The ENUBET Demonstrator:

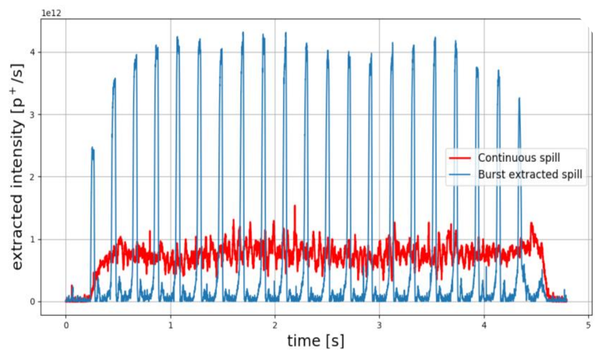
instrumented decay tunnel prototype for a monitored neutrino beam

Author's information

Leon Halić on behalf of NP06/ENUBET collab.

Ruđer Bošković Institute, Zagreb, Croatia

Leon.Halic@irb.hr



Slow proton extraction

continuous for 2 s

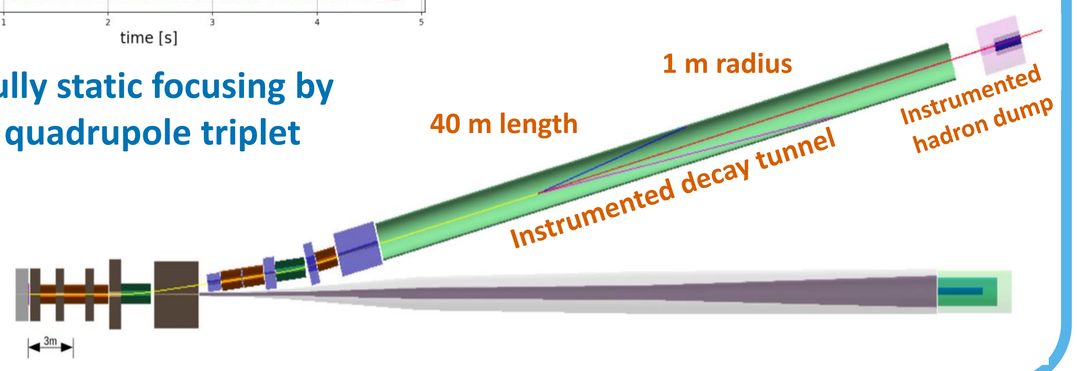
Narrow-band beam

p = 8.5 GeV/c ± 10%

ENUBET – a monitored neutrino beam story

Monitored neutrino beams are a novel technology to measure the neutrino flux at the source by **observing the charged leptons** that are created in the ***K*** and ***π*** decays

Fully static focusing by quadrupole triplet



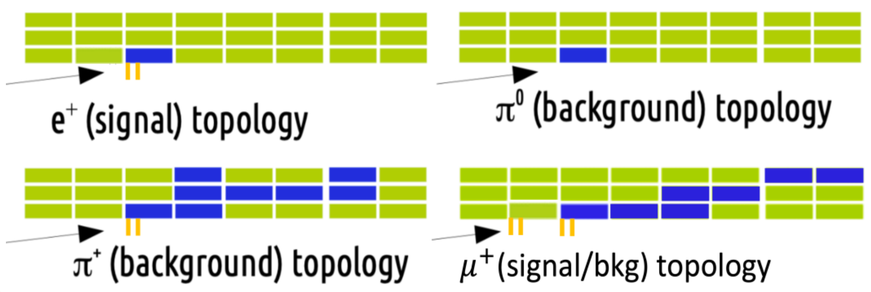
ENUBET's goals

- ✓ Knowledge of absolute ν_e and ν_μ flux at **1% level**
- ✓ ν_μ energy at 10% level

$$\pi^\pm \to \mu^\pm \bar{\nu}_\mu \qquad K^\pm \to \pi^0 e^\pm \bar{\nu}_e$$
$$K^\pm \to \mu^\pm \bar{\nu}_\mu$$

