ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI FISICA E ASTRONOMIA
Department of Physics and Astronomy - DIFA

Assegno di Ricerca

Title of the Project: ***The accretion properties of low luminosity Active Galactic Nuclei***

Supervisor: **Dr. Marcella Brusa (DIFA) -** marcella.brusa3@unibo.it

Outline of the Project:

LLAGN are powered by accretion onto black holes with masses typically between ~10^5 and 10^8 $M_\odot$ and exhibit relatively low accretion rates compared to QSOs. The accretion in LLAGN is thought to occur via a radiatively inefficient mode, where the gas is unable to efficiently radiate its thermal energy due to low densities and/or high magnetic fields. This results in lower radiative efficiency and a harder X-ray spectrum, which can be used to distinguish them. Another feature is that LLAGN lack or weak big-blue bump, associated with the blackbody radiation of the smaller orbits of a thin accretion disk (Ho 2008). The exact mechanism driving the accretion in LLAGN is still debated, with some models invoking a hot, advection-dominated flow (ADAF), while others propose a more standard geometrically thick, optically thin disk (CDAF). Understanding the nature of the accretion flow in LLAGN is crucial for elucidating their evolution and fuelling mechanisms, and for constraining the growth of supermassive black holes in the local universe.

The project is based on the exploitation of multifrequency data of a sample of Low-Luminosity AGN in the local universe (Lemmings sample, Baldi et al. 2018) and the main goal will be to **derive Eddington ratio distributions for AGN in the low-luminosities regime.**
The Post-Doctoral Research Associate (PDRA) will be **in charge of data collation, validation and analysis of multi-wavelength data** (from X-ray to radio wavelengths), relevant to provide a comprehensive characterisation of the accretion properties. He/she will **focus their analysis on HST data** (e.g. extracting forced photometry at the positions of radio counterparts and testing various apertures)**.** They will become a member of the Lemmings team and will be responsible of the **dissemination of the results** through publications in international (peer reviewed) Journals and presentations at International conferences, and of **submission of proposals** to obtain follow-up exposures with JWST for the most interesting targets.

The successful candidate will work at the Bologna Astrophysics campus, that includes DIFA, INAF-OAS, INAF-IRA and CTA. The research area provides a highly motivated and motivating astrophysical environment. In particular, the PDRA will collaborate with local (@DIFA, OAS, IRA) team members of the BiD4BEST (http://blackholewinds.inaf.it/index.php/team/) and Lemmings project and with other world-known experts in the area of AGN physics, AGN-galaxy coevolution.

Detailed work plan:

The radio, optical/UV and X-ray data will be used to:

1) **Radio and optical/UV:** to locate the central nucleus in each host galaxy by comparing the position of the peak radio emission to high resolution HST images. This will permit to retrieve the most reliable estimate of the nuclear emission free from contamination by host galaxy emission.
2) **X-ray and optical/UV:** to calculate the alpha_ox, explore the alpha_ox-L relation in the regime of LLAGN and compare it with the trends observed for luminous AGN (also as a function of the radio luminosity). This relation will be then introduced as prior in the SED fitting tool CIGALE to derive the bolometric luminosity of the AGN.
3) **Multi-frequency and catalogued data:** to estimate the Eddington ratios (Lbol/Ledd; where LEdd can be derived by the available BH masses for the sample) and construct the Eddington ratio distributions in the low-luminosities regime

In all these steps the candidate will have the opportunity to design and optimise the sample selection for the analysis, perform and optimise data analysis techniques to characterize the nuclear flux and spectral properties of the samples sources; and compare the results with theoretical model predictions.