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Current status of the light neutralino thermal dark matter in the phenomenological MSSM

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Abstract: We explore the parameter space of the phenomenological Minimal Supersymmetric Standard Model (pMSSM) with a light neutralino thermal dark matter ($m_{\text{DM}} \leq m_{\text{Higgs boson}}/2$) that is consistent with current collider and astrophysical constraints. We consider both positive and negative values of the higgsino mass parameter (μ). Our investigation shows that the recent experimental results from the LHC as well as from direct detection searches for dark matter by the LUX-ZEPLIN (LZ) collaboration rule out the Z-funnel region for the $\mu > 0$ scenario. The same results severely restrict the h-funnel region for positive μ , however, the allowed points can be probed easily with few more days of data from the LZ experiment. In the $\mu < 0$ scenario, we find that very light higgsinos in both the Z and h funnels might survive the present constraints from the electroweakino searches at the LHC, and dedicated efforts from experimental collaborations are necessary to make conclusive statements about their present status. We also study the impact of light stau sleptons on this parameter space.

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