

***The evolution of radio emitting electrons in the cosmic web***

The research project

This project will study the spatial and energy evolution of relativistic electrons accelerated by cosmic shocks, and their radio emission. Fundamental to this project will be the development and the optimisation of new numerical algorithms to model the energy evolution of electrons in time, combined with numerical methods being developed by the MAGCOW group.

A strong numerical expertise with cosmological simulations and advanced numerical methods is crucial for this project.

Funding

This Post Doctoral Fellowship project is funded by the European Research Council (ERC) Starting Grant no.714196 MAGCOW-The Magnetised Cosmic Web, active from 2017 to 2022.

This Post-Doctoral Fellowship is expected to start no later than January 2018 and to last 3 years (2+1 years).

Through this project, the Post-Doctoral Fellow will get additional funding resources to attend international conferences, training activities and to visit collaborators abroad.

Main scientific goals

- The gaseous distribution of the cosmic web can be traced through the radio emission from relativistic electrons accelerated by accretion shocks around filaments and galaxy clusters, which should be detectable by the incoming generation of radio telescopes (LOFAR, MWA, ASKAP and SKA). The detection of the radio signal from the rarefied gas in cosmic filaments will give us crucial hints about the origin of extragalactic magnetic fields, which is still unknown, as this environment is predicted to keep dynamical memory of past seeding events of magnetic fields.
- Predicting the spectral energy evolution of radio emitting electrons accelerated by cosmic shocks and their ageing in this rarefied environment is crucial to interpret future radio data and to assess the best observing strategies and analysis pipelines.
- Through the use of large existing simulations produced by the MAGCOW group and by creating new numerical algorithm, the Post-Doctoral Fellow will investigate in detail the radio spectral evolution of relativistic electrons in the frequency range interesting to radio observations ( $\sim 50$  MHz to  $\sim 2$ GHz) as well as to soft and hard X-ray ( $0.5$ keV to  $10$  keV) searches of Inverse Compton emission by the same electrons

Implementation Strategy

- First order assessment of the spectral evolution of injected power-law distributions of electrons by cosmic shocks with different shocks parameters and under a range of plasma conditions. The Post-Doctoral Fellow will have access to Fokker-Planck methods developed in MAGCOW to study the ageing of electrons for a range of physical conditions, directly extracted from cosmological simulations.
- Implementation of the Fokker-Planck solver on the ENZO cosmological code. Based on the results of the first step, the Post-Doctoral Fellow is expect to design the best strategy to incorporate in the cosmological code of reference for the group (the grid code ENZO, enzo-project.org) run-time recipes to follow the spectral evolution of electrons and make predictions on their observational signatures. The choice of the best strategy (e.g. lagrangian passive tracers vs eulerian-based Fokker Planck solver) is not obvious and a careful design optimisation will be required.
- Production of new cosmological runs and observational predictions tailored for new radio observations, as well as for future X-ray observations of Inverse Compton emission with the ATHENA satellite.

International Context

- The Post-Doctoral Fellow will have the opportunity of conducting this research in a florid research environment, closely connected with the most important international multi-band surveys of the

next decade (with the Square Kilometer Array, Euclid, Athena, etc).

- The ERC group MAGCOW is also closely connected with the University of Hamburg (Germany), which is the second beneficiary of the grant, and this will allow the PhD candidate to work in close contact with international colleagues since the start of the project.
- Through the collaborators of MAGCOW, the Post-Doctoral Fellow will also have access to the numerical data and code implementations developed by the group, and to the large simulated dataset used by the group ([http://cosmosimfrazza.myfreesites.net/the\\_magnetic\\_cosmic\\_web](http://cosmosimfrazza.myfreesites.net/the_magnetic_cosmic_web)).

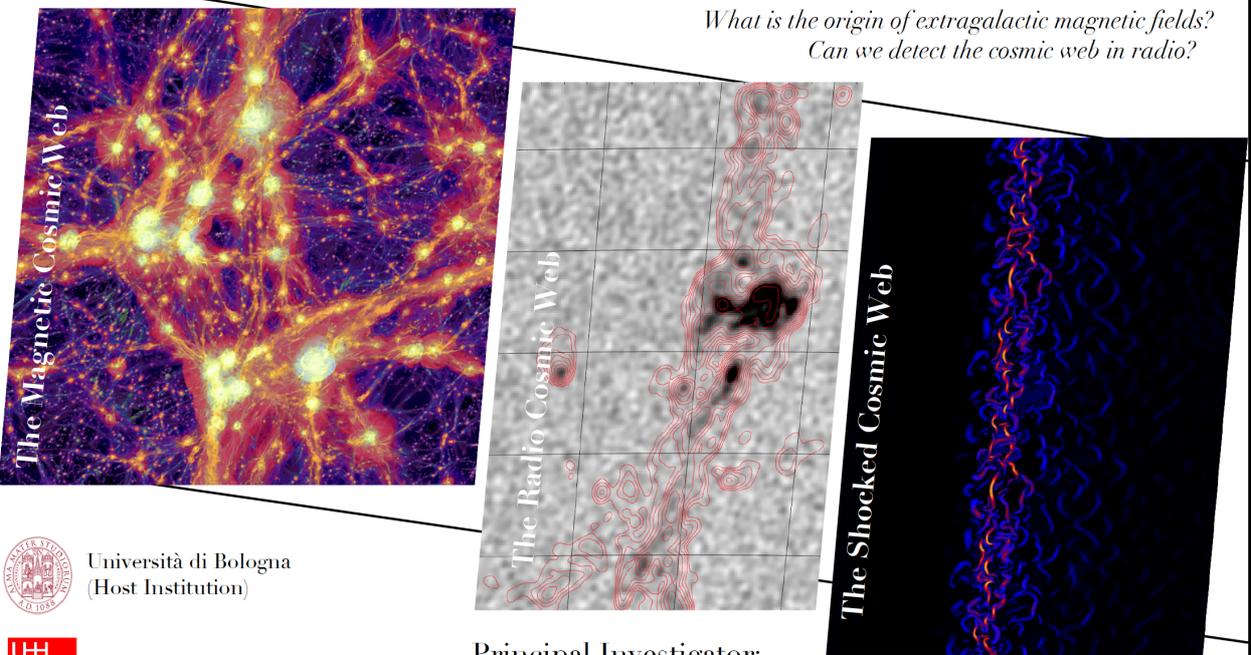
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*What is the origin of extragalactic magnetic fields?  
Can we detect the cosmic web in radio?*



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