



PhD project in ASTROPHYSICS

Title of the Project: Magnetic fields in the large-scale structure

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Scientific Case:

The advent of radio low-frequency facilities, such as LOFAR*, has opened a new window for the study of magnetic fields on the large-scale structure. Recently, we have discovered the first radio emission originating from a bridge of interacting cluster pairs. These observations demonstrate that relativistic electrons and magnetic fields permeate also the regions in-between clusters, tracing the cosmic web.

Radio bridges pose severe challenges to both theories of magnetogenesis and particle acceleration. We suggested that turbulence generated in vast filaments connecting massive clusters can amplify magnetic fields via small-scale dynamo and accelerate particles via 2nd order Fermi mechanisms. A statistical assessment of the occurrence of radio bridges and a firm measure of their properties is possible only with LOFAR, and is the first step to understand the origin of these sources and of the magnetic field underlying them.

Outline of the Project:

The PhD candidate will use LOFAR data to investigate, for the first time, the properties of magnetic field in the bridges and filaments that connect galaxy clusters in the cosmic web. LOFAR data will be used in combination with numerical simulations and theoretical models to constrain the properties of magnetic fields, the allowed scenarios for cosmic magneto genesis, and the particle-acceleration mechanisms. Different leverage will be given to observational or theoretical parts depending on the candidate attitudes and preferences.

The PhD thesis is part of a larger project DRANOEL (*Deciphering RADio NON-Thermal Emission on the Largest-scale* <https://annalisa-bonafede.myfreesites.net/erc-stg-project-dranoel>) financed by the European Research Council (ERC-2016-STG 71425). The PhD candidate will work in close contacts with the other group members and will be part of the LOFAR cluster group within the Survey key science project. The PhD candidate will be involved in international working groups, and travels to visit collaborators in the Netherlands, Germany, and USA are planned.

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*the LoW Frequency ARray,