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Formation of primordial black hole clusters in early dark matter halos

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The Poisson fluctuations in the primordial black holes (PBHs) number density lead to the formation of more massive dark matter (DM) halos at high redshifts, compared to the predictions of standard cold dark matter cosmology. In particular, this work considers the case where the fraction of dark matter $f_{PBH} = 0.1$ is presented in the form of PBHs with mass $m = 10 M_{\odot}$ and it is shown that halos of mass $M_h \sim 10^5 M_{\odot}$ are actively formed at a redshift $z \sim 20$. The further evolution of such a halo is of great interest: PBHs actively interact both with each other and with DM particles in such a halo, as a result of which density of PBHs at the centers of such structures significantly increases, that eventually leads to the formation of a dense cluster of PBHs. The potential effect of these dynamic effects on the black holes merger rate and the abundance of such clusters in the modern era is also discussed.

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