



Pos-Doctoral Fellowship in ASTROPHYSICS

Title of the Project: *Reconstructing the network of the magnetic cosmic web*

Supervisor : Prof. F. Vazza (DIFA)

Scientific Case:

The large-scale structure in the Universe is organised in a complex network of filaments connecting virialized halos, and separated by voids. The analysis of the topology and connectivity of elements in this network can give important inputs to cosmological studies, as well as enable observational studies of the thermal and non-thermal properties of the diffuse gas in filaments of the network, whose direct observation is still missing.

The detection of the synchrotron emission from shocked magnetised filaments of the cosmic web, and its relation with the other surrounding network elements (clusters of galaxies, sheets of matter and cosmic voids) is a key research topic of the ERC-funded MAGCOW project as it can tell us about the origin of cosmic magnetism.

Predicting the volumetric properties and topology statistics of voids, sheets, filaments and halos is also fundamental to characterise the average population of cosmic structures along the deep line of sights now routinely probed by new radio surveys of the sky at all latitudes (e.g. using LOFAR, MWA, ASKAP, MEERKAT, SKA).

The combination of advanced cosmological numerical simulations of the cosmic web with efficient methods to characterised the degree of connectivity of different components of the cosmic network is key to interpret the complex multi-wavelength data that can be already used to study the origin of cosmic magnetism, and the relation between magnetised filaments and their larger scale environment, as function of redshift and scale.

Outline of the Project:

This Post-Doctoral Fellowship project is aimed to deploy, optimise and make a large use of statistical tools to constrain the distribution of structure across the entire continuum range of spatial scales in the simulated cosmic web, and to measure the properties of connectivity between nodes in the network, estimating the tendency to form highly clustered configurations or voids.

The project will extend the range of available statistics of the cosmic web, typically produced with dark-matter only simulations, to the new generation of magneto-hydrodynamical simulations produced within by the MAGCOW project in the latest years.

An important goal of this project is to capture the the dynamics of network, by studying the time evolution of the various network metrics, as measured in different epochs of the simulated cosmic web and jointly with the dynamical information of the internal evolution of cosmic structures and of their associated magnetic field.

Moreover, synthetic radio observations of simulations produced during the project will represent a fundamental output to compare with existing radio observations (available to members of the MAGCOW group) as well as to propose observing strategies for new radio observations.

Given its topic and expected workflow, this project calls for candidates who have a strong documented experience with network statistics, big data analysis, cosmological simulations and have familiarities with cosmology and machine learning.

