PROJECT: Studi di Cosmologia		WP3-6X1
WP TITLE: Feasibilty study for future balloon-borne high-frequency CMB experiments **CONTRACTOR**: **Dipartimento di Fisica, Sapienza Università di Roma** **START EVENT**: KO **END EVENT**: RF **WP MANAGER**: **Paolo de Bernardis**		**Sheet**: 1 **of** 1 **Issue Ref**: 1 **Issue Date**:01/09/2016

1 RATIONALE OF THE PROJECT

- Design a high-frequency experiment for CMB B-modes search and foregrounds cleaning, to complement, in the medium term, the ground-based efforts (S4), and to prepare the technology/methodology for the next-generation CMB satellite.
- Study the feasibility of a balloon-borne measurement of the spectral distortions of the CMB (both absolute and anisotropic).

2 RESULTS EXPECTED AFTER SIX MONTHS FROM THE KO-MEETING

- Review of ISD polarization models and data
- Review of CMB polarization models and data
- Review of spectral distortions of the CMB
- Simulation of atmospheric effects in polarization and spectral emission/anisotropy

3 RESULTS OBTAINED AFTER SIX MONTH FROM THE KO-MEETING

3.1 Review of ISD polarization models and data

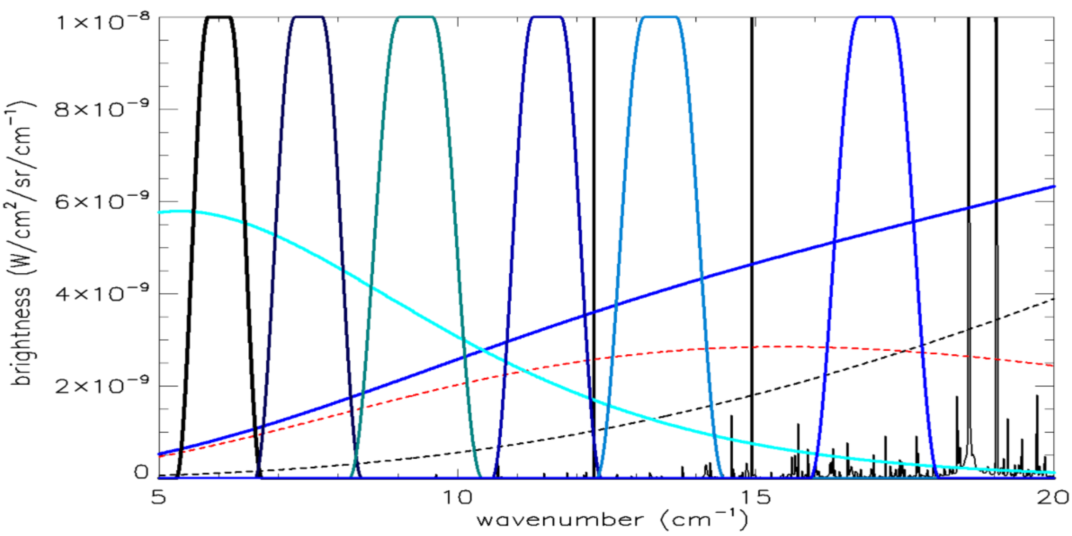

Figure 1. The atmospheric brightness at balloon altitude (thin black line) is compared to a 2-components spcetrum of dust emission (blue line), resulting from one component at 18 K (black dashed line) and one component at 5 K (red dashed line). Six possible polarimetric bands for a balloon-borne polarimeter are also overplotted in different degrees of blue. These are centered at [180, 225, 280, 345, 400, 510] GHz. For comparison, the CMB is the solid cyan line. Dust and CMB spectra (as well ans fiters transmissions) are arbitrarily normalized, to be visible in the plot.

A review of ISD polarization models and data has been included in section 1 of the study document. In section 3 (Feasibility Study: Next-generation balloon-borne CMB experiments) we have included a comparison of typical dust spectra and atmospheric emission at stratospheric altitude, with a determination of the best observation bands (minimizing the background from the residual atmosphere and maximizing the coverage of dust brightness in a wide frequency range, so that the parameters for a two-components dust model can be retrieved from the data. All this is described in paragraph 4.3 of section 3 of the study. In figure 1 we show the location of the best bands for accurate ISD polarization monitoring.

3.2 Review CMB polarization models and data

A review of CMB polarization models and data has been included in section 1 of the study document. In section 3 (Feasibility Study: Next-generation balloon-borne CMB experiments) we have included a review of the CMB observables in the framework of stratospheric-balloon observations. The range of frequencies, angular resolutions, angular scales and sky coverage best suited for CMB polarization observations has been investigated (paragraph 3.1.1 of section 3 of the study). In figure 2 below we show the effect of finite sky coverage, in a few relevant cases for balloon-borne observations.

