

Haruhi Fujimori (haruhi.fujimori@cern.ch, Chiba University) on behalf of the FASER Collaboration
25th of June 2026, XXXII International Conference on Neutrino Physics and Astrophysics, University of California, Irvine, U.S.A.



1. FASER experiment

Neutrino measurement in the unexplored TeV region and search for long-lived particles

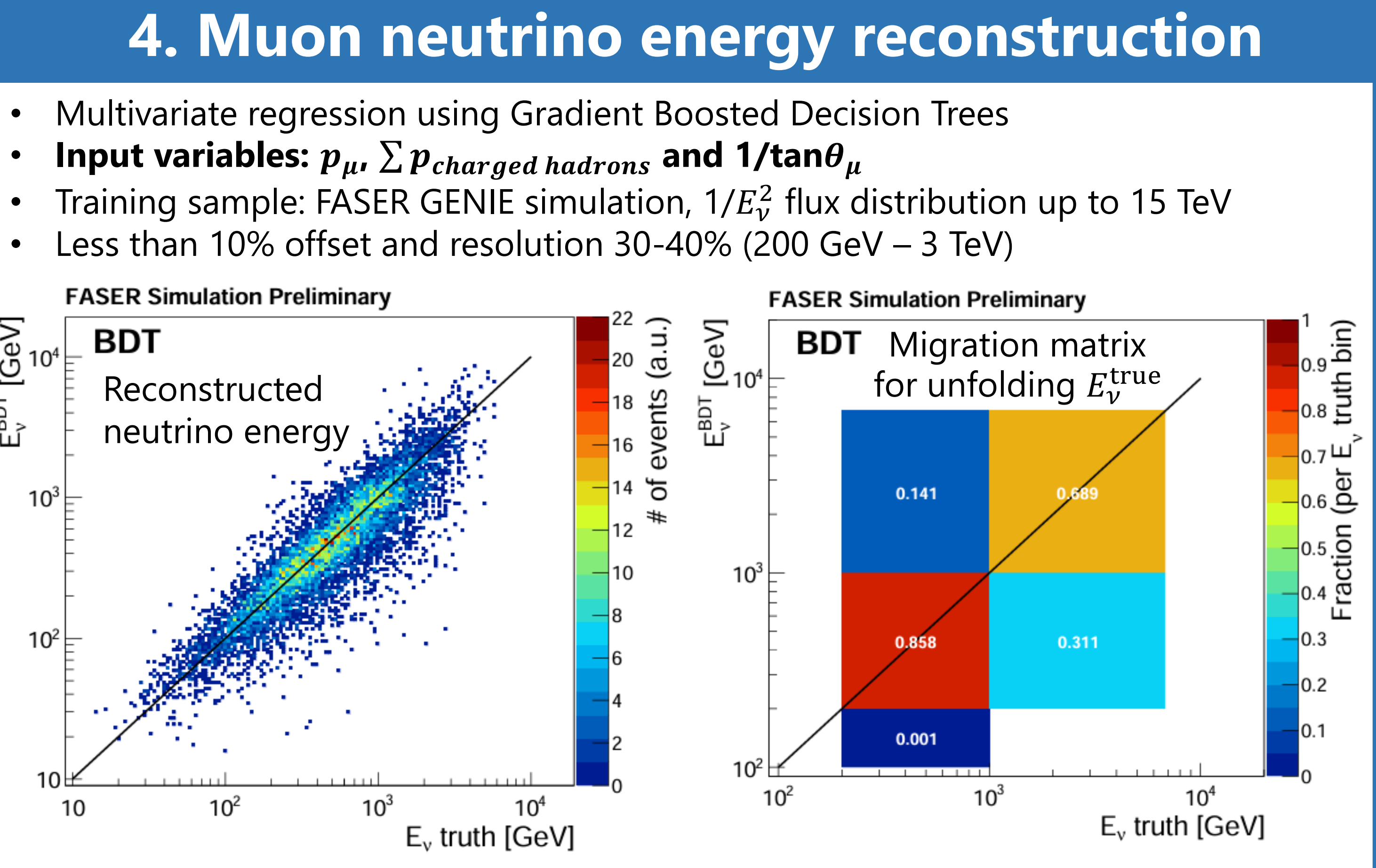
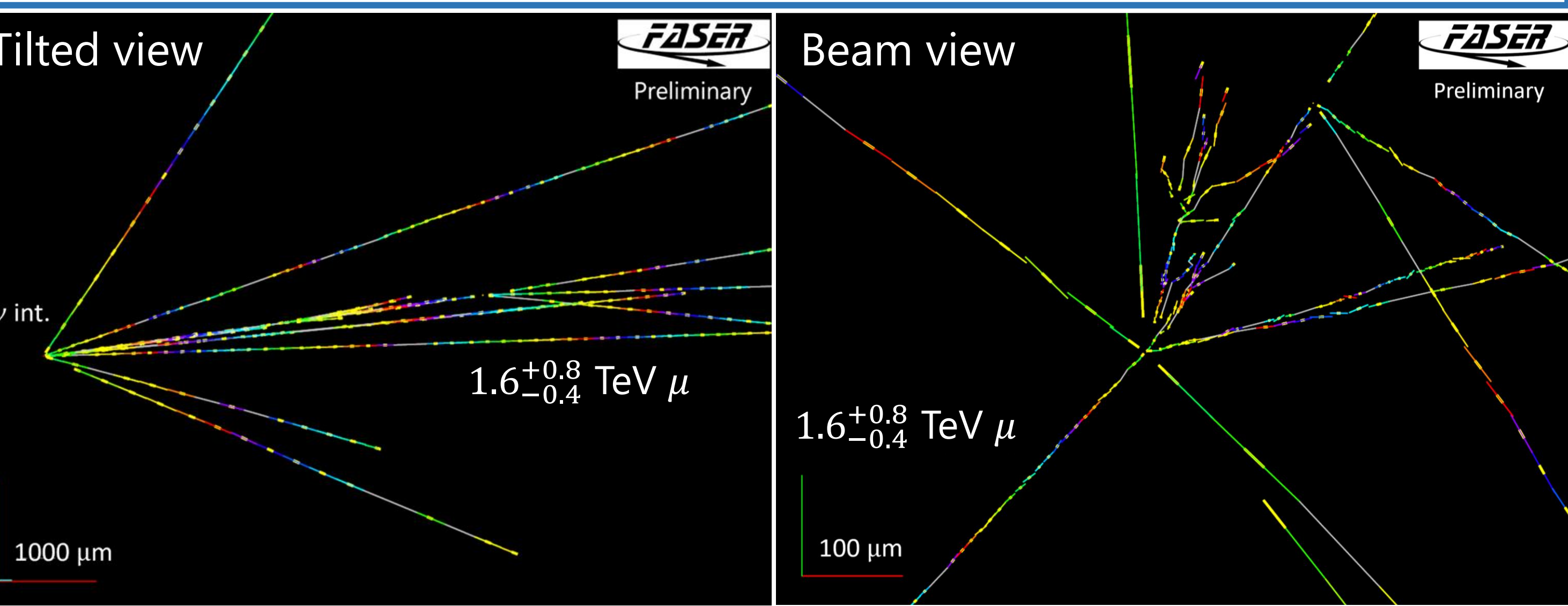
LHC(Large Hadron Collider) at CERN 13.6 TeV p-p collision
charged particles ($p < 7$ TeV)
forward jets
LHC magnets
480 m
~100 m of rock
T12 tunnel
~5 m
FASER
neutrino, dark photon
p-p collision at IP of ATLAS

