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Tracers of Primordial Black Holes through Dark Matter and Neutrino Interactions

We investigate the astrophysical and cosmological tracers of the Primordial Black Hole (PBH) through neutrino and 21-cm signal observations. We consider two mechanisms for neutrino production from PBH. An intermediate dark matter process, in which the PBH evaporates into superheavy dark matter in the early universe through Hawking Radiation. These dark matter particles resist the energy depleting interactions before decaying into high-energy neutrinos at late time. We compare the neutrino flux coming from this metastable dark matter mechanism with the high-energy neutrino observatories like KM3NeT and IceCube. The second neutrino production mechanism is through the direct evaporation of PBH into neutrinos. We study the neutrino interaction of these PBH induced neutrinos with Cosmic Neutrino Background ($\bar{\nu}_B$) producing secondary photons, heating the Intergalactic gas, thereby changing the global 21-cm brightness temperature of the universe from the standard cosmological processes near redshift of $z \sim 17$. From the new absorption feature, we constrain the PBH fraction relative to the mass of the PBH. Overall, our study motivates the observation of multi-messenger signatures like neutrinos as well as 21-cm radio photons to probe the exotic phenomenon in the universe.

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