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The interrelation between stability of Vacuum (absence of new physics up to Plank scale) and value of running mass of top-quark: problems and perspectives.

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After the discovery of the Higgs boson - the last important building block of the Standard Model (SM) required by its renormalizability - and the still missing direct detection of new physics beyond SM at the LHC, the self-consistency of the SM has attracted a lot of notice. One of the approaches to determine the scale at which SM may break down is based on the renormalization group (RG) analysis of the SM running couplings, specifically of the Higgs self-coupling and the question whether it stays positive up to the Planck scale which would imply the vacuum to remain stable.

Recently, the detailed renormalization group analysis of the stability of vacuum was done by a few groups with common conclusion that the current values of Higgs boson and top-quark masses imply that our vacuum is metastable. It was observed, that higher order radiative corrections to RG equations and matching conditions as well as the numerical value of top-quark mass play an important role in this analysis. The small variation of the top-quark mass gives rise to stability of vacuum so that new physics does not appear up to Plans scale, there is no Landau problem for Higgs self-coupling in this case, does not exist the hierarchy problem in Standard Model, and even more, the Higgs of Standard Model can serve as inflaton.

One of the manifestations of stable-vacuum scenario is the large EW contribution to the value of running mass of top-quark so that the sum of QCD and EW contribution are almost perfectly canceled. We treat this effect as indication of importance of two-loop electroweak radiative corrections which play the same role as three- and/or four-loop QCD corrections to any physical processes.

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