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The Distribution and Annihilation of Dark Matter Around Black Holes JEREMY SCHNITTMAN, NASA Goddard — We consider a simple model for dark matter self-annihilation where the cross section depends on energy, analogous to many standard model particle interactions. Since the only known way to accelerate dark matter is through gravitational forces, we focus on the collisions of particles orbiting around black holes. To do so, we use a Monte Carlo code to integrate the geodesic orbits of test particles around Kerr black holes, generating a distribution function of both bound and unbound populations of dark matter particles. From this distribution function, we calculate annihilation rates and observable gamma-ray spectra. We find that for rapidly spinning black holes, the collisional Penrose process can reach efficiencies of >600%, leading to a high-energy tail in the annihilation spectrum. Furthermore, the high particle densities and large proper volume of the region immediately surrounding the horizon ensures that the observed flux from these extreme events is non-negligable.

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