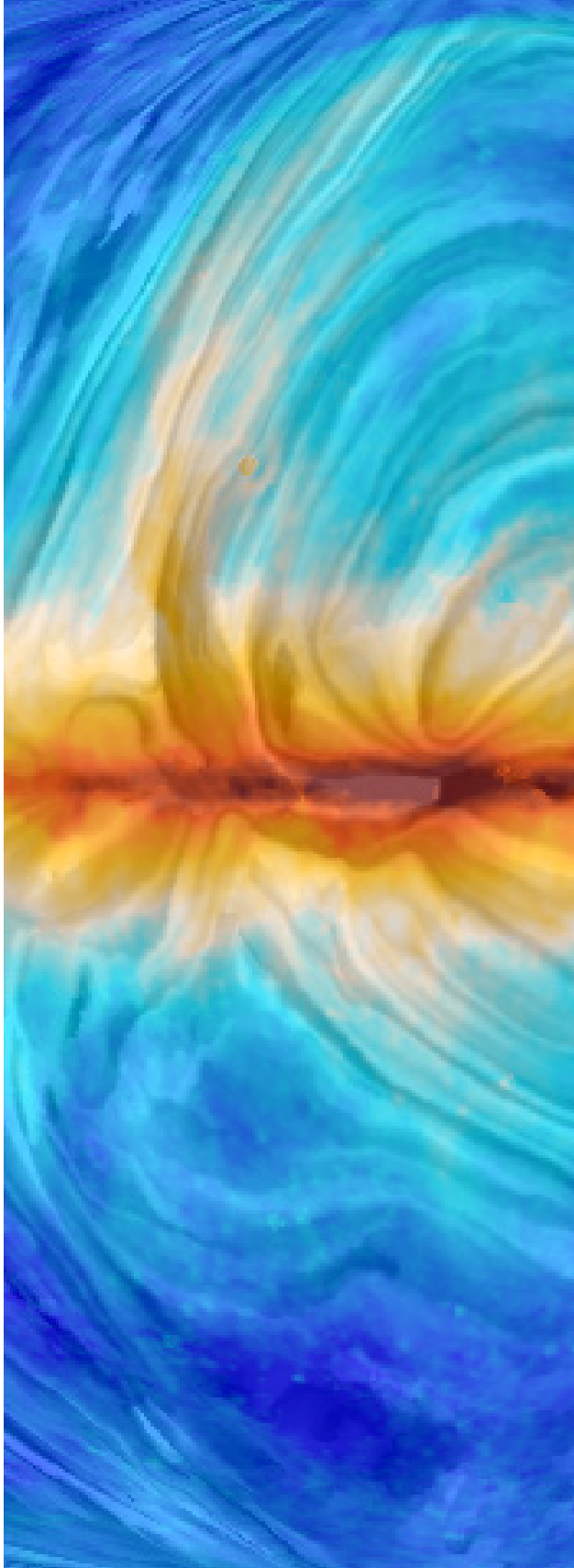
Unveiling the complexity of **radio foregrounds**
for the detectability of the CMB polarization B-mode

RADIO FOREGROUNDS+



Funded by the European Union

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Looking for
primordial gravitational waves from the Big Bang

The cosmic microwave background (CMB) is the fossil radiation arising from the Big Bang. It has a temperature of 3 K, and is observable in the microwave spectral range (1-300 GHz; 0.1-30 cm). It is the oldest light that we can observe in the Universe, generated just 380,000 years after the Big Bang. Its study is an important tool in cosmology to explore the origins of our Universe and how it evolved in time, and discover the nature of its main constituents.

All this information is encoded in the CMB anisotropies, the small variations in the intensity of the radiation depending on the observing direction on sky.

This relic CMB light is polarised, and those polarisation properties contain information about the physical conditions in the very early Universe.

In particular, they provide a window to understand inflation, a period of accelerated expansion at the earliest instants after the Big Bang, and where primordial gravitational waves are expected to be generated.

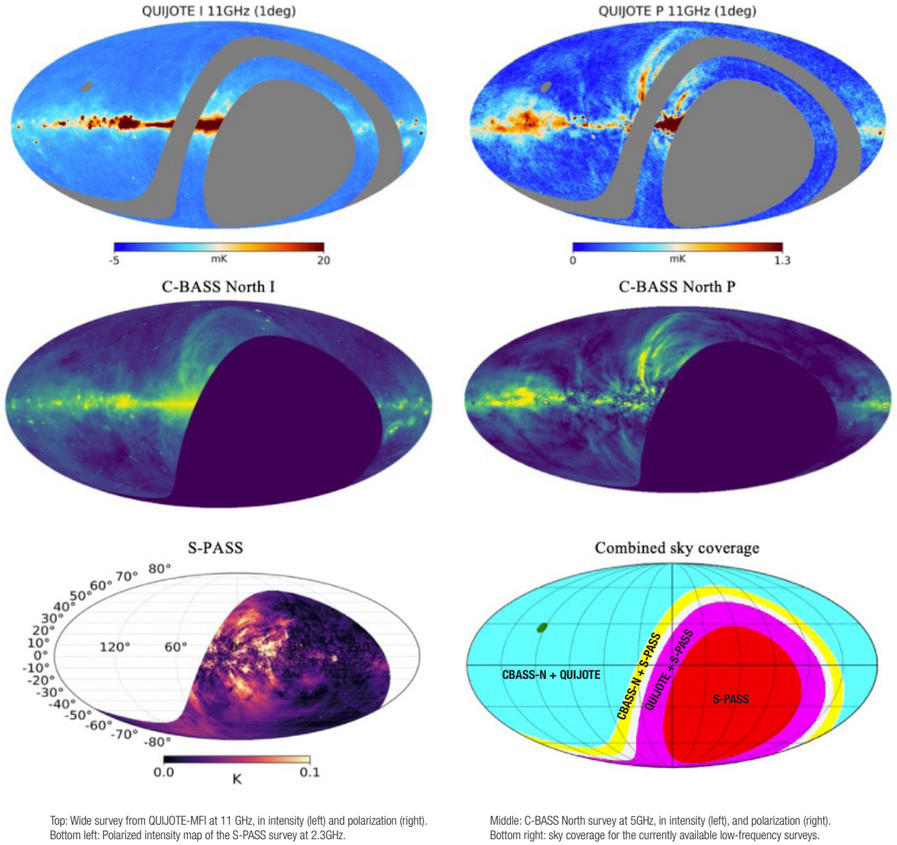
However, foreground signals, and in particular emission from our Galaxy in the microwave domain, will be a major limiting factor of the possible constraints on the existence of primordial gravitational waves from inflation.



