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Extragalactic transient phenomena at very high energies with H.E.S.S. and preparations for the future



CTA observatory

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Title : Extragalactic transient phenomena at very high energies with H.E.S.S. and preparations for the future CTA observatory

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Team : Cosmic radiation and dark matter ; H.E.S.S. and CTA groups

Description :

Observations of the sky at high energies allow the study of non-thermal radiation processes at work in the vicinity of compact objects, such as active galactic nuclei (AGN), binary systems or supernova remnants. The emission brings information on the particle acceleration occurring on these objects up to energies unreachable to man-made accelerators on Earth. Recently, the study of the transient aspect of these cataclysmic events dramatically took off, thanks, for instance, to the search for electromagnetic counterparts associated with compact mergers detected through gravitational waves with LIGO/Virgo, or the search for coincident events with high energy neutrinos as detected with IceCube and high energy counterpart. One can also note the very recent detection, in 2019, of gamma-ray bursts at very high energies (VHE; $E > 100$ GeV), previously detected up to a few tens of GeV only.

H.E.S.S. (High Energy Stereoscopic System) is an international experiment contributing to such studies. Constituted of an array of five telescopes, located in Namibia, H.E.S.S. allows the exploration of the cosmos at very high energies, including observations of extragalactic transient events. Our group is very actively involved in this project, studying the diffuse emission at VHE, searching for signs of Lorentz invariance violation, or through the study of extragalactic sources. CTA (Cherenkov Telescope Array), a successor to such experiments, will be constituted of two arrays, one in each hemisphere, from 20 to 100 telescopes each. CTA will enable deeper studies of these sources at very high energies with respect to current experiments such as H.E.S.S., with a larger accessible energy range and a better sensitivity.

An active participation to the H.E.S.S. data analyses is expected, with specific interest in the analysis and interpretation of variable activity from AGN and gamma-ray bursts. Furthermore, one of the five H.E.S.S. cameras was upgraded end of 2019, and an implication into the characterization of the instrument response of this camera, associated with the rest of the array, is also expected. The understanding of the instrument makes use of Monte Carlo simulations - of air showers triggered by incoming gamma rays or cosmic rays in the upper atmosphere, and of the camera electronic response - which are under the responsibility of the PhD advisor within the H.E.S.S. collaboration. The PhD thesis will also probe for perspectives offered by the future CTA observatory for the characterization of the source temporal evolution (in terms of flux, energy spectra, ...), via simulations of observations of transient events and the development of such analysis tools.

Work location: LPNHE, Paris

Possible trips: Observation shift in Namibia, H.E.S.S. and CTA collaboration meetings, H.E.S.S. and CTA working group meetings, international conferences

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Documentations :

- <https://www.mpi-hd.mpg.de/hfm/HESS>
- <https://www.cta-observatory.org>