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Light neutrino mass spectrum with one or two right-handed singlet fermions added

Neutrino oscillation experiments showed that neutrinos have tiny but non-zero masses. The seesaw mechanism is the most fruitful explanation of the light neutrino masses and mixings, which connects the tiny neutrino masses with heavy right-handed neutrino masses. After spontaneous symmetry breaking of the Standard Model gauge group one obtains a $(n_L + n_R) \times (n_L + n_R)$
Majorana mass matrix M_ν for the neutrinos. The mixing between the
n_R right-handed singlet fermions and the neutral parts of the
n_L lepton doublets gives masses to the neutrinos which are of the
size expected from neutrino oscillations.

The diagonalization of the mass matrix gives rise to a split spectrum
consisting of heavy and light states of neutrinos given by $U^T M_\nu U = \mathrm{diag}(m_{n_L}^{\mathrm{light}}, m_{n_R}^{\mathrm{heavy}})$. We
analyse two cases of the minimal extension of the Standard Model when
one or two right-handed fields are added to the three left-handed
fields. A second Higgs doublet is included in our model.

We calculate the one-loop radiative corrections to the mass parameters
which produce mass terms for the neutral leptons. In both cases we
numerically analyse light neutrino masses as functions of the heavy
neutrino masses. Parameters of the model are varied to
find light neutrino masses that are compatible with experimental data of
solar $\Delta m_\odot^2$ and atmospheric $\Delta m_{\mathrm{atm}}^2$
neutrino mass differences for normal and inverted hierarchy. We choose values for the parameters of the
tree-level by numerical scans, where we look for the best agreement between computed and experimental
neutrino oscillation angles. Different mixing angles between the Higgs fields give different mass spectra of
light neutrinos and different distributions of neutral Higgs masses.

Summary

Primary author(s) :   Dr. JURCIUKONIS, Darius (Vilnius University Institute of Theoretical Physics and Astronomy)

Co-author(s) :   Dr. JUODAGALVIS, Andrius (Vilnius University Institute of Theoretical Physics and Astronomy); Dr. GAJDOSIK, Thomas (Vilnius University, Physics Faculty)

Presenter(s) :   Dr. JURCIUKONIS, Darius (Vilnius University Institute of Theoretical Physics and Astronomy)

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