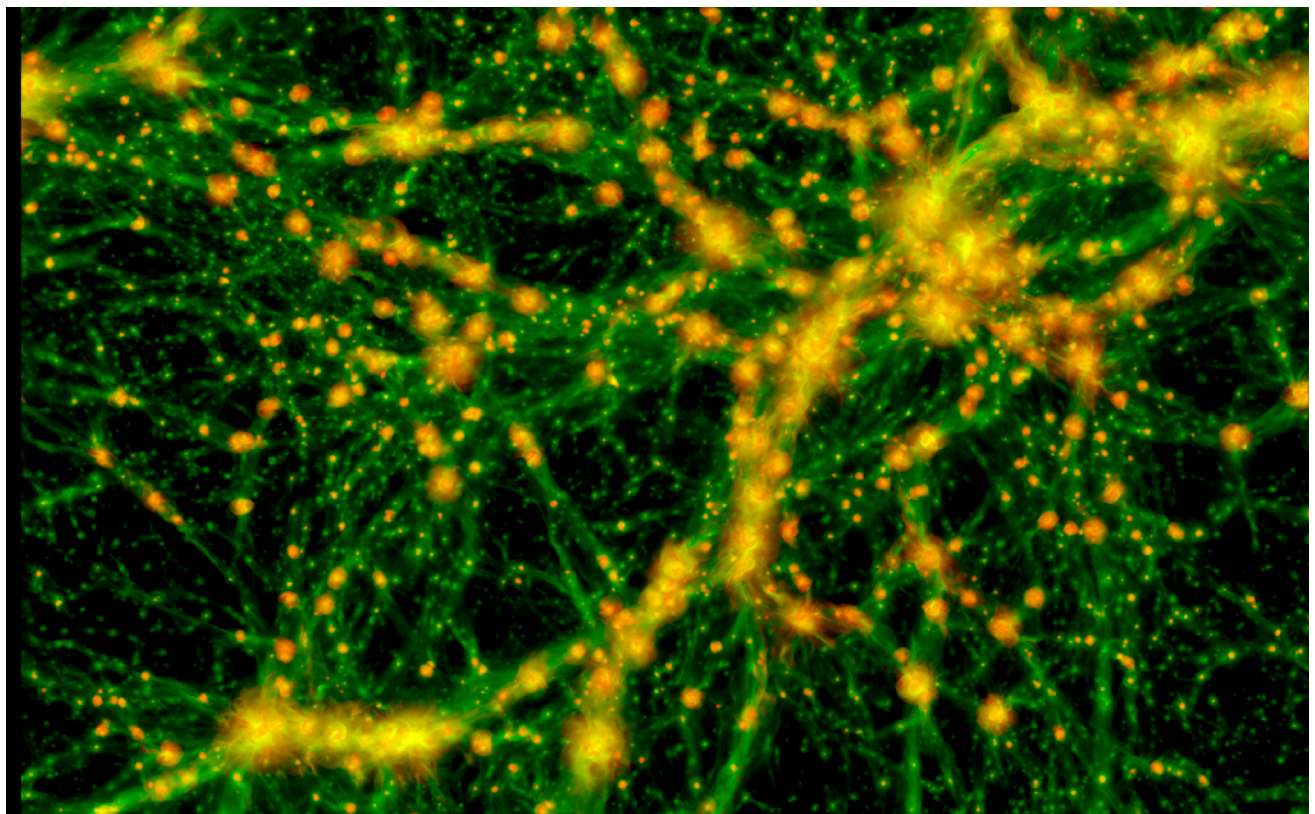
Development and formative plan

The Post-Doctoral fellow will be involved in all existing scientific activities and lines of research of the MAGCOW group (<https://cosmosimfrazza.myfreesites.net/erc-magcow>). The candidate will have access to all numerical method and physical models developed by the group, which will be helpful to model the ageing and re-acceleration of fossil plasmas in complex objects.

The candidate will be encouraged to keep all existing collaborations alive, to present new results to conferences and workshops (in presence or remotely), to be the lead author or publications resulting from this line of research as well as to perform any possible outreach activity to maximise the project's impact on the general public.

All activities foreseen for this project can be performed even remotely.

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<https://cosmosimfrazza.myfreesites.net/erc-magcow>





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UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI FISICA E ASTRONOMIA
"AUGUSTO RIGHI"

FORM TO BE FILLED AND ATTACHED TO CV IN THE APPLICATION

This call for a research fellowship is open to candidates in possession of the following requirements:

- to be a citizen and resident of Ukraine,
- to be refugee from Ukraine
- to be refugee in Ukraine
- to be evacuee from Ukraine
- to hold a permanent residence permit in Ukraine
- to hold a 2nd cycle/specialist degree or degree from previous system or equivalent qualification in Astrophysics or Physics.

THE UNDERSIGNED

SURNAME _____

NAME _____

BORN IN _____ (PROVINCE/COUNTRY _____)

ON _____ (fill in exactly the same personal details as shown in the enclosed copy of passport or identity document)

E-MAIL (compulsory) _____

HEREBY APPLIES

for the call for the selection running at DIPARTIMENTO DI FISICA E ASTRONOMIA of the Alma Mater Studiorum University of Bologna for the award of 1 grant research fellowship, for the execution of research activities, even remotely, within the project entitled "Reconstructing the network of the magnetic cosmic web", according to the annexed Activity Programme for 12 (twelve) months starting approximately from June 1st, 2022

AND DECLARES:

- to be a citizen and resident of Ukraine to be a refugee from Ukraine
- to be a refugee in Ukraine
- to be an evacuee from Ukraine
- to hold a permanent residence permit or international protection in Ukraine

AND ENCLOSES THE FOLLOWING DOCUMENTS:

- scanned copy of the passport or valid Identification Card and, only for non-Ukrainian citizens, of the residence permit or international protection in Ukraine;
- a duly signed declaration indicating the eligibility for one of the above-mentioned categories;
- scientific and professional curriculum vitae also containing scientific productivity.

As required by the call, In the online application, following the web procedure instructions, candidates must indicate, under their own responsibility:

- surname and name;
- date and place of birth;
- nationality;



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- residence and chosen address for correspondence for the purposes of this selection;
- that they do not have a criminal record and are not involved in any current criminal proceedings (or if so, state which);
- that they have the qualification required by art. 2 of the call for applications, specifying the University and year in which it was obtained or that they possess an academic qualification obtained abroad, which is deemed equivalent.

Date, Signature _____

Processing of personal data Personal data collected are processed as described in the "Privacy policy for participants in the University's competitive selection procedures" available at: www.unibo.it/privacy