Contribution ID: **65** Type: **not specified**

Vacuum Induced CP Violation Generating a Complex CKM Matrix with Controlled Scalar FCNC

Friday, 19 April 2019 09:50 (25 minutes)

We propose a viable minimal model with spontaneous CP violation in the framework of a Two Higgs Doublet Model. The model is based on a generalised Branco-Grimus-Lavoura model with a flavoured $\mathbb{Z}_2$ symmetry, under which two of the quark families are even and the third one is odd. The lagrangian respects CP invariance, but the vacuum has a CP violating phase, which is able to generate a complex CKM matrix, with the rephasing invariant strength of CP violation compatible with experiment. The question of scalar mediated flavour changing neutral couplings is carefully studied. In particular we point out a deep connection between the generation of a complex CKM matrix from a vacuum phase and the appearance of scalar FCNC. The scalar sector is presented in detail, showing that the new scalars are necessarily lighter than 1 TeV. A complete analysis of the model including the most relevant constraints is performed, showing that it is viable and that it has definite implications for the observation of New Physics signals in, for example, flavour changing Higgs decays or the discovery of the new scalars at the LHC. We give special emphasis to processes like $t \to \mathrm{h}c, \mathrm{h}u$, as well as $\mathrm{h} \to bs, bd$, which are relevant for the LHC and the ILC.

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Session Classification: Flavor

Track Classification: Flavor