

**“Inauguration of Next-generation Neutrino Science Organization
for the Hyper-Kamiokande Nucleon Decay and Neutrino Experiment”**

The Hyper-Kamiokande project aims to address the mysteries of the origin and evolution of the Universe’s matter as well as to confront theories of elementary particle unification. To realize these goals it will combine a high intensity neutrino beam from J-PARC with a new detector based upon precision neutrino experimental techniques developed in Japan and built to be approximately 10 times larger than the running Super-Kamiokande.

On October 1st, 2017, The University of Tokyo launched its “Next-generation Neutrino Science Organization (NNSO),” in cooperation with the Institute for Cosmic Ray Research (ICRR), the Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU), and the University of Tokyo’s School of Science. The NNSO is a means of pioneering the future of neutrino physics through the development of neutrino research techniques and detector technologies. In particular, it aims to advance what will become its flagship facility, the Hyper-Kamiokande project. To mark the occasion, an inaugural ceremony was held on November 8th, 2017, at the Kamioka Observatory in Japan (see photos in Attachment 1).

Professor Takaaki Kajita, director of NNSO and a Nobel laureate for the discovery of neutrino oscillations demonstrating that neutrinos have mass, started the ceremony with opening remarks: *“Understanding the neutrino, whose mass is extremely small, is not only important to particle physics, but is also thought to have deep connections to the origins of matter. Indeed, by observing neutrinos created with the high intensity proton accelerator J-PARC at Hyper-Kamiokande and testing whether or not neutrino and antineutrino oscillations are the same, we expect to close in on the mysteries of our matter-dominated universe. Further, we would like to discover the decay of the proton and thereby verify the unification of the three forces that act between elementary particles. Through the research represented by these goals, I would like to greatly expand our knowledge of elementary particles and the universe.”*

Professor Masashi Haneda, Executive Vice President of The University of Tokyo and Director of The University of Tokyo Institutes for Advanced Study, greeted attendees with these words: *“Through the cooperation of these three important institutions, I’m sure that a world-class center for neutrino research will be established. Further, it will contribute much to cultivate talented young researchers. Succeeding Kamiokande and Super-Kamiokande, the Hyper-Kamiokande project will lead the world’s neutrino research. I would like to underline that the University of Tokyo will do our best to support this newly established organization.”*

Professor Hiroyuki Takeda, Dean of the School of Science, also gave an address: *“The School of Science has a long and intimate relationship to the research in Kamioka, because Professor Koshiba started the original Kamiokande experiment when he was a faculty member of the School of Science. It is our great pleasure that we can further deepen the relationship with ICRP and Kavli IPMU through this organization to promote neutrino physics and the Hyper-Kamiokande project.”*

Professor Hitoshi Murayama, director of the Kavli Institute for the Physics and Mathematics of the Universe, delivered this message: *“I firmly believe that the Hyper-Kamiokande experiment will be one of the most important experiments in the foreseeable future to study the Universe. Kavli IPMU would like to contribute to the Hyper-Kamiokande experiment with experimental expertise, theoretical support, and international networking. I'm very excited. Let's make the Hyper-Kamiokande experiment happen!”*

Tomonori Nishii, Director of Scientific Research Institutes Division, Ministry of Education, Culture, Science and Technology (MEXT), Japan, presented congratulations: *“In July of this year, the MEXT Roadmap 2017, which outlines the basic plan for pursuing large-scale projects, has been compiled by the Council for Science and Technology. It made the implementation priority of such projects clear. “Nucleon Decay and Neutrino Oscillation Experiment with a Large Advanced Detector”, that is Hyper-Kamiokande, is highly evaluated and listed in the roadmap with six other projects. MEXT, together with you, looks forward to seeing this new organization thrive as an international collaborative research hub and produce excellent scientific research achievements.”*

The ceremony was attended by about 100 people from MEXT, the University of Tokyo, KEK, local government and community, the Kamioka Mining and Smelting Company, and collaborating scientists. At the end, all attendees got together to take a group photo and celebrated the start of the new organization for promotion of neutrino physics and the Hyper-Kamiokande project.

