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125 GeV Higgs signal at the LHC in the CP-violating MSSM

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The ATLAS and CMS collaborations independently discovered a Higgs-like particle with mass $M_h \sim 125$ GeV and properties similar to that predicted by the Standard Model (SM) at the Large Hadron Collider (LHC) in 2012. Although the measurements so far indicate that the newly discovered particle is compatible with the SM predictions, however due to some uncertainties in few of the Higgs detection channels, there are still possibilities of testing this object as being a candidate for some Beyond the SM (BSM) physics scenarios, for example, the CP-conserving Minimal Supersymmetric Standard Model (CPC-MSSM). Moreover there are unsettled issues like the hierarchy problem, which add more objectives to go for the BSM scenarios. In the present work, we evaluate the modifications of these CPC-MSSM results when CP-violating (CPV) phases are introduced explicitly, leading to the CP-violating MSSM (CPV-MSSM). We investigate the role of the CPV phases of (some of) the soft Supersymmetry (SUSY) terms (viz., the gluino mass M_1 and the trilinear Higgs couplings with the sfermions A_f , $f = t, b, \tau$) on both the mass of the lightest Higgs boson h_1 , and the rates for the processes

$$\begin{aligned}
 &gg \rightarrow h_1 \rightarrow \gamma\gamma, \\
 &gg \rightarrow h_1 \rightarrow ZZ^* \rightarrow 4l, \\
 &gg \rightarrow h_1 \rightarrow WW^* \rightarrow l\nu l\nu, \\
 &pp \rightarrow Vh_1 \rightarrow Vb\bar{b} \text{ and} \\
 &pp \rightarrow Vh_1 \rightarrow V\tau^+\tau^-, \\
 &(V \equiv W^\pm, Z)
 \end{aligned}$$

at the LHC, considering the impact of the flavor constraints as well as the stringent constraints coming from the Electric Dipole Moment (EDM) measurements for the electron, neutron, Thallium and Mercury. We find that it is possible to have the lightest Higgs boson mass of around 125 GeV with relatively small $\tan \beta$, large A_t and a light stop, which is consistent with the SUSY particle searches at the LHC. We show that the imaginary part of the top and bottom Yukawa couplings can take small but non-zero values even after satisfying the recent updates from both the ATLAS and CMS collaborations within $1-2\sigma$ uncertainties which might be a strong signature of the CP violation to look for at the future run of the LHC. Our analysis shows that the CPV-MSSM could be an equally potent solution (like the CPC-MSSM) to the recent LHC Higgs data, in fact offering very little in the way of distinction between these two SUSY models

(CPC-MSSM and CPV-MSSM) at the 7 and 8 TeV run of the LHC. Improvement in different Higgs coupling measurements is necessary in order to test the possibility of probing the small dependence on these CPV phases in the MSSM Higgs sector.

Oral or Poster Presentation

Oral

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