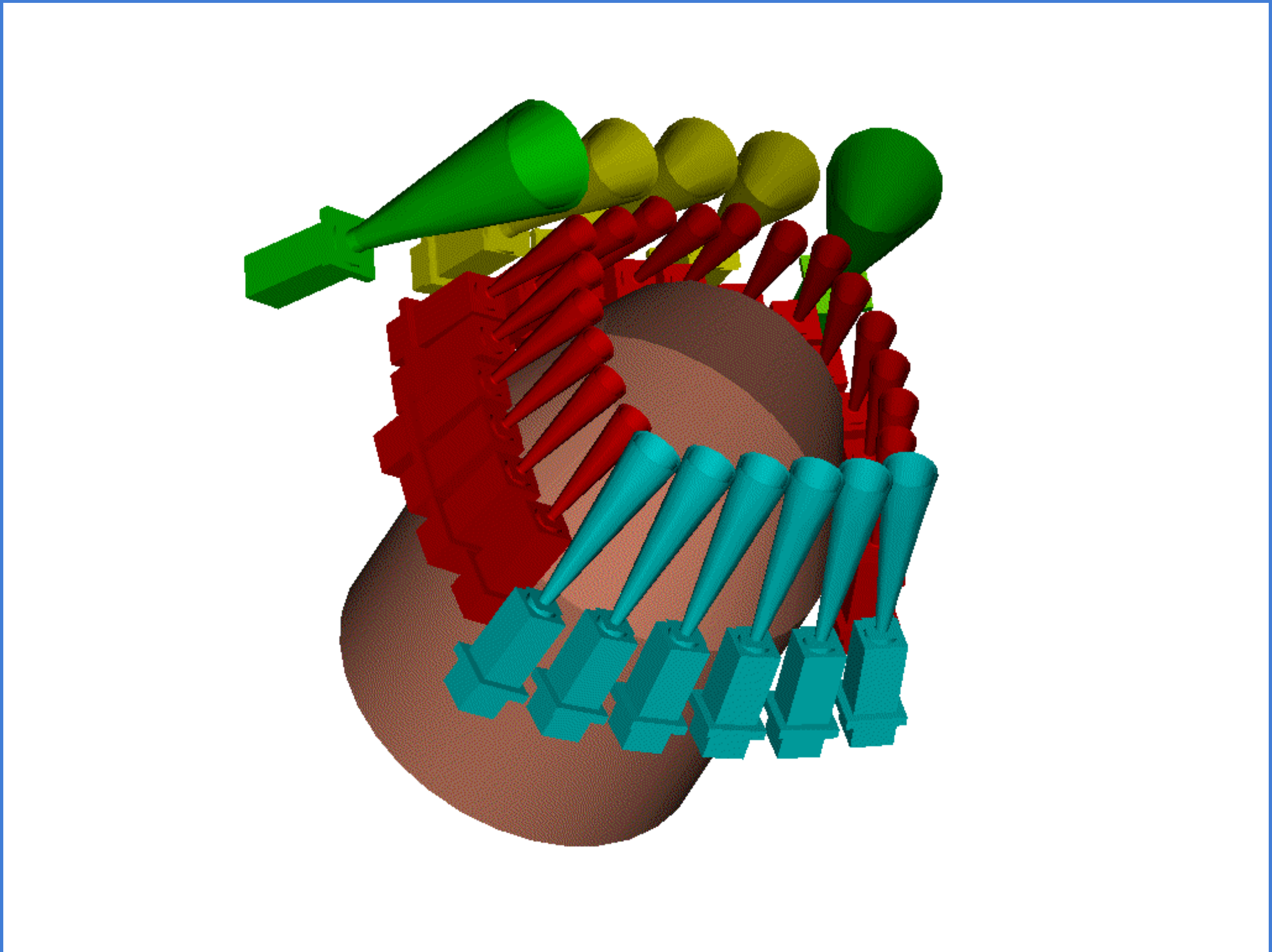

Telescope
Instruments
Shields
Service Module
