IRFU : Institut de recherche sur les lois fondamentales de l'univers

Saclay

Modélisation des bandes aromatiques dans l'univers proches – Préparation au JWST

Spécialité Astrophysique

Niveau d'étude Bac+5

Formation Master 2

Unité d'accueil

Candidature avant le 07/05/2018

Durée 3 mois

Poursuite possible en thèse oui

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Résumé

Ce stage a pour objet la nature et les propriétés des grains interstellaires porteurs de l'émission des omniprésentes bandes aromatiques infrarouges. Cette étude se basera sur la modélisation physique de spectres infrarouges obtenus par plusieurs satellites.

Sujet détaillé

Les grains de poussière jouent un rôle majeur dans la physique du milieu interstellaire (MIS). Ils absorbent et réémettent en infrarouge (IR) l'essentiel de la puissance stellaire rayonnée dans les régions de formation d'étoiles. De plus, ils sont responsables du chauffage du gaz dans les régions de photodissociation (PDR) et servent de catalyseur à de nombreuses réactions chimiques. Leurs propriétés (composition chimique, distribution de taille, etc.) sont cependant encore mal connues. Ces incertitudes soumettent à caution de nombreux pans de notre connaissance du MIS : mesure de masse, modèles de PDR, dérougissement, etc. Raffiner notre compréhension de la poussière est aussi crucial pour comprendre le cycle du MIS et son effet sur l'évolution des galaxies.

Le stage que nous proposons se concentrera sur les propriétés des plus petits grains (rayon

Mots clés

Milieu interstellaire - évolution des galaxies

Compétences

Traitement de donne?es : visualisation, convolution, projection astrome?trique, propagation des erreurs, statistique de base. Mode?lisation : ajustement moindres-carre?s de mode?les non-line?aires, physique statistique, e?lectromagne?tisme.

Logiciels

DL ou Python ou Fortran.

Aromatic band modelling in the nearby universe - Preparation to JWST

Summary

This internship is aimed at studying the nature and properties of interstellar grains responsible for the emission of the ubiquitous infrared bands. This study will consist in the physical modelling of infrared spectra obtained with several satellites.

Full description

Dust grains play a major role in the physics of the interstellar medium (ISM). They absorb and reemit in the infrared (IR) most of the stellar power radiated in star forming regions. Moreover, they are responsible for the gas heating in photodissociation regions (PDR) and are catalysts of numerous chemical reactions. However, their properties (chemical composition, size distribution, etc.) are still widely unknown. These uncertainties make several aspects of our knowledge of the ISM uncertain : mass estimates, PDR models, unreddening, etc. Improving our knowledge of interstellar dust is also crucial to understand the lifecycle of ISM and its consequence on galaxy evolution.
The internship we are proposing will focus on the properties of the smallest grains (radius
These aromatic bands have been largely studied with the Spitzer satellite. However, these studies were limited by the spectral coverage (5-40 µm), not being able to draw constraints from the 3.3 µm feature. This band is essential to differentiate between the effects of heating, charge and size of the grains. Thanks to a France-Japan collaboration project, we have completed down to 3 µm the spectra of several nearby galaxies, with the Akari satellite. These spectra are an important key to unlock the degeneracies on the properties of these grains.
The first stage of this study will consist in selecting the spectra to study, and homogenizing them (degrading the spatial resolution, reprojecting, propagating the uncertainties, etc.), in order to produce spectral maps. The spatial variations of the band intensities will be extracted from these cubes with a spectral decomposition code, which we have developed. Finally, these results will be interpreted with our stochastic heating code. If the student has time, the gas properties will be modelled in more details with the photoionisation code Cloudy.

This project is particularly relevant for the preparation of the observations of the James Webb Space Telescope (JWST; 2019).

Keywords

Interstellar medium ; galaxy evolution.

Skills

Data processing : visualizing, convolution, astrometric projection, uncertainties propagation, basic statistics. Modelling: least- squares fit of non-linear models, statistical physics, electromagnetism.

Softwares

DL ou Python ou Fortran.