

Astrophysics Sector, Department of Physics and Astronomy (DIFA) of the Alma Mater Studiorum - University of Bologna, Italy

Via Piero Gobetti 93/2, 40129 Bologna Italy

Marie Skłodowska-Curie Innovative Training Networks, Early Stage Researcher (H2020-MSCA-ITN-2019)

Deadline for applications: April 1st 2020

Expected starting date: November, 1st 2020

Supervisor: Prof. Marcella Brusa

Job duration: 36 months

Main research field: Astrophysics, Physics

Job description:

The job is a full time position for an early stage researcher (ESR) in the field of Galaxies and AGN co-evolution — **Galaxies properties, environment and accretion onto the black holes**. The title of the project is: “Constraints on AGN Eddington ratio distributions from the *J-PAS*, X-ray, *AllWise* and *LeMMINGs* survey”. Our goal is to create advanced Bayesian inference and Monte Carlo methods to account for observational selection effects in the determination of the accretion properties (Eddington ratios) of AGN.

The appointed ESR will be enrolled in the PhD program (36 cycle) and submit the thesis within the period of employment. Training activities involve PhD courses, participation to seminars/workshops/conferences. The supervisor will be **Prof. Marcella Brusa** (University of Bologna). This is a joint project with Fundacion Donostia International Physics Center (DIPC, Spain) and **Dr. Silvia Bonoli** will be the PhD co-supervisor.

Project description

The main goal of the project is to determine unbiased tracers of the accretion history of supermassive black holes as a function of AGN luminosity, obscuration, galaxy properties and environment down to the lowest value of the Eddington ratios typical of AGN in their latest phases. This is fundamental to understand what galaxy and environment properties facilitate the accretion onto black holes.

The project is divided in 2 parts:

1. measure the Eddington ratio (accretion) distributions of AGN by combining the J-PAS narrow-band photometric survey with deep pencil beam and wide-area X-ray (e.g., XXL, Stripe82X, and the upcoming eROSITA) and IR (e.g. All WISE) surveys, and complement with the local, complete and multi-wavelength LeMMINGs survey with new Chandra full coverage. The use of pencil-beam, wide area, and local complete surveys at multiple wavebands is key to select AGN at the lowest luminosities. In particular, recent X-ray surveys combine sufficient area and sensitivity that promise a leap forward in constraining $z < 0.5$ AGN statistics in the often neglected low luminosity range. This part of the project envisages secondments at DIPC (Spain) with Dr. Silvia Bonoli and at University of Southampton (UK) with Prof. F. Shankar.
2. we will adopt advanced statistical tools based on Bayesian interference, Monte Carlo routines, and datacube analysis to account for the multiple and complex selection effects which can significantly alter the shape of the observed Eddington ratio distribution. We will use the intrinsic shape of the de-biased AGN accretion rates distribution as a function of host galaxy properties and environment to compare with the predictions Semi Analytic and Semi Empirical Models (SAM/SEM). This part of the project will benefit from a secondment at Unbound (UK) focused on the developing of deep learning applications.

The project is open in the framework of **BiD4BEST** (Big Data for Black hole Evolution Studies; GA 860744; Coordinator: Dr. Francesco Shankar, University of Southampton), a H2020 Marie Skłodowska-Curie Innovative Training Network (MSCA-ITN-ETN) that offers an innovative and intersectoral research training programme for 13 PhD students in one of the most visible areas of astrophysical research: *the formation and evolution of supermassive black holes in galaxies*.

A coordinated research training effort in this field has been established to mobilise the community in Europe and prepare a core group of young scientists in anticipation of new observational data in the early/mid 2020s from future space missions with strong European involvement. These data will have the quality and volume to yield transformational science on the formation of black-holes in galaxies, as long as the necessary expertise and synergies among observation, theory and data analytics exist within the European astronomy community. BiD4BEST brings together leading scientists in observational and theoretical studies of black holes and galaxies, industrial experts in cutting-edge big-data technologies, and professionals in science dissemination. The 13 doctoral research projects available in the network combine state-of-the-art observations, numerical simulations and innovative analytic tools to compare theory with observation and shed light on the physics of black hole formation in the context of galaxy evolution. The training on expertise from different research areas (observational astronomy, theoretical astrophysics) and sectors (academic, industrial) will be achieved by carefully designed secondments, mixed doctoral supervisory committees (academia, industry), well coordinated events for team communication and interaction, as well as network-wide courses on astrophysics and transferable skills. The proposed research training programme aspires to generate individuals that in addition to academic competences, master big-data analytics and have the capacity to apply these technologies to solve problems in different sectors (research, industry, non-academic) by developing innovative products and services. Further information can be found at <https://wwwmpa.mpa-garching.mpg.de/~kdolag/BiD4BEST/index.html> and <https://cordis.europa.eu/project/id/860744>

Institution description and working place:

The Department of Physics and Astronomy (DIFA) of the Alma Mater Studiorum - University of Bologna, is one Department of the Science School and one of the most scientifically productive Physics Departments of Italy, internationally well-known for its activities in a wide range of research fields.

The Department is a teaching site of the University and provides lectures in all fields of astronomy and astrophysics at all academic levels. Furthermore, it is one of the only four institutions in Italy to offer an international PhD program fully dedicated to Astrophysics. The Department has its own scientific libraries, several meeting rooms that host regular weekly seminars from highly renowned scientists from the whole world, as well as smaller regular meetings and several informal talks of the different research groups. Moreover, DIFA will deploy and install in spring 2020 a High Performance Computing cluster called "Matrix" with 896 virtual cores and 4 GB RAM/core, equipped with 240 TB of disk storage space, used both for DIFA research activities in the context of the Open Physics Hub project, and for innovative teaching courses.