Solar array
I/F to Ariane

PLANCK

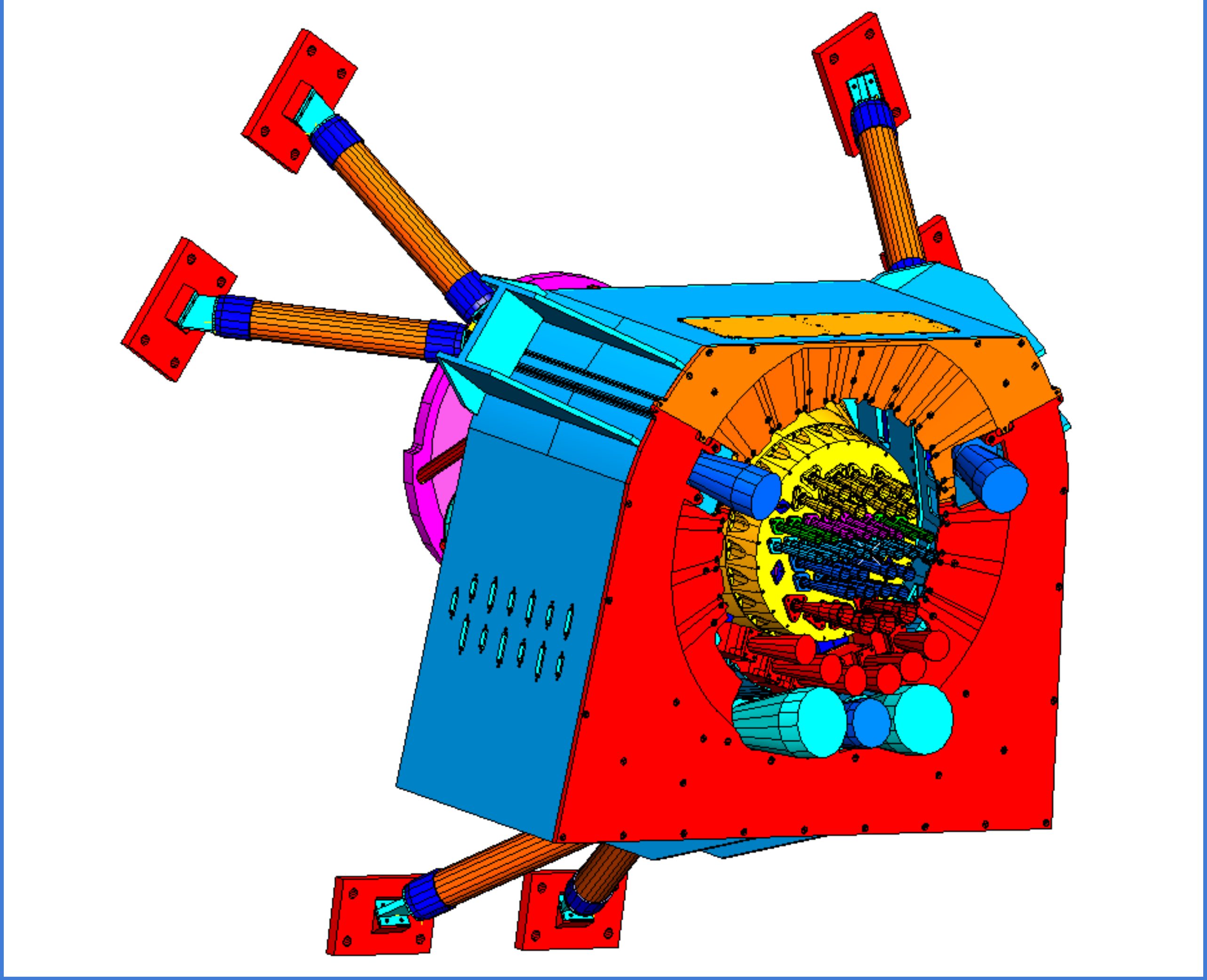


