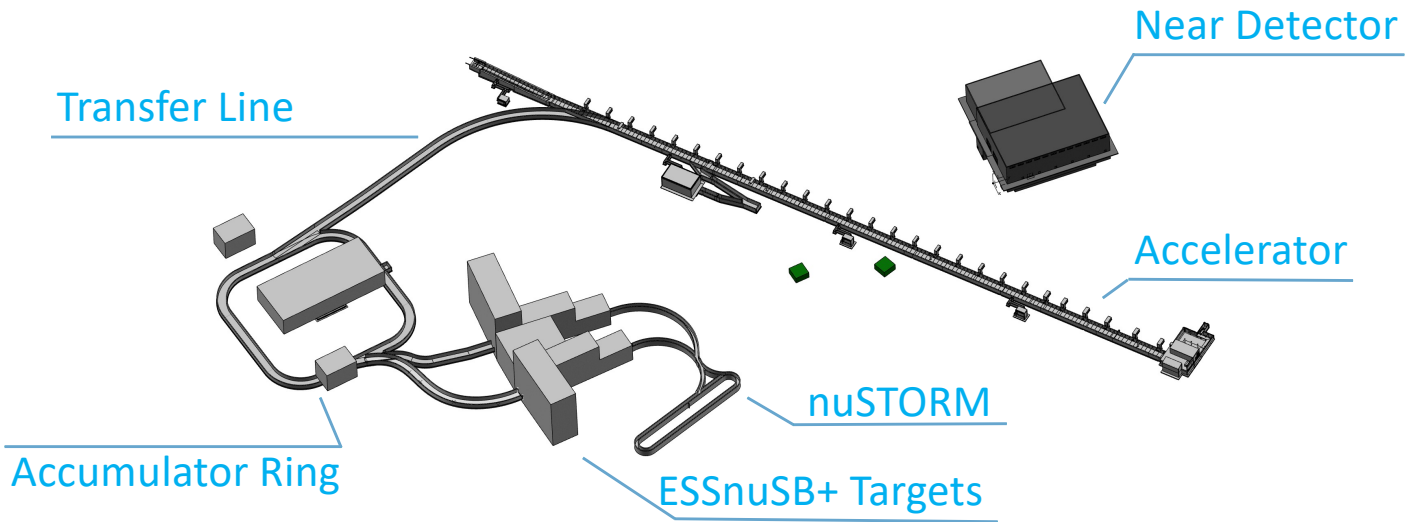




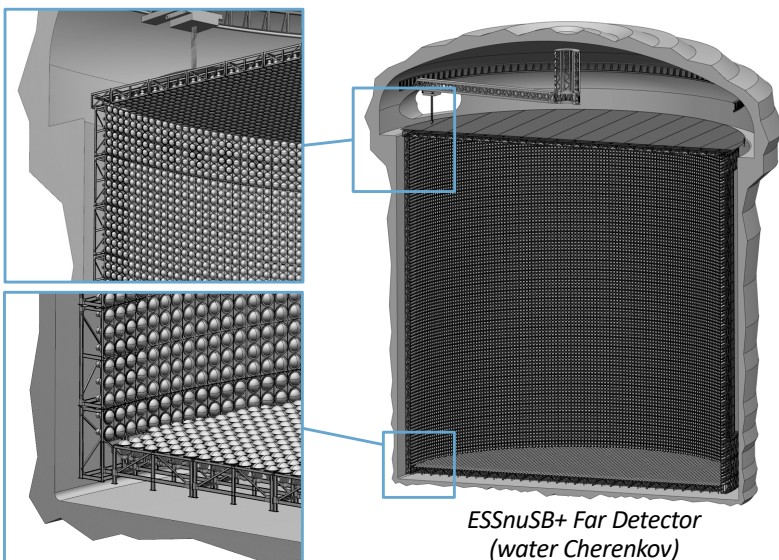
The neutron facility of the European Spallation Source – ESS is currently undergoing construction and installation in Lund, Sweden with the goal to achieve a 5MW proton beam of 2 GeV Linear Accelerator (LINAC). A new proposal to upgrade the beam energy to a 2.5 GeV and to operate the LINAC at 28 Hz repetition rate, with a total power of 10 MW, adding H⁻ ions interleaved with the original protons would produce an intense neutrino beam. This neutrino beam would then be aimed at a megaton water Cherenkov detector to be hosted underground and at a distance of about 500 km (corresponding to the second oscillation maximum). Innovative observations of CP violations could take place in the leptonic sector with such a setup and in-depth studies of the matter-antimatter asymmetry in the universe would be possible with this novel neutrino experiment.

The ESS neutrino Super Beam plus (ESSnuSB+) project is a proposal to upgrade the ESS facility and accommodate for ESSnuSB+ operations, with a new accumulator ring, a 2nd target station, a near detector and a far detector, as depicted below.



Conceptual integration design of ESSnuSB+

The structural modifications to the existing ESS accelerator tunnel are estimated to a minimum, with the primary task of creating access in the south tunnel wall to allow for extraction of the proton beam at the downstream area of the high-energy end. This modification will allow for the connection to the new and curved transfer line that will then lead the H⁻ beam to the accumulator ring. The switchyard ensures that the extracted beam from the accumulator ring will then reach the 2nd target for neutrino production. The neutrinos produced pass through the near detector, following the geographical north with a trajectory aiming to the ESSnuSB+ Far Detector.



*ESSnuSB+ Far Detector
(water Cherenkov)*

The Zinkgruvan mine, located 360 km from ESSnuSB+ in Lund, has been assessed for potentially hosting the underground Far Detector. The Zinkgruvan mine appears to be closer to the ideal choice, subject to investigation in progress of this study. This mine has all the appropriate access and infrastructure available to benchmark data for a detailed site-feasibility study. The Far Detector cavern, with unprecedented dimensions for such an experiment (approximately 78m by 78m in a cylindrical cross section) is estimated to be located in an average depth of almost 1 km below the ground level. The geological investigation for both ESS site and mine site is under preparation and each has challenging requirements to fulfill: the mine site will be one of the deepest in earth man-made constructions ever; whereas the new tunnelling system for the ESSnuSB+ at the ESS site will need to be built possibly under the water level, making it similar to an underwater construction.

