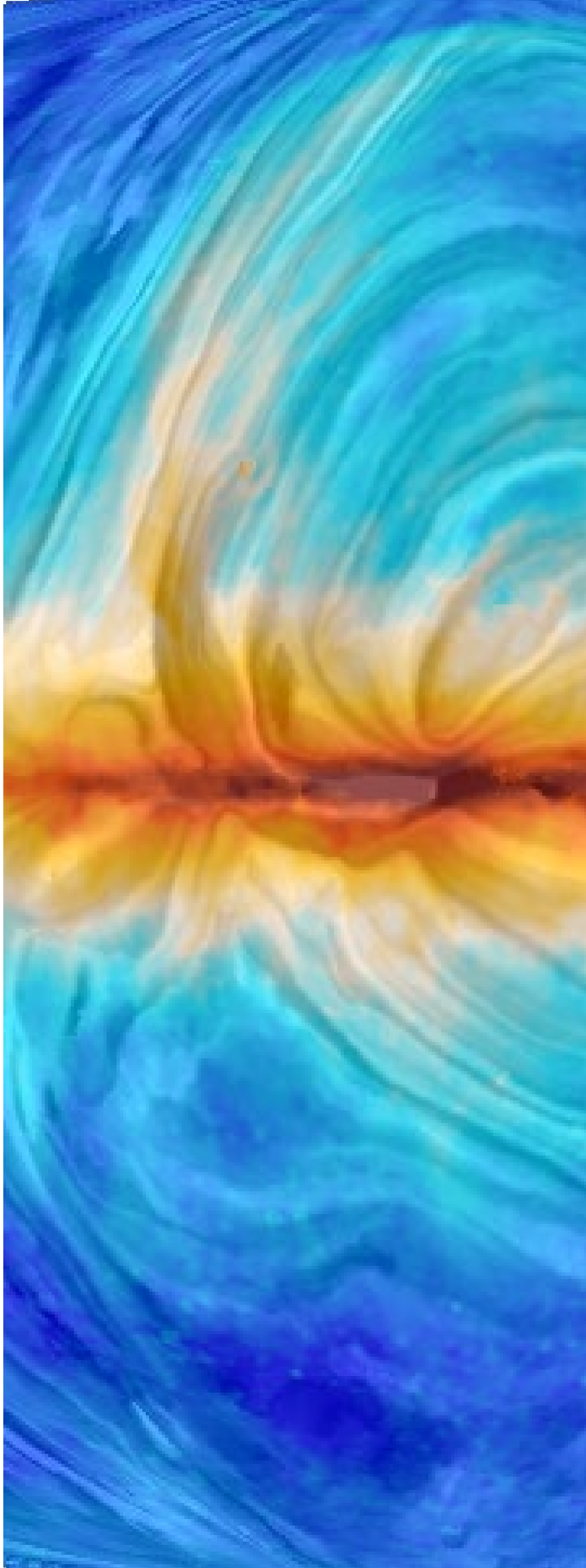
Ultimate modelling of
Radio Foregrounds:
a key ingredient for Cosmology

RADIO
FOREGROUNDS



"This project has received funding from the European Union's Horizon 2020 research and innovation programme (COMPET-05-2015) under grant agreement number 687312."

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; 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.

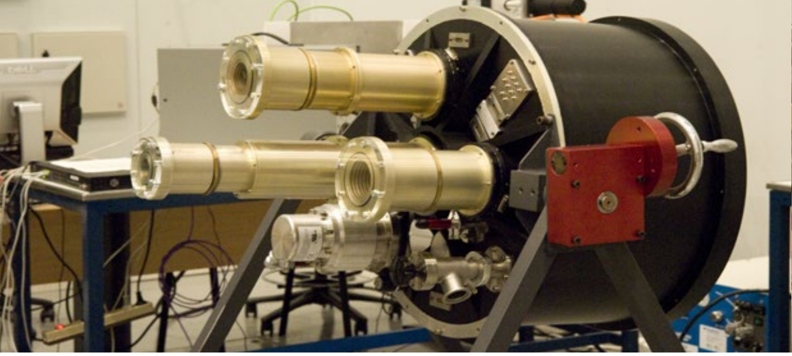
All this information is encoded in the CMB anisotropies, the small variations in the intensity of the radiation depending on the observing direction on sky.

