P3.006 Development of neutron tagging algorithm for Hyper-Kamiokande with pure water

Y Okajima[1], M Kuze[1], M Ishitsuka[1], M Shiozawa[2], A Takeda[2] and T Yano[3]

[1]Tokyo Institute of Technology, Japan, [2]Kamioka Observatory, Institute for Cosmic Ray Research, University of Tokyo, Japan, [3]Kobe University, Japan

on behalf of the Hyper-Kamiokande collaboration

Hyper-Kamiokande is a proposed future neutrino experiment with physics goals such as the discovery of leptonic CP violation, nucleon decay, supernova relic neutrino, and so on, using a large volume water Cherenkov detector. In order to reach these goals, precise measurements are necessary.

Neutrons are generated in some neutrino interactions like charged current interaction between anti-neutrino and proton. If the neutron can be detected, we can identify $\nu/\bar{\nu}$ more precisely. This is important for CP violation and supernova relic neutrino search.

After the neutrino interaction, neutrons are also generated by the nuclear effect and hadron interaction. Because the major background of nucleon decay analysis is atmospheric neutrino interaction, neutron tagging is also important for the background rejection.

The neutron does not emit any Cherenkov lights. However, it can be captured by hydrogen, gadolinium and so on. In this study, we evaluate the events with neutron which is captured by hydrogen in a Hyper-Kamiokande water tank. When the hydrogen captures a neutron, a 2.2 MeV y is emitted. Therefore, we can detect neutrons generated in water by searching for 2.2 MeV y signals.

Super-Kamiokande has only 20% tagging efficiency, but Hyper-Kamiokande is expected to have higher tagging efficiency because Hyper-Kamiokande is planned to use new photomultipliers (PMTs), which have twice as high photon detection efficiency as Super-Kamiokande PMTs.

In this presentation, I will describe the progress of neutron tagging algorithm development and the evaluation result of tagging efficiency in Hyper-Kamiokande with pure water.