

Title: Detecting Forming Exoplanets in Hyperspectral Data

More than 4500 exoplanets have been discovered as of now, most of them being formed billions of years ago. The recent direct imaging detection of planets still in the process of formation [1] opens an unprecedented observing window on the initial stages of planetary system assembly (tens of millions of years).

The discovery of forming exoplanets was made possible thanks to the advances of efficient adaptive optics systems coupled to medium-resolution integral field spectrographs (IFS), producing hyperspectral data at high spatial and spectral resolutions. The rich diversity of these data can be used for efficiently removing the bright stellar halo and isolating the sparse signal (line-emission) produced by the planets. The data processing methods implemented thus far remain simple and do not allow for a robust evaluation and rejection of false positives.

Several powerful and versatile methods (anomaly detection, match filters, etc) have been proposed for isolating scarce signals in hyperspectral data with various applications (remote sensing, ground-based astronomy, medical imaging, etc). The student will work on adapting these methods to detect forming exoplanets in hyper-spectral data collected on the MUSE instrument operating at the Very-Large Telescope (VLT, Chile). The work will rely on existing codes available in Python and developed by collaborators. The student will also evaluate the methods using standard approaches (ROC curves, etc).

This internship is introductive to a PhD thesis funded by the French National Research Agency (ANR). A separate call for candidates for the PhD position will be issued in the spring of 2022.

Refs: [1] Haffert et al. 2019, Nature Astronomy, 3, 749. <https://arxiv.org/pdf/1906.01486.pdf>

Duration: 3 to 5 months

Profile: We are looking for a Master Student (Second year master student or equivalent) with a background in Data Science and strong interest in astrophysics. The student should show a proficiency for solving complex problems rigorously and for dealing with data and algorithms. She/He should have excellent writing skills in English (French is a plus) and be able to present her/his work. Teamwork skill is essential.

Management team:

- *M. Bonnefoy (IPAG)
- *F. Chatelain (Gipsa-Lab)
- *P. Delorme (IPAG)

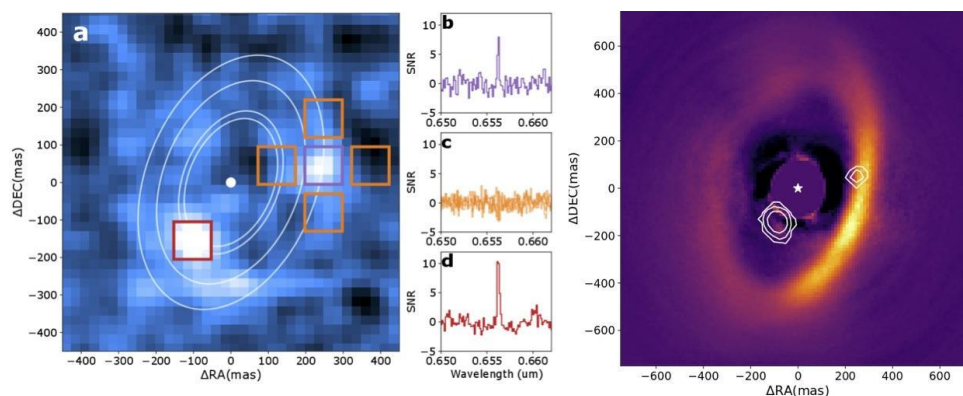


Figure 1: Detection of the sparse signals of two forming planets (red and violet squares on the left panel image) in hyperspectral data (VLT/MUSE; source: Haffert et al. 2019)