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

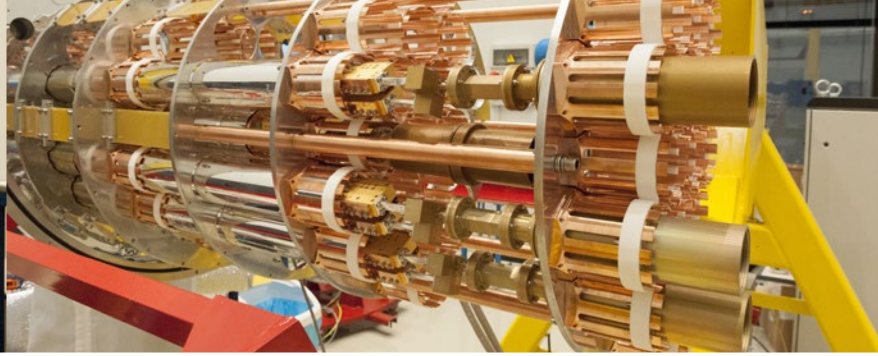
In particular, they provide a window to understand inflation, a period of accelerated expansion at the earliest instants after the Big Bang, and where primordial gravitational waves are expected to be generated.

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.



QUIJOTE MFI Instrument (11, 13, 17, 19 GHz)

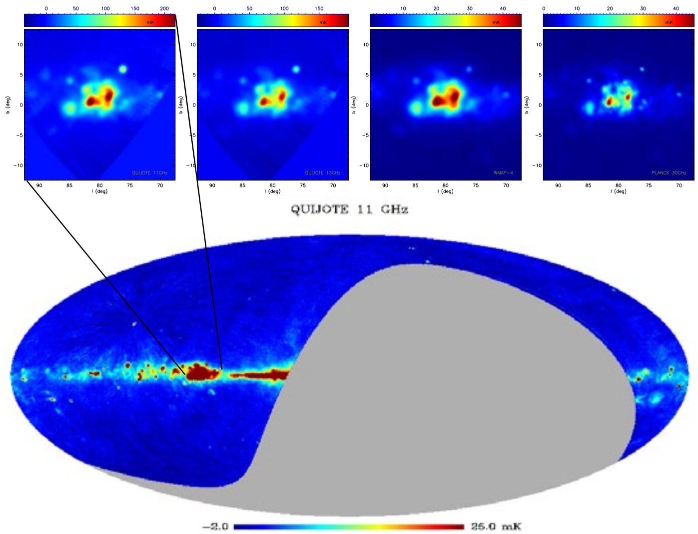


Second QUIJOTE Instrument TGI (30 GHz)

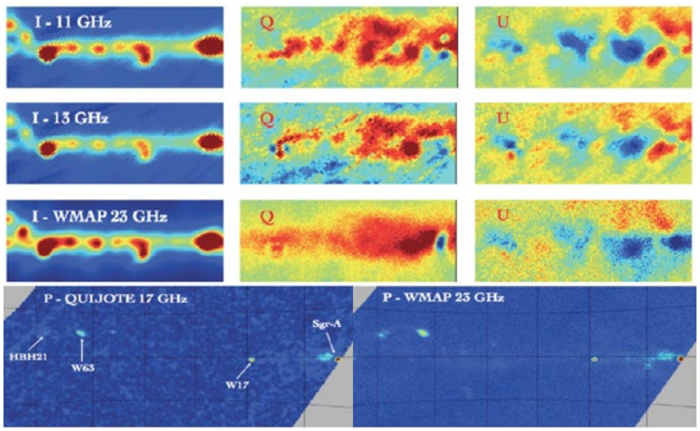
The **QUIJOTE** experiment

The QUIJOTE (Q-U-I JOint TEnerife) experiment is a scientific collaboration between the IAC, the Instituto de Física de Cantabria, the Departamento de Ingeniería de Comunicaciones-Universidad de Cantabria, the Jodrell Bank Observatory, University of Manchester (United Kingdom) and the Cavendish Laboratory, University of Cambridge (United Kingdom). The telescopes have been constructed by the company IDOM.

