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A relatively light, highly bino-like dark matter in the Z_3-symmetric NMSSM and recent LHC searches

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A highly bino-like Dark Matter (DM), which is the Lightest Supersymmetric Particle (LSP), could be motivated by the stringent upper bounds on the DM direct detection rates. This is especially so when its mass is around or below 100 GeV for which such a bound tends to get most severe. Requiring not so large a higgsino mass parameter, that would render the scenario reasonably 'natural', prompts such a bino-like state to be relatively light. In the Minimal Supersymmetric Standard Model (MSSM), in the absence of comparably light scalars, such an excitation, if it has to be a thermal relic, is unable to meet the stringent experimental upper bound on its abundance unless its self-annihilation hits a funnel involving either the Z-boson or the Standard Model (SM)-like Higgs boson. We demonstrate that, in such a realistic situation, a highly bino-like DM of the popular Z_3-symmetric Next to-Minimal Supersymmetric Standard Model (NMSSM) is viable over an extended range of its mass, from our targeted maximum in the vicinity of the mass of the top quark down to about 30˜GeV. This is facilitated by the presence of comparably light singlet-like states that could serve as funnel (scalars) and/or coannihilating (singlino) states even as the bino-like LSP receives a minimal (but optimal) tempering triggered by suitably light higgsino states that, in the first place, evade stringent lower bounds on their masses that can be derived from the Large Hadron Collider (LHC) experiments only in the presence of a lighter singlino-like state. An involved set of blind spot conditions is derived for the DM direct detection rates by considering for the very first time the augmented system of neutralinos comprising of the bino, the higgsinos and the singlino which highlights the important roles played by the NMSSM parameters 'λ' and $\tan\beta$ in delivering a richer phenomenology.

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