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

Saclay

Recherche de contreparties d'ondes gravitationnelles avec H.E.S.S. et CTA

Spécialité Astrophysique

Niveau d'étude Bac+5

Formation Master 2

Unité d'accueil

Candidature avant le 30/06/2018

Durée 3 mois

Poursuite possible en thèse oui

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Résumé

Sujet détaillé

voir descriptif anglais

Mots clés

Compétences

Logiciels

C++ et/ou Python

Searching for Gravitational Wave counterparts with H.E.S.S. and CTA

Summary

The detection of gravitational waves from a NS-NS merger and the subsequent successful MWL campaign marks the beginning of multi-messenger astronomy. In this internship we'll improve the performance of the high-energy gamma-ray observatories H.E.S.S. and CTA in this new and exciting domain.

Full description

H.E.S.S. is a system of Imaging Atmospheric Cherenkov Telescopes that investigates cosmic gamma rays in the energy range from 10s of GeV to 10s of TeV. The name H.E.S.S. stands for High Energy Stereoscopic System, and is also intended to pay homage to Victor Hess , who received the Nobel Prize in Physics in 1936 for his discovery of cosmic radiation. H.E.S.S. is located in Namibia, near the Gamsberg mountain, an area well known for its excellent optical quality. The first of the four telescopes of Phase I of the H.E.S.S. project went into operation in Summer 2002. A much larger fifth telescope - H.E.S.S. II - is operational since July 2012, further improving sensitivity, extending the energy range and allowing for very rapid reactions to transient events. The H.E.S.S. observatory is operated by a collaboration of more than 170 scientists, from 32 scientific institutions and 12 different countries.

Since the first direct detections of Gravitational Waves in 2015, a new field of astrophysics and a new window to the universe is opening up: multi-messenger astrophysics. In this novel domain, we are combining information from various observatories across the electromagnetic spectrum with data obtained from gravitational wave observatories and high-energy neutrino telescopes. In August 2017, Virgo and Ligo detected the first gravitational waves emitted by the merger of a binary neutron star system. The subsequent detection of the same event across a large range of the electromagnetic spectrum is a major milestone in the field and produced a wealth of new information (and new questions) about these violent events. The H.E.S.S. collaboration is actively participating in these follow-up observations of Gravitational Waves and other exciting events. F. Schüssler, the tutor for the internship proposed here, leads the dedicated working group within the H.E.S.S. collaboration.

During the internship we will prepare the next data-taking period of the gravitational wave interferometers Virgo and Ligo, which will start in summer 2018. Based on the experience of the previous years, incl. the very successful follow-up of the binary neutron star event in August 2017, we will adapt and refine the strategy of H.E.S.S. follow-up observations of these exciting events. We will improve the existing algorithms that allow to select the most interesting GW events and then (fully automatically) determine an optimal pointing strategy of the H.E.S.S. telescopes that allows to cover the localization uncertainty provided by Virgo/Ligo as fast as possible. The improved methods will finally be implemented in the real-time alert system at the H.E.S.S. site in Namibia.

Keywords

gravitational waves, high-energy gamma rays, multi-messenger

Skills

data analysis + simulations

Softwares

C++ et/ou Python