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Vector Boson Dark Matter From Trinification

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We show how trinification models based on the gauge group $SU(3)_C \times SU(3)_L \times SU(3)_R$ realized near the TeV scale can provide naturally a variety of dark matter (DM) candidates. These models contain a discrete T parity which may remain unbroken even after spontaneous symmetry breaking. The lightest T-odd particle, which could be a fermion, a scalar, or a gauge boson, can constitute the dark matter of the universe. This framework naturally admits a doublet-singlet fermionic DM, a singlet scalar DM, or a vector boson DM. Here we develop the vector boson DM scenario wherein the DM couples off-diagonally with the usual fermions and vector-like fermions present in the theory. We show consistency of this framework with dark matter relic abundance and direct detection limits as well as LHC constraints. We derive upper limits of 900 GeV on the vector gauge boson DM mass and 4.5 TeV on the vector-like quark masses. We also show the consistency of spontaneous gauge symmetry breaking down to Standard Model times an extra $U(1)$ while preserving the T-parity.

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