The OLIMPO Experiment

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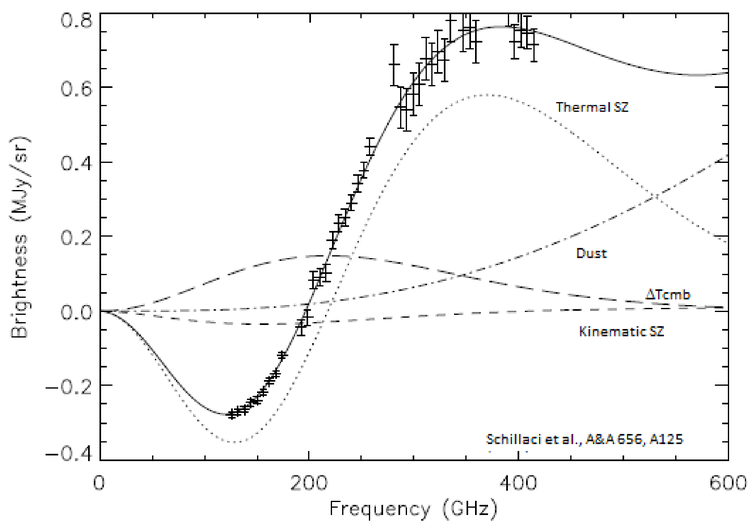
Abstract

The OLIMPO experiment is a balloon borne millimetric wavelengths telescope, built to measure the Sunyaev-Zel'Dovich effect (SZ) in clusters of galaxies during a long duration flight. The measurements are carried out, during the approximate two weeks flight in the stratosphere in four frequency bands centered respectively at 150, 220, 350 and 480GHz, coupled to the 2.6 meters Cassegrain telescope with a resolution respectively of 4.2, 2.9, 1.8 and 1.8. In order to better disentangle the extragalactic signal from always possible foregrounds contaminations, we added to photometric measurements planned also the spectroscopic ability, which is achieved by means of a differential Fourier transform spectrometer. The experiment is ready to be flown from Svalbard islands in a circumpolar summer season long duration flight at about 40km of altitude. Here we describe the instrument, focusing on the low frequency detection chain.

Science

OLIMPO will produce an SZ spectroscopic survey of about 40 clusters and high resolution maps of CMB anisotropy in selected areas, to measure the damping tail of the power spectrum of CMB anisotropy at multipoles up to l ~ 4000. High galactic latitude sky regions feature mainly primary anisotropy (CMB), SZ in clusters of galaxies, and the far infrared background from distant galaxies (CIB) and unresolved AGNs. These measurements will complement at higher frequency and similar resolution the measurements carried out by ground based telescopes at 150 GHz, thus investigating better the nature of the detected anisotropy at small angular scales. Above 200 GHz, cirrus clouds in the interstellar medium are present even in the cleanest parts of the sky at high galactic latitudes. The bands of OLIMPO were optimized for optimal separation of the different components, and the Differential Fourier Transform Spectrometer (DFTS) allows us to extract efficiently the SZ and CMB anisotropy from contaminating foregrounds.

Experiment Performance



The Experiment in a nutshell

Balloon borne experiments give the opportunity to observe high frequencies (like our 350 and 480GHz bands) which are strongly affected by atmospheric noise in ground-based experiments. OLIMPO uses cryogenic bolometers as detectors, cooled by a 3-He cryostat at ~ 0.3K for more than 15 days. Two different detector technologies are used: TES at low frequency, NTD bolometers at high frequency.

2.6m telescope: among the largest single-dish telescopes ever flown on a stratospheric-balloon

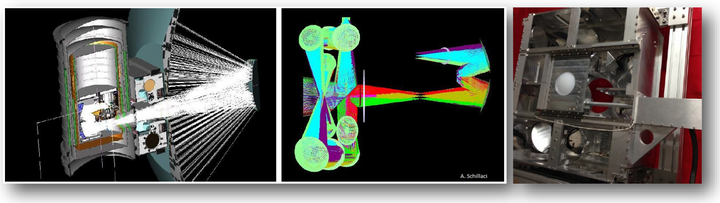
The primary mirror is tilted continuously (following a ~ 0.1 Hz period triangle wave with a p-p amplitude up to ~ 2°) producing sky scans in cross-elevation.

The re-imaging optics is cooled at 2K to implement a cold Lyot stop, reducing spillover and the background on the detectors.

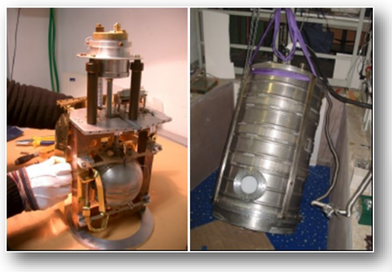
The DFTS plug-in adds a low-resolution spectroscopic mode with spectral resolution up to 1.9GHz; the comparison of spectroscopic and photometric measurements produces high accuracy determination of the parameters of the SZ clusters [see A&A 538, A86 (2012) for details].

