Thesis subject

Laboratory : LAM

Thesis supervisor : Nathan Hara

Co-supervisor : TBD

Title of the thesis subject : Enhancing Radial Velocity Techniques for the Detection of Earth-like Exoplanets

Description of the thesis subject :
The discovery of Earth-like exoplanets (exo-Earths) is a pivotal milestone in the quest to understand the potential for life elsewhere in the Universe. By the 2040s, several advanced imaging instruments will target exoplanetary atmospheres, searching for biosignatures. The scientific impact of these instruments would be significantly enhanced if a prior catalog of nearby exo-Earths were available, which could, so far, be achieved using the radial velocity (RV) technique.
However, detecting exo-Earths using RV measurements remains extremely challenging. The weak signal of an exo-Earth is often buried in the stochastic variability caused by the stellar photosphere. Progress in this field requires the development of advanced models to mitigate stellar noise.
Building on recent discoveries of RVs of planets that are the closest to Earth in terms of separation and mass (PI N. Hara), this PhD project aims to design and implement novel data analysis techniques for radial velocity measurements that surpass the capabilities of existing methods (see [1]). Leveraging full stellar spectra and machine learning approaches, particularly unsupervised learning, the student will develop new techniques aiming to use all the information in the raw data.
Additionally, these methods will provide new insights into the physical processes on the surfaces of GKM-type stars, making them a valuable tool for stellar characterization (see [2]).

References:[1] Hara & Ford 2023, Annual Review of Statistics and Its Application, https://www.annualreviews.org/content/journals/10.1146/annurev-statistics-033021-012225[2] Hara & Delisle 2023, arXiv:2304.0848