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Finite-temperature (supercooled) bubble-nucleation with shifting scale hierarchies

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Focusing on supercooled phase transitions in models with classical scale symmetry, we investigate the limitations of derivative expansions in constructing a thermal EFT description for bubble nucleation. We demonstrate that derivative expansions for gauge field fluctuations diverge after the two leading orders because the gauge field mass varies strongly between the high- and low-temperature phases. By computing such contributions directly using the fluctuation determinant, we show that these effects can be captured while at the same time accounting for large explicit logarithms at two loops utilising the exact renormalisation group structure of the EFT. We show how this construction can be used to improve nucleation rate calculations, providing a more robust framework for describing gravitational waves from supercooled phase transitions in models like the SU(2)cSM.

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