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False vacuum decay in quantum mechanics and scalar field theory

When the Higgs boson was discovered in 2012 it was realized that electroweak vacuum may suffer a possible metastability on the Planck scale and can eventually decay. To understand this problem it is important to have reliable predictions for the vacuum decay rate within the framework of quantum field theory. For now, it can only be done at one loop level, which is apparently is not enough. The aim of this work is to develop a technique for the calculation of two and higher order radiative corrections to the false vacuum decay rate in the framework of four dimensional scalar quantum field theory and then apply it to the case of the Standard Model. To achieve this goal, we first start from the case of d=1 dimensional QFT i.e. quantum mechanics. We show that for some potentials two and three loop corrections can be very important and must be taken into account. Next, we use quantum mechanical example as a template for the general d=4 dimensional theory. In it we are concentrating on the calculations of bounce solution and corresponding Green function in so called thin wall approximation. The obtained Green function is then used as a main ingredient for the calculation of two loop radiative corrections to the false vacuum decay rate.

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