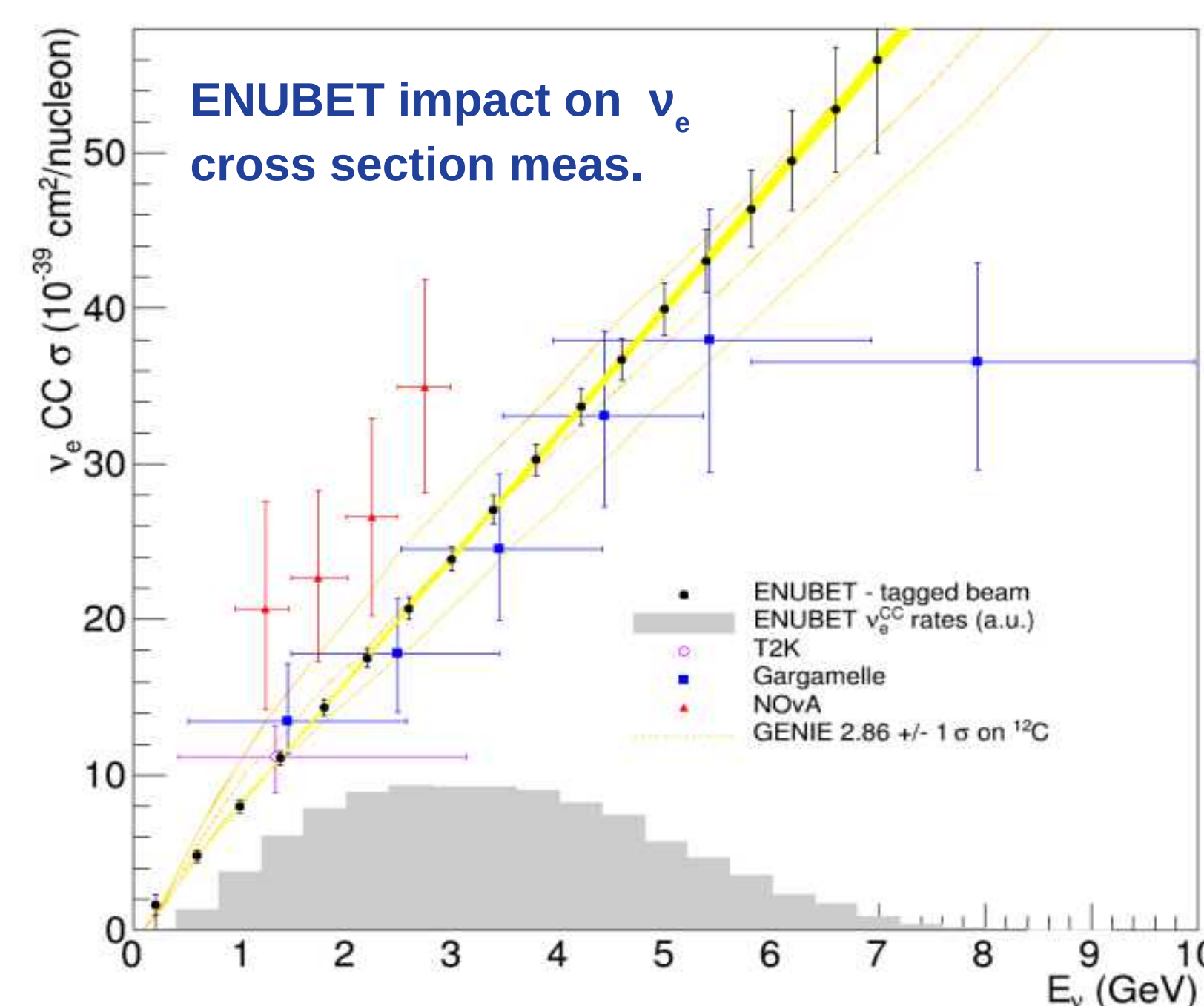