Demonstrator concept

1.7 m long quarter-section of the decay tunnel



Calorimeter

Plastic scintillator and iron interleaved

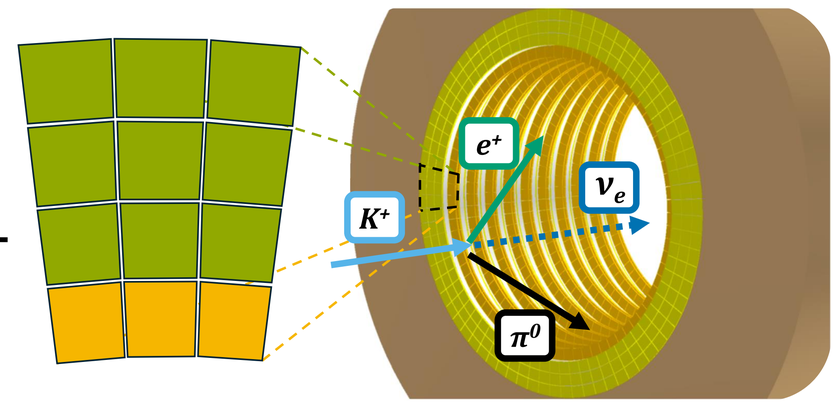
3 radial layers

WLS fibers to SiPM for light collection

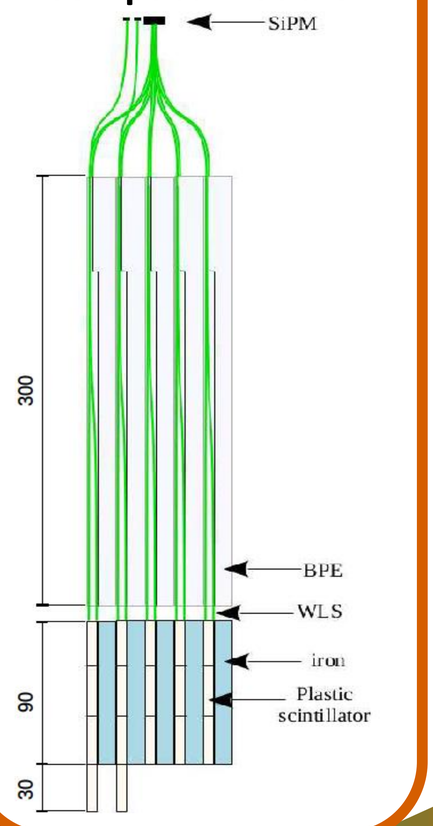
Photon veto

No iron between plastic scintillators

Reject neutral particles (photons and π^0)

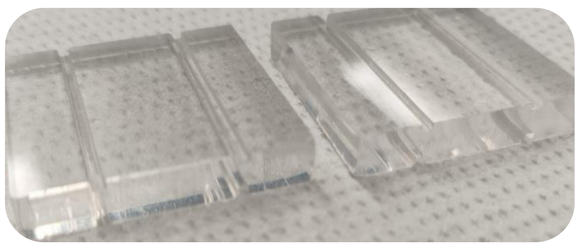


Lateral-readout Compact Module



Demonstrator

- ✓ ~3 x 3 cm² plastic scintillator tiles
- ✓ 15 channels along the *z* (beam) direction
- ✓ 10 ϕ (angular) channels in the first 8 *z* layers and 25 ϕ channels in the remaining 7 layers
- ✓ 30 cm Borated PolyEthylene shielding that protects the SiPMs from neutron irradiation

