Contribution ID: **27** Type: **Parallel talk**

A universally enhanced light-quarks Yukawa couplings paradigm

Thursday, July 11, 2019 9:30 AM (15 minutes)

We propose that natural TeV-scale new physics (NP) with $O(1)$ couplings to the standard model (SM) quarks may lead to a universal enhancement of the Yukawa couplings of all the light quarks, perhaps to a size comparable to that of the SM b-quark Yukawa coupling, i.e., $y_q \sim O(y_b^{SM})$ for $q = u, d, c, s$. I will discuss this scenario in an effective field theory (EFT) extension of the SM, and show that the potential EFT contribution to the light quarks Yukawa couplings is $y_q \sim O(f\frac{v^2}{2})$, where Λ is the typical scale of the underlying heavy NP and f depends on its properties and details. For example, with $\Lambda \sim 1.5$ TeV and natural NP couplings $f \sim O(1)$, one obtains $y_q \sim 0.025 \sim y_b^{SM}$. I will also discuss this enhanced light quarks Yukawa paradigm in extensions of the SM which contain TeV-scale vector-like quarks (VLQ) and match them to the EFT description. The flavor structure and the constraints on this scenario will also be explored as well as the resulting "smoking gun"signals that should be searched for at the LHC, e.g., multi-Higgs production $pp \to hh, hhh$ and single Higgs production in association with a high p_T jet or photon and with a single top-quark, i.e., $pp \to hj, h\gamma$ and $pp \to ht$.

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Session Classification: Higgs Physics

Track Classification: Higgs Physics