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I. ABSTRACT

After the DAYA BAY's result of the mixing angle - θ_{13}, the main goal of the physics program on neutrino oscillation is to find out if CP violation is present in the leptonic sector and what is the sign of the atmospheric mass squared difference, i.e., neutrino mass hierarchy. This thesis mainly focuses on finding the discovery reach of CP violation in neutrino oscillation experiments using DAYA BAY's experimental value of $\sin\theta_{13}$.

In **Chapter 1**, a brief introduction about the phenomenon of neutrino oscillation and its present status along with some future experimental options are presented.

In **Chapter 2**, we have studied the CP violation discovery reach in neutrino oscillation experiment with superbeam in presence of non-standard interactions of neutrinos with matter for both short and long baselines. For the most important channel of oscillation ($\nu_\mu \to \nu_e$) for CP violation discovery there is significant effect in the oscillation probability particularly due to NSIs' $\varepsilon_{e\mu}$ and $\varepsilon_{e\tau}$ for longer baseline and higher energy in comparison to other NSIs'. Interestingly for these two NSIs' (for real and higher allowed values) there is possibility of better discovery reach of CP violation than that with only Standard Model interactions of neutrinos with matter provided that NSI values are known. For complex NSIs' we have shown the CP violation discovery reach in the plane of Dirac phase δ and NSI phase ϕ_{ij}. Our analysis indicates that for some values of some NSI phases total CP violation may not be observable for any values of δ.

In **Chapter 3**, using a low energy neutrino factory ($E_\mu < 10$GeV) with MIND detector, we have studied the optimization of CP violation discovery reach in the leptonic sector for different baselines and different parent muon energy considering only Standard Model interactions of neutrinos with matter. Considering such optimized experimental set-up of baseline and energy we have addressed the question of how CP violation discovery reach could get affected by the presence of non-standard interactions of neutrinos with matter during the propagation of neutrinos. For off diagonal NSI elements there could be complex phases ϕ_{ij} which could also lead to CP violation. In presence of these complex phases we have shown the contours showing the discovery reach of δ and ϕ_{ij}. We have also shown the discovery reach of NSIs in the same experimental set-up which is optimized for discovery of CP violation in the leptonic sector.

In **Chapter 4**, considering the recently obtained value of θ_{13} from Daya Bay and other reactor experiments we have studied the prospects of considering mono-energetic neutrino beam in studying CP violation in the leptonic sector. Using a neutrino beam from electron capture process for nuclei $^{110}_{50}$Sn and ^{152}Yb and considering two baselines - 130 Km and 250 Km with Water Cherenkov detector, we have shown the discovery reach of CP violation in neutrino oscillation experiment. Particularly for $^{110}_{50}$Sn nuclei CP violation could be found for about 80% of the possible δ values for a baseline of 130 km with boost factor $\gamma = 500$. This result is obtained with conservative choice of neutrino energy resolution using the possible vertex resolution at the detector and taking into account beam spreading. The nuclei ^{152}Yb is although more suitable technically for the production of mono-energetic beam, but is found to be not so suitable for good discovery reach of CP violation.

In **Chapter 5**, we have discussed that till now the exact neutrino masses are still unknown. However, the knowledge of neutrino oscillation and its mass squared differences along with the help of the end point spectrum of beta decay can be used in obtaining a bound on the sum of the neutrino masses. The lower bound is given as 0.0568 eV and the upper bound is 7.90908 eV. Cosmological observations considering ΛCDM models and experimental data like WMAP and CMB also help in obtaining an upper bound on the sum of the neutrino masses of about 0.36 eV.

In **Chaper 6**, we have summarise the main results of this thesis. It seems for superbeam, 130 Km baseline and for neutrino factory, 3000 Km baseline is better for finding CP violation. Although our study shows using pure ν_e neutrino source from electron capture could provide the best discovery reach of CP violation but its technology is yet to be implemented.