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Cogenesis of baryon and dark matter with PBH and QCD axion

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We study the role of an ultra-light primordial black hole (PBH) dominated phase on the generation of baryon asymmetry of the Universe (BAU) and dark matter (DM) in a type-I seesaw framework augmented by Peccei-Quinn (PQ) symmetry which solves the strong CP problem. While the BAU is generated via leptogenesis from the decay of heavy right-handed neutrino (RHN) at the seesaw scale dictated by the PQ scale, DM can arise either from QCD axion or one of the RHNs depending upon the PQ scale. The ultra-light PBH not only affects the axion DM production via misalignment mechanism, but can also produce superheavy RHN DM via evaporation. Depending upon the PBH parameters and relative abundance of axion DM, axion mass can vary over a wide range from sub-μeV to sub-eV keeping the detection prospects promising across a wide range of experiments. While hot axions produced from PBH evaporation can lead to observable $\Delta N_{\rm eff}$ to be probed at future cosmic microwave background (CMB) experiments, stochastic gravitational waves (GW) produced from PBH density fluctuations can be observed at future detectors like CE, DECIGO, LISA and even future runs of LIGO-VIRGO.

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