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Cherenkov Telescope Array Sensitivity to the Putative Millisecond Pulsar Population responsible for the Galactic Center Excess

Summary

The leading explanation of the Fermi Galactic center gamma-ray excess is the extended emission from a unresolved population of millisecond pulsars (MSPs) in the Galactic bulge. Such a population would, along with the prompt \gammaγ rays, also inject large quantities of electrons/positrons (e+e-)into the interstellar medium. These e+e- could potentially inverse-Compton (IC) scatter ambient photons into gamma rays that fall within the sensitivity range of the upcoming Cherenkov Telescope Array (CTA). In this article, we examine the detection potential of CTA to this signature by making a realistic estimation of the systematic uncertainties on the Galactic diffuse emission model at TeV-scale gamma-ray energies. We forecast that, in the event that e+e- injection spectra are harder than Eˆ{-2}, CTA has the potential to robustly discover the IC signature of a putative Galactic bulge MSP population sufficient to explain the GCE for e+e- injection efficiencies in the range approximately 2.9% to 74.1%, or higher, depending on the level of mismodeling of the Galactic diffuse emission components. On the other hand, for spectra softer than Eˆ{-2.5}, a reliable CTA detection would require an unphysically large e+e- injection efficiency of ⊠158%. However, even this pessimistic conclusion may be avoided in the plausible event that MSP observational and/or modeling uncertainties can be reduced. We further find that, in the event that an IC signal were detected, CTA can successfully discriminate between an MSP and a dark matter origin for the radiating e+e-.

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