Studies of neutrino production, propagation, and interaction in an unexplored energy regime

FASERν + FASER hybrid detector
1.2-ton active target, charge ID by spectrometer

FASERν detector
- 1.2-ton target mass, 1000 each of 1-mm tungsten, emulsion films
- Spatial resolution 0.4 μm
- Angular resolution of ~0.1 mrad
- 380 μs EM shower reco.
- Muon reco. by the MCS
- 10 Δm
- Muon identification
- Energy resolution ΔE/E ~ 30%
- Exchange films 10 times during Run 3

FASER spectrometer complements the charge ID for muons → Measurement of ν̄μ/νμ separately

In-situ measurement of background in 2018
Emulsion detectors installed in the TI12 tunnel. The measured flux in TI12 = 3.8 × 10⁴ tracks fb⁻¹ cm⁻¹ in all angular space. 1.9 × 10⁴ tracks fb⁻¹ cm⁻¹ in the main peak, consistent with the FLUKA prediction of 2 × 10⁴ fb⁻¹ cm⁻¹. The background is sufficiently low to carry out neutrino studies.

Schedule and milestones
Data taking in LHC Run 3 (150 fb⁻¹)
2020 2021 2022 2023 2024 2025 2026 2027 2028 ...

Production
Prompt neutrino production at 100 GeV in fixed target
QCD (charm/gluon PDF, intrinsic charm)

Propagation
Unique energy and baseline, L/E=10⁻³ m/MV
Neutrino oscillation at Δm²~100 eV²
Neutrino induced heavy quark production
New physics effects

Interaction

Interaction energy spectra and FASERν cross section reach in Run 3 (2022-2024)

- Fluxes were computed with the hadron interaction generators: Epos-LHC, QGSJet, Sibyll, Pythia 8 (Monash, minimum bias A2)
- Production interaction
- High energy frontier
- Technical Proposal:
- # of CC int. (FASER original) # of CC int. (FLUKA-based) Mean interacting energy
- Expected # of interactions in Run 3 (2021-2024) with 7+7 TeV, 350 fb⁻¹, detector mass 1.2 ton
- 30 kg target, 12.5 fb⁻¹ of data

References
FASERν physics paper (LOI to CERN): 10.1140/epjc/s10052-020-7631-5
General info about FASER: https://faser.web.cern.ch/ Twitter: @FASER