

Primordial Black Hole catalyze the First-Order Electroweak Phase Transition and its Parameter Space

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We discuss the catalysis of the primordial black holes (PBH) on the first-order electroweak phase transition (FOEWPT). We accurately studied the nucleation rate for bubbles around the PBH by solving the Einstein and bounce equations rather than applying the thin-wall approximation. We found the ordinary thin-wall approximation will overestimate the nucleation rate. For the first time, we showed how the PBH altered the parameters space of new physics. We use the concrete model: the triplet extension of the standard model (Σ SM) to demonstrate this effect and found the PBH with suitable mass $M_{PBH} < 10^{11}g$ will nearly double the viable parameter space for the two-step FOEWPT in Σ SM. Those PBHs will also induce a supercooling FOEWPT in the new extended parameter regions and generate an observable stochastic gravitational wave signal without changing the observational signal for ordinary parameters space.

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