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## PAPER

# Gravitationally produced dark matter and primordial black holes

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Abstract

We examine how the existence of a population of primordial black holes (PBHs) influences cosmological gravitational particle production (CGPP) for spin-0 and spin-1 particles. In addition to the known effects of particle production and entropy dilution resulting from PBH evaporation, we find that the generation of dark matter (DM) through CGPP is profoundly influenced by a possible era of PBH matter domination. This early matter dominated era results in an enhancement of the particle spectrum from CGPP. Specifically, it amplifies the peak comoving momentum  $k_*$  for spin-1 DM, while enhancing the plateau of the spectrum for minimally coupled spin-0 particles for low comoving momenta. At the same time, the large entropy dilution may partially or completely compensate for the increase of the spectrum and strongly mitigates the DM abundance produced by CGPP. Our results show that, in the computation of the final abundance, CGPP and PBH evaporation cannot be disentangled, but the parameters of both sectors must be considered together to obtain the final result. Furthermore, we explore the potential formation of PBHs from density fluctuations arising from CGPP and the associated challenges in such a scenario.

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