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Gamma ray signatures of ultrahigh energy cosmic ray sources in magnetized environments

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The quest for sources of ultrahigh energy cosmic rays has long been associated with the search of their secondary gamma ray signatures. While propagating, the former indeed produce very high energy photons through the interactions with particles of the intergalactic medium, or by synchrotron emission in the presence of substantial magnetic fields.

We examine the prospects for the detectability of gamma ray counterparts of ultrahigh energy cosmic ray sources in a general case, exploring a wide range of astrophysical parameters. We demonstrate the fair robustness of the gamma ray flux according to these parameters and that its normalization ultimately depends on the energy injected in the primary cosmic rays. We show that only very powerful and rare sources could be detectable with the current and upcoming instruments. We further demonstrate that if the extended emission of this signature is resolved (which should be the case with Fermi and CTA), such a detection should provide a distinctive proof of the propagation of ultrahigh energy cosmic rays. Finally, we also briefly discuss the detection of nearby sources, considering the radiogalaxy Cen A as a prototypical example.

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