Additional NNSO details are provided on the website:

<http://nnsso.jp>

For more information about the Hyper-Kamiokande project, please see Attachment 2 and the website below:

<http://www.hyper-k.org>

Inquiries

- Concerning the ceremony and the Next-generation Neutrino Science Organization

Yumiko Takenaga, Public Relations Officer
The University of Tokyo Institute for Cosmic Ray Research
TEL : 0578-85-9704
E-mail : takenaga@km.icrr.u-tokyo.ac.jp

- Concerning Hyper-Kamiokande
Professor Masato Shiozawa
The University of Tokyo Institute for Cosmic Ray Research, and
Next-generation Neutrino Science Organization
TEL : 0578-85-9611
E-mail: masato@icrr.u-tokyo.ac.jp



Opening remarks by Professor Takaaki Kajita, Director of NNSO

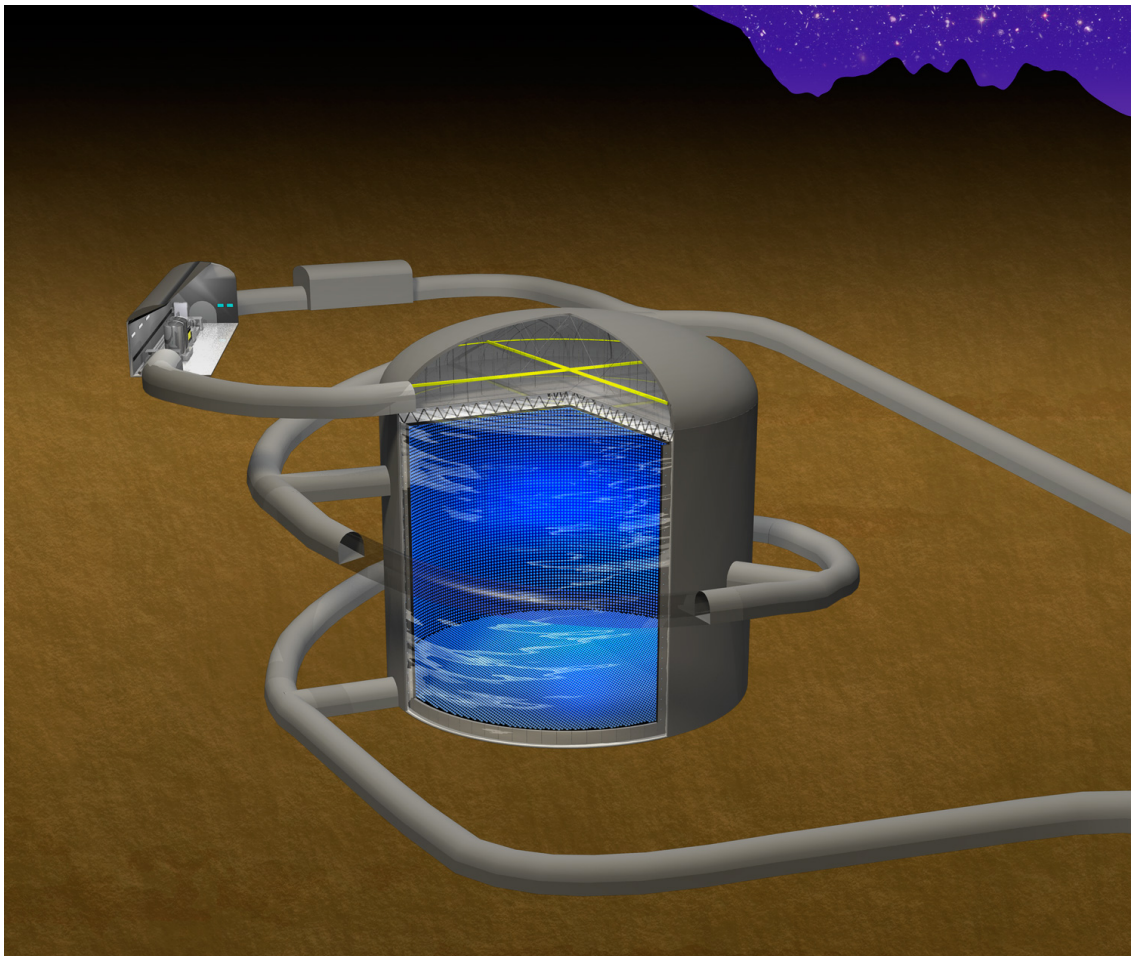


Unveiling ceremony for the NNSO monument sign by attendees, from right: Kavli IPMU Director Hitoshi Murayama; Dean of the School of Science Hiroyuki Takeda; Director of ICRR and NNSO Takaaki Kajita; Executive Vice President of The University of Tokyo Masashi Haneda; Director of Scientific Research Institutes Division, MEXT Tomonori Nishii; Executive Director of KEK Toshikazu Ishii; Chair of Board of Education, Hida city Koichi Yamamoto; President of Kamioka Mining and Smelting Company Keizo Nakayama.



