

Amplified J-factors in the Galactic Center for velocity-dependent darkmatter annihilation in FIRE simulations

Wednesday 29 March 2023 19:03 (1 minute)

We use FIRE-2 zoom cosmological simulations of Milky Way size galaxy halos to calculate astrophysical J-factors for dark matter annihilation and indirect detection studies. In addition to velocity-independent (s-wave) annihilation cross sections σv , we also calculate effective J-factors for velocity-dependent models, where the annihilation cross section is either either p-wave ($\propto v^2/c^2$) or d-wave ($\propto v^4/c^4$). We use 12 pairs of simulations, each run with dark-matter-only (DMO) physics and FIRE-2 physics. We observe FIRE runs produce central dark matter velocity dispersions that are systematically larger than in DMO runs by factors of ~ 2.5 – 4 . They also have a larger range of central (~ 400 pc) dark matter densities than the DMO runs ($\rho_{\text{FIRE}}/\rho_{\text{DMO}} \sim 0.5$ – 3) owing to the competing effects of baryonic contraction and feedback. At 3 degrees from the Galactic Center, FIRE J-factors are 5–50 (p-wave) and 15–500 (d-wave) times higher than in the DMO runs. The change in s-wave signal at 3 degrees is more modest and can be higher or lower (~ 0.3 – 6), though the shape of the emission profile is flatter (less peaked towards the Galactic Center) and more circular on the sky in FIRE runs. Our results for s-wave are broadly consistent with the range of assumptions in most indirect detection studies. We observe p-wave J-factors that are significantly enhanced compared to most past estimates. We find that thermal models with p-wave annihilation may be within range of detection in the near future.

Primary author: MCKEOWN, Daniel (University of California-Irvine)

Presenter: MCKEOWN, Daniel (University of California-Irvine)

Session Classification: Reception and Poster Session in the same room

Track Classification: Indirect dark matter detection