Contribution ID: **64** Type: **Oral**

Dyssymetry: Unleashing Extra Yukawa Couplings

Wednesday, 23 October 2019 12:20 (20 minutes)

The h(125) boson was discovered at the LHC in 2012, but as Run 2 has ended, nothing beyond the Standard Model (SM) has emerged, be it supersymmetry, extra gauge bosons, or any new particle. We call this situation, Dyssymmetry, as spoken by Nature. As such, we take the simplicity path to reexamine any presumed symmetries. In particular, we scrutinize the usual Z2 symmetry associated with having an extra Higgs doublet. Releasing this Z2 symmetry assumption, extra Yukawa couplings are rightfully restored to the general two Higgs doublet model (g2HDM). Compared to the Natural Flavor Conservation condition proposed by Glashow and Weinberg over 4 decades ago, Nature has spoken since: there be charged fermion mass and mixing hierarchies; let the h(125) boson be rather close to the SM Higgs boson — alignment. Together with the exotic Higgs being somewhat heavier, these emergent phenomena can help contain the problems with flavor changing neutral Higgs (FCNH) couplings.
In this talk we elucidate: 1) how an extra top Yukawa coupling (or two) could give enough CP violation to drive electroweak baryogenesis (EWBG); 2) how O(1) Higgs quartics, needed for first order electroweak phase transitions for sake of EWBG, could still allow the alignment phenomenon to emerge, i.e. to allow large parameter space for exotic CP-even Higgs H not to mix much with h(125); 3) associated phenomenology, from electron EDM, $\tau \longrightarrow \mu\gamma$, $B \longrightarrow \mu\nu$(bar), and LHC collider signatures involving extra ttA/H, tcA/H and $\tau\mu$A/H Yukawa couplings, where A and H are exotic CP odd and even scalars of g2HDM. The A, H and charged Higgs H+ could well be sub-TeV in mass and awaiting LHC discovery.
Simplicity could be quite complex, as Nature decides.

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Session Classification: Session