WP9-6X1
Foreground Modeling and Removal
Stato di Avanzamento per RA1

Team

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Tasks

Task 9-6X1.1: Support to Experimental Design

- **Purpose**: support for forecasting component separation for feasibility studies using semi-analytic techniques
- **Leaders**: Carlo Baccigalupi, Davide Poletti
- **Status**: forecasting software ready, case studies are in progress

Task 9-6X1.2: Diffuse Polarized Foreground Data Analysis

- **Purpose**: analysis of existing datasets for constraining polarized foreground emission
- **Leaders**: Nicoletta Krachmalnicoff, Francesca Perrotta
- **Status**: derivation of constraints on synchrotron, dust-synchrotron cross-correlation, from the S-PASS radio survey and Planck data is in progress

Task 9-6X1.3: Diffuse Polarized Foreground Modeling

- **Purpose**: 3D modeling of Galactic diffuse polarized emission, comparison with data
- **Leaders**: Francesca Perrotta
- **Status**: modification of codes for simulating the 3D distribution of Galactic diffuse Synchrotron emission ongoing

Task 9-6X1.4: Polarized Component Separation

- **Purpose**: production and testing of foreground cleaning data analysis software finalized to polarization and B-modes
- **Leaders**: Davide Poletti, Carlo Baccigalupi
- **Status**: implementation of parametric fitting for component separation with python and c++ interfaces done, testing and applications are in progress

Task 9-6X1.5: Data Analysis & Simulations

- **Purpose**: production and testing of foreground cleaning data analysis software finalized to polarization and B-modes
- **Leaders**: Carlo Baccigalupi
- **Status**: analysis of Planck data for the 2017 data release is ongoing, analysis of S-PASS data in combination with Planck and WMAP data for new constraints on Galactic polarized diffuse synchrotron emission is ongoing, study of constraints on low frequency foregrounds from composition of S-PASS, LSPE, QUIJOTE in progress, analysis of extra-Galactic sources from the Planck Compact Source Catalogue as B-mode foreground is in progress, analysis of data from PolarBear Large Patch is ongoing, simulations for Simons Array ongoing.

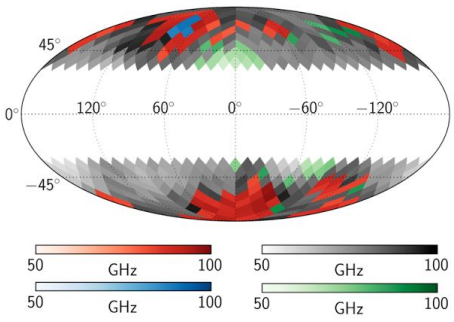
Highlights on activities

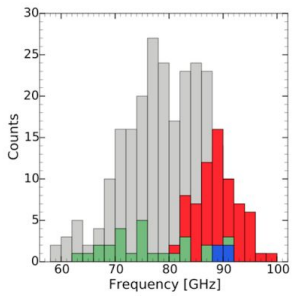
Tasks 9-6X1.2, 9-6X1.5

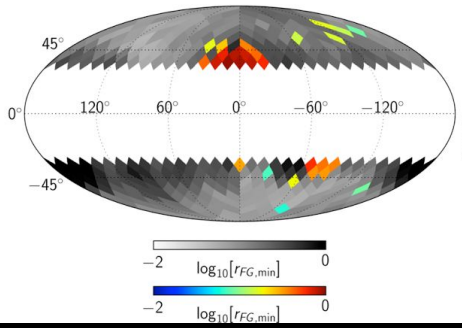
Polarized Synchrotron: Data Analysis of SPASS

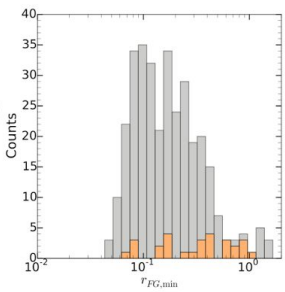
Krachmalnicoff, Baccigalupi, SISSA group, SPASS CORE team

Foreground data analysis: CMB contamination at degree scales









Frequency at which the minimum of FG emission is reached

Foreground minimum

expressed in terms of equivalent *r*

Detections:

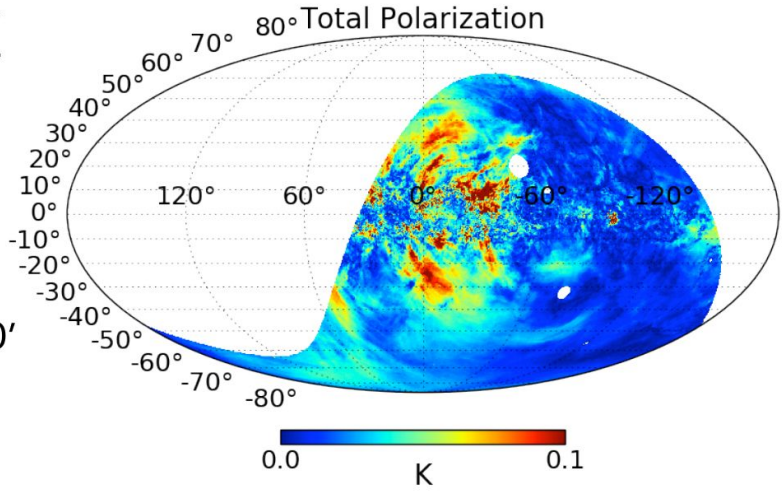
$$0.06 \lesssim r_{\mathrm{FG,\ min}} \lesssim 1.0$$

Upper limits:

$$0.048 \lesssim r_{\mathrm{FG,\ min}} \lesssim 1.5$$

SPASS survey

Carretti et al. 2013
Carretti et al. in prep



Frequency: 2.3 GHz
Angular resolution: 10'
Sky coverage: ~50%
S/N: >3 everywhere

Diffuse Synchrotron emission as CMB contaminant:

(Krachmalnicoff et al. in prep)

- Angular power spectra at different Galactic latitudes up to ell~500
- Contamination to CMB B-modes in small sky regions at high Galactic latitude
- Correlation with other data (WMAP-Planck): SED, spectral index variation, correlation with dust emission

Tasks 9-6X1.4

B-mode Parametric Fitting of Diffuse Foregrounds

Poletti and the SISSA group

The implementation and development of a Maximum Likelihood Parametric Fitting for B-mode foreground cleaning (Stompor et al. 2009) is currently available in two versions:

- **MiraMare (MM): massively parallelized (Fortran-MPI) for map based Monte Carlo simulations**
- **PyMM: serial version with a pyton interface**

Both are available on GitHub.

Performances were assessed on simulations of a variety of experimental and observational setups (Stompor et al. 2009, Stivoli et al. 2010, Fantaye et al. 2011, 2012). Fisher versions of the codes has been studied and implemented by Errard et al. (2011), Errard et al. (2016), Stompor et al. (2016) and extensively used in the design of forthcoming CMB experiments (POLARBEAR2, Simons Array, Simons Observatory, Litebird). The method is currently applied on the data of the POLARBEAR large patch measurements (700 squared degrees), expected to set competitive constraints on degree-scale primordial B-modes.