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Unification of the Standard Model and Self-Interacting Dark Matter in [SU(5)*U(1)]^4 GUT

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A spontaneously broken hidden U(1)*h gauge symmetry can explain both the dark matter stability and the observed relic abundance. In this framework, the light gauge boson can mediate the strong dark matter self-interaction, which addresses astrophysical observations that are hard to explain in collisionless cold dark matter. Motivated by flavoured grand unified theories, we introduce right-handed neutrinos and a flavoured B-L gauge symmetry for the third family U(1)*{B-L}. The unwanted relic of the U(1)*h gauge boson decays into neutrinos via the kinetic mixing with the U(1)*{(B - L)_3}$ gauge boson. This model can also explain the lepton flavour universality violation in semi-leptonic B meson decays that is recently found in the LHCb experiment. We found that the dark sector is naturally obtained when there is a strong SU(5) gauge interaction, U(1) gauge interaction, and fermions with appropriate representations at a UV scale. This implies that the whole sector can be unified by a [SU(5)*U(1)]^4 gauge theory. The first three sets of gauge groups are spontaneously broken to the SM gauge groups while the last one becomes strong at an intermediate scale and gives a self-interacting dark matter at a low energy scale.

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