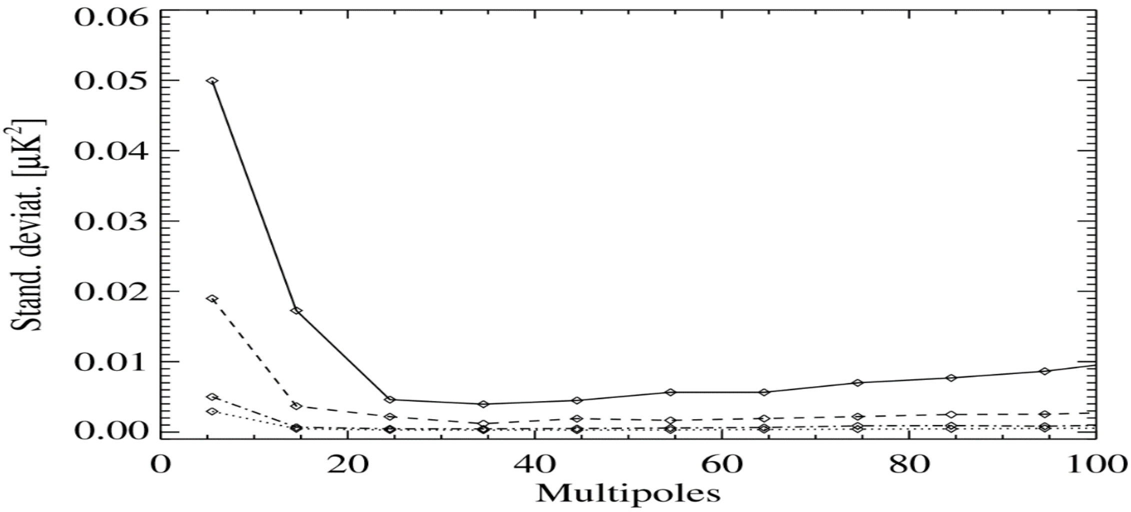

Figure 2: Comparison of standard deviations on the angular power spectrum BB, due to cosmic/sampling variance related to incomplete sky coverage. The spectra and their variation have been estimated by an implementation of the MASTER pseudo-Cl method, from 100 CMB-only (r=0.03) Monte-Carlo-simulated maps. Different observed sky patches have been considered: 30° x 30° (solid line), 360° x 20° (dashed line), 360° x 45° (dashed-dotted line), 360° x 90° (dotted line).

We have also included a list of current and forthcoming balloon-borne surveys of CMB polarization.

3.3 Review of spectral distortions of the CMB

The spectral distortion of interest for balloon-borne measurements have been reviewed and listed in a detailed table in paragraph 3.2.1 of section 3 of the study. Instrumental approaches have also been described and compared; the brightness of the residual atmosphere has been compared to the most important spectral distortions, and the best frequencies for observation have been selected.

3.4 Simulation of atmospheric effects in polarization and spectral emission/anisotropy

A stratospheric brightness and transmission model has been setup. Background, noise and polarization effects have been reviewed. In figure 3 below we plot the brightness temperature, in the model developed for this study, for 3 possible balloon altitudes, in the spectral range of interest here. All this is reported in paragraph 4 of section 3 of the study.

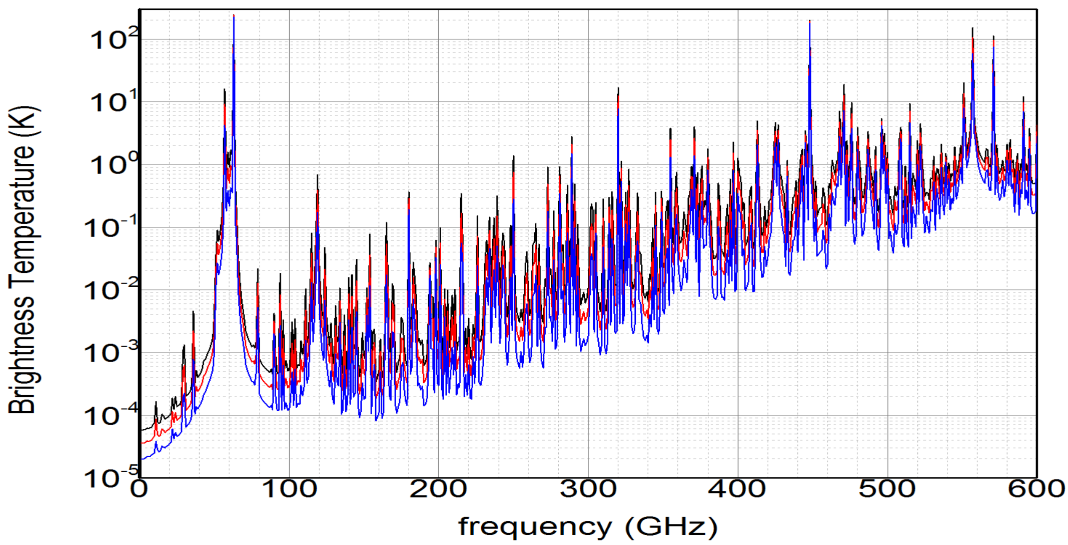

Figure **3:** Stratospheric emission at different altitudes for a 45° elevation slant path to space starting at 35km (black), 38 km (red), 45 km (blue) of altitude. In the range of altitudes accessible by stratospheric balloons the brightness of the residual stratosphere does not change very significantly with altitude.

4 PEOPLE INVOLVED

This part of the WP has been coordinated by Paolo de Bernardis, with contributions from Elia Battistelli, Carlo Baccigalupi, Carlo Burigana, Alessandro Buzzelli, Fabio Columbro, Massimo Gervasi, Silvia Masi, Francesco Piacentini, Andrea Tartari.