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The Weak Eightfold Way: $SU(3)_W$ unification of the electroweak interactions

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In a recent work, a successful prediction has been made for $\sin^2 \theta_W$ at an energy scale of $O(\text{TeV})$ based on the Dirac quantization condition of an electroweak monopole of the $EW-\nu_R$ model. The fact that such a prediction can be made has prompted the following question: Can $SU(2)$ be unified with $U(1)$ at $O(\text{TeV})$ scale since a prediction for $\sin^2 \theta_W$ necessarily relates the $U(1)$ coupling g' to the $SU(2)$ weak coupling g ? It is shown in this manuscript that this can be accomplished by embedding $SU(2) \times U(1)$ into $SU(3)_W$ (The Weak Eightfold Way) with the following results: 1) The same prediction of the weak mixing angle is obtained; 2) The scalar representations of $SU(3)_W$ contain all those that are needed to build the $EW-\nu_R$ model and, in particular, the real Higgs triplet used in the construction of the electroweak monopole. 3) Anomaly freedom requires the existence of mirror fermions present in the $EW-\nu_R$ model. 4) Vector-Like Quarks (VLQ) with unconventional electric charges are needed to complete the $SU(3)_W$ representations containing the right-handed up-quarks, with interesting experimental implications such as the prediction of doubly-charged hybrid mesons.

Summary

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