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Two Top Utilities of Two Higgs Doublets: Electroweak Baryogenesis and Alignment

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Existence of a second Higgs doublet is highly likely, but we should let Nature decide on its couplings, and not impose extra discrete symmetry. Besides new flavor changing neutral Higgs couplings, a new top Yukawa coupling of the heavy neutral Higgs bosons H^0 and A^0 (denoting 125 GeV boson as h, the SM-like Higgs), is naturally of order 1 in strength. It also naturally carries a new CPV phase. Together with order 1 Higgs boson couplings involving the exotic Higgs bosons, there can be sufficient CPV as well as strong first order electroweak phase transition for sufficient electroweak baryogenesis. The order 1 new top Yukawa and Higgs couplings would balance each other naturally, such that apparent alignment could result, without decoupling. The relatively strong couplings and CPV phase in the new top Yukawa coupling lead to many testable phenomenological consequences, such as electron edm, higgs to two photons, t -> ch, triple Higgs coupling, and possibilities for h -> mu tau and tau -> mu gamma.

Primary author: Prof. HOU, George W.S. (National Taiwan University)

Presenter: Prof. HOU, George W.S. (National Taiwan University)

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