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

![Diagram of ENUBET Static Transfer Line]

<table>
<thead>
<tr>
<th>Expected Hadronic rates @ Tunnel Entrance</th>
</tr>
</thead>
<tbody>
<tr>
<td>In parenthesis (ENUBET EPJ initial estimate)</td>
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<table>
<thead>
<tr>
<th>Preliminary</th>
<th>$\pi^+/\text{pot} \ (10^{-3})$</th>
<th>$K^+/\text{pot} \ (10^{-3})$</th>
<th>Increase factor wrt ENUBET proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horn-based transfer line</td>
<td>77.3 (33.5)</td>
<td>7.9 (3.7)</td>
<td>~2.2</td>
</tr>
<tr>
<td>Static transfer line</td>
<td>19.0 (3.6)</td>
<td>1.37 (0.43)</td>
<td>5.2 ($\pi$), 3.2 (K)</td>
</tr>
</tbody>
</table>

- **Reference parameters**: 100 m baseline, 500 t detector (e.g. ICARUS@FNAL or Protodune-SP/DP@CERN)
- **Ke3 decays**: $\nu_e$ @ neutrino detector
- **3-body decay → large angle $e^+$**
- **Measure positrons in a FULLY INSTRUMENTED decay region**
- **“By-pass” uncertainties from POT, hadro-production, beamline efficiency**
- **$\nu_e$ flux prediction = $e^+$ counting**
Flux Monitoring

- **Kaon Yield** (main source of $\nu_e$ 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
  - $e^+/\gamma$ 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 $\nu$-detector:** $O(10^4)\nu_e$ CC events, $O(10^6)\nu_\mu$ CC events in about 1 year of data taking at CERN SPS (400 GeV protons) **even without a horn**

**Static system:**

- slow extraction (2 s, $\sim 3 \times 10^{13}$ pot/spill)
- strong reduction of rates in the instrumented decay tunnel
- pave the way to the “tagged neutrino beams”