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Fate of electroweak symmetry in the early Universe: Non-restoration and trapped vacua in the N2HDM

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Extensions of the Standard Model (SM) Higgs sector allow for a rich cosmological history around the electroweak (EW) scale. In the context of the next-to 2HDM (N2HDM) we analyse the phenomena of EW symmetry non-restoration as well as vacuum trapping. We show that these phenomena can occur in relevant parts of the parameter space. Focusing on the type II N2HDM and taking into account various theoretical and experimental constraints, we demonstrate how these novel finite-temperature effects are related and how they can be used to further constrain the parameter space of the model. In particular, we show that the presence of a global EW minimum at zero temperature might not be a sufficient requirement for the validity of the vacuum configuration.

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