Review of accelerator based neutrino oscillation results and implication in astro-nuclear physics

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Abstract

The latest results on the neutrino oscillation measurement by the accelerator experiments are reviewed along with the discussion about the implication in astro-nuclear physics. Recently the mixing angle between the first and third generations (θ_{13}) has been measured by the accelerator [1, 2] and the reactor [3, 4, 5] neutrino experiments. Since then T2K group has increased the beam data by about factor of two compared to that in last year with the improvements of the analysis method and systematic uncertainties. They observed 10 ν_e candidate events, and archived the evidence of $\nu_\mu \rightarrow \nu_e$ oscillation, i.e. detecting non-zero θ_{13}, with 3.2σ significance. MINOS group conducted ν_e analysis with their full beam data, and observed marginal excess for both neutrino and antineutrino sample after selecting signal-like events using the sophisticated event selection. They rejected the hypothesis of non-zero θ_{13} with 96% confidence level. The discovery of $\nu_\mu \rightarrow \nu_e$ oscillation will bring non-trivial effect on astrophysics, such as supernova nucleaosynthesis and atmospheric neutrinos, and give the opportunities to probe the neutrino mass hierarchy from their observations. In future, Nova group will start ν_e measurement with partial detector from 2013 in order to probe for CP violation and mass hierarchy. Hyper-Kamiokande will be able to determine CP violation and mass hierarchy with excellent performance by measuring the accelerator and atmospheric neutrinos.

References

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