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

The current generation of short baseline neutrino experiments is approaching intrinsic source limitations in the knowledge of flux, initial neutrino energy and flavor. A dedicated facility based on conventional accelerator techniques and existing infrastructures designed to overcome these impediments would have a remarkable impact on the entire field of neutrino oscillation physics. It would improve by about one order of magnitude the precision on ν_μ and ν_e cross sections, enable the study of electroweak nuclear physics at the GeV scale with unprecedented resolution and advance searches for physics beyond the three-neutrino paradigm. In turn, these results would enhance the physics reach of the next generation long baseline experiments (DUNE and Hyper-Kamiokande) on CP violation and their sensitivity to new physics. In this document, we present the physics case and technology challenge of high precision neutrino beams based on the results achieved by the ENUBET Collaboration in 2016-2018. We also set the R\&D milestones to enable the construction and running of this new generation of experiments well before the start of the DUNE and Hyper-Kamiokande data taking. We discuss the implementation of this new facility at three different level of complexity: ν_μ narrow band beams, ν_e monitored beams and tagged neutrino beams. We also consider a site specific implementation based on the CERN-SPS proton driver providing a fully controlled neutrino source to the ProtoDUNE detectors at CERN.

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