All attendees got together to take a group photo.

■ Hyper-Kamiokande project



Hyper-Kamiokande, or Hyper-K, is a straightforward extension of the successful water Cherenkov detector experiment Super-Kamiokande. It employs well-proven and high-performance water Cherenkov detector technology with established capabilities of neutrino oscillation studies by accelerator and atmospheric neutrinos, proton decay searches, and precision measurements of solar and supernova neutrinos. Hyper-Kamiokande will provide major new capabilities to make new discoveries in particle and astroparticle physics thanks to an order of magnitude increase in detector mass and improvements in photon detection, along with the envisioned J-PARC Megawatt-class neutrino beam.

An international Hyper-Kamiokande proto-collaboration has been formed to carry out the experiment; it consists of about 300 researchers from 15 countries as of April 2017. The Hyper-Kamiokande member states are Armenia, Brazil, Canada, Ecuador, France, Italy, Japan, Korea, Poland, Russia, Spain, Switzerland, UK, Ukraine, and USA. The Institute for Cosmic Ray Research of the University of Tokyo and the Institute of Particle and Nuclear Studies of the High Energy Accelerator Research

Organization KEK have signed a MoU affirming cooperation in the Hyper-K project to review and develop the program.

Hyper-K is to be built as a tank with a 187 kiloton fiducial volume containing about 40,000 50-cm photo-multiplier tubes (PMTs), providing 40% photo cathode coverage (Figure 1). The proto-collaboration has succeeded in developing new PMTs with double the single-photon-sensitivity of those in Super-K (Figure 2).

The Hyper-K and J-PARC neutrino beam measurement of neutrino oscillation is more likely to provide a 5-sigma discovery of CP violation than any other existing or proposed experiment (Figure 3). Hyper-K will also be the world leader for nucleon decays. The sensitivity to the partial lifetime of protons for the decay modes of $p \rightarrow e^+ \pi^0$ is expected to exceed 10^{35} years (Figure 4). This is the only known, realistic detector option capable of reaching such a sensitivity for the $p \rightarrow e^+ \pi^0$ mode. Finally, the astrophysical neutrino program involves precision measurement of solar neutrinos and their matter effects, as well as high-statistics supernova burst and supernova relic neutrinos.