Telescopio

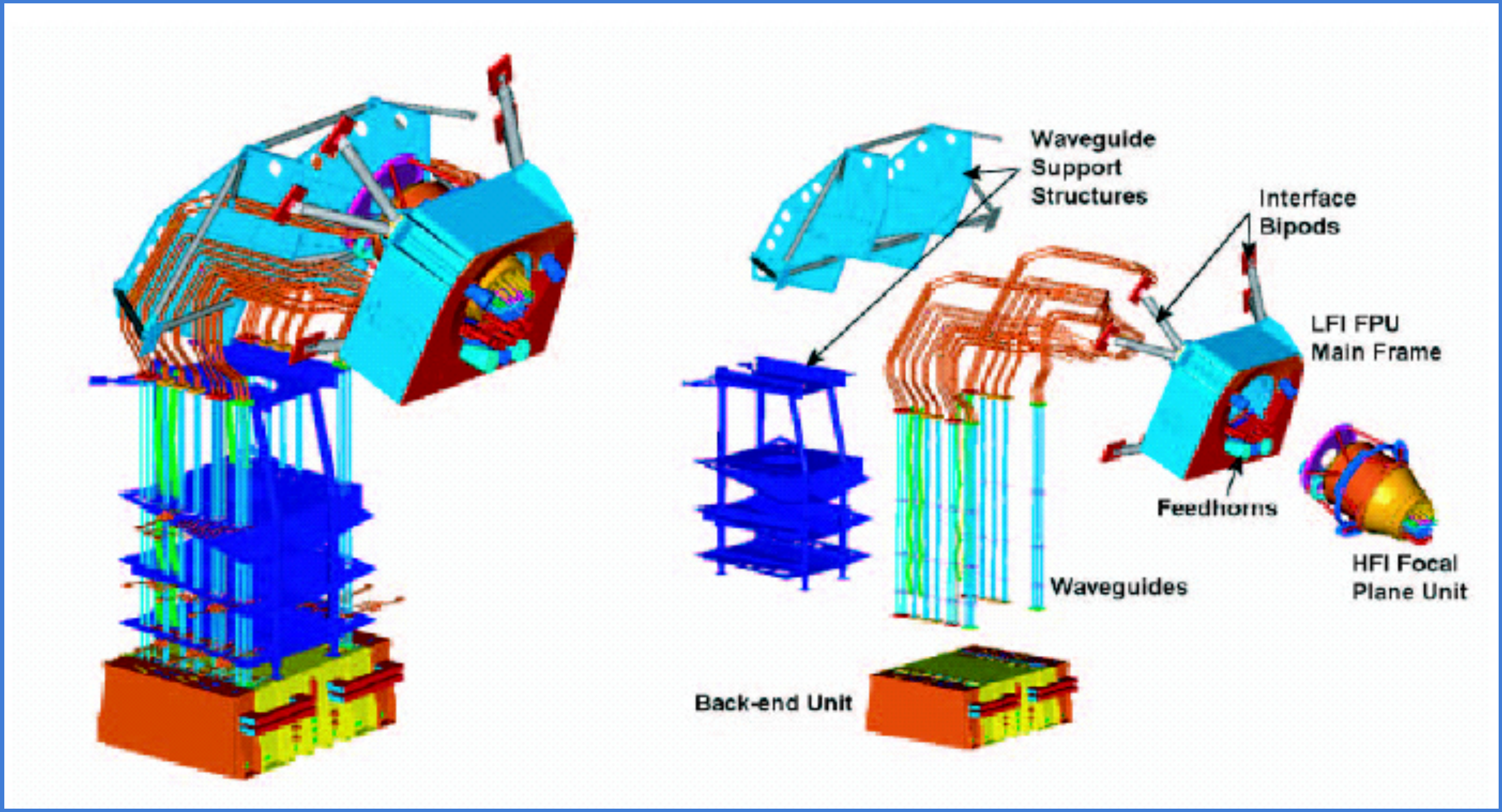