The FASERν detector

FASERν detector
FASER spectrometer
Identify three generation neutrinos
 $\nu_e, e, \nu_\mu, \mu, \nu_\tau, \tau$
Charged particle tracks are recorded as grains
Emulsion film
20 μ m

- 730 x [tungsten (1.09 mm) + emulsion film thickness]
- 25 x 30 cm², 1.1 tons (8 λ_{int} , 220 X_0)
- Successfully collected ~250 fb⁻¹ during Run3
- Expected ~10000 neutrino interactions ($\nu_e \sim 1700, \nu_\mu \sim 8500, \nu_\tau \sim 30$)

N tracks
Data
Fit
 $\sigma = 0.29 \mu$
High spatial resolution
 $\Delta x [\mu m]$



2. Momentum reconstruction

- Momentum reconstruction of charged particles in the TeV range is critical for kinematical analysis in the FASERν detector**
- The method is based on multiple Coulomb scattering (MCS) with tungsten plates
- Utilizing the excellent position resolution of FASERν ($\sigma_{pos} = \sim 0.3 \mu m$)

Calculate position difference s_i

Calculate $s_{n_{cell}}^{RMS}$ by shifting and increasing #cell

$s_{plane}^{RMS} = \sqrt{\left(\frac{2}{3} \cdot \frac{13.6 MeV}{p} \cdot n_{cell} \cdot z_{cell} \sqrt{\frac{n_{cell} \cdot z_{cell}}{X_C}}\right)^2 + (\sqrt{6} \sigma_{pos})^2}$

z_{cell} : The thickness of one emulsion film and tungsten plate
 X_C : Compound radiation length (4.57 mm, cf: $X_W = 3.5$ mm)

Momentum extracted from a fit of s^{RMS} in p and σ_{pos}

Performance evaluation using MC simulations

- Momentum measurement using 100 tungsten plates and emulsion films
- Muons simulated with Geant4 (apply position smearing to match data)

FASER Simulation
Flat distribution
Good linearity even above 1 TeV
 $p_{rec} [GeV]$
 $p_{true} [GeV]$
N tracks

FASER Simulation
Resolution: 20-30% (< 1 TeV)
30-40% (above 1 TeV)
 $\sigma_{pos} = 0.0 \mu m, n_{cell}^{max} = 24$
 $\sigma_{pos} = 0.2 \mu m, n_{cell}^{max} = 24$
 $\sigma_{pos} = 0.3 \mu m, n_{cell}^{max} = 24$
 $\sigma_{pos} = 0.4 \mu m, n_{cell}^{max} = 24$
Resolution
 $p_{true} [GeV]$

3. Validation with test beam data

- The test beam performed at the H8 beamline at the SPS in July 2024
- Momentum measurement with 100-layer detector, irradiated with 100, 200 and 300 GeV muons
- Compared with the single muon MC

H8 beamline setup
Beam pipe
XDWC
Vacuum pipe
Module
Inside box
Push plate
Module
10 films in 1 pack

FASER Testbeam
 μ^- 300 GeV
Data
MC
 p_{center} has good linearity
 $p_{center} [GeV]$
 $p_{beam} [GeV]$

FASER Testbeam
 μ^- 300 GeV
Data
MC
Fit $1/p_{rec}$ distribution with Gaussian
 p_{center} : 1/mean
Resolution: sigma/mean
 $p_{rec} [GeV]$
 $1/p_{rec} [GeV^{-1}]$

p_{beam}	p_{center}		Resolution	
	Data [GeV]	MC [GeV]	Data [%]	MC [%]
100 GeV	98.1 ^{+4.6} _{-4.3}	98.4 ^{+4.6} _{-4.3}	20.7 ± 0.6	20.7 ± 0.1
200 GeV	195.2 ^{+9.3} _{-8.5}	198.7 ^{+0.2} _{-0.2}	22.7 ± 0.6	22.6 ± 0.1
300 GeV	288.6 ^{+13.5} _{-12.4}	299.7 ^{+0.4} _{-0.3}	23.2 ± 0.4	24.2 ± 0.1

Test beam data and MC show good agreement arXiv:2602.17575

5. Neutrino cross section measurements

- Dataset: 2nd 2022 module 9.5 fb⁻¹, analyzed target mass = 681.1 kg
- 33 ν_μ and 7 ν_e observed** while 40 ν_μ and 7.7 ν_e expect

Event selection
 $\otimes \nu$
lepton
 $N\ tracks \geq 5$
 $E_e, p_\mu > 200\ GeV$
 $\Delta\phi > 90^\circ$
 E_ν^{reco} is unfolded to E_ν^{true}
Extract cross section by likelihood fit

FASER Preliminary
Measured p_μ
MC (ν_μ CC)
Data (ν_μ CC)
 $p_{lep} [GeV]$
N events

FASER Preliminary
Reconstructed muon neutrino energy by BDT
L = 9.5 fb⁻¹
Observed (stat. errors)
MC, scaled to luminosity and target mass (w/o. bkg)
Reconstructed neutrino energy [GeV]
Number of events/bin

FASER Preliminary
Accelerator ν
LHC ν
Astrophysical ν
 $\sigma(E_\nu)/E_\nu [10^{-38} cm^2 GeV^{-1} nucleon^{-1}]$
Neutrino Energy $E_\nu [GeV]$
CERN-FASER-CONF-2026-002

$E_{\nu\mu}$	10-200 [GeV]	200-1000 [GeV]	>1000 [GeV]
n_{exp}^{true}	0.00 ^{+0.00} _{-0.00}	22.3 ^{+8.4} _{-5.4}	17.9 ^{+7.0} _{-4.7}
n_{exp}^{reco}	0.02 ^{+0.00} _{-0.00}	25.8 ^{+9.0} _{-6.1}	15.5 ^{+5.8} _{-4.0}
N_{obs}^{reco}	0	19	14