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A 3D likelihood based approach for extended VHE source extraction

Ground based Imaging Atmospheric Cherenkov Telescopes have proven to be very powerful in detecting very high energy gamma-ray source (>100 GeV). Nevertheless, their limited field-of-view (~2 degrees in radius) makes the detection of large emission, as for pulsar halos, quite challenging. This is due to the presence of a strong residual hadronic background which is usually statistically removed using source free region in the FoV.

A 3D likelihood minimisation using field-of-view background models, eg: as implemented in gammapy and ctools, could overcome this limitation and yield significant improvement in the sensitivity of IACT to large scale emission. The efficacy of FoV background models in detecting extended sources in the galactic plane has been demonstrated by Jardin-Blicq et al, 2019.
In this contribution, we use the instrument response functions from the H.E.S.S. public data release to characterise the efficiency of 3D likelihood technique to detect pulsar halos. We also show the implementation of an energy dependent morphological model, which would be expected with advection or diffusion loss driven scenario in pulsar winds, and simulate what would be seen with the current generation IACTs.

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