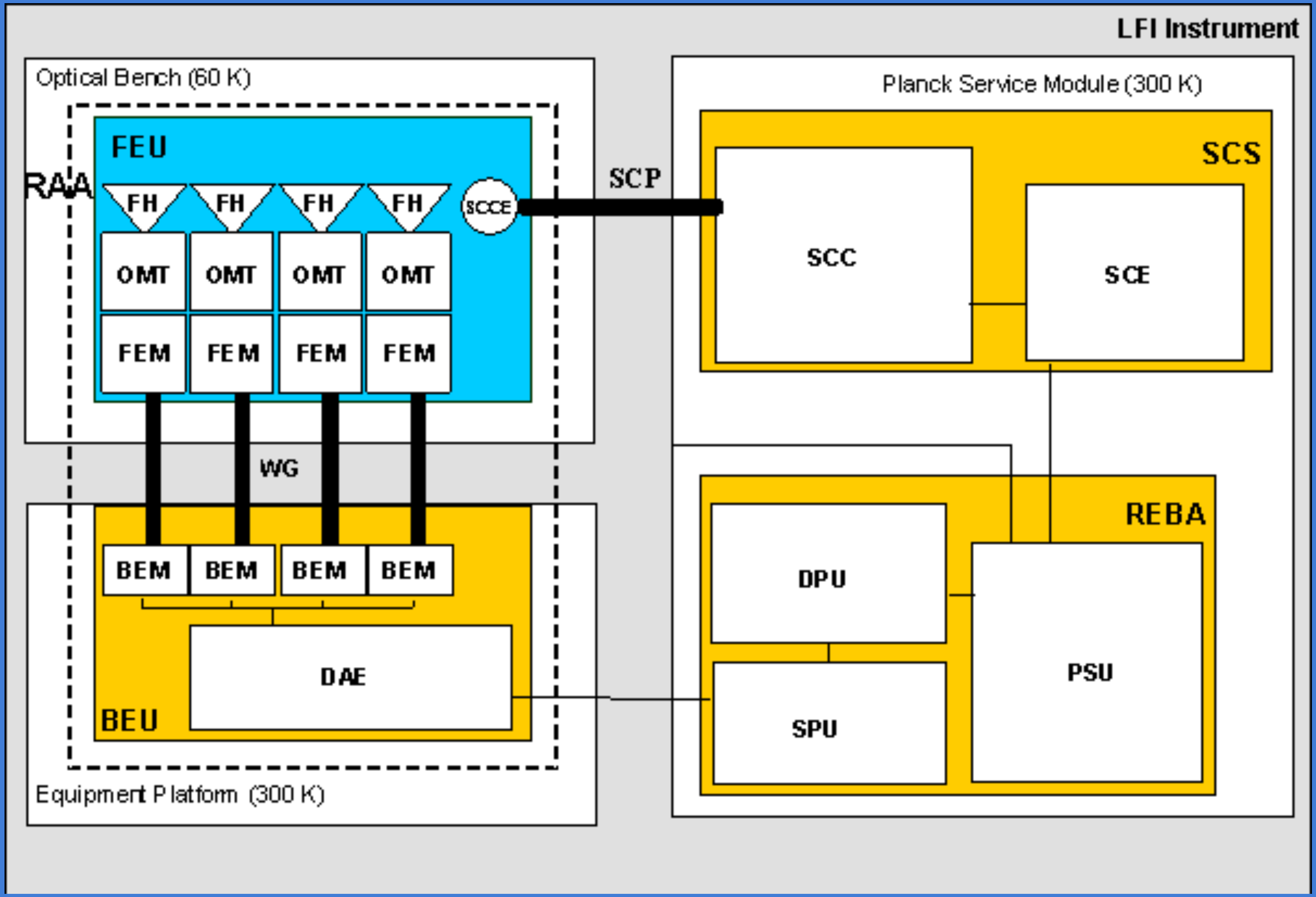
Front end strumento a bassa frequenza (vecchia versione)



