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Tagged neutrino beam in the P2O experiment

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Momentum of an interacting neutrino is known with a poor accuracy in accelerator-based neutrino experiments. The type and chirality of neutrino interacting in the detector are also often not exactly known in these experiments. These problems could be solved by using a new experimental method called neutrino tagging. The method consists in exploiting the kinematics of the neutrino production process, the $\pi^{\pm} \to \mu^{\pm} + \nu_{\mu}(\widetilde{\nu}_{\mu})$ decay. In tagged neutrino beams simultaneously with the registration of neutrino interaction in the detector a special tagging station measures the momentum of the parent particle, as well as the momentum of charged particle from $\pi^{\pm} \to \mu^{\pm} + \nu_{\mu}(\widetilde{\nu}_{\mu})$ decay. Then it is possible to reconstruct the momentum and the type of a produced neutrino with a high accuracy. The main problem in tagged neutrino beams construction is how to relate the neutrino interaction to the corresponding parent particle decay. For this, both temporal and spatial referencing of events registered in the neutrino detector and in the tagging station detectors are used. In this paper, we describe a technique for the tagged neutrino production from $\pi^{\pm} \to \mu^{\pm} + \nu_{\mu}(\widetilde{\nu}_{\mu})$ decays at the U-70 (Protvino) accelerator complex. A description of the method and achievable key performances is presented, together with its potential benefits for long baseline experiment P2O (Protvino to ORCA).

Primary author(s) :   Prof. SOKOLOV, Anatoly (National Research Centre "Kurchatov Institute" – IHEP, Protvino, Moscow region, Russia)

Co-author(s) :   Mr. GORYACHEV, Vladimir (National Research Centre "Kurchatov Institute" – IHEP, Protvino, Moscow region, Russia); Mr. NOVOSKOLTSEV, Fedor (National Research Centre "Kurchatov Institute" – IHEP, Protvino, Moscow region, Russia); Mr. SINYUKOV, Roman (National Research Centre "Kurchatov Institute" – IHEP, Protvino, Moscow region, Russia)

Presenter(s) :   Prof. SOKOLOV, Anatoly (National Research Centre "Kurchatov Institute" – IHEP, Protvino, Moscow region, Russia)

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