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Resonant Di-Higgs Production in the $b\bar{b}W^+W^-$ channel: Probing the Electroweak Phase Transition at the LHC

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With the discovery of Standard Model(SM) Higgs boson at the LHC, exploring the thermal history associated with electroweak symmetry-breaking (EWSB) has taken on heightened interest. The process of the electroweak phase transition (EWPT) in early universe provides conditions able to explain the observed cosmic matter-antimatter asymmetry, if the transition were of first order and sufficiently strong. The prospects for resonant di-Higgs production searches at LHC, in the context of probing the EWPT in Higgs portal extension of the SM, will be presented. We explore the sensitivity of the $b\bar{b}W^+W^-$ channel, with W leptonic decays. The presence of neutrinos in the final state does not allow the reconstruction of the invariant mass of the heavy scalar, diminishing the sensitivity of this channel. We present a novel technique, called Heavy Mass Estimator (HME), that allows to fully reconstruct the kinematic of the process, and therefore to reconstruct the heavy Higgs invariant mass. We prove that, with HME technique, this channel can be sensitive as much as $b\bar{b}b\bar{b}$, $b\bar{b}\gamma\gamma$, and $b\bar{b}\tau\tau$ channels, leading to a potential discovery of resonant di-Higgs production with the datasets accumulated in High Luminosity phase of LHC, foreseen in 2035

Summary

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