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Softly Shifting Away from Dark Matter Direct Detection: Reviving the Higgs Portal

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We propose soft breaking mechanism for dark matter (DM) shift symmetry in a class of composite dark matter models, where both DM and the Higgs boson arise as pseudo Nambu-Goldstone bosons from novel strong dynamics. Our mechanism is utilized to suppress the non-derivative portal coupling between the Higgs boson and DM particle, which can evade the stringent bound of current DM direct detection experiments. Otherwise this non-derivative portal coupling would naturally be at the same order of the Higgs quartic, rendering this class of models under severe crisis. For realizing soft breaking mechanism, we introduce vector-like top partners, dubbed as “softons”, to restore the shift symmetry of DM in top Yukawa sector, which however is only broken by the softon masses. The portal coupling would automatically vanish as the shift-symmetry-breaking softon masses approach zero. Specifically we present a proof-of-concept model of soft breaking, based on the coset O(6)/O(5) and the simplest fermion embedding, and study its DM phenomenology, where we show a large amount of novel parameter space is opened up by using the soft breaking mechanism.

Summary

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