CP violation in neutrino mass matrix

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Received 3 August 2006; received in revised form 8 February 2007; accepted 8 February 2007
Available online 16 February 2007

Abstract

We constructed rephasing invariant measures of CP violation with elements of the neutrino mass matrix, in the basis in which the charged lepton mass matrix is diagonal. We discuss some examples of neutrino mass matrices with texture zeroes, where the present approach is applicable and demonstrate how it simplifies an analysis of CP violation. We applied our approach to study CP violation in all the phenomenologically acceptable 3-generation two-zero texture neutrino mass matrices and shown that in any of these cases there is only one CP phase which contributes to the neutrino oscillation experiment and there are no Majorana phases.

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1. Introduction

In the Standard Model there is only one source of CP violation, which is in the charged–current mixing matrix in the quark sector. The charged–current mixing matrix in the quark sector contains one CP phase, which has been observed. It is not possible to identify the position of the CP phase, since it is possible to make any phase transformations to the quarks. However, it is possible to define a rephasing invariant quantity as product of elements of the mixing matrix that remains invariant under any rephasing of the quarks [1,2]. This is known as Jarlskog invariant.

In the leptonic sector, standard model does not allow any CP violation. If one considers extensions of the Standard Model to accommodate the observed neutrino masses, then there can be several CP phases [3–6]. In the simplest scenario of three generations, there could be one CP phase in the mixing matrix in the leptonic sector, similar to the quark sector. In addition, if neutrinos are Majorana particles they can have two more Majorana CP phases [4]. In this case

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doi:10.1016/j.nuclphysb.2007.02.009