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Boosted sub-GeV Dark Matter from Primordial Black Holes in DarkSide-50

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The direct detection of sub-GeV dark matter interacting with nucleons is hampered by the low recoil energies induced by scatterings in the detectors. This experimental difficulty is avoided in the scenario of boosted dark matter where a component of dark matter particles is endowed with large kinetic energies. By focusing on the concept of boosted dark matter, wherein a subset of dark matter particles possesses significant kinetic energies, we identify the current evaporation of primordial black holes, ranging in mass from 10^{14} to 10^{16} grams, as a potential source of such particles with energies ranging from tens to hundreds of MeV. Specifically, we investigate the implications of this phenomenon on the DarkSide-50 experiment, demonstrating that relativistic dark matter particles originating from primordial black holes could yield signals orders of magnitude larger than existing upper bounds. Consequently, we propose that this avenue enables the constraint of the combined parameter space encompassing primordial black holes and sub-GeV dark matter. Additionally, we provide preliminary forecasts on the potential impact of these findings on the upcoming DarkSide-20k experiment.

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