Large-Scale Features in the Observed Sky from Radio to Gamma Rays

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Present telescopes from radio to gamma-ray energies are offering an amazing and unprecedented view of the sky, discovering thousands of sources, and unveiling properties of the non-thermal emission in the Milky Way. Indeed, recent instruments, such as Planck in microwaves and Fermi in gamma rays, have observed diffuse emission from the Milky Way produced by cosmic rays interacting with the interstellar medium while they propagate in the Galaxy for more than 10 million years.
Maps of the all-sky at radio, at microwaves, and at gamma rays, even though very different to each other, show a strong common emission corresponding to the Galactic plane and the Galactic center. Some other regions of enhanced emissions show up as Galactic large-scale features, which sometimes partially overlap at different frequencies. Examples of these features are the famous Fermi Bubbles seen in gamma rays, two large lobes-like structures extending for 10 kpc from the Galactic center maybe being a signal of the past activity of the Milky Way's black hole. The Fermi Bubbles can potentially be connected to the Haze seen in microwaves, whose origin is still unknown. The problem is that the detection of such features and similar ones, and the identification of their morphologies and spectra strictly depend on our knowledge of the interstellar medium and are model dependent.

This project aims at investigating Galactic large-scale features of many available data from radio to gamma rays, both spatially and spectrally.
Deep Machine Learning techniques will be developed to analyze and cross-correlate multi-wavelength data, which will be then interpreted with physically based models. The latest models of the diffuse emission will be used to help on this. Eventually, observations of these emissions will reveal information on cosmic rays, magnetic fields, and the interstellar medium. This work will impact also on potential gamma-ray missions such as AMEGO, possible observatories at TeV energies such as SWGO, and planned microwave missions such as EUCLID.

The student will be exposed to international collaborations.
We are looking for someone who is comfortable working both in a team and independently, driven by self-initiative and with a strong interest in the physical processes that generate Galactic emission and in how to develop codes and software for the analysis.
The ideal student has background in astrophysics or particle physics, and has programming knowledge. We expect the student to publish in scientific peer-reviewed journals.
Excellent knowledge of English is required.

All qualified and interested candidates of any nationality, gender, religion, are encouraged to contact Elena Orlando (eorlando@units.it).