UE Structure et évolution stellaires

Niveau d'étude
Bac +5

ECTS
3 crédits

Composante
UFR Physique, Ingénierie, Terre, Environnement, Mécanique (PhITEM)

Période de l'année
Automne (sept. à dec./janv.)

Diplômes intégrant cet élément

- Master Physique fondamentale et applications

Langue(s) d'enseignement: Français
Bi-langue: Partiellement en anglais
Ouvert aux étudiants en échange: Oui
Code d'export Apogée: PAX9STAB

Présentation

Description

In this Lecture, we wish to explore three fascinating subjects:
how stars form;
how stars evolve: explain the Hertzsprung-Russell diagram;
how stars end;

Because physics (and astrophysics too) relies on observations and theory, we will make constant reference to observational studies. In the process, students are expected to acquire a background on objects.

Stars are, for many reasons, absolutely fundamental objects for virtually all astrophysical topics. First, and foremost, because they allow to measure the universe, and also to constrain its geometry and its evolution: stars are essential to cosmology. The ESO/ Gaia mission is currently building the most extended and accurate HR diagram for billions of stars, providing new insights in our understanding of the evolution of the universe.

Informations non contractuelles.
Dernière mise à jour le 30 juin 2026

Because stars synthesize the heavy elements in the Universe, the first stars which formed presumably at a redshift of ~10-20 provided the Universe with the first metals giving birth to the Universe as we see it. Stellar feedback is also essential to understand the evolution of galaxies in the Universe. Furthermore, the rate of star formation is not a flat function of time: understanding star formation is thus a key to build a comprehensive view of the evolution of the Universe.

The observational context is extremely favorable: the increasing sensitivity of telescopes (ALMA, soon-coming NASA/JWST) allows observations of star formation and evolution at high redshift when the first galaxies formed in the Universe, widening considerably the scope of our knowledge on the structure and evolution of stars.

In this lecture, we will explore the physical processes that drive the formation, evolution, and death of stars. Although some of these processes will be investigated in quite some depth, approximations must be used because the many, coupled, physical processes would otherwise require involved numerical simulations. In a first part, we will establish the set of ordinary differential equations that describe the physical and chemical state of a star. We will then use these equations to elucidate the remarkable features of the Hertzsprung-Russell diagram.

The lectures are in french, but all slides, problems, articles, references, etc… are in English.

Heures d'enseignement

CMTD	Cours magistral - Travaux dirigés	22,5h

Pré-requis recommandés

Solid background in general physics (statistical physics, quantum mechanics, thermodynamics)

Syllabus

The Lecture is divided into three parts:
1. The formation of stars
2. Structures of stars on the main sequence and beyond
3. Introduction to compact objects (white dwarfs, neutron stars, black holes)

Période : Semestre 9

Infos pratiques

Campus

Grenoble - Domaine universitaire

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