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Collider and Gravitational Wave Complementarity in the 2HDM

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The Higgs potential is crucial for us to understand the mechanism of EWSB. We show how collider measurements and observations of stochastic gravitation wave can complement each other to explore the scalar potential in the 2HDM scenario. Through a comprehensive study, accounting for theoretical and current experimental constraints, we study the key ingredients in the shape of the Higgs potential triggering the strong first order phase transition and compare the dominant collider signals at the HL-LHC. We obtain that the heavy Higgs searches with fermionic decay, $H/A/H^\pm \rightarrow ff$, are the leading smoking gun signatures of strong first order EWPT in the 2HDM.

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