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Two-loop corrections to the Higgs trilinear coupling in models with extended scalar sectors

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The precise study of the properties of Higgs boson offers a unique and crucial opportunity to probe Physics beyond the Standard Model (BSM) indirectly. One important example of such property is the Higgs trilinear coupling, which determines the shape of the Higgs potential and in turn the nature of the electroweak phase transition (EWPT). It has been known for some time that, in a variety of BSM models with extended Higgs sectors (e.g. with doublets, singlets, etc.), the value of the Higgs trilinear coupling can deviate significantly from its Standard-Model prediction at one-loop order, because of non-decoupling effects in the radiative corrections involving the additional scalar states. Indeed, deviations from the SM can reach a hundred percent or more without violating perturbative unitarity. Such effects would ensure that the EWPT is of strong first order, which is necessary for the success of the scenario of electroweak baryogenesis. It is then natural to ask if two-loop corrections can modify this result, and whether new large corrections can appear again.
In this talk, I will present new results on the calculation of dominant two-loop corrections to the Higgs trilinear coupling in two models with extended scalar sectors, namely a Two-Higgs-Doublet Model and the Inert Doublet Model, using the effective-potential approximation. I will illustrate the analytical results with numerical examples and show that, while they remain smaller than their one-loop counterparts and do not modify significantly the non-decoupling effects observed at one loop, the two-loop corrections are not entirely negligible – a typical size being 10-20% of the one-loop corrections.

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