

論文の内容の要旨

論文題目

Study of the neutrino mass hierarchy with the atmospheric neutrino data
observed in Super-Kamiokande

(スーパーカミオカンデで観測された大気ニュートリノのデータを用いた
ニュートリノの質量階層性の研究)

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This thesis presents the full three flavor neutrino oscillation analysis carried out with Super-Kamiokande atmospheric neutrino data in order to obtain information on the mass hierarchy for the first time. The entire set of oscillation parameters, which include two mass differences Δm_{12}^2 and Δm_{32}^2 , three mixing angles θ_{12} , θ_{23} , θ_{13} , and the CP phase parameter δ_{CP} , and the mass hierarchies are considered. This is the first study to probe the mass hierarchy with neutrino and anti-neutrino enriched event samples from the Super-Kamiokande atmospheric neutrino data.

Super-Kamiokande is a 50 kton water Cherenkov detector which started taking data since 1996. All the observed data of atmospheric neutrino through running periods SK-I, SK-II, SK-III and SK-IV collected from 1996 to 2012 are used in this analysis.

Data selection is summarized in this thesis. The separation of neutrino and anti-neutrino enriched samples with likelihood method is also presented.

Sensitivity study shows that the newly developed neutrino and anti-neutrino enriched samples help to improve the sensitivity on mass hierarchy and other oscillation parameters. The analysis are carried out for both cases of free θ_{13} and fixed θ_{13} . In case of fixed θ_{13} , inverted hierarchy is slightly favoured with significance $\Delta\chi^2 (= \chi^2_{\min}(\text{NH}) - \chi^2_{\min}(\text{IH}))$ of 1.2, which is still low to draw a conclusion for the mass hierarchy. It is expected that the mass hierarchy can be constrained with atmospheric neutrinos with longer exposure time or larger detector size in future experiments.