



The Hyper-Kamiokande Experiment

Thursday 5 July 2012 16:15 (15 minutes)

We propose the Hyper-Kamiokande (Hyper-K) detector as a next generation underground water Cherenkov detector. It will serve as a far detector of a long baseline neutrino oscillation experiment envisioned for the upgraded J-PARC, and as a detector capable of observing – far beyond the sensitivity of the Super-Kamiokande (Super-K) detector – proton decays, atmospheric neutrinos, and neutrinos from astronomical origins. The baseline design of Hyper-K is based on the highly successful Super-K, taking full advantage of a well-proven technology.

Hyper-K consists of two cylindrical tanks lying side-by-side, the outer dimensions of each tank being 48 m (W) x 54 m (H) x 250 m (L). The total (fiducial) mass of the detector is 0.99 (0.56) million metric tons, which is about 20 (25) times larger than that of Super-K. A proposed location for Hyper-K is about 8 km south of Super-K (and 295 km away from J-PARC) at an underground depth of 1,750 meters water equivalent (m.w.e.). The inner detector region of the Hyper-K detector is viewed by 99,000 20-inch PMTs, corresponding to the PMT density of 20% photo-cathode coverage (one half of that of Super-K).

Hyper-K presents the potential for determination of the CP phase δ in the 3-flavor framework and therefore has discovery reach for CP violation in the lepton sector. With a total exposure of 5 years (one year being equal to 10^7 sec) to a 2.5 degree off-axis neutrino beam produced by the 1.66 MW J-PARC proton synchrotron, it is expected that the CP phase δ can be determined to better than 18 degrees for all possible δ values and CP violation can be established with a statistical significance of 3σ for 70% of the δ parameter space assuming the recent measured θ_{13} by T2K, Daya Bay, and RENO, and a known mass hierarchy. The mass hierarchy itself can be determined with more than 3σ statistical significance for 46% of the δ parameter space. Furthermore, Hyper-K's high statistics data sample of atmospheric neutrinos will allow us to extract additional information on the mass hierarchy and the octant of θ_{23} . With a full 10 year duration of data taking, the significance for the mass hierarchy determination is expected to reach 3σ or greater if $\sin^2\theta_{23} > 0.4$.

Hyper-K will extend the sensitivity to nucleon decays beyond what can be achieved by Super-K by an order of magnitude or more. The sensitivities to the partial lifetime of protons for the decay modes $p \rightarrow e^+\pi^0$ and $p \rightarrow \nu\bar{\nu}K^+$ are expected to exceed 1×10^{35} years and 2×10^{34} years, respectively. This is the only known, realistic detector option capable of reaching such a sensitivity for the $p \rightarrow e^+\pi^0$ mode.

The scope of studies at Hyper-K also covers high precision measurements of solar neutrinos, observation of both supernova burst neutrinos and supernova relic neutrinos, and dark matter searches.

Author: Dr SEKIYA, Hiroyuki (Kamioka Observatory ICRR University of Tokyo)

Presenter: Dr SEKIYA, Hiroyuki (Kamioka Observatory ICRR University of Tokyo)

Session Classification: TR 8 - Neutrinos RM 219

Track Classification: Track 8. Neutrinos