The project will take place at the premises of DIFA's Astrophysics Sector (Via Gobetti 93/2 40129 Bologna Italy), located within the heart of the newly established Bologna Astrophysics Campus, which includes: INAF-Osservatorio di Astrofisica e Scienza dello Spazio di Bologna (INAF-OAS), INAF-Istituto di RadioAstronomia (INAF-IRA) and the Cerenkov Telescope Array (CTA) Headquarters, all within walking distances and shared facilities. This is the largest astrophysical center in Italy with a strong group at the forefront of the European research in the field of galaxy formation and AGN-co-evolution and key involvement in next ESA's missions Euclid and Athena. Dedicated secondments at the DIPC and the University of Southampton (UK) and in other non-academic partners such as Unbound (UK) is planned.

Candidate profile

The candidate can be of any nationality and is required to have a master degree in Astrophysics, Physics or related fields giving access to PhD school and NOT to have any kind of PhD degree. Previous research experience (which must be no longer than 4 years) although appreciated, is not mandatory. Willingness to travel internationally for the purpose of research, training and dissemination/outreach is mandatory.

Eligibility requirements

ESR appointments are full time fixed term for 36 months. The researcher will commit to work exclusively for the action. There are strict eligibility rules associated with the recruitment of Early stage Researchers in Marie Skłodowska-Curie Innovative Training Networks, and these are:

Career: At the date of recruitment, the ESR must have a master degree giving access to PhD, shall be in the first 4 years (full-time equivalent research experience) of their research careers and have not been awarded a doctoral degree. Previous research experience, especially in extragalactic Astrophysics and galaxy evolution is appreciated but is not mandatory. A PhD degree in any field is not compatible with this ESR position.

Mobility: Trans national mobility is an essential requirement of Marie Skłodowska-Curie Training Networks. The ESR must not have resided or carried out his/her main activity (work, studies etc.) in Italy for more than 12 months in the 3 years immediately prior to the recruitment date. Compulsory national service and/or short stays such as holidays are not taken into account. Applicants must be prepared for a secondment for a total of 11 months at most in the United Kingdom, The Netherlands and Germany.

Language: A good knowledge of spoken and written English is required and will be evaluated during the selection process.

If these criteria are not fulfilled, the applications will be rejected. Candidates matching the required profile will be interviewed until a successful candidate is appointed. Candidates that do not fulfill the mobility requirement are encouraged to look in the network webpage for other open positions within the network (<https://euraxess.ec.europa.eu/jobs/486901>).

How to apply

Applicant should apply through the online portal (<https://concorsi.unibo.it>) and should provide

- An application form duly completed.
- A CV including previous technical and scientific experiences with a list of publications (if any) and/or participation to scientific meetings and research expertise. The CV should indicate all the courses attended during the master degree.
- A letter of motivation, including research interests and the reasons for applying for this programme;
- Undergraduate level certificates, including university grades and the detailed list of university courses with grades. Copies of any other scientific publication that the candidate believes significant are also welcome.
- The applicant must also provide the name and contacts of two referees.

A confirmation message will be sent.

Evaluation and interview

The selection process will consist of two different selection steps:

1. CVs and record evaluation;
2. Interview.

After the CVs and record evaluation, only the admitted candidates will be contacted for the second selection step. Candidates will be interviewed by a committee that includes at least two BiD4BEST members. The interview to assert the skills, the motivation and the fluency in English, will take place at the host institution or, for those candidates not able to travel to Bologna, via Skype. After the interview, some of the applications could be rejected. The remaining candidates will be ranked according to both their records and the interview. The candidate at the highest rank position will be offered the position. **The process is expected to finish by May 31st, 2020.** If, for any reason, the selected candidate will decline the offer or will fail to comply with the requirements for enrolment in the position, the one following in the list will be chosen.

At the University of Bologna, we value diversity and equality. The University recognises that employees may wish to have working patterns that fit with their caring responsibilities or work-life balance. Due consideration will also be given to applicants who have had career breaks for reasons including maternity, paternity or adoption leave, disability or illness.

Rights and responsibilities of researchers participating in Marie Skłodowska-Curie Actions

The European Charter for Researchers is a set of general principles and requirements which specify the roles, responsibilities and entitlements of both researchers and the employers and/or funders of researchers. The aim of the Charter is to ensure that the nature of the relationship between researchers and employers or funders is conducive to successful performance in generating, transferring, sharing and disseminating knowledge and technological development and to the career development of the researchers.

It is obligatory for applicants to read and understand the detailed information regarding the rights and responsibilities of researchers engaged in a Marie Skłodowska-Curie Innovative Training Network. The European Charter for researchers can be accessed at:

<https://euraxess.ec.europa.eu/jobs/charter/code>

Employment contract and remuneration

The selected candidate will be appointed under a 36-months full-time employment contract with full social security and fiscal coverage, as foreseen by the Italian national legislation. The remuneration will be compliant with the rules of the H2020-MSCA-ITN-2019, as by the Marie Skłodowska-Curie Innovative Training Networks 2019, 'European Union Contribution and Applicable Rates'. The gross amount per year of the allowances includes the salary (40966 €), the mobility allowance (7200€) and a family allowance if eligible (6000€). These gross amounts include all compulsory deductions under national applicable legislation (taxes depend on the country of the host institution).

The contract includes fundings for all the travel expenses needed for the successful development of the PhD thesis (meetings, trainings, workshops, observations, collaborations, etc.).

Personal Data: any personal data will be processed in accordance with the General Data Protection Regulation 679/2016 EU (GDPR) on the Protection of Individuals.