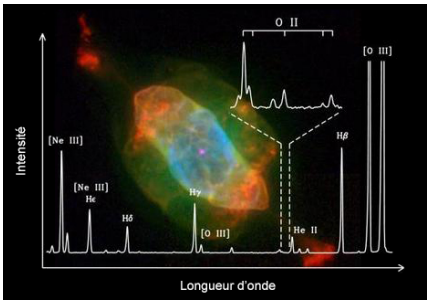
Stellar and Galactic Physics

Astrophysics of Gaseous and Dusty Nebulae



Ionized plasmas and dusty environments play an important role in many aspects of astrophysics. H II regions and planetary nebulae, ionized by hot stars, provide opportunities to measure chemical abundances and several physical quantities that are related to star formation, stellar evolution, and the chemical evolution of galaxies. In addition, dust formation can hamper the derivation of physical properties of such objects. The goal of this module is to describe the physics of circumstellar environments and associated spectral diagnostics, including ionization and thermal equilibria together with dust radiative transfer. Practical applications to circumstellar environments will be performed as well as an introduction to the DUSTY radiative transfer code. Projects involving high-resolution images of circumstellar environments (collected with ESO/VLT instruments) will also be proposed to the students.

Theory

by Patrick de Laverny

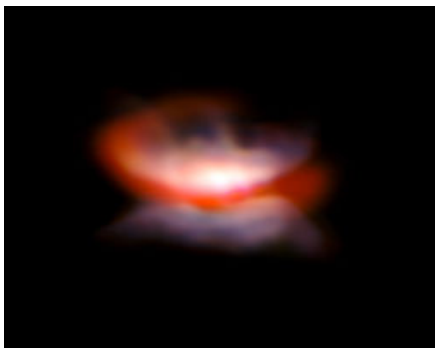
All stars form in the interstellar medium (ISM) and create in their core new chemical elements via nucleosynthesis during their life. These newly formed elements are then injected back to the ISM during the ultimate phases of stellar evolution. Understanding star formation and the final stages of their evolution is thus a key to understand the chemical enrichment of galaxies. During their ejection phases, these objects are surrounded by circumstellar material (ionized or neutral gas and dust). As all the informations we can obtain from these stars come from their emerging light, we need to study how photons interact with gas and dust.

This module aims at making the students familiar with the study of ionized and dusty circumstellar environments from both the theoretical and observational points of view.

The theoretical part will enable students to understand the different types of gaseous nebulae, to study the physics of gas ionisation by hot photons, to understand the formation of emission spectra for these objects and how we can determine physical properties and chemical abundances. The students will also become familiar with dust radiative transfer, to study the interaction of light with the circumstellar dust.

Applications

by Eric Lagadec



Once the students are familiar with theoretical concepts, they will get their hands on state of the art data and modeling codes. They will be taught how to analyse data taken with the Very Large Telescope (VLT) in Chile with instruments like VISIR and SPHERE. They will learn how to derive the morphological, physical and chemical properties of circumstellar environments. This will be done by using the dust radiative transfer code DUSTY and optical and infrared diffraction limited images using extreme adaptive optics. They will thus learn how to measure physical parameters of the circumstellar environment via modeling of the observations, thus directly applying the theoretical knowledge they acquired before.

See also

Astrophysics of Gaseous Nebulae, D.E. Osterbrock & G.J. Ferland

DUSTY radiative transfer code

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