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The European Spallation Source neutrino super beam

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The discovery of neutrino Charge-Parity Violation (CPV) became an important candidate to explain the matter dominance in the Universe. The goal of the ESSnuSB project is to discover and measure neutrino CPV with unprecedented sensitivity. *The construction of the European Spallation Source, ESS, the world's most intense proton source, represents an outstanding opportunity for such project to take place. ESSnuSB has been granted from EU in the framework of H2020 (2018-2022) and Horizon Europe (2023-2026) to make Design Studies. The aim of the first Design Study was to demonstrate that the ESS linac can be used to generate an intense neutrino beam by doubling its average beam power and that a megaton water Cherenkov detector can be constructed in a mine 360 km from ESS providing detection of neutrinos at the 2nd neutrino oscillation maximum. A CDR* has been published in which it is shown the high physics performance to discover CPV and precisely measure the violating parameter δCP . For this, the modification for neutrino generation to compress the proton pulse length from 2.86 ms, to 1.3 μs has been studied.*

The second, ongoing, Design Study, ESSnuSB+, is devoted to neutrino cross-section measurements relevant to the CPV discovery. Two facilities are proposed, a low energy nuSTORM (muons decaying to neutrinos in a race-track storage ring) and low energy ENUBET (pions decaying to a muon and a neutrino, allowing the neutrino beam to be monitored by detection of the decay muon).

Footnotes

- A Very Intense Neutrino Super Beam Experiment for Leptonic CP Violation Discovery based on the European Spallation Source Linac, Nuclear Physics B, Vol 885, Aug 2014, 127-149, doi:10.1016/j.nuclphysbps.2015.09.278
- ** The European Spallation Source neutrino Super Beam conceptual design report. Eur. Phys. J. Spec. Top. 231, 3779–3955 (2022), doi:10.1140/epjs/s11734-022-00664-w

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