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Higgs Properties and Fourth Generation Leptons

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It is possible that there are additional vector-like generations where the quarks have mass terms that do not originate from weak symmetry breaking, but the leptons only get mass through weak symmetry breaking. We discuss the impact that the new leptons have on Higgs boson decay branching ratios and on the range of allowed Higgs masses in such a model. We find that if the fourth generation leptons are too heavy to be produced in Higgs decay, then the new leptons reduce the branching ratio for $h \rightarrow \gamma\gamma$ to about 30% of its standard-model value. The dependence of this branching ratio on the new charged lepton masses is weak. Furthermore the expected Higgs production rate at the LHC is very near its standard-model value if the new quarks are much heavier than the weak scale. If the new quarks have masses near the cutoff for the theory then for cutoffs greater than 10^{15} GeV, the new lepton masses cannot be much heavier than about 100 GeV and the Higgs mass must have a value around 175 GeV.

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