

Proposition de stage – Année 2020-2021

Niveau du stage :	L3 / M1
Durée du stage :	6 semaines

Responsable du stage :	Dr Mathew Smith / Dr Mickael Rigault
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Thématique : Astrophysics et cosmologie observationnelle
Intitulé du stage : The diversity of type Ia supernova in the local Universe from ZTF

Description du travail demandé :

Overview:

In the last decade, observations of distant cosmic explosions, type Ia supernova, have completely altered how we think of the Universe. By precisely measuring the distance to these cosmic light-bulbs, we have discovered that the expansion rate of the universe is accelerating, not slowly down as would naively be expected. Determining what causes this acceleration, "dark energy", is the key question in physics today.

However, our understanding of dark energy is now limited to figuring out the physics that causes these particular types of supernova, and whether they differ in brightness depending on the environments in which they explode. The Zwicky Transient Factory (ZTF), co-led by IP2P3 is specifically designed to solve this problem. As the world's largest transient astronomical sky survey, ZTF has accurately measured the distance and spectroscopic properties of over 1000 of these events and precisely determined the environment in which they explode. The next step is to link these measurements together. Over the course of this project, we will compare the environmental properties of these events to their spectral and photometric properties to determine whether these objects are different today compared to the distant past, and establish the optimal route to measure the size, content and eventual fate of the Universe.

Objectives:

The student will draw on existing expertise in the IP2i/USNAC/ZTF group to obtain multi-wavelength (UV, optical and near/far-IR) images of the galaxy in which each ZTF supernova has exploded. Measuring how the brightness of each host galaxy changes across the electro-magnetic spectrum and comparing these results to physical models, we will infer the mass, star-formation rate and dust content of galaxies that host type Ia supernova.

With measured distances and photometric properties of all ZTF supernova, we will study how the location in which a SN explodes affects its brightness and determine which SNe produce the best constraints on the expansion rate, content and eventual fate of the Universe.

Methods:

This project involves the collection and analysis of observational data from astronomical telescopes using the python programming language and associated scientific / machine-learning libraries. The student will draw on existing expertise in the IP2I/USNAC group: M. Rigault (PI:ZTF), M. Smith, Y. Copin and N. Nicolas (PhD) are experts in the study of type Ia supernovae, while Y-L Kim, M. Briday (PhD) and J. Lezmy (PhD) have developed tools to model galaxies from photometric data. This project will combine this expertise to analyse the ZTF sample. The training will be primarily conducted in English.

ZTF is a global collaboration. The student will have unique access to this project, sharing their results and insights with recognised world experts in the field of SN cosmology.