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Electroweak Phase Transition in the Z_3-invariant NMSSM Implications of LHC and Dark matter Searches and Prospects of Detecting the Gravitational Waves

We study in detail the viability and the patterns of a strong first-order electroweak phase transition as a prerequisite to electroweak baryogenesis in the framework of Z_3-invariant Next-to-Minimal Supersymmetric Standard Model (NMSSM), in the light of recent experimental results from the Higgs sector, dark matter (DM) searches and those from the searches of the lighter chargino and neutralinos at the Large Hadron Collider (LHC). For the latter, we undertake thorough recasts of the relevant, recent LHC analyses. With the help of a few benchmark scenarios, we demonstrate that while the LHC has started to eliminate regions of the parameter space with relatively small $\mu_{\rm eff}$, that favors the coveted strong first-order phase transition, rather steadily, there remains phenomenologically much involved and compatible regions of the same which are yet not sensitive to the current LHC analyses. It is further noted that such a region could also be compatible with all pertinent theoretical and experimental constraints. We then proceed to analyze the prospects of detecting the stochastic gravitational waves, which are expected to arise from such a phase transition, at various future/proposed experiments, within the mentioned theoretical framework and find them to be somewhat ambitious under the currently projected sensitivities of those experiments.

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