Thesis subject

Name of the laboratory: Laboratoire d'Astrophysique de Marseille

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Co-advisors: Emmanuel Caux, IRAP, Toulouse ; Edward B. Jenkins, Princeton University

Subject's title: Gas constituents in the debris disks around hot main-sequence stars.

Subject description:
Debris disks around stars evolve from gas-rich protoplanetary disks, which ultimately lead to the formation of exoplanet systems. A vast number of millimeter, sub-millimeter and far-IR observations tell us much about the nature of solid and molecular constituents associated with such disks, but UV absorptions in the spectra of the central stars reveal the amounts, compositions, and excitations of the atomic gas that accompanies the dust and planetesimals, and these properties vary from one system to the next.

The thesis will address the nature of debris-disks around hot stars from the analysis of a sample of HST high-resolution UV spectra of late B- and early A-type stars that are known to have debris disks.
From the UV spectra one can measure gaseous element abundances, which can lead to insights on the origins of the orbiting material. Absorption features arising from atoms in excited fine-structure states and high excitation metastable levels reveal the rates of collisional excitations and optical pumping, which in turn allow us to determine the characteristic electron density, temperature, and distance of the gaseous disk from the star. One of such spectra (from the star 51 Oph) has been studied thoroughly by Cecile Gry and Edward B. Jenkins (article submitted in January 2020). Further investigation of a diverse collection of systems during the thesis will allow providing new insights on the fundamental mechanisms that create and modify the different properties of circumstellar gas.

The thesis will comprise an aspect of data-analysis with profile fitting of absorption lines in UV spectra from the STIS instrument on board of HST. The student will help optimizing a new profile-fitting program recently written in Python. Interpretation of the results through the development of physical models will be the subject of the more theoretical part of the thesis, which will be done in collaboration with Edward Jenkins of the Princeton University (NJ, USA).