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The ENUBET experiment

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The ENUBET experiment (*) aims at demonstrating the feasibility of a "monitored" neutrino beam, in which the absolute normalization of the neutrino flux produced by a narrow band meson beam can be constrained at the 1% level. The electron neutrino component is determined by monitoring large-angle positrons from Ke3 decays in a 40 m long instrumented decay tunnel (tagger). The measurement of muons in the tagger and after the hadron dump allows to determine the nu_mu flux from kaons and pions respectively. In addition, in a narrow band beam (p=8.5GeV +/- 10%), the transverse position of the neutrino interaction at the detector can be exploited to determine a priori, with significant precision, the neutrino energy spectrum without relying on the final state reconstruction. These concepts can be implemented in a single facility based on standard accelerator technologies for a new generation of high precision nu_e and nu_mu cross section measurements at the GeV scale and for precision searches of Physics beyond the standard three neutrino paradigm.

We will present the optimization and performances of a 20 m long focusing transfer line allowing for a continuous measurement of Ke3 positrons at single-particle level. The (quadrupole-based) focusing system is designed to be operated with a slow extraction proton scheme where protons can be diluted over several seconds. This timing allows for the direct monitoring of muons after the hadron dump and extends the original scope of the project towards a full-fledged "time-tagged" neutrino beam: time-coincidences among the lepton at the source and the neutrino at the detector would enable an unprecedented purity and the possibility to reconstruct the neutrino kinematics at source on an event by event basis.

At ICHEP we will present for the first time the design of the horn-based beamline. We have recently improved the initial transfer line design by introducing an additional dipole giving an increased bending angle for momentum selection (˜8.5 GeV/c mesons). It ensures a reduced background from the untagged neutrino component at the neutrino detector and an higher purity of the meson beam at the expense of a reduced meson yield. The neutrino flux reduction is compensated in this option by a horn-based focusing and a "burst slow extraction" that has been recently demonstrated experimentally at CERN-SPS in the context of the ENUBET machine studies.

This contribution will report on another major milestone: the final design of the ENUBET demonstrator for the instrumented decay tunnel that is due end 2021, and has been selected on the basis of the results of the 2016-2018 testbeams. This large detector prototype will prove the scalability and performance of the selected detector technology: an iron-scintillator modular sampling calorimeter (for e/pi separation) with a lateral light readout through WLS fibers connected to SiPMs, complemented by a photon veto system (for e/pi0 separation) made by an
inner ring of plastic scintillator trackers.

(*) ENUBET is an ERC project (2016-2021, p.i. Andrea Longhin). Since March 2019 ENUBET is also a CERN Neutrino Platform experiment, approved under the name NP06/ENUBET.

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