Optimisation of the hadronic collector for the ESSνSB neutrino superbeam.

During these last decades, particle physics made lots of progresses in particular in neutrino physics with the discovery of the oscillation mechanism and bring the proof that these particles are massives which is not foreseen by the current theory. This result opens a window to new physics beyond the Standart Model. Since 2012, most ot the parameters of the PMNS oscillation mixing matrix have been estimated with a certain accuracy, but the CP violation in the leptonic sector remains unknown. This measurement could have an important cosmological implications due to their large abundance in the Universe.
In order to go beyond our current knowledge and taking into account the very low interaction cross section with matter, very intense neutrino beams and large detector are necessary. These superbeams require the development of proton drivers with one order of magnitude higher in intensity compared to the existing devices and are currently under consideration by the whole community.
Our research group in collaboration with other european instituts proposes to design such superbeam using the European Spallation Source (ESS) based in Lund (Sweden).The ESS LINAC will produced a pulsed proton beam at 5 MW power scale and will be in ten years the most powerfull proton beam in the world. At the end of the linear accelerator, the proton beam comes into an accumulator whose purpose is to reduce the pulse time width of the beam from 2.86 ms to 1.32 μs. The beam impinging onto a fixed target produces secondary particles which are focused by a four horn system into a decay tunnel. The emerging neutrino beam will point toward a Water Cherenkov detector (MEMPHYS) located 532 kilometers downstream in the Garpenberg mine. The focusing system is a key element which strongly influence the intensity, the energy and the physics performances of the experiment. In order to optimize the parameters of this system, all the processes have to be simulated from the particle production in target, the propagation and the neutrino interactions inside the detector and extract the evaluate the physics performances.
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The goal of the master internship will be to optimize the neutrino superbeam taking into account of the current configuration of the four horns with a Monte Carlo simulation based on GEANT4/FLUKA.

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