QUIJOTE, Observatorio del Teide.

RadioForegroundsPlus project

The aim of this project is to combine the nine Planck all-sky (30-857 GHz) maps, with three unique low-frequency data sets: the QUIJOTE maps (at 11, 13, 17 and 19 GHz), the C-BASS survey (at 5 GHz) and the S-PASS data (at 2.3 GHz) to provide the best possible characterization of the physical properties of polarized emissions in the microwave domain. This legacy information will be essential for future ground-based, sub-orbital or space experiments exploring the physics of inflation.



Top: Wide survey from QUIJOTE-MFI at 11 GHz, in intensity (left) and polarization (right).
Bottom left: Polarized intensity map of the S-PASS survey at 2.3GHz.

Middle: C-BASS North survey at 5GHz, in intensity (left), and polarization (right).
Bottom right: sky coverage for the currently available low-frequency surveys.

RadioForegroundsPlus
objectives

The joint analysis of these data (Planck, QUIJOTE, C-BASS and S-PASS) will allow us to achieve the following ground-breaking objectives:

i. to provide state-of-the-art legacy maps of the synchrotron, free-free and anomalous microwave emissions over extended sky coverage;

ii. to characterize the spectral behaviour of synchrotron emission with high precision over the full sky, pinning down its deviations from a simple power-law;

iii. to model the recovered diffuse Galactic synchrotron emission in terms of a 3D physical interpretation of the distribution of cosmic rays propagating through the magnetic field;

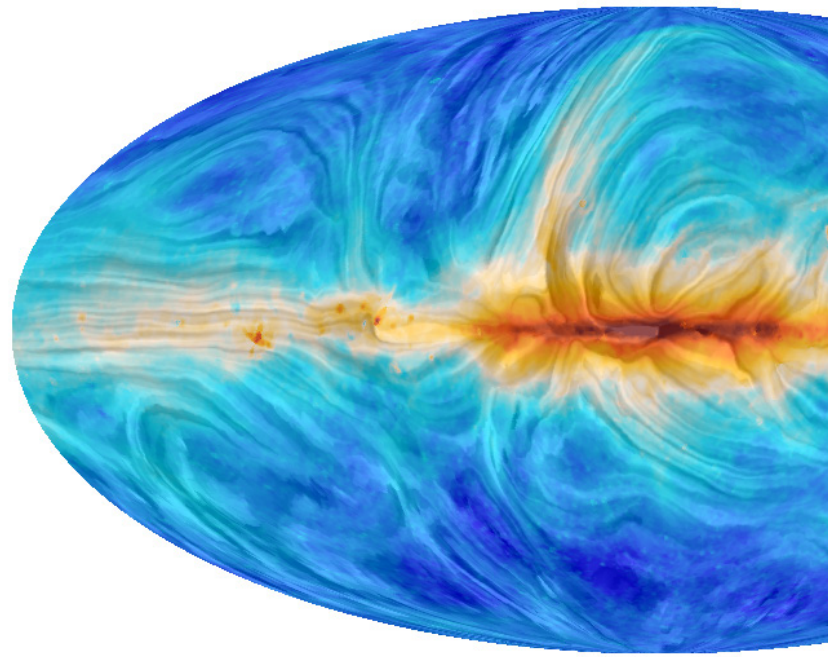
iv. to model and characterize, or to constrain tightly, the level of a possible contribution of polarized Anomalous Microwave Emission (AME);

v. to reconstruct the regular and turbulent components of the Galactic magnetic field;

vi. to provide improved catalogues of the population of radio sources observed by Planck including unique information from additional frequencies;

vii. to make robust predictions about the effect of radio foregrounds on the detectability of the B-mode of polarization for future CMB experiments; and

viii. to provide updated maps of thermal dust emission and to characterise its correlation with synchrotron.



Magnetic field lines traced by synchrotron radiation at 30 GHz by Planck satellite data.
Credits: ESA and the Planck Collaboration.

https://research.iac.es/proyecto/radioforegroundsplus/