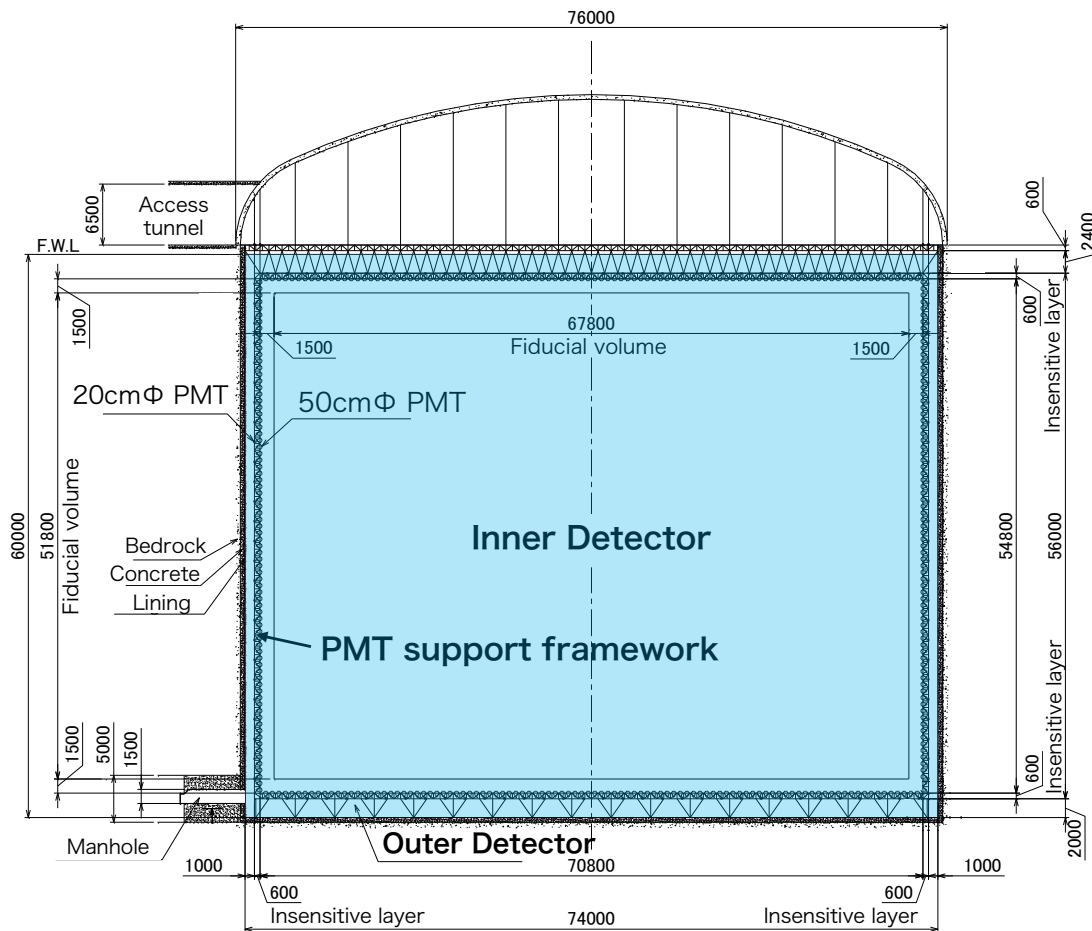


Figure 1: Schematic view of the Hyper-Kamiokande detector

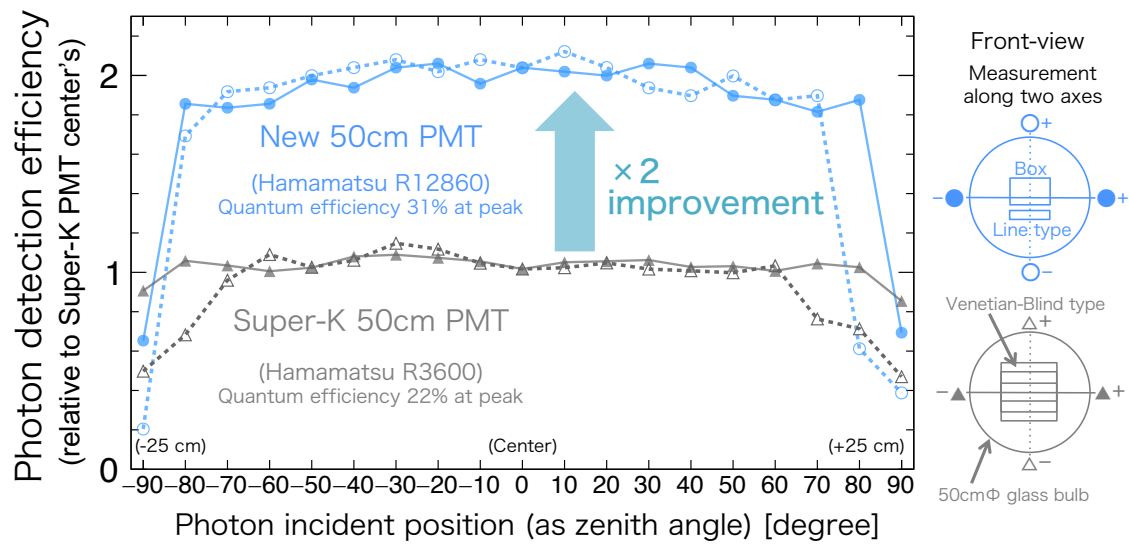


Figure 2: Single-photon sensitivity for the photo-sensors used in the running Super-Kamiokande (blank and filled triangles) and those for Hyper-Kamiokande (blank and filled circles)

