

Shadow of rotating black hole surrounded by dark matter

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Dark matter (DM), a fundamental cosmic component, motivates the study of its influence on black hole (BH) shadows, especially for spinning BHs confirmed by EHT observations. This work generalizes the Schwarzschild BH surrounded by DM to an axisymmetric Kerr BH using the Newman–Janis Algorithm (NJA), investigating the resulting event horizon and ergosphere structures. Employing null geodesics, we examine the effects of DM mass (ΔM) on BH shadow, including its radius, distortion, and the associated energy emission rate. Our analysis reveals that DM has a negligible effect below a critical mass, once this threshold is surpassed, all BH structures expand significantly. Furthermore, DM robustly contributes to the shadow maintaining a near circular shape, even for highly spinning BHs. This pronounced structural expansion under high DM mass may potentially exceed current observational constraints, suggesting that DM must either be absent in the immediate vicinity of the BH or its localized mass must remain below this critical value to be consistent with astrophysical observations.

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