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Constraining Majorana CP phase in precision era of cosmology and double beta decay experiment

We show that precision measurement of (1) sum of neutrino masses by cosmological observation and (2) lifetime of neutrinoless double beta decay in ton-scale experiments, with supplementary use of (3) effective mass measured in single beta decay experiment, would allow us to obtain information on the Majorana phase of neutrinos. To quantify the sensitivity to the phase we use, in addition to the conventional allowed region plots, the CP exclusion fraction, a fraction of the CP phase parameter space that can be excluded for a given set of assumed input parameters, a global measure for CP violation. We illustrate the sensitivity under varying assumptions, from modest to optimistic ones, on experimental errors and theoretical uncertainty of nuclear matrix elements. We find that in the latter case one of the two Majorana phases (denoted as alpha_{21} can be constrained rather strongly by excluding \simeq 10-50% of the phase space at 3 sigma CL for the lowest neutrino mass of 0.1 eV. The characteristic features of the sensitivity to alpha_{21}, such as dependences on the other phase alpha_{31} and on the true values of alpha_{21}, are addressed. We also raise the question of whether the uncertainties of nuclear matrix elements could be constrained by consistency of such measurement.

Summary

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