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Higgs Alignment and Novel CP-Violating Observables in 2HDM

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Null results from searches for new physics at the Large Hadron Collider (LHC) enforce the belief that new particles must be much heavier than the weak scale. We undertake a systematic study of the interplay between Higgs alignment and CP-violation in complex two-Higgs-doublet models (C2HDMs), which enables us to construct a CP-violating scenario where new Higgs bosons are close to the weak scale after including stringent constraints from the electric dipole moment and measurements at the LHC. In addition, we propose a smoking-gun signal of CP-violation in the Higgs-to-Higgs decay, (h3 $\longrightarrow$ h2h1 $\longrightarrow$ 3h1), where h3,h2, and h1 are the heaviest, second heaviest and the SM-like neutral Higgs bosons, respectively. The mere presence of this decay channel is sufficient to establish CP-violation in C2HDMs. The final state with three 125 GeV Higgs bosons is distinct and provides a unique venue for new measurements at the LHC.

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