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Random Matrices Approach to Neutrino Masses

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The origin of neutrinos masses is one of the great mysteries of modern physic. As it turns out, the Standard Model of particle physics cannot account for massive neutrinos. They can only be described as massless Weyl spinors (left handed) due to symmetry constraints. On the other hand, experiments on neutrinos oscillations have provided strong evidence for a non-zero mass, which indicate the presence of a mechanism or phenomenon beyond the current limit of our understanding. To generate the neutrino masses, we choose to work in a minimal extension of the standard model in which three right handed (sterile) neutrinos are added to the particle content in order to use the type I seesaw mechanism. However, due to the lack of knowledge about the underlying theory of neutrino masses and mixing, the parameters and couplings of the two mass matrices allowed by gauge invariance (i.e. the Dirac and Majorana mass matrices M^D and M^R respectively) cannot be predicted.

In order to overcome this obstacle, we choose to adopt the anarchy scenario proposed by Murayama et al., which allow us to randomly generate these matrices and study the resulting spectrum (for the eigenvalues) with the tools develop in the study of random matrix theory. In this work, we propose to compute the joint probability distribution for the mass matrix eigenvalues (of arbitrary dimensions) using the seesaw mechanism and extract information on neutrinos masses from the resulting spectrum. This statistical analysis allows determining among other things, the hierarchy of the mass spectrum and the mass gap between generations.

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