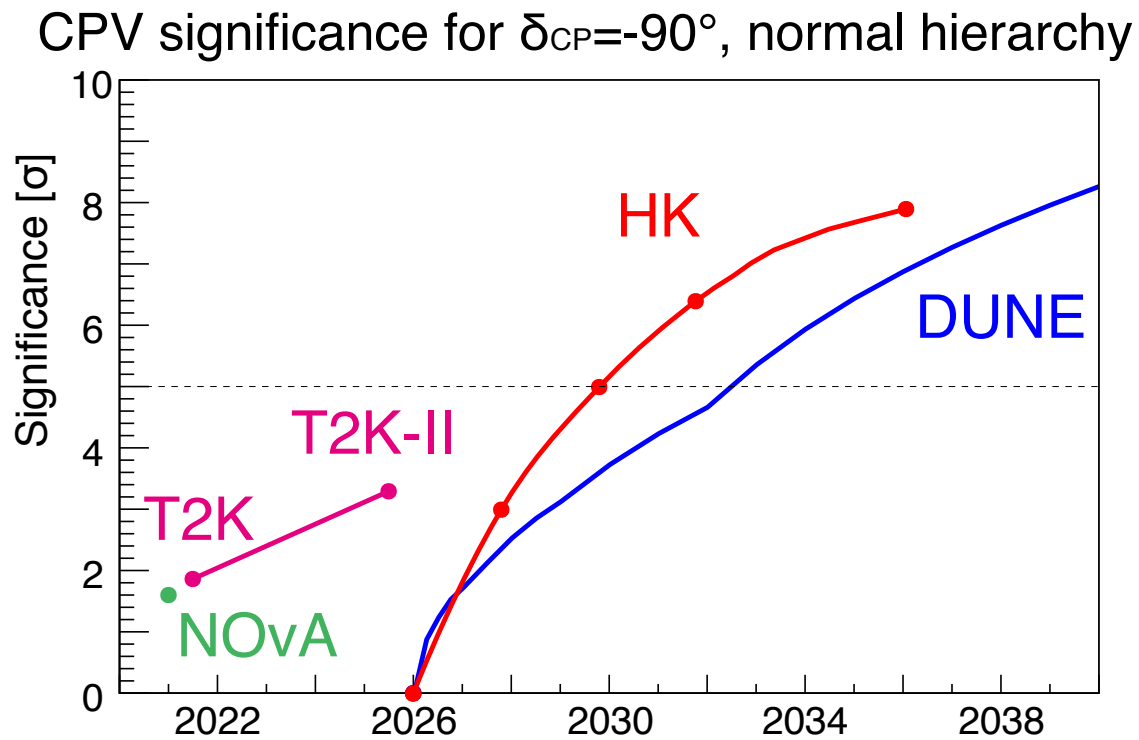


Figure 3: Expected significance of CP violation observation for Hyper-Kamiokande (HK), a future US-based project (DUNE), and running experiments (T2K, NOvA). X-axis is year.

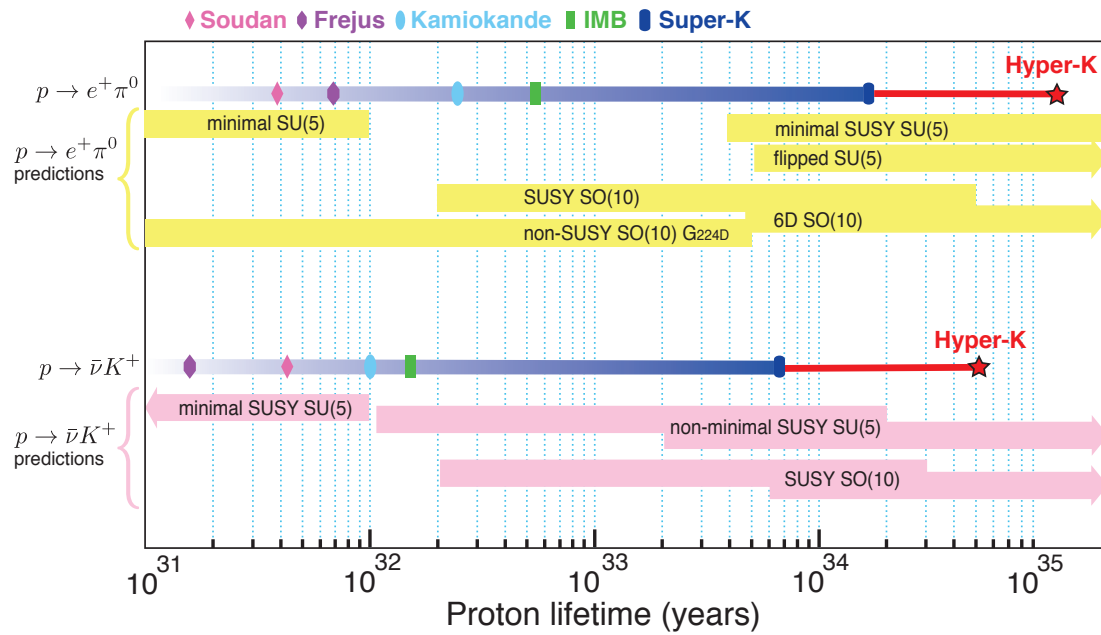


Figure 4: Hyper-K's expected reach for proton decays (red stars) compared with the experimental limits obtained by Super-K and other past experiments. Bands show predictions by various grand unified theories. X-axis shows proton lifetime divided by the branching ratio.