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The Hyper-Kamiokande experiment: input to the update of the European Strategy for Particle Physics

This document summarises the input of the Hyper-Kamiokande collaboration to the 2026 Update to the European Strategy for Particle Physics, ESPPU.

Hyper-Kamiokande is a large infrastructure for particle and astroparticle physics being built in Japan and aiming to start operations by the end of 2027 whose objective is to address the most important questions in science today, for instance how the universe began and evolved. It aims to measure with the highest precision the leptonic Charge-Parity violation parameter that could explain the baryon asymmetry in the Universe and study / challenge the standard three-flavour neutrino framework using both a Mega-Watt intense neutrino beam and high-statistics atmospheric neutrino samples. The combination of these samples will break the degeneracies between the effects of the Mass Ordering and Charge-Parity violation, allowing for their measurement without relying on external information.

Hyper-Kamiokande is also a neutrino observatory for astrophysical events that will collect the highest statistics due to its size. It will also be able to precisely measure solar neutrino oscillations and other astrophysics events as supernova bursts, relic supernova neutrinos, neutrinos in correspondence with gravitational waves, etc. It can also detect neutrinos from sources such as dark-matter annihilation, gamma-ray burst jets, and pulsar winds, further increasing our understanding of some of the most spectacular, and least understood, phenomena in the Universe.

Furthermore, due to its size and particle identification capability, the experiment has an excellent potential to search for proton decay, providing a
significant improvement in discovery sensitivity over current searches for the proton lifetime and nucleon decays.

Hyper-Kamiokande is expected to run at least 20 years from the start of operations and is supported by 10 countries in Europe that are contributing to its construction, future operation and data analysis. Prototyping and assembly are also being carried out at CERN.
The reduction of the flux systematic uncertainties would benefit from new hadron production measurements at the NA61/SHINE experiment at CERN, also with a low-energy beam.
A final upgrade of the magnetised off-axis near detector (ND280++) for the high-statistics phase in the 2030s aim to be sought and would benefit from CERN support.

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