Implications of the Fermi-LAT Pass 8 Galactic Center excess on supersymmetric dark matter

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Abstract

The Fermi Collaboration has recently updated their analysis of gamma rays from the center of the Galaxy. They reconfirm the presence of an unexplained emission feature which is most prominent in the region of 1–10 GeV, known as the Galactic Center GeV excess (GCE). Although the GCE is now firmly detected, an interpretation of this emission as a signal of self-annihilating dark matter (DM) particles is not unambiguously possible due to systematic effects in the gamma-ray modeling estimated in the Galactic Plane. In this paper we build a covariance matrix, collecting different systematic uncertainties investigated in the Fermi Collaboration's paper that affect the GCE spectrum. We show that models where part of the GCE is due to annihilating DM is still consistent with the new data. We also re-evaluate the parameter space regions of the minimal supersymmetric Standard Model (MSSM) that can contribute dominantly to the GCE via neutralino DM annihilation. All recent constraints from DM direct detection experiments such as PICO, LUX, PandaX and Xenon1T, limits on the annihilation cross section from dwarf spheroidal galaxies and the Large Hadron Collider limits are considered in this analysis. Due to a slight shift in the energy spectrum of the GC excess with respect to the previous Fermi analysis, and the recent limits from direct detection experiments, we find a slightly shifted parameter region of the MSSM, compared to our previous analysis, that is consistent with the GCE. Neutralinos with a mass between 85–220 GeV can describe the excess via annihilation into a pair of W-bosons or top quarks. Remarkably, there are models with low fine-tuning among the regions that we have found. The complete set of solutions will be probed by upcoming direct detection experiments and with dedicated searches in the upcoming data of the Large Hadron Collider..