

## Coleman-Weinberg Potential in Dimensional Regularisation

Spontaneous symmetry breaking is essential for giving masses to non-Abelian gauge fields. It appears to be the only method which is available which is unitary and renormalizable in 4 dimensions. Sidney Coleman and Erick Weinberg investigate how radiative corrections, otherwise the loop corrections, can produce spontaneous symmetry breaking, in the kind of theory for which the semiclassical (tree) approximation does not indicate such breakdown. In particular for theories which have no initial mass scale. The simplest model in which this phenomenon in principle could occur is the massless  $\phi^4$  theory. They obtained the effective renormalized potential for this theory over four decades ago. And found that while there are non-trivial minima of the 1-loop effective potential those minima lie outside the validity of the approximation being used. Coleman and Weinberg use the cut-off method to obtain the potential but we know that this method does not respect gauge invariance (even though in that model one does not have a gauge symmetry). Our present work is to obtain the same form of the potential but using the techniques of Dimensional Regularization, we obtain the same result. We also clarify the uses of this method, more convenient for several reasons, like the preservation of local symmetries (gauge invariance) in classical action.

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