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Towards searching for photons with energies beyond the PeV range from galactic PeVatrons

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Several gamma-ray observatories have discovered photons of cosmic origin with energies in the PeV (10^{15} eV) range. Photons at these energies might be produced as by-products from particle acceleration in so-called PeVatrons, which are widely assumed to be the sources of a large part of galactic cosmic rays. Based on recent measurements of these PeV γ -sources by LHAASO and HAWC, we extrapolate the energy spectra up to the ultra-high-energy (UHE, here ≥ 10 PeV) regime. The goal of this study is to evaluate if giant air-shower observatories, for example the Pierre Auger Observatory, could contribute to test the UHE luminosity of PeV γ -sources. Possible propagation effects are investigated as well as the required discrimination power to distinguish photon- and hadron-initiated air showers. For present detector setups, it turns out to be challenging to achieve the required sensitivity due the energy threshold being too high or the detection area too small. Dedicated detector concepts appear to be needed to explore the UHE frontier of PeV γ -sources. Ultimately, this could provide complementary information on the sources of cosmic rays beyond the PeV regime – a key objective of current efforts in multimessenger astronomy.

Summary

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