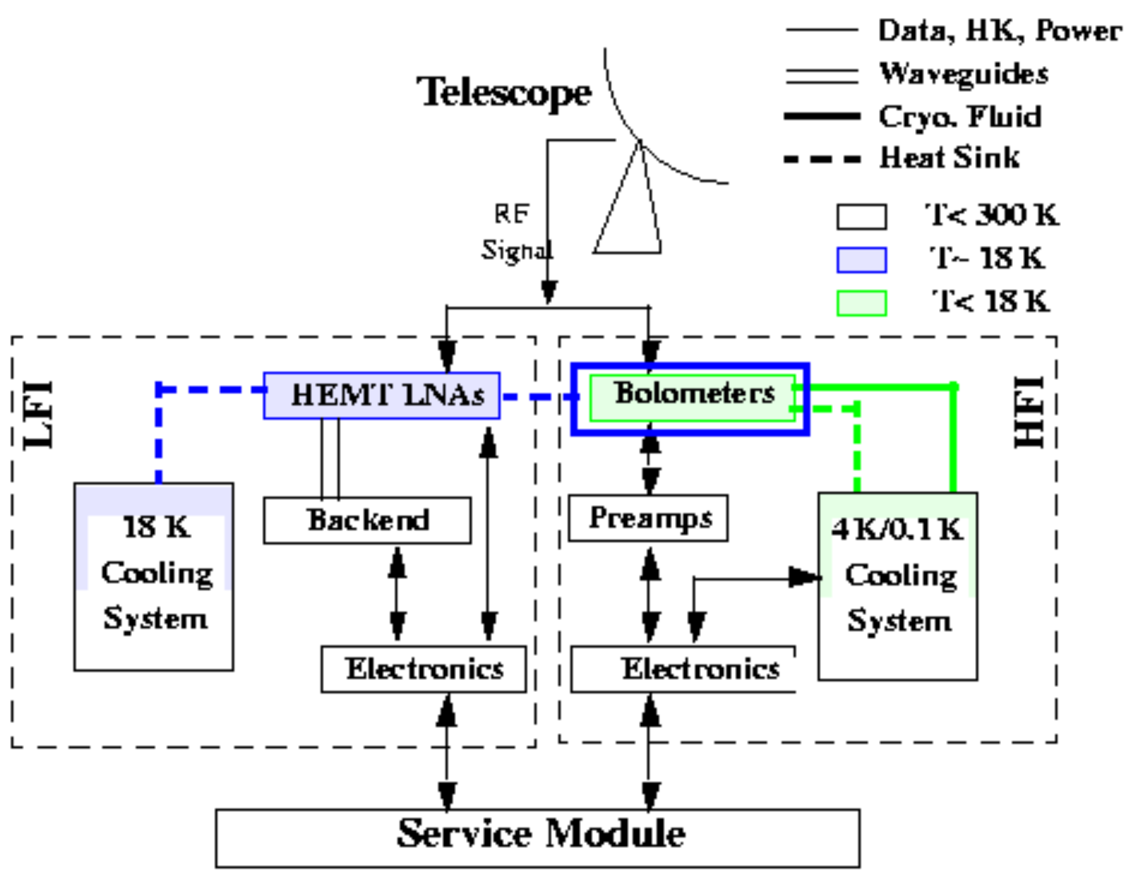
Versione attuale strumenti ad alta e bassa frequenza (30-857 GHz)



