ENUBET (Enhanced NeUtrino BEams from kaon Tagging)

Enabling high precision flux measurements in conventional neutrino beams

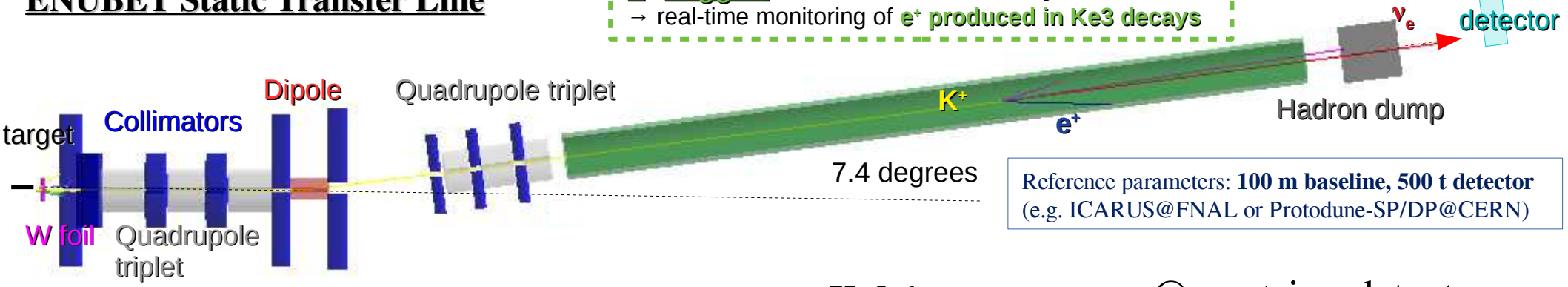
The **next generation** of short baseline experiments for **cross-section measurements** and, in general, for precision physics at short baseline should rely on:

- A high precision, **direct measurement of the neutrino fluxes**
- a neutrino beam scanning the region of interest **from sub-GeV to multi-GeV**
- a narrow band beam where **the neutrino energy is known a priori** from the beam width

the ENUBET facility fulfills simultaneously all these requirements

ENUBET Static Transfer Line

e^+ Tagger: **40m instrumented decay tunnel**
→ real-time monitoring of **e^+ produced in Ke3 decays**



Reference parameters: **100 m baseline, 500 t detector**
(e.g. ICARUS@FNAL or Protodune-SP/DP@CERN)

Ke3 decays → νe @ neutrino detector
→ **e+** *3-body decay → large angle e+*

Measure positrons
in a FULLY INSTRUMENTED decay region

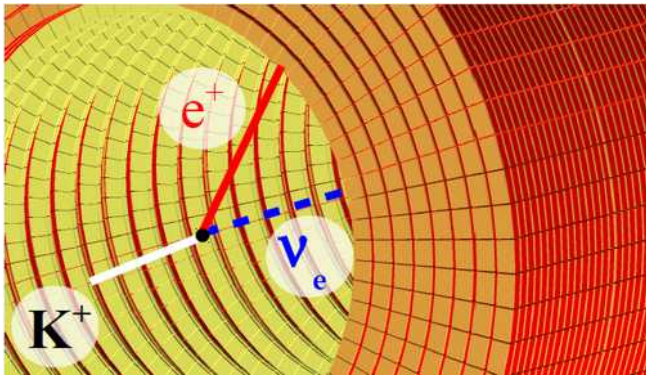
- "By-pass" uncertainties from POT, hadro-production, beamline efficiency
- **νe flux prediction = e+ counting**

Expected Hadronic rates @ Tunnel Entrance
In parenthesis (ENUBET EPJ initial estimate)

Preliminary	π^+/pot (10^{-3})	K^+/pot (10^{-3})	Increase factor wrt ENUBET proposal
Horn-based transfer line	77.3 (33.5)	7.9 (3.7)	~2.2
Static transfer line	19.0 (3.6)	1.37 (0.43)	5.2 (π), 3.2 (K)

