Contribution ID: **12** Type: **not specified**

Reconciling Higgs physics and pseudo-Nambu-Goldstone dark matter in the S2HDM using a genetic algorithm

We investigate a possible realization of pseudo-Nambu-Goldstone (pNG) dark matter in the framework of a singlet-extended 2 Higgs doublet model (S2HDM). pNG dark matter gained attraction due to the fact that direct-detection constraints can be avoided naturally because of the momentum-suppressed scattering cross sections, whereas the relic abundance of dark matter can nevertheless be accounted for via the usual thermal freeze-out mechanism. We confront the S2HDM with a multitude of theoretical and experimental constraints, paying special attention to the theoretical limitations on the scalar potential, such as vacuum stability and perturbativity. In addition, we discuss the complementarity between constraints related to the dark matter sector, on the one hand, and to the Higgs sector, on the other hand. In our numerical discussion we explore the Higgs funnel region with dark matter masses around 60GeV using a genetic algorithm. We demonstrate that the S2HDM can account for the measured relic abundance while being in agreement with all relevant constraints. We also discuss whether the so-called center-of-galaxy excesses can be accommodated, possibly in combination with a Higgs boson at about 96GeV that can be the origin of the LEP- and the CMS-excess observed at this mass in the bb-quark and the diphoton final state, respectively.

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Session Classification: Physics beyond the standard model