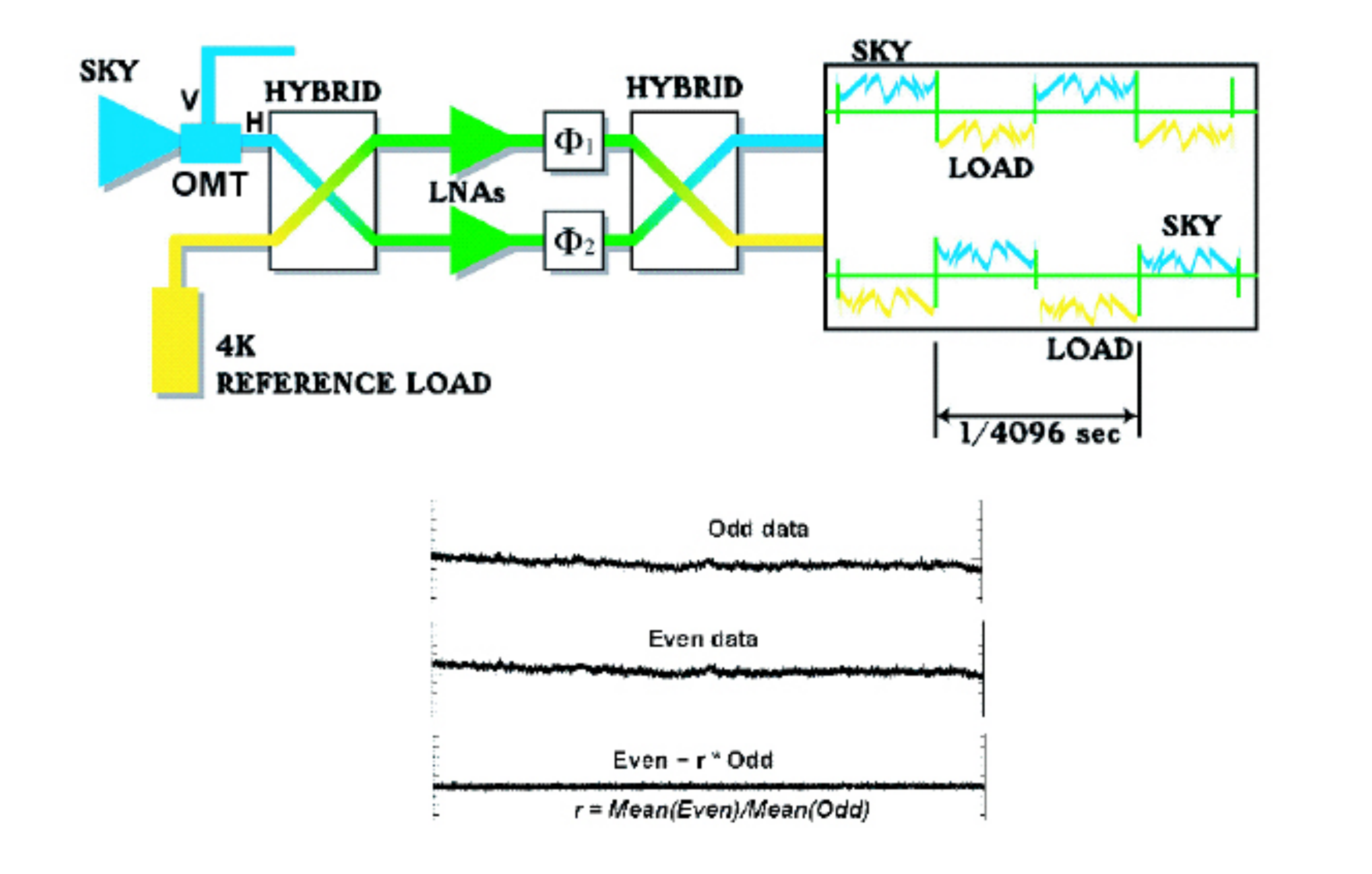
Collegamento front-end back-end in guida d’onda