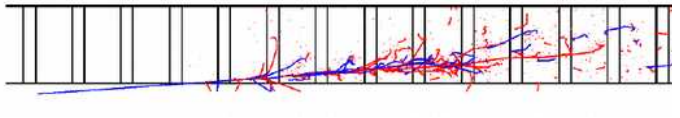
Flux Monitoring

- Kaon Yield (main source of ν_e in ENUBET)
- Pion Yield: conventional techniques + constraints from kaons

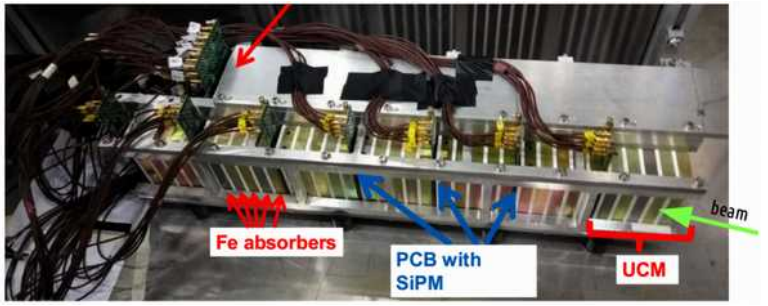


Particle Identification in the Decay Tunnel

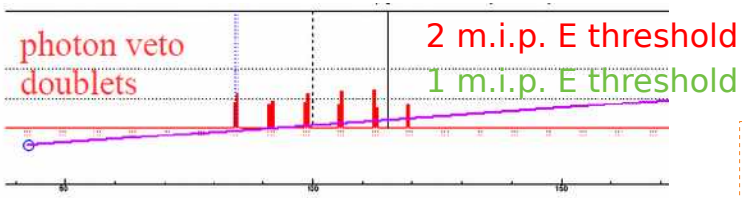
$e^+/\pi^+/\mu$ separation



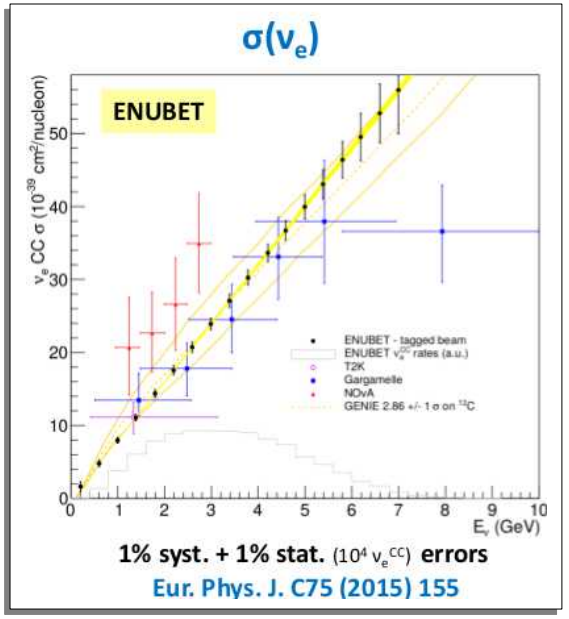
(1) Compact shashlik calorimeter (3x3x10 cm^2 Fe+scint. modules + energy catcher) with longitudinal ($4X_0$) segmentation and SiPM embedded in the bulk of the calorimeter



e^+/γ separation



(2) Rings of 3x3cm^2 pads of plastic scintillator



R&D and Tests in 2017-2018:

- Both calorimeter options (shashlik and lateral readout) ✓
- Photon veto ✓
- Radiation hardness up to nominal ENUBET doses (both ionizing and non-ionizing) ✓

Rates at the ν-detector: O(10^4) ν_e CC events, O(10^6) ν_μCC events in about 1 year of data taking at CERN SPS (400 GeV protons) **even without a horn**

Static system:

- **slow extraction (2 s, ~3 10^{13} pot/spill)**
- **strong reduction of rates in the instrumented decay tunnel**
- **pave the way to the "tagged neutrino beams"**