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Multi-Wavelength Probing of Primordial Black Holes as Dark Matter

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Primordial black holes (PBHs) continue to be promising candidates for dark matter across several mass windows, providing opportunities for investigation through diverse electromagnetic observations. Spanning from radio to ultra-high gamma-ray frequencies, PBHs can generate detectable signals by integrating semiclassical phenomena—specifically, their Hawking evaporation and the their final bursts—with recently proposed quantum effects, such as "memory burden."

The mass range of PBHs as potential dark matter candidates spans from 10^4 grams to asteroid-scale masses. To constrain their properties, we employ data from the cosmic X-ray background (CXB), gamma-ray observations, and galactic source samples to delineate the parameter space. Moreover, our analysis uncovers previously neglected radiation processes across the pertinent energy spectrum, which could significantly tighten the constraints on PBHs. These processes encompass direct emissions from Hawking radiation, in-flight annihilation, the final state of radiation, and positronium annihilation.

We have established stringent constraints on PBHs within their plausible dark matter mass range and projected their detection limits through simulations of future experimental sensitivities.

Collaboration you are representing

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