Constraints on L= 2 Vector Bosons with Tree Couplings to SM Leptons

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We investigate phenomenological implications of vector bosons V transforming as (1, 2, -3/2) under the standard model (SM) product gauge group $SU(3)_C$, $SU(2)_L$ and $U(1)_Y$. These vector bosons can couple to two SM leptons at tree-level forming dimension-4 operators. These operators dictate V to have two units of global lepton number, $\Delta L = 2$. The operators generated conserve the global lepton number but can violate generational lepton numbers. We study constraints on the couplings Y of V to SM particles using tree-level processes such as $l_\alpha^- \to l_\beta^+ l_\rho^- l_\sigma^-$, muonium and antimuonium oscillation, neutrino trident scattering, inverse muon decay, $e^- e^+ \to l^- l^+$, and also one-loop level processes such as the magnetic dipole moment of a charged lepton and $l_i \to l_j \gamma$. Strong constraints are obtained from $l_\alpha^- \to l_\beta^+ l_\rho^- l_\sigma^-$ with $\left|Y_{ee}Y_{\mu e}^*\right| < 3.29 \times 10^{-11}\,(m_V/\mathrm{GeV})^2$, $\left|Y_{ee}Y_{e\mu}^*\right| < 3.29 \times 10^{-11}\,(m_V/\mathrm{GeV})^2$ and from $l_i \to l_j \gamma$ with $\left|Y_{\tau e}Y_{\mu \tau}^*\right| < 3.46 \times 10^{-12}(m_V/\mathrm{GeV})^2$, $\left|Y_{e\tau}Y_{\tau\mu}^*\right| < 3.46 \times 10^{-12}\,(m_V/\mathrm{GeV})^2$, respectively. Interestingly, the imaginary part of the coupling constant in our model induces CP violation, which is constrained by experimental limits on the electric dipole moment.

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