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How large are curvature perturbations from slow first-order phase transitions?

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When strongly supercooled cosmological first-order phase transitions (FOPTs) are sufficiently slow, super-horizon inhomogeneities can be generated. We compute these super-horizon curvature perturbations by employing a gauge-invariant, multi-fluid formalism. By resolving the gauge ambiguities inherent in conventional separate-universe simulations, we demonstrate that Primordial Black Holes are unlikely to be produced by these super-horizon inhomogeneities. We also derive a fitting formula for the resulting curvature perturbations and discuss potential observational constraints on FOPTs imposed by limits on primordial curvature perturbations and associated scalar-induced gravitational waves.

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