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Minimal dark matter in SU(5) grand unification

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Minimal dark matter is an attractive candidate for dark matter because it is stabilized without the need to impose additional symmetries. It is known that the SU(2)L quintuplet fermion can serve as a minimal dark matter candidate, with its mass predicted to be around 14 TeV, based on the thermal production mechanism. In this work, we embed the quintuplet dark matter within non-supersymmetric SU(5) grand unified theories. We find that two pairs of colored sextet fermions are required at the O(1-10) TeV scale to achieve gauge coupling unification, with the unification scale near the reduced Planck scale. These colored sextet fermions become metastable because their interactions are suppressed by the unification scale. Our model can be tested through comprehensive searches for colored sextet fermions in collider experiments, as well as through indirect and direct detection methods for minimal dark matter. Once the minimal dark matter scenario has been experimentally confirmed, it will have implications for modifying string theories.

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