QUIJOTE consists of two telescopes and three instruments dedicated to measuring the polarisation of the microwave sky in the northern hemisphere, in the frequency range between 11 GHz and 40GHz, and at angular scales of one degree, from the Teide Observatory. In particular, the first QUIJOTE instrument (MFI) provides four unique frequency bands (11, 13, 17 and 19 GHz), complementary to those covered by NASA's WMAP satellite, and ESA's PLANCK satellite.



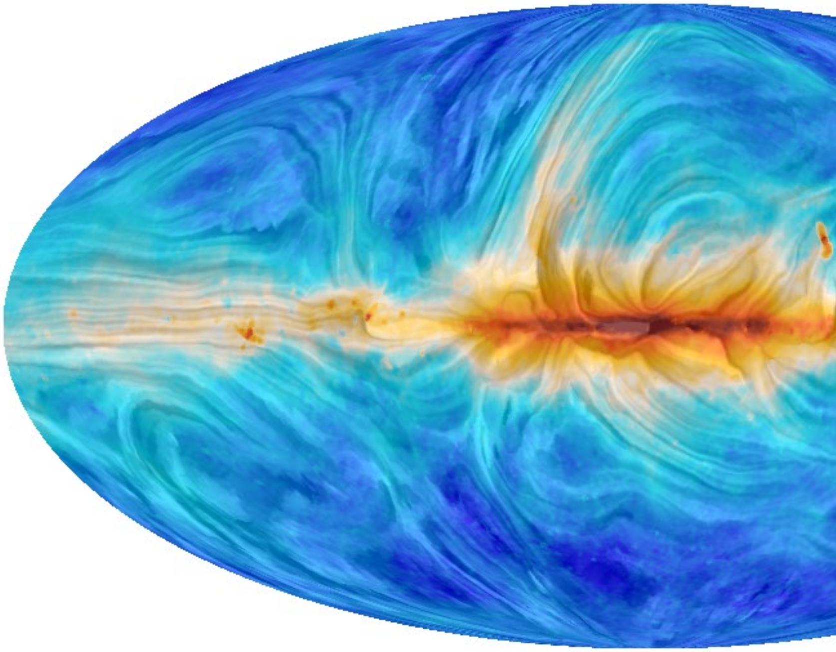
Above: The Cygnus region in our Galaxy, as seen by QUIJOTE at 11 and 13 GHz, WMAP at 23 GHz, and Planck at 30 GHz.
Below: An intensity map at 11 GHz obtained with QUIJOTE.



Above: Region of 6ºx20º as seen by QUIJOTE at 11 and 13 GHz, compared to WMAP at 23 GHz. The three columns show intensity (I), and two polarisation parameters (Q and U).
Below: Region of 30ºx60º in polarised intensity, as seen by QUIJOTE at 17 GHz, and WMAP at 23 GHz.

RADIOFOREGROUNDS
project

The aim of this project is to combine two unique datasets, the nine Planck all-sky maps (30-857 GHz) and the four QUIJOTE. Northern sky maps (10-20 GHz), to provide the best possible characterisation of the physical properties of polarised emission in the microwave domain, together with an unprecedentedly thorough description of the intensity signal. This legacy information will be essential for future sub-orbital or satellite experiments exploring the physics of inflation.



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

RADIOFOREGROUNDS
objectives

The combination of Planck and QUIJOTE will allow us to achieve the following objetives:

- To provide state-of-the-art legacy maps of the synchrotron and AME emissions in the Northern sky.
- To characterise the synchrotron spectral index with high accuracy, fitting for the curvature of the synchrotron spectrum to constrain cosmic-rays electron physics.
- To study the large-scale properties of the Galactic magnetic field using the radio information.
- To model and characterise the level of a possible contribution of polarised anomalous microwave emission (AME).
- To characterise the population of radio sources measured by Planck by adding unique information in the frequency domain of 10-20GHz.
- To provide “added-value” data products for the scientific community.
- To provide specific (open source) software tools for data processing, data visualisation and public information.

www.radioforegrounds.eu
Twitter: **@radioforeground**
Facebook: **https://www.facebook.com/radioforegrounds**

EXCELENCIA SEVERO OCHOA