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Hyper-Kamiokande

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Hyper-Kamiokande (Hyper-K) is proposed as a next-generation underground water Cherenkov detector having an enormous potential to discover proton decays and leptonic CP violation in neutrino oscillations. Two cylindrical tanks, each with a height of 60m and a diameter of 74m, will be filled with 520,000 metric tons of ultrapure water, a volume approximately 10 times larger than that of predecessor experiment Super-Kamiokande (Super-K). The innermost main water volume of each tank will be viewed by 40,000 ultrasensitive 50cm diameter photosensors.

The Hyper-K project has been strongly supported by both the high energy physics community and the cosmic-ray community, and the project was selected as one of top 28 important large research projects in the "Master Plan 2017" by the Science Council of Japan. Various R&D works as well as the physics potential studies have been done by members of the Hyper-K international proto-collaboration, which was formed in January 2015 and now consists of about 300 researchers from 15 countries. One of major international R&D activities for Hyper-K is to develop new photosensors as alternatives to Hamamatsu R3600 50cm PMTs, which have been successfully used for 20 years in Super-K. We have developed a new 50cm PMT having a high quantum efficiency photocathode and Box-and-Line type dynodes. The new PMT has twice higher single photon detection efficiency and much better timing and charge resolution than those of R3600.

Hyper-K is presently the only experiment aiming to have the 3σ discovery potential for the proton decay mode into $e^+\pi^0$ even if the proton lifetime is as long as 10^{35} years. In the search for the proton decay mode into $\bar{\nu}K^+$, which is favored by supersymmetry grand unified theories, the 3σ discovery potential will reach $\tau/B = 2.5 \times 10^{34}$ years in 10 years of Hyper-K running. Considering the latest J-PARC beam power projection, the CP violating phase δ_{CP} will be measured with 1σ error of 7 (21) degrees after 10 years if δ_{CP} is 0 (90) degrees. The neutrino CP violation will be discovered with more than 3σ (5σ) significance for 78\% (62\%) of values of delta. The high statistics data sample of atmospheric neutrinos obtained by Hyper-K will also play an important role to grasp the full picture of neutrino oscillations. The neutrino mass hierarchy will be determined with 3σ significance in a few years of atmospheric neutrino observation by Hyper-K in combination with the beam neutrino measurement. As for the solar neutrino observation, the upturn in the solar neutrino energy spectrum, which is caused by the matter effect in the Sun, will be observed with 5σ significance in 10 years Hyper-K running. Hyper-K has also a great potential to discover the diffuse supernova neutrino background, often called the relic supernova neutrinos.

In this talk, the latest status of the Hyper-K project as well as its sensitivities in various physics programs will be presented.

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