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Gauge-independence of tunneling rates (15' + 5')

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Despite the gauge dependence of the effective action at zero and finite temperature, it is shown that it leads to tunneling and nucleation rates that remain independent of the choice of gauge-fixing. Taking as a starting point the path integral that defines the transition amplitude from a false vacuum to itself, a careful treatment of the boundary conditions and the gauge-fixing allows to show that decay rates are exactly determined by the effective action evaluated at a generalized bounce configuration. The latter is a solution to the quantum equations of motion, with boundary conditions fixed by the false vacuum. The resulting tunneling rate is gauge-independent, as the Nielsen identities imply that the explicit gauge dependence in the effective action is exactly cancelled by the gauge dependence of the solution. This holds for any election of gauge-fixing that leads to an invertible Faddeev-Popov matrix. The result is nonperturbative and model-independent, and also clarifies how to incorporate radiative corrections in tunneling calculations.

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