Doctoral School 352 Physics and Science of Matter

Thesis subject

Name of the laboratory: LAM

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Subject's title: Developing new image processing techniques for the detection of exoplanetary systems with ground-based high contrast imaging instruments

Subject description:
The detection and characterization of extrasolar systems with direct imaging offer several opportunities to understand their formation mechanisms. Imaging offers a complete view of their outskirts, including far-out giant gaseous planets and dusty planetesimal belts, and let us observe possible interactions between them. By collecting photons from these planets, we can study their atmospheres and bulk properties, and constrain their forming processes. However, the direct detection of these systems is a technical challenge due to their extreme contrast to their host stars. Imaging extrasolar systems requires an exquisite control of the starlight throughout our instruments to be able to cancel it at best as possible before it reaches the science camera. The images need then to be heavily processed to further subtract the residual starlight leaking through the instrument. These so-called post-processing techniques have been significantly improved over the recent years, but are still imperfect in particular when applied to ground-based telescope images. The goal of this thesis is to adapt modern processing techniques developed for Hubble's imagers to two ground-based telescope imagers (NACO and SPHERE), to study their performance for ground-based data, and develop new processing methods to improve their detection limits. These methods will use the large and diverse image archives of these instruments to optimize the starlight subtraction in the science data, techniques that enabled the first images of a dozen planetesimal belts in archival Hubble data in the recent years.

Bibliography:

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Choquet et al. 2017, ApJ, 834L, 12: First Scattered-light Images of the Gas-rich Debris Disk around 49 Ceti

Choquet et al. 2016, ApJ, 817L, 2: First Images of Debris Disks around TWA 7, TWA 25, HD 35650, and HD 377