



SISSA at the forefront of the search for cosmological gravitational waves

The RadioForegroundsPlus project funded under the Horizon Europe programme

The 'RadioForegroundsPlus' project has received funding of around 200,000 euros from the European Research Council as part of the Horizon Europe programme and will see SISSA at the forefront of the management of research teams and the preparation of data analysis algorithms for the search for cosmological gravitational waves. Partners in the initiative will be the Institute of Astrophysics of Cantabria (IFCA), the Institute of Astrophysics of the Canary Islands in Spain, the Universities of Manchester and Oxford in the UK and the National Research Centre in France.

The aim of the project is strategically to search for signals of cosmological gravitational waves emitted during the Cosmic Inflation, i.e. in the very first moments of the expansion of the universe. These signals are hidden in the cosmic microwave background, the 'fossil' light left over from the Big Bang. This light is polarised, and the properties of this polarisation contain valuable information about the conditions of the early universe. However, the signal from the cosmic microwave background is weak compared to the emissions generated by our galaxy, so it is extremely important to be able to measure and understand these 'foreground' emissions in order to subtract them and access the cosmological signal.

"In this context of global effort, it is extremely important to use the data available at frequencies contiguous to those that will be observed because they can give us decisive information with respect to galactic contamination of the cosmological signal," explains Carlo Baccigalupi, coordinator of the Astrophysics and Cosmology (APC) group at SISSA.

"The RadioForegroundsPlus project represents a natural continuation of RadioForegrounds, the project funded by Horizon 2020 in the three-year period 2016-2019 that dealt with the reduction and interpretation of data from telescopes such as QUIJOTE, S-PASS and C-BASS, located in Europe, Australia and the UK, which have been observing for years the diffuse synchrotron radiation emitted by our Galaxy," explains Francesca Perrotta, researcher in the APC group and coordinator of the original project.

In the coming years, an ambitious programme will add many new observations of the cosmic background in an attempt to identify the all-important 'gravitational footprint' of the Big Bang. As early as 2023, observations by the Simons Observatory, a telescope system located at an altitude of 5000 m in Chile's Atacama Desert, will start, to be joined in the coming years by the Japanese Space Agency's LiteBIRD satellite and by the CMB-Stage-IV system, which will add more telescopes at the South Pole.

During the RadioForegrounds programme, Nicoletta Krachmalnicoff, now a tenure track at SISSA, led the drafting of work that forms an integral part of the sky models that are used by the scientific community to develop data analysis algorithms capable of protecting the background from contaminants in these future observation campaigns. It was on this basis that the new 'RadioForegroundsPlus' programme was proposed, which was funded under the ERC-Horizon Europe programme.

"Galactic emissions have turned out to be more complex than expected, imposing on the simulation and analysis algorithms an evolution that is largely still in progress, absorbing the new information made available by new data in particular from the QUIJOTE telescope in the Teide Plateau, in the Canary Islands, and others in the future, for which the new funding will allow us to carry out the studies needed by the international community just as cosmological observations are beginning," says Nicoletta Krachmalnicoff.

The SISSA Astrophysics and Cosmology group would like to express its gratitude to the School's Project Management office for its valuable support in preparing the proposal and planning resources.