Radiative transfer around hot massive stars for optical high-spectral-and-angular observations

Massive stars are key components of the Universe and understanding these extreme objects is crucial for all astronomical domains, from stellar physics to galactic evolution and the early Universe which they re-ionized. Through strong winds and supernovae, they inject kinetic and radiative energy, dust, and metals into the interstellar medium. Their final collapse is at the origin of neutron stars and black holes. Massive stars are fascinating objects, which call for a clear understanding of their birth, evolution, and death. But such an understanding requires a good physical description of their interior including rotation and pulsations, their observable atmosphere, and their often-complex circumstellar environment.

In the frame of the ANR project MASSIF (https://www.anr-massif.fr/), which aims at building synergies between specialists in optical interferometry, radiative transfer, and stellar interiors in the field of massive stars study, the Laboratoire Lagrange of the University Côte d'Azur (Nice, France) is offering a two years postdoc position in radiative transfer of environments of hot massive stars.

The aim is to develop radiative transfer models dedicated to the analysis of the huge amount of spectro-interferometric measurements that is being collected by our team on tens of massive stars with complex environments using the latest generation of interferometric instruments at ESO-VLTI and CHARA. The environments to be studied include radiative winds of main-sequence OB stars and hot supergiants (focusing on anisotropic wind due to fast-rotation), gaseous disks around classical Be stars, and complex dusty and gaseous environments of unclassified and supergiants B[e] stars.

The postdoc will work on developing the radiative transfer models for these objects, either using and modifying codes that are available to the community (such as for instance, RADMC3D, HDUST or CMFGEN…) or developing and using his own code, including experimental ideas on GPU-accelerated computing that are in gestation in our team. The outputs from the code, spectrally-resolved images from the visible to the mid-infrared, SEDs and, spectrum, will be used to infer the physical parameters of the stars and their circumstellar environments (mass-loss, density distribution, temperature, velocity fields…). This analysis will be performed by our team in Nice and the postdoc could also participate to the model-fitting work (using classical methods such as MCMC and/or IA-based modeling).

The postdoc will also work in collaboration with the MASSIF team in Toulouse working on modeling of stellar interiors and photosphere of massive rotating stars (ESTER code developed in Toulouse). In this frame, the work will focus on building a consistent model that links the central star and its environment. For instance, the ESTER code can provide the temperature, density, and velocity distribution from the interior up to the vicinity to the stellar surface that could be used as input to the radiative transfer model in the environment.

To perform these tasks we are looking for a motivated candidate with a PhD in astrophysics, and having a strong background in radiative transfer, numerical simulation and stellar physics. A background or interest in optical interferometry, high-angular resolution observations, AI-modeling techniques, or GPU-accelerated computing will certainly be a plus. Our proposal is based on a culture of inclusion and diversity and an environment that guarantees equal opportunities. We also strongly encourage applications from women.