ECOGAL: observations as constraints for the theories of star and planet formation in galactic environments

Research Project – Piano di ricerca

The objective of the ERC Synergy project ECOGAL is to build a unifying predictive model of star and planet formation in the Milky Way. Based on a unique combination of theoretical modeling and multi-wavelengths observations, we will trace the properties of planet-forming disks back to their environment in different parts of the Galaxy, determine the physical processes that regulate the birth to stars and determine their key parameters, deliver a well calibrated galaxy template which can be used to study systems in the distant Universe. To reach these goals, ECOGAL combines four research groups (at CEA, University of Bologna, Heidelberg University and INAF, in partnership with ESO, CNRS, and Manchester University) to combine our unique expertise in observational astronomy, numerical astrophysics, instrument development, and astroinformatics, whose synergy will enable transformative progress in our understanding of our Galaxy.

Among the responsibilities of the Department of Physics and Astronomy of the University of Bologna (in short DIFA) within ECOGAL is the comparison of numerical models with observational data of young stellar objects with the goal of determining the chemical and physical properties of planet forming disks: the inheritance of these properties from the larger core scales and environment and how these are shaped by the interactions with forming planets. To this end, the DIFA group is involved with CEA in the NOEMA Large Programme ENYGMA (PIs. A. Maury and L. Testi) and in the development of the new ALMA Band 2 receivers. In collaboration with CEA we are also developing the techniques to postprocess numerical simulations to compare them meaningfully with ALMA and NOEMA observations, among others.

The postdocs will work as part of a team of researchers, postdocs and students on the postprocessing of numerical simulations and their comparison to observational data from NOEMA and ALMA or on the calibration, imaging and analysis of observational data from world leading observatories (NOEMA, ALMA, VLT, LBT, among others). The team will work on data to charaterise the properties of gas and dust in protostars and protoplanetary disks, the properties of the central star and its interaction with the disk, as well as the detection and characterization of forming planets in the disk. The goal will be to provide constraints to the numerical models being developed in other ECOGAL partners and understand how the outcome of the star and planet formation process is shaped by the different physical conditions across the Galaxy.

Description of activities - Piano delle attività

The postdocs will work at DIFA as part of a group of researchers, postdocs and students. The postdoc will work on one of the following projects, also supporting the mentoring of students:

- Postprocessing (using and possibly improving upon the existing ECOGAL pipelines) of numerical simulations from other ECOGAL nodes with the goal of performing a meaningful comparison with the NOEMA and ALMA data acquired by the partnership
- Acquire, analyse and compare with theoretical models submm data from ALMA and NOEMA with the goal of characterizing the properties of forming disks and their evolution as a function of the environment, in particular get involved with the NOEMA-ENYGMA Large Programme
- Acquire, analyse and compare with models infrared data from world leading facilities with the aim of characterizing disk-planet interaction and young planet properties
- Use and develop the disk population simulations code available in our group to compare with observations of disk populations.