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Cogenesis of Baryon asymmetry and gravitational dark matter from primordial black holes

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We propose a scenario where dark matter (DM) with a wide mass range from a few keV to PeV can be produced solely from evaporating primordial black holes (PBH), while being consistent with the required free streaming length for structure formation. If DM does not have any other interactions apart from gravity and the universe has a PBH dominated phase at early epoch, then PBH evaporation typically leads to overproduction of DM in this mass range. By incorporating this gravitational DM within a Type-I seesaw scenario with three right handed neutrinos (RHN), we bring the abundance of PBH generated DM within observed limits by late entropy injection due to decay of one of the RHNs, acting as the diluter. The diluter, due to its feeble coupling with the bath particles, gets produced primarily from the PBH evaporation thereby leading to the second stage of early matter domination after the end of PBH dominated era. The other two RHNs contribute to the origin of light neutrino mass and also lead to the observed baryon asymmetry via leptogenesis with contributions from both thermally and PBH generated RHNs. The criteria of DM relic and baryon asymmetry can be satisfied simultaneously if DM mass gets restricted to a ballpark in the MeV-GeV regime with the requirement of resonant leptogenesis for heavier DM mass in order to survive the large entropy dilution at late epochs.

Primary authors: BARMAN, Basabendu; Dr BORAH, Debasish (Indian Institute of Technology Guwahati); JYOTI DAS, Suruj (Indian Institute of Technology Guwahati); ROSHAN, Rishav (Indian Institute of Technology Guwahati)

Presenter: JYOTI DAS, Suruj (Indian Institute of Technology Guwahati)

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