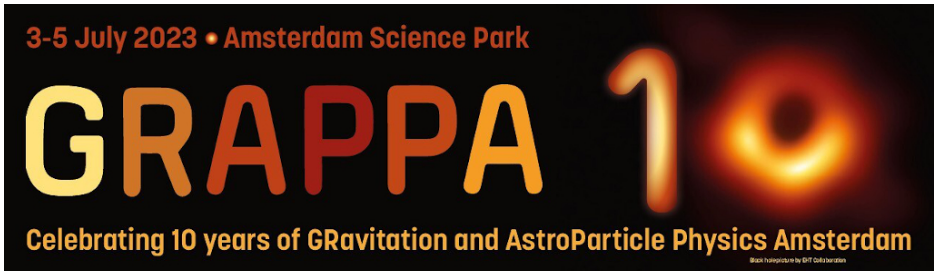

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Spinning primordial black holes in a matter dominated universe

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Interest in primordial black holes (PBHs) has spiked since the first detection of gravitational waves, and a few mass windows remain in which PBHs may still make up an appreciable part of dark matter. In a matter dominated universe, e.g. in the case of a first-order QCD phase transition, PBH production is enhanced and PBHs may have large dimensionless spins. We investigate the re-entry and collapse of superhorizon perturbations with initial dimensionless spins of $\chi_0^\xi \sim 0.1$ in this setting using full 3+1D numerical relativity simulations. We find that PBHs are formed with dimensionless spins $\chi_{\rm PBH}$ smaller than but the same order of magnitude as χ_0^ξ and argue this suggests no PBHs with $\chi_{\rm PBH} > 0.5$ are produced. Furthermore, we find that the addition of angular momentum only has a minor effect on the PBH mass and accretion rate. Additionally, we discuss apparent black hole horizons and cosmological horizons in the context of numerical relativity simulations of expanding spacetimes.

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