10.2.16 WP 8-6X1: Non-Gaussianity from Inflation

PROJECT: **Studi di Cosmologia**		**WP REF.: 8-6X2**
WP TITLE: **Non-Gaussianity from Inflation** **SUB-CONTRACTOR**: **Dip. Fisica e Astronomia / Università di Padova** **START EVENT**: KO **END EVENT**: RF **WP MANAGER**: **Michele Liguori**		**Sheet**: 1 **of** 1 **Issue Ref**: 1 **Issue Date**:01/09/2016

1. OBJECTIVES

- Primordial non-Gaussianity (PNG) parameter forecasts, using temperature and polarization bispectrum and trispectrum in future CMB surveys
- PNG parameter forecasts using CIB
- PNG parameter forecasts, using correlations between CMB spectral distortions and temperature/polarization anisotropies
- Development of NG estimators for future datasets.

2. INPUTS

- Non-Gaussian CMB simulated maps
- *Planck* (and other CMB experiments) data
- Modeling of CIB
- Specification of noise levels for relevant experiments and characterization of component separation methods

3. TASKS

Main collaborations: Ferrara, ROMA2, SISSA

A crucial observable to probe the physical mechanism behind inflation is *primordial non-Gaussianity* (PNG), in that it allows to test the interactions among quantum fields during inflation. Therefore, along with primordial gravitational waves, PNG can allow to probe fundamental aspects of inflation and to distinguish among very different inflation models.

The main target of this WP is to prepare for the analysis of future CMB datasets to constrain PNG by exploiting different observables that can be extracted from CMB measurements through a variety of methods. The WP contains three main levels of tasks. Firstly, we will develop and calibrate a pipeline to measure CMB 3- and 4-point correlation functions among CMB temperature and polarization anisotropies. This will be done in different domains, like, e.g., harmonic, needlet and real space. A second task is devoted to fully characterize the exploitation of the CIB power spectrum (that can be extracted from the high frequency channels of *Planck* or future CMB surveys) in relation to non-Gaussian signatures that can be left imprinted on it (via, e.g, the so called ``scale-dependent'' halo bias on the largest scales). To fulfill this task a study of the CIB power spectrum modeling is required and a characterization of the dust contributions will be carried on as well. The study of the CIB power spectrum offers also the opportunity to investigate cosmological signatures other than PNG, such, e.g. general relativistic effects on very large scales.

A third task will be devoted to the analysis of how to exploit the spectral content of the CMB spectrum in the frequency domain. In particular we will investigate the correlations (2- and 3-point) between CMB anisotropies (in temperature and polarization) and CMB spectral distortions as a powerful potential tool to greatly improve current constraints on PNG. For that respect we will first provide predictions and forecasts for specific models of inflation producing an enhanced signal that can be already constrained with present or forthcoming data, and then we will characterize realistic conditions for the exploitation of these observables from future experiments, dealing with foreground subtraction and systematics.
Finally, as part of the activities of this WP, we will exploit some of the techniques developed for measurements of primordial NG in other related issues: on one side we will develop component separation techniques for polarized foregrounds (especially B-mode), based on estimators targeted to measurements of directional PNG (in strict connection with the WP on Inflationary Gravitational waves); on the other hand we will apply PNG-based statistical estimators to investigate secondary anisotropies at low redshift, such as CMB lensing and SZ effects, with the goal of measuring Modified Gravity parameters and neutrino masses.

4. OUTPUTS

Deliverables

- Simulations of CMB datasets
- CMB data analysis software
- Data analysis pipelines for CMB 3 and 4-point functions
- Estimators of cross-correlation between CMB anisotropies and spectral distortions
- Estimators to exploit CIB data

5. SCHEDULE

<u>First Year, t0+12months</u>

- Calibration of different pipelines (in different domains, e.g. harmonic, needlet and real space) to measure CMB 3- and 4-point correlation functions (focus on CMB polarization data)
- Study of the CIB power spectrum in relation to non-Gaussian signatures that can be left imprinted on it

<u>Second year, t0+18months</u>

- Modeling of CIB power spectrum. Characterization and analysis of the dust contributions and of general relativistic effects present on the largest cosmological scales
- Development of component separation techniques for polarized foregrounds (especially B-mode), based on estimators targeted to measurements of directional PNG

<u>Second year, t0+24months:</u>

- Study of correlations (2 and 3-point functions) among spectral distortions (e.g. μ e y) and CMB anisotropies in temperature and polarization. Predictions and forecasts for specific models of inflation producing an enhanced signal that can be already constrained with present or forthcoming data.

<u>Third year, t0+30months:</u>

- Study of correlations (2 and 3-point functions) among spectral distortions (e.g. μ e y) and CMB anisotropies in temperature and polarization. Predictions and forecasts for specific models of inflation producing an enhanced signal that can be already constrained with present or forthcoming data.

- Forecasts for PNG measurements for future missions exploiting a joint analysis of different datasets, and all techniques studied earlier (CMB, CIB, 2- and 3-point correlation functions of CMB temperature and polarization

Third year, t0+36months:

- Study of non-Gaussian signatures from secondary anisotropies at low redshifts: CMB lensing, Sunyaev-Zeld'ovich effect. Estimators for bispectrum and trispectrum of SZ y-Compton parameter and related forecasts/measurements, in relation to neutrino mass and Modified Gravity constraints.