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CP-mirror Extension of Standard Model in SU(3)×SU(2)$_L$×SU(2)$_R$×U(1)$_I$

We propose an extension of standard model based on SU(3)×SU(2)$_L$×SU(2)$_R$ ×U(1)$_I$ gauge group, where for each standard model (SM) fermion (plus the right handed neutrino) there is a CP-mirror counterpart with the same lepton or color quantum number. Thus for left handed lepton and quark doublets $\begin{pmatrix} \nu^0 \\ e^- \end{pmatrix}_L$, $\begin{pmatrix} u^{2/3} \\ d^{-1/3} \end{pmatrix}_L$ (respectively (1,\textbf{2},1,-1) and (3,\textbf{2},1,1/3)) we have right handed lepton and quark doublets with reverse hypercharges, i.e. $\begin{pmatrix} E^+ \\ N^0 \end{pmatrix}_R$, $\begin{pmatrix} D^{1/3} \\ U^{-2/3} \end{pmatrix}_R$ (respectively (1,1,\textbf{2},1) and (\textbf{3},1,\textbf{2},-1/3)). While for right handed lepton and quarks singlets, $e_R^-, \nu_R^0, u_R^{2/3}, d_R^{-1/3}$ (respectively (1,1,1,-2), (1,1,1,0), (\textbf{3},1,1,4/3), (\textbf{3},1,1,-2/3)), we have a left handed lepton and quark singlet with reverse hypercharges, $E_L^+, N_L^0, U_L^{-2/3}, D_L^{1/3}$ (respectively (1,1,1,2), (1,1,1,0), (\textbf{3},1,1,-4/3), (\textbf{3},1,1,2/3)). We also impose a global lepton number conservation, thereby there is no majorana neutrino in this model. In the Higgs sector we have left and right Higgs doublets, but no bidoublet (thus no FCNC and no mixing between the W_L and W_R). Additionally we have two lepto-quark singlet ((**3***,1,1,-2/3) and (**3***,1,1,2/3)) and one singlet scalars (1,1,1,0). This model by construction is anomaly free.

After spontaneous symmetry breaking, the left and right Higgs doublets will acquire vacuum expectation values (vev) with $v_R > v_L$, breaking the parity spontaneuously. The two set of fermions will have different masses with the standard model particles have their usual masses through the usual mechanism, while the CP-mirror counterpart will have very heavy masses due to its Yukawa coupling with the right handed Higgs doublet. As an exception is the neutrino, since both the the singlet right handed neutrino and its CP-mirror counterpart have $I = 0$, we can have a mixing between them with arbitrary heavy bare mass. This mixing will lead to a type-I Dirac seesaw-like mechanism which, in the mass basis, gives one neutrino with a very small mass and the other one with very large mass. The lepto-quark scalars will facilitate the decay of the very heavy CP-mirror leptons into the SM quarks and the very heavy CP-mirror quarks into the SM leptons. Several other consequence will also be explored.

Keywords: extended standard model, left-right symmetry, seesaw mechanism

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