Lepton flavor mixing and baryogenesis

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Abstract

Recently a new general class of quark mass matrix ansatz has been proposed, which originates from some flavor symmetry. We extend that symmetry to the lepton sector and study the neutrino mass matrix and address the question of the baryon asymmetry of the universe in this model.

The question of flavor mixing and fermion masses can lead us to physics beyond the standard model, where several experimental results are present without any theoretical insight. As an attempt to derive relationship between the quark masses and flavor mixing hierarchies, several mass matrix ansätze were suggested about two decades ago. It is expected that some theoretical consideration will give us these ansätze eventually.

Out of the several ansätze of quark mass matrices, the cannonical mass matrices of the Fritzsch-type have been generally taken to predict the entire Cabbibo–Kobayashi–Maskawa (CKM) matrix. However, this ansatz is ruled out because it predicts a light top quark with mass less than 100 GeV. Recently this form of mass matrix has been generalized to accommodate the large top quark mass while keeping the calculability of the ansatz. It was shown that this generalized form of the mass matrix could originate from breaking the maximal permutation symmetry.

In this letter we study the neutrino masses and mixing which originate as a consequence of the breaking of the maximal permutation symmetry in the lepton sector. Since this symmetry acts on both the left- and the right-handed quark fields, when we generalize it to the lepton sector, it would be natural to include the right-handed neutrinos. We shall assume that lepton number is broken at some intermediate scale when the right handed neutrinos get a Majorana mass. Then the usual Higgs doublets will combine the left-handed neutrinos to the right-handed neutrinos through the Dirac mass term, so that the left-handed neutrinos get a small see-saw Majorana mass. There is no SU(2)L triplet Higgs scalar, which can break lepton number at some high scale and give a Majorana mass to the left-handed neutrinos.

From the recent observation of neutrino experiments, it is likely that the mixing pattern of neutrino sector is quite different from those of quark and charged lepton sectors. See Table 1. Different origin of such a mixing.

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