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Breaking into the window of primordial black hole dark matter with x-ray microlensing

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Primordial black holes (PBHs) in the mass range $10^{-16} - 10^{-11}\ M_\odot$ may constitute all the dark matter.
We show that gravitational microlensing of bright x-ray pulsars provide the most robust and immediately implementable opportunity to uncover PBH dark matter in this mass window.
As proofs of concept, we show that the currently operational NICER telescope can probe this window near $10^{-14}\ M_\odot$ with just two months of exposure on the x-ray pulsar SMC-X1, and that the forthcoming STROBE-X telescope can probe complementary regions in only a few weeks.
These times are much shorter than the year-long exposures obtained by NICER on some individual sources.
We take into account the effects of wave optics and the finite extent of the source, which become important for these subatomic size PBHs.
We also provide a spectral diagnostic to distinguish microlensing from transient background events and to broadly mark the PBH mass if true microlensing events are observed.
In light of the powerful science case, i.e., the imminent discovery of dark matter searchable over multiple decades of PBH masses with achievable exposures, we strongly urge the commission of a dedicated large broadband telescope for x-ray microlensing.
We derive the microlensing reach of such a telescope by assuming sensitivities of detector components of proposed missions, and find that with hard x-ray pulsar sources PBH masses down to a few $10^{-17}\ M_\odot$ can be probed.

Track type

Dark Matter

Author: Mr TAMTA, Manish (IISc Bangalore)

Co-authors: Prof. RAJ, Nirmal (IISc Bangalore); Prof. SHARMA, Prateek (IISc Bangalore)

Presenter: Mr TAMTA, Manish (IISc Bangalore)

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