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Spins of primordial black holes formed in the radiation-dominated phase of the universe: first-order effect

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The standard deviation of the initial values of the nondimensional Kerr parameter a* of primordial black holes (PBHs) formed in the radiation-dominated phase of the universe is estimated to the first order of perturbation for the narrow power spectrum. Evaluating the angular momentum at turn around based on linearly extrapolated transfer functions and peak theory, we obtain the expression. This implies that for M⊠MH, where MH is the horizon mass at the horizon entry, the higher the probability of the PBH formation, the larger the standard deviation of the spins, while PBHs of M≪MH formed through near-critical collapse may have larger spins than those of M⊠MH. In comparison to the previous estimate, the new estimate has the explicit dependence on the ratio M/MH and no direct dependence on the current dark matter density. On the other hand, it suggests that the first-order effect can be numerically comparable to the second-order one.

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