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

Saclay

DAp/LCS

Études en cosmologie avec les ondes gravitationnelles et l'agglomération des galaxies

Spécialité Astrophysique

Niveau d'étude Bac+5

Formation Master 2

Unité d'accueil DAp/LCS

Candidature avant le 28/02/2019

Durée 5 mois

Poursuite possible en thèse oui

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Résumé

The topic of this stage is the study of gravitational waves (GW) as "standard sirens" for cosmology. Galaxy clustering together with machine learning will be used to statistically infer the redshift of the unknown GW host galaxy for the majority of GW events without electromagnetic counterpart.

Sujet détaillé

Voir version anglaise.

Mots clés

Compétences

Logiciels

python, C, C++.

Cosmology with gravitational waves and galaxy clustering

Summary

Ce stage a comme but l'étude les ondes gravitationnelles (OG) comme des "sirènes standard" en cosmologie. L'agglomération des galaxies et l'apprentissage automatique sera utilisée à mesurer le décalage vers le rouge de la galaxie hôte de l'OG en absence de contrepartie electro-magnétique.

Full description

The recent direct detections of gravitational waves (GW) from mergers of massive compact objects has opened a new window to our Universe. The GW signal allows us to measure the luminosity distance to the merger, from which we can constrain the expansion history of the Universe, including the Hubble constant H_0 and dark-energy properties. However, most GW events are expected to have no detectable electro-magnetic counterpart. We thus have to employ statistical analyses to use these events in a cosmological context. The
spatial distribution of galaxies, or galaxy clustering, can help us to infer the redshift of a population of events in a statistical way.

Work to date has focused on spectroscopic galaxies. By extending this to galaxy surveys in broad-band photometry the number and limiting magnitude of available galaxies for clustering analysis can be vastly increased. The challenge in this approach is the determination of precise redshifts.

This project aims to estimate the impact of redshift estimation on the clustering analysis of GW events for cosmological parameter inference. Forecasts will be done for current ground-based data coming from LIGO/VIRGO\footnote{\url{https://www.ligo.org/}} for GW, and optical galaxy surveys such as CFIS (http://www.cfht.hawaii.edu/Science/CFIS), as well as for the future space mission LISA (https://lsst.org) and Euclid (https://www.euclid-ec.org).

The tasks and objectives of the internship are as follows.

1. Get familiar with the statistical analysis of GW events, and redshift estimation of photometric surveys.
2. Apply and compare different methods of redshift estimation that are developped in the CosmoStat group.
3. Estimate the impact of redshift errors on cosmological analysis of current and future data.

Keywords

Skills

During the stage, the student will work on various methods of galaxy redshift estimation. This includes photometric redshifts, clustering redshift, and machine learning techniques.

Softwares

python, C, C++.