

TITLE: High Performance driven Radio Astronomy with LOFAR**Supervisors: Claudio Gheller, Marco Bondi****UniBo Ref: Annalisa Bonafede**

In the next decade, current and upcoming radio-interferometers, like the Low Frequency Array, LOFAR (in the perspective of the Square Kilometre Array - SKA) will produce huge volumes of complex data. This will represent not only an invaluable opportunity for scientists, but also an outstanding technological challenge. Corresponding data processing will have to be performed exploiting the most advanced High Performance Computing (HPC) resources and related programming techniques. Consequently, in these years, data reduction and imaging software tools will have to be developed in order to efficiently run on HPC scale.

Among the most interesting perspectives on the horizon, there is the possibility of mapping large portions of the sky at high spatial resolution with LOFAR. This is possible thanks to the long baseline of LOFAR stations, on 1000 km across Europe, and to novel computing-intensive techniques for calibration and data reduction that have been recently developed in the LOFAR Collaboration. Mapping the Universe at sub-arcsecond resolution with the unprecedented sensitivity reached by LOFAR will lead to a major breakthrough in several areas in astrophysics and cosmology, including weak-lensing studies, the physics of supermassive black holes in the distant Universe and their impact on the evolution of galaxies, and the magneto-genesis and the physics of the most distant galaxy clusters and proto-clusters. On the other hands, the computational needs that are required by data calibration techniques of LOFAR long-baselines and by mapping the LOFAR large fields of view at sub-arcsecond resolution are far greater than what typical computing systems are currently capable of handling.

The first part of the PhD program will be devoted to enable current algorithms to run efficiently on modern HPC systems; the work will be carried out within the LOFAR Collaboration using HPC systems (Pleiadi, INAF Tier3) that are already available at INAF. This action will put the PhD candidate in a unique position, exploiting LoTSS and deep fields (es EDFN) data, to carry out front-end research in the field of AGN, interplay between massive black hole and galaxies, and on the most distant galaxy clusters.

The exact scientific topic is flexible and will be discussed with the candidate taking into account his/her attitudes and interests. We invite interested candidates to contact the supervisors.