ADDENDUM for the European Particle Physics Strategy

A high precision neutrino beam for a new generation of short baseline experiments

1 Interested community

This proposal is of interest to the community of scientists involved in high precision neutrino cross sections measurements and to the entire community that contributes to the neutrino oscillation programme at future long baseline experiments, as outlined in the text. The main authors of the document are listed in Sec. 2. The R&D described in the proposal has been performed in the framework of the ENUBET and NUTECH projects (Sec. 3). Most of the authors are also members of the ENUBET Collaboration.

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3 The ENUBET ERC project and NUTECH

The ENUBET [1, 2, 4, 3] (Enhanced NeUtrino BEams from kaon Tagging) project is funded by the ERC through the Consolidator Grant programme (ERC-CoG-2015, P.I. A. Longhin, Grant Agreement 681647). The project has started on June 2016 and will continue until June 2021 with a 2 MEUR budget. It is shared between the Istituto Nazionale di Fisica Nucleare (INFN) and Padova University which has joined in as Host Institution since March 2018. The goal of the project is a thourough investigation of the feasibility of a monitored neutrino beam with a superior control of the neutrino flux. In monitored neutrino beams, the decay tunnel of the narrow band beam is instrumented in order to tag on an event-by-event level large-angle positrons produced by $K^+ \to e^+\pi^0\nu_e$ (or their charge conjugate in the negative polarity run). The study is exploring this possibility at the energies of available proton drivers in a site-independent way. An intense experimental campaign has been carried out by the ENUBET Collaboration in 2016-2018 at the CERN-PS T9 beamline to validate the performance of the detectors used for the instrumentation of the tunnel. Furthermore a detector based on scintillator tracking planes has been developed to separate electromagnetic showers produced by positrons or neutral pion decays (photon-veto, t_0-layer). In parallel the design of the hadronic beamline is being developed with detailed simulations (TRANSPORT, G4Beamline, FLUKA) both with static focusing elements and magnetic horns. A novel time structure of the extracted protons is also being developed in collaboration with the CERN-BE-OP-SPS, (F.Velotti, M.Pari, V.Kain, B.Goddard) which would enable the possibility to employ a focusing system based on pulsed magnetic horns with high effienciency. The design of the instrumentation will be finalized in 2019 and ENUBET will commence the construction of the final demonstrator in 2020. Updated lists of the project publications and public presentations are available at [5] and [6], respectively.

NUTECH (NeUtrino Time-tagged bEams with CHerenkov detectors) is a satellite project of ENUBET funded by the Italian Ministry of Research (MIUR) with a 220 kEUR budget since January 2018 (P.I. A. Longhin). The goal of the project is to develop fast timing detectors that can replace the ENUBET t_0-layer providing time tagging at the 100 ps level. As outlined in the text, this R&D enables the technology needed for tagged neutrino beams.

References

[1] ENUBET EU reference page: https://cordis.europa.eu/project/rcn/200776_en.html

[2] ENUBET-UNIPD webpage: https://www.unipd.it/en/sites/en.unipd.it/files/ENUBET-%20Longhin.pdf

[3] ENUBET-INFN webpage: http://www.pd.infn.it/erc-enubet-longhin/

[4] Project webpage: http://enubet.pd.infn.it

[5] Publications: http://enubet.pd.infn.it/publications.html

[6] Public presentations: http://enubet.pd.infn.it/presentations.html