10.2.6 WP 3-6X1: Future balloon borne CMB experiments

PROJECT: **Studi di Cosmologia**		**WP REF.: 3-6X1**
WP TITLE: **Future balloon borne CMB experiments** **SUB-CONTRACTOR**: **Dip. Fisica / Università La Sapienza** **START EVENT**: KO **END EVENT**: RF **WP MANAGER**: **Paolo De Bernardis**		**Sheet**: 1 **of** 1 **Issue Ref**: 1 **Issue Date**:01/09/2016

1. OBJECTIVES

- 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. INPUTS

- Contract and Technical Annex
- Work plan & Schedule
- Planck (and other CMB experiments) data

3. TASKS

Main collaborations: all nodes

- Review of Interstellar Dust Polarization using current data at mm/submm wavelengths
- Quantitative study of the best detection method, polarimetry method, observation wavelengths, angular resolution, sky coverage for a CMB survey
- Optimization of instrument configuration and balloon-borne platform for a multiband survey of mm and submm polarization at high Galactic latitudes, aimed at sensitive measurements of CMB B-modes and precise cleaning from the polarized interstellar dust foreground. This requires careful design, confirmed by numerical simulations, of the optical/detection/cryo systems, including laboratory tests of selected key subsystems: telescope (in particular emissivity), baffling (to avoid straylight), polarization modulator (to achieve high modulation efficiency at high frequency), spectral filtering (to avoid leakage), detection pixels (to maximize sensitivity), etc.
- Review of spectral-spatial anisotropies and spectral distortion of the CMB
- Review of spectral features in the residual atmosphere at balloon altitude in the mm/submm range
- Quantitative study of the best spectral measurement method, observation wavelengths, angular resolution, sky coverage for a spectral-spatial anisotropy survey and/or absolute spectrum survey.
- Optimization of instrument configuration and balloon-borne platform for a spectral survey of the mm and submm sky at high Galactic latitudes, aimed at sensitive measurements of spectral features in the CMB (both absolute, if feasible at the required precision, and anisotropic). This requires careful design, confirmed by numerical simulations, of the optical/detection/cryo

systems, including laboratory tests of selected key subsystems: telescope (temperature and emissivity), window, spectral modulation (over a wide spectral coverage including selected optimal wavelengths), differencing method (reference in the sky or internal).

4. OUTPUTS

- Optimized payload configuration (telescope, polarimeter, detectors, scanning) for CMB polarization surveys at high frequency
- Optimized observations plan and performance estimate
- Flight requirements
- Optimized payload configuration (telescope, spectrometer, detectors, reference, scanning) for spectral-spatial anisotropy or absolute spectrum measurements
- Optimized observations plan and performance estimate
- Flight requirements

5. SCHEDULE

First Year, t0+6 months

- 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

First Year, t0+12 months

- Review of the spectrum of the residual stratospheric atmosphere
- Review of state-of-the-art detection technology
- Review of available polarimetric techniques
- Review of available spectral measurements techniques
- Review of available stratospheric-flight opportunities and capabilities

Second year, t0+18 months

- Preliminary design of a payload for an S4-level high-frequency polarization survey on a stratospheric balloon
- Preliminary performance/cost optmization
- Assessment of the feasibility of absolute spectral measurements
- Assessment of the feasibility of differential spectral measurements

Second year, t0+24 months:

- Design and construction of prototypes of selected key subsystems for the polarization measurement

- Design and construction of prototypes of selected key subsystems for the spectral measurement
- Preliminary design of a payload for a spectral distortion survey on a stratospheric balloon