Contribution ID: **64** Type: **not specified**

Gradient effects on false vacuum decay in gauge theory

Friday 25 September 2020 14:24 (12 minutes)

We study false vacuum decay for a gauged complex scalar field in a polynomial potential with nearly degenerate minima. Radiative corrections to the profile of the nucleated bubble as well as the full decay rate are computed in the planar thin-wall approximation using the effective action. This allows to account for the inhomogeneity of the bounce background and the radiative corrections in a self-consistent manner. In contrast to scalar or fermion loops, for gauge fields one must deal with a coupled system that mixes the Goldstone boson and the gauge fields, which considerably complicates the numerical calculation of Green's functions. In addition to the renormalization of couplings, we employ a covariant gradient expansion in order to systematically construct the counterterm for the wave-function renormalization. The result for the full decay rate however does not rely on such an expansion and accounts for all gradient corrections at the chosen truncation of the loop expansion. The ensuing gradient effects are shown to be of the same order of magnitude as non-derivative one-loop corrections.

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Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium.

Track Classification: Cosmology & Astroparticle Physics