ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DIPARTIMENTO DI FISICA E ASTRONOMIA
Department of Physics and Astronomy - DIFA

PhD project in ASTROPHYSICS

Title of the Project: ***Physical and chemical conditions for the formation of exoplanets and their atmospheres***

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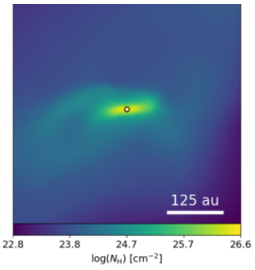
Co-Supervisors : A. Maury (ICREA, Barcelona, E), P. Hennebelle (CEA, Saclay, F)

Scientific Case: Exoplanetary systems show a vast variety of architectures, and the Solar System seems to be a rare occurrence. Nevertheless, the basic physical and chemical processes that shaped our own cosmic home appear to be common, but the devil is in the details: how diverse are initial conditions and how these depend on environment? The ERC ECOGAL project aims to answer this question comparing the results of well-controlled numerical experiments (simulations) with a wealth of new observational constraints from ALMA, NOEMA, the VLT and other major facilities. The international ECOGAL team has completed most of simulation production runs and the observational campaigns are well advanced and planned for 2025/2026. This PhD project aims at delivering the analysis of the observational data, combine with the outcome of the numerical simulations and deliver a solid statistical basis to the initial conditions that lead to the formation of planets and their atmospheres.



Disk forming inside a non ideal MHD simulation (Lebreuilly+2023)

Young disk-outflow system observed with ALMA and JWST (Cacciapuoti+2023)

Outline of the Project: The student will analyze high angular resolution ALMA/NOEMA observations of young forming protoplanetary disks in molecular line and continuum, with the aim of separating the disk emission from the forming environment and derive its physical parameters. The data analysis will be carried out by applying, and in some cases improving upon procedures developed in a series of previous studies of our group (Maury+2019, Cacciapuoti+2023, Frediani+2025). The bulk parameters of young protoplanetary disks will be compared with the same parameters extracted from numerical simulations of disk formation and population synthesis analysis of their subsequent evolution, also developed and analyzed by our group (Lebreuilly+2023, Tung+2024, Somigliana+2024). The final goal of this project will be to derive a solid statistical understanding of the initial conditions for protoplanetary disks and planet formation, based on a curated observational sample and supported by a theoretical understanding of the underlying physical processes.

The student will be part of the Bologna-based, ERC-funded *ECOGAL* project, and will work in collaboration with an international network of colleagues from Italy, France, Germany and Spain.

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