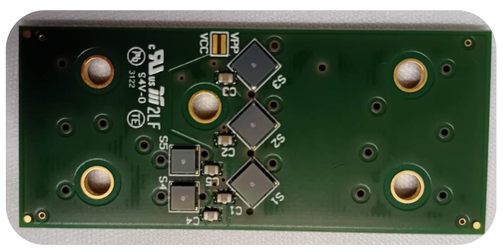


Hamamatsu S14160-4050HS 4 × 4 mm² SiPM - Calorimeter

5 layers of tiles interleaved with iron slabs along the *z*-axis makes for 1 channel - 4.3 radiation lengths in beam direction

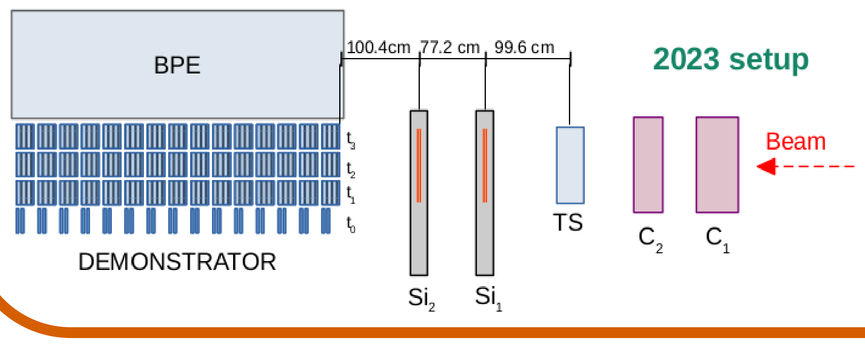
Hamamatsu S14160-3050HS 3 × 3 mm² SiPM - Veto

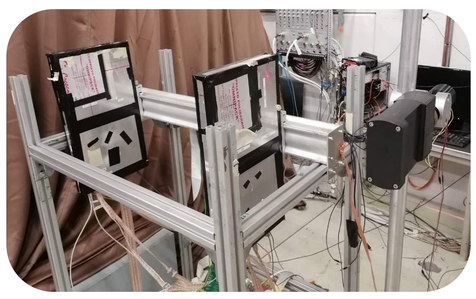
2 layers of tiles without iron along the *z*-axis makes for 1 channel



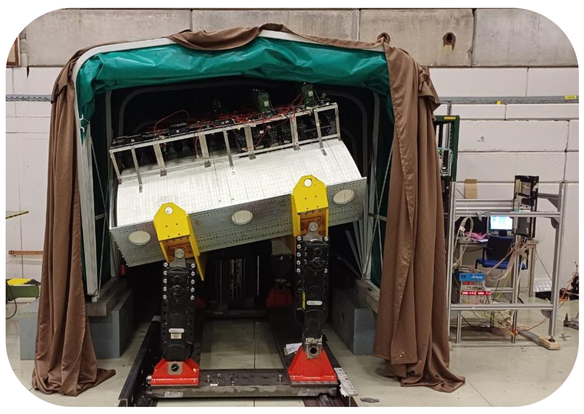
Beam test setup at CERN PS East area

- ✓ Beams of electrons, hadrons and muons with momenta 0.5–10 GeV/c
- ✓ Two 9.3×9.3 cm² silicon microstrip trackers for primary particle track reconstruction
- ✓ One 10×10 cm² plastic scintillator as a trigger for the acquisition of the whole system
- ✓ Two Cherenkov threshold detectors from the T09 beamline for particle ID



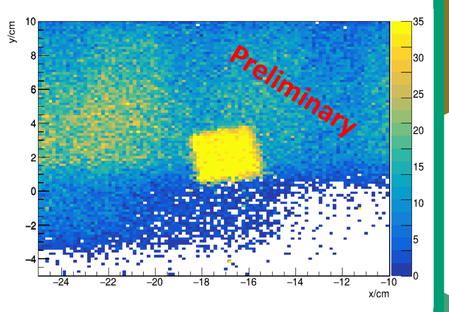


Various tilt angles (0,50,100,200 mrad)

