A Fresh Look at the Calculation of Tunneling Actions

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The calculation of tunneling actions, that control the exponential suppression of the decay of metastable phases (like the unstable electroweak vacuum), can be reformulated as an elementary variational problem in field space. This alternative approach circumvents the use of bounces in Euclidean space by introducing an auxiliary function, a tunneling potential Vt that connects smoothly the metastable and stable phases of the field potential V. The tunneling action is obtained as the integral in field space of an action density that is a simple function of Vt and V and can be considered as a generalization of the thin-wall action to arbitrary potentials. This formalism provides new handles for the theoretical understanding of different features of vacuum decay, can be easily extended to include gravitational effects in an elegant way and has a number of useful applications that I will discuss.