

# PeVatron metrics with gammapy

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## Abstract

Criteria for detecting Galactic accelerators at PeV energies can be applied to the Cherenkov Telescope Array (CTA) simulated instrumental response, in order to assess its ability to find and characterize these elusive sources. The outputs of this kind of studies are called the PeVatron metrics. Following the example of [1], we computed PeVatron metrics for CTA, assuming an observation livetime of 10 *h*. This means: (i) simulating the  $\gamma$ -ray emission from sources characterized by very hard spectra with cutoffs at different energies, (ii) convolving it with a given production of simulated CTA IRFs and then (ii) fitting the data both with simple powerlaws (PL) and exponential-cutoff powerlaw spectra (ECPL). The comparison between the fit statistics in the two cases (TS) allows to determine whether the cutoff can be detected or not, under the given assumptions. As a first step, we reproduced the results of [1] using gammapy ([2]), thus providing a crosscheck to the ctools study and also validating our analysis pipeline. Then, we introduced new features that go beyond the reference study: for the first time, we computed the metrics using 3D (space + energy) analysis, instead of standard 1D aperture photometry. Furthermore, we introduced realistic hadronic models using naima ([3]-[4]): we simulated and fitted  $\gamma$ -ray models depending directly on the spectral shape of the parent population of CR protons. This way, we built the metrics in the proton's parameter space, i.e. directly in the space of interest for PeVatron searches.

## References

- [1] E. O. Anguner, F. Cassola, H. Costantinia, C. Trichard and G. Verna for the CTA Consortium, *Cherenkov Telescope Array potential in the search for Galactic PeVatrons*, PoS(ICRC2019)618.
- [2] <https://gammapy.org/>
- [3] <https://naima.readthedocs.io/en/latest/>

- [4] E. Kafexhiu, F. Aharonian, A.M. Taylor, G.S. Vila, *Parametrization of gamma-ray production cross sections for p-p interactions in a broad proton energy range from the kinematic threshold to PeV energies*, 2014, Physical Review D, 90, 123014

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