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Vacuum stability in the SM: Towards a four-loop precision analysis

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During the last years the question of the stability of the vacuum state in the Standard Model extended up to high scales has become an exciting topic for precision physics since for the currently measured Higgs and top mass values the electroweak vacuum seems to be located close to the border between stability and metastability.

The effective Higgs potential, which characterizes all possible vacuum states, is closely connected to the evolution of the couplings and field strengths in the theory. This evolution is described by beta functions and anomalous dimensions. The state of the art discussion of vacuum stability in the SM involves the full set of three-loop beta functions in the MSbar-scheme and the matching of experimentally measured quantities to MSbar parameters at two-loop accuracy.
Now the leading contributions to the beta function for the strong coupling [JHEP 1602 (2016) 095], the top-Yukawa coupling and the Higgs self-coupling [paper in preparation] are available at four-loop level which constitutes a first step towards a full calculation of the gauge coupling beta functions at this precision.

In this talk we briefly review the vacuum stability problem in the SM and present the latest four-loop results for the most important beta functions connected to this problem as well as their impact on the stability of the electroweak vacuum state. Furthermore, a comparison of the most important sources of uncertainty will be given.
Finally, a few technical issues will be discussed such as the treatment of gamma_5 matrices in dimensional regularization which is the main limitation towards a full four-loop beta-functions and three-loop on-shell to MSbar matching discussion of this problem.

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