The ENUBET monitored neutrino beam
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Physics programme:
The ideal facility for a new generation of cross section experiments: improvement by one order of magnitude the measurement of $\nu_e$ and $\nu_\mu$ cross sections and precision study of neutrino interactions with nuclei. Highly beneficial for tackling the main open neutrino-related issues: (leptonic CP violation, mass hierarchy, $\theta_{23}$ octant) by reducing the systematic budget of DUNE and HyperK. First step towards a time tagged neutrino beam: direct production/detection correlation.

Enhanced NeUtrino BEams from kaon Tagging

New technique employed to determine the absolute $\nu_e$ and $\nu_\mu$ flux based on the reconstruction of large angle positrons and muons in the instrumented decay tunnel from three-body $K^+ \rightarrow e^+ \pi^0 \nu_e$ decays. Reduction of the systematic uncertainties on the knowledge of the initial neutrino flux to O(1%) level.

Monitored Neutrino Beams

Full Geant4 simulation of the detector (validated for reconstruction by prototype tests at CERN during 2016-2018): particle propagation and decay from transfer line to detector; hit level detector response; pile-up effects included: 1. Ke3 reconstruction: Eff. = 22±0.2% & S/N = 2 2. Kπ reconstruction: Eff. = 34±0.6% & S/N = 6

Lepton Reconstruction

R&D using the CERN-SPS as a benchmark, in collaboration with CERN A&T Division (p=400 GeV/c, 4.5 x 10^19 pot/spill). Focusing: “slow” extraction to mitigate the rate of leptons in the decay tunnel

Proton Extraction

Horn: 2-5 ms extractions in the flat top
Purely static focusing: 2 s extraction

Static Beamline

Large bending angle (14.8°) with 2 dipoles. Collimated beam and reduced background from muons; reduced from early decays in detector; ~14% contamination of in detector produced before tagger and after the 2nd bending dipole

Multi-Momentum Beamline

-Set of different neutrino spectra spanning from the “Hyper-K” to DUNE regions of interest.
-Focus 8.5, 6 or 4 GeV/c secondaries.
-Larger bending angle (18°)
-Tools: Optics optimization TRANSPORT + G4Beamline. Validation + higher order effects with MAJX/PTC-TRACK. Doses and Background reduction studies: FLUKA
-Detailed description of existing magnetic elements
-Under consideration: whole beamline tilted w.r.t. target

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