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vector like leptons at LHC

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The performance of LHC and the results already achieved have been outstanding. The lightest Higgs scalar boson mass in supersymmetry can be raised significantly by extra vector-like quark and lepton supermultiplets with large Yukawa couplings but dominantly electroweak-singlet masses.

We are interested in a model consisting of a $\mathbf{10} + \overline{\mathbf{10}}$ of $SU(5)$. The non-MSSM particles in this case consist of charge $+2/3$ quarks $t'_{1,2}$, a charge $-1/3$ quark b' , and a charged lepton τ' , and their scalar partners. We assumed that the mixing of the new fermions with Standard Model fermions is large enough to provide for prompt decays. Mixing with the third Standard Model family are considered, for which the constraints are much easier to satisfy.

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We gave attention to the vector like lepton τ' . τ' can decay to $W\nu$, $Z\tau$, and $h^0\tau$.

Because there is only one relevant Yukawa mixing term, the branching ratios depend only on $m_{\tau'}$.

The largest branching ratio for τ' is always to $W\nu$. The most immediately relevant searches at hadron colliders will be in the mass range of $m_{\tau'}$ just above 100 GeV, where the electroweak pair-production cross-section can be sufficiently large. We have shown that there are certain multilepton channels with a good possibility to observe desired signal over the backgrounds at 13 TeV. In order to do this we have implemented particular cuts to select events that are useful. We also considered some of the more optimistic scenarios where one of the branching ratio to $W\nu$, $Z\tau$, and $h^0\tau$ are close to 1.

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