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Evidence Against a Dark Matter Explanation of the Galactic Center Excess

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An anomalous, apparently diffuse, gamma-ray signal not readily attributable to known Galactic sources has been found in Fermi space telescope data covering the central ~ 10 degrees of the Galaxy. This “Galactic Center Gamma-Ray Excess” (GCE) signal has a spectral peak at ~ 2 GeV and reaches its maximum intensity at the Galactic Centre (GC) from where it falls off as a radial power law $\sim r^{-2.4}$. Given its morphological and spectral characteristics, the GCE is ascribable to self-annihilation of dark matter particles governed by an Navarro-Frenk-White-like density profile. However, it could also be composed of many dim, unresolved point sources for which millisecond pulsars (MSPs) or pulsars would be natural candidates given their GeV-peaked spectra. Statistical evidence that many sub-threshold point sources contribute up to 100% of the GCE signal has recently been claimed. We have developed a novel analysis that exploits hydrodynamical modelling to better register the position of gamma-ray emitting gas in the Inner Galaxy. Our improved analysis reveals that the excess gamma-rays are spatially correlated with both the X-shaped stellar over-density in the Galactic bulge and the nuclear stellar bulge. Given these correlations, we argue that the excess is not a dark matter phenomenon but rather associated with the stellar population of the X-shaped bulge and the nuclear bulge.

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