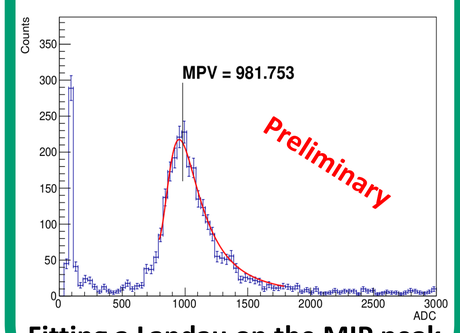


Channel equalization

Energy deposit of MIPs



Sub-sample of events where a particle hits the channel



Fitting a Landau on the MIP peak

Energy resolution for electrons

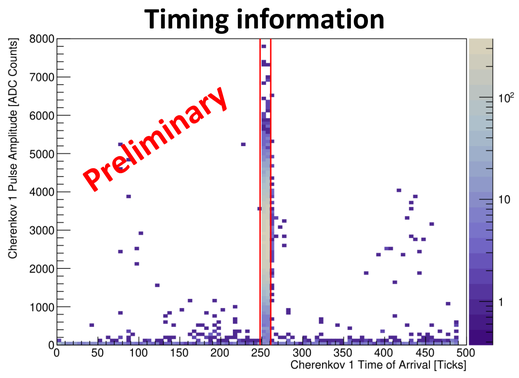
Considering only electron whose electromagnetic showers are fully contained within the calorimeter

Electron selection using 2 Cherenkov detectors filled with CO_2

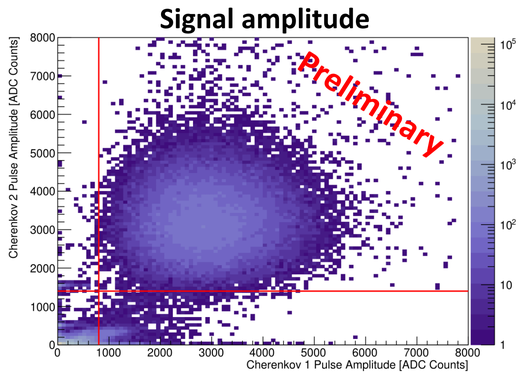
1st detector's CO_2 pressure: **< Pion Ch. threshold**

2nd detector's CO_2 pressure: **< Muon Ch. threshold**

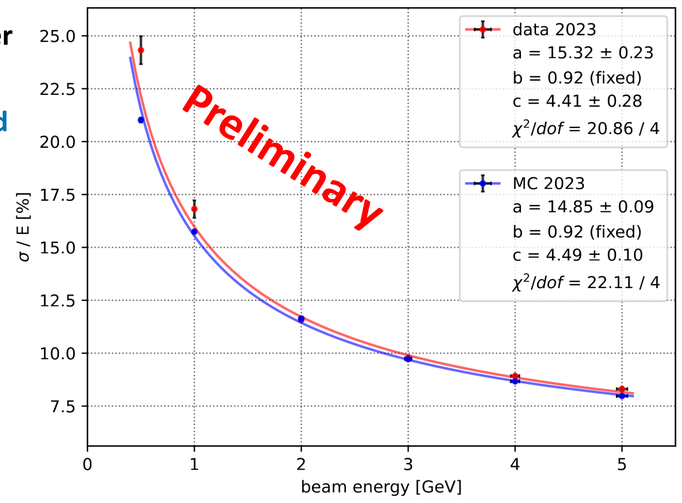
Timing information



Signal amplitude



Electron energy resolution



References

- F. Acerbi et al., Design and performance of the ENUBET monitored neutrino beam. Eur. Phys. J. C 83, 964 (2023)
- ENUBET Collaboration, NP06/ENUBET annual report 2024 for the SPSC, CERN-SPSC-2024-018, SPSC-SR-349

More on ENUBET

Plenary talk by **Giulia Brunetti** on Friday at 11:20

Poster **#13** by **Filippo Bramati** on Friday

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