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Laboratoire : Laboratoire Leprince Ringuet
Groupe : HESS
Tuteur : Mathieu de Naurois
Address : Laboratoire Leprince-Ringuet, Ecole Polytechnique, 91128 PALAISEAU Cedex
Telephone : +33 1 69 33 55 97
e-mail : denauroi@in2p3.fr

Diffuse Very-High-Energy gamma-ray Emission in the LMC and in the Milky Way with HESS

Summary:

Diffuse emission is the most prominent observational signature from the sky at Gigaelectronvolt (GeV) energies. Galactic diffuse emission was established before individual gamma-ray sources started to emerge and is thought to be a prime source of knowledge about cosmic-ray particle interactions and radiation processes ever since. Diffuse GeV gamma-ray emission still constitutes the systematic limit of source detection near instrumental threshold. In contrast to the GeV domain the search for diffuse emission at Teraelectronvolt (TeV) energies is still in its infancy, largely due to the predominant charged particle background that is a principal instrumental challenge of the atmospheric Cherenkov technique. Diffuse emission is expected in the VHE domain, too: on Galactic scale primarily from hadronic particle interactions with interstellar gas and Inverse Compton scattering of high energy electrons with interstellar radiation fields, but also when encountering intense radiation fields or dense molecular clouds in the local vicinity of cosmic accelerators. Both processes are indicative for particle escape from their acceleration regions and for their propagation through their Galaxy.

The proposed project aims at establishing the existence, spatial and spectral signature of diffuse emission at TeV energies, both on the Large Magellanic Could (LMC) and on the Milky Way. H.E.S.S. observations are to be compared with predictions from a model of diffuse VHE emission that is currently being developed. On the instrumental side, the investigation will push the limits of atmospheric Cherenkov imaging in sensitivity and energy through the development of more effective background subtraction methods. Advanced modelling of the isotropic charged particle background and development of a likelihood-based analysis technique is proposed, the latter being a novelty for investigating VHE data.

In the first stage, data already acquired on the LMC will be used to test the background subtraction techniques: the size of the LMC (~10° degrees across, larger than the field of view but still small compared to the galactic plane) make it perfectly suitable to the development of novel background subtraction techniques. Due to high radiation fields and high density of cosmic rays and interstellar medium, the diffuse emission in the LMC is also expected to be comparatively easier to establish than that of the Milky Way. In a second stage, the ~3000 hours of data acquired on the Galactic Plane will be used to investigate the Galactic Diffuse Emission at TeV energies.

Detection and characterization of diffuse emission in the LMC and in the Milky Way would allow an indirect measurement of the Cosmic Rays density and energy distribution in the Galaxy, thus improving the global picture of production and propagation of Cosmic Rays.

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