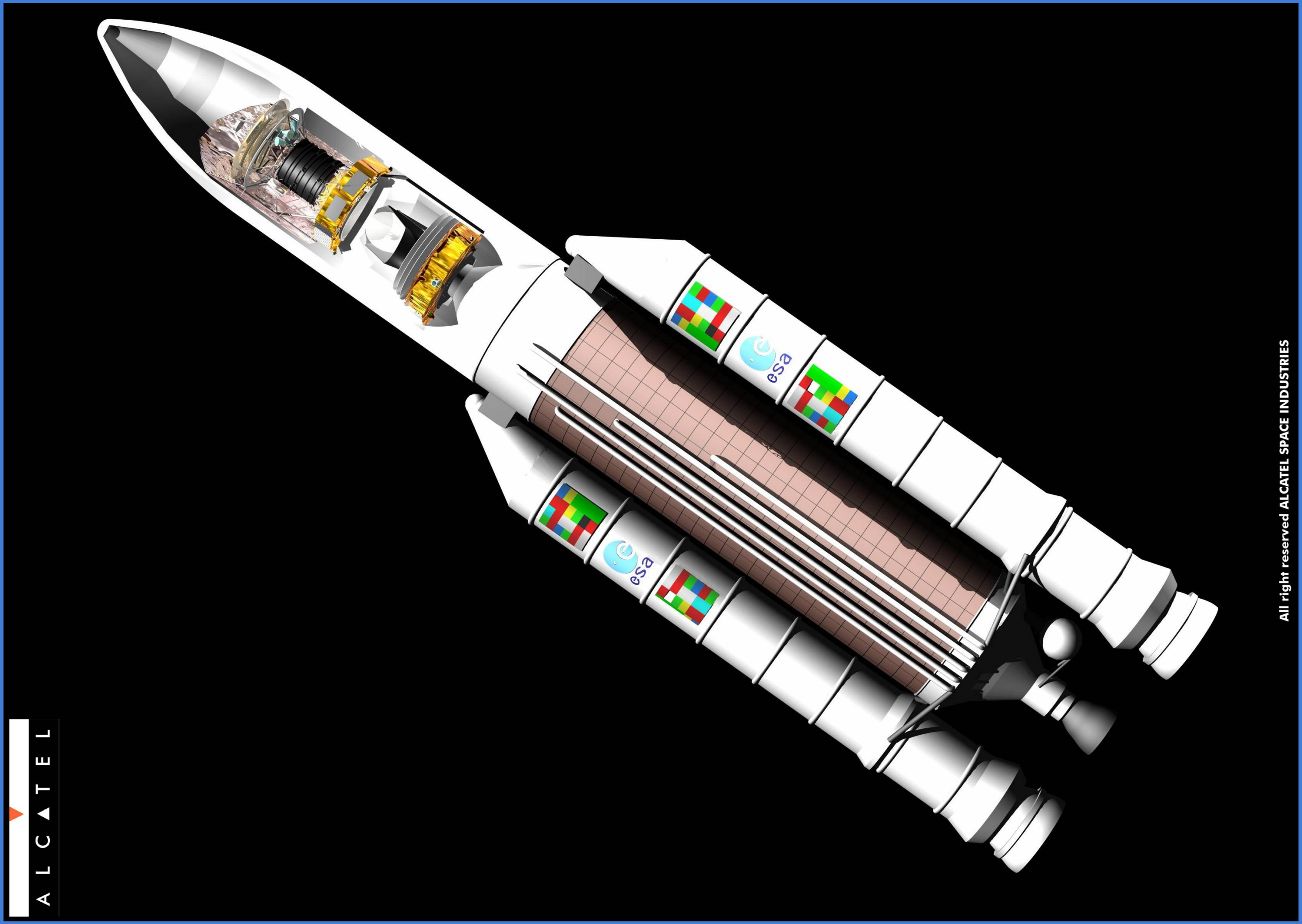
Schema strumento a bassa frequenza (30-44-70 GHz)



LFI=Low Frequency Instrument HFI=High Frequency Instrument



Schema di misura strumento a bassa frequenza



Planck e *Herschel* su *Ariane V*

FINE

Herschel

Planck