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Anarchy and Neutrino Physics

The anarchy principle leading to the seesaw ensemble is studied analytically with the usual tools of random matrix theory. The probability density function for the seesaw ensemble of N × N matrices is obtained in terms of a multidimensional integral. This probability density functions is then used to extract information on the relevant physical parameters of the neutrino sector of a seesaw-extended Standard Model. For N = 2 and N = 3, the distributions of the light neutrino masses, as well as the mixing angles and phases, are obtained using numerical integration methods. A systematic comparison with the much simpler type II seesaw ensemble is also performed to point out the fundamental differences between the two ensembles. It is found that the type I-III seesaw ensemble is better suited to accommodate experimental data. Moreover, the results indicate a strong preference for the mass splitting associated to normal hierarchy. However, because of the decoupling of the probability density function for the light neutrino masses and the neutrino mixings, which implies no correlation between the neutrino mass eigenstates and the neutrino mixing matrix, every permutations of the singular values are found to be equally probable for a particular mass splitting. This leads to a loss of predictive power when comparing with observations as predictions regarding the hierarchy of the mass spectrum remains out of reach in the framework of anarchy.

Experimental Collaboration

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