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The ENUBET monitored neutrino beam for high precision cross section measurements

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The main source of systematic uncertainty on neutrino cross section measurements at the GeV scale originates from the poor knowledge of the initial flux. The goal of cutting down this uncertainty to 1% can be achieved through the monitoring of charged leptons produced in association with neutrinos, by properly instrumenting the decay region of a conventional narrow-band neutrino beam. Large angle muons and positrons from kaons are measured by a sampling calorimeter on the decay tunnel walls, while muon stations after the hadron dump can be used to monitor the neutrino component from pion decays. This instrumentation can provide a full control on both the muon and electron neutrino fluxes at all energies. Furthermore, the narrow momentum width (<10%) of the beam provides a 0(10%) measurement of the neutrino energy on an event by event basis, thanks to its correlation with the radial position of the interaction at the neutrino detector. The ENUBET project has been funded by the ERC in 2016 to prove the feasibility of such a monitored neutrino beam and, since 2019, ENUBET is a CERN neutrino platform experiment (NP06/ENUBET). In this talk we will present the final results of the ERC project, together with the complete assessment of the feasibility of its concept. The breakthrough the project achieved is the design of a horn-less beamline that allows for a 1% measurement of ν_e and ν_μ cross sections in about 3 years of data taking at CERN-SPS using ProtoDUNE as far detector. Thanks to the replacement of the horn with a static focusing system (2 s proton extraction) we reduce the pile up by two orders of magnitude, and we can monitor leptons from pion and kaon decays with a signal/background >2. We will hence discuss the implementation of a monitored neutrino beam at CERN and FNAL, its performance and perspectives for a new generation of cross section experiments to study neutrino-nucleus interactions and improve the physics reach of DUNE and Hyper-Kamiokande.

Attendance type

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