Sub Systems

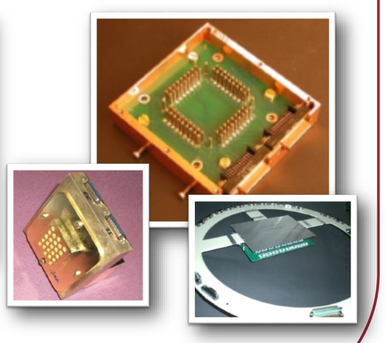
Optics and DFTS



Cryogenics



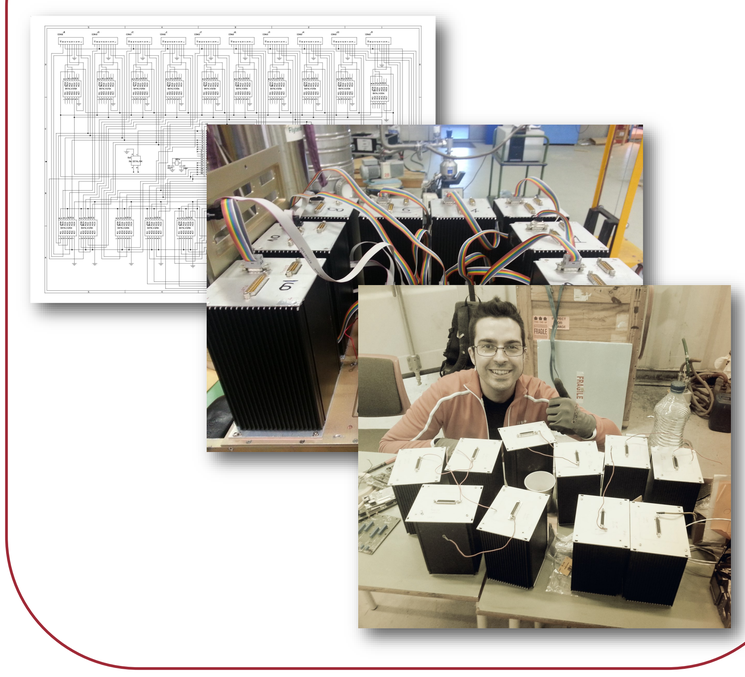
Hi Frequency Bolos



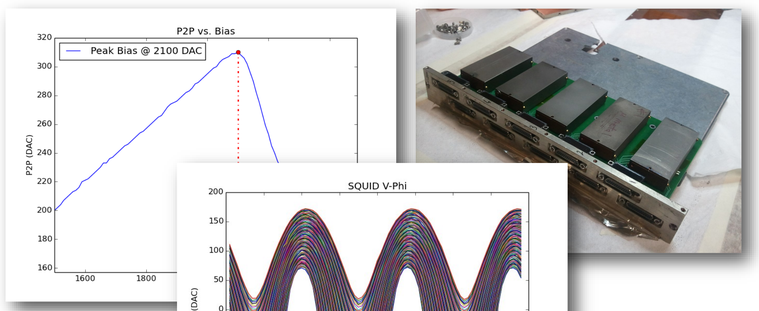
OLIMPO ready to fly

@ Longyearbyen - Svalbard

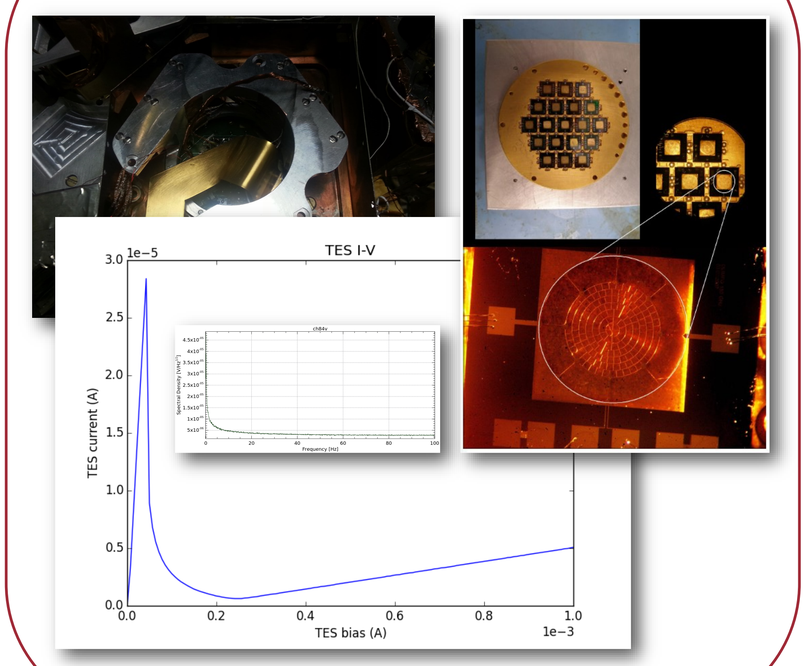
LF Read-out



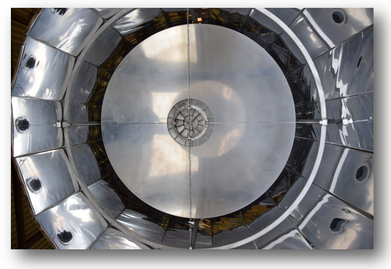
The SQUID tuning



The TES tuning



Download the poster @:



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