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Gamma-ray Limits on Neutrino Lines from Dark Matter Annihilation

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Monochromatic neutrinos from dark matter annihilations ($\chi\chi \rightarrow vv^-$) are always produced in association with a model-independent gamma-ray spectrum generated by electroweak bremsstrahlung. Consequently, these neutrino lines can be searched for not only with neutrino detectors but also indirectly with gamma-ray telescopes. Here, we derive limits on the dark matter annihilation cross section into neutrinos based on recent Fermi-LAT and HESS data. We find that, for dark matter masses above 200 GeV, gamma-ray data actually set the most stringent constraints on neutrino lines from dark matter annihilation and, therefore, the model-independent upper bound on the dark matter total annihilation cross section. In addition, we point out that gamma-ray telescopes, unlike neutrino detectors, have the potential to distinguish the flavor of the final state neutrino. Our results indicate that we have already entered into a new era where gamma-ray telescopes are more sensitive than neutrino detectors to neutrino lines from dark matter annihilation.

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