Contribution ID: **54** Type: **not specified**

Accidental Suppression of Wilson Coefficients in Higgs Coupling

Tuesday 22 October 2024 17:30 (20 minutes)

Higgs couplings are essential probes for physics beyond the Standard Model (BSM), as the Higgs potential can be generically modified by new physics, particularly through the Higgs portal interaction $|H|^2\mathcal{O}$. These modifications influence Higgs interactions via dimension-6 operators of the form $\sim \left(\partial|H|^2\right)^2$ and $\sim |H|^6$, which are generally expected to be of comparable size. This paper discusses a phenomenon of accidental suppression, where the $|H|^6$ coupling is significantly smaller than $\left(\partial|H|^2\right)^2$. This suppression, arising from the truncation of the tree-level effective potential, lacks a clear symmetry explanation but persists in Higgs-portal and neutrino-portal couplings. We explore toy examples and a specific model–the Standard Model (SM) gauge singlet extension of the Standard Model–in detail, aiming to inspire further studies on additional instances of accidental suppression without symmetry explanations or a general framework to characterize such suppression. We also discuss future collider constraints on the Wilson coefficients of the two dimension-6 operators for various benchmark scenarios of the concrete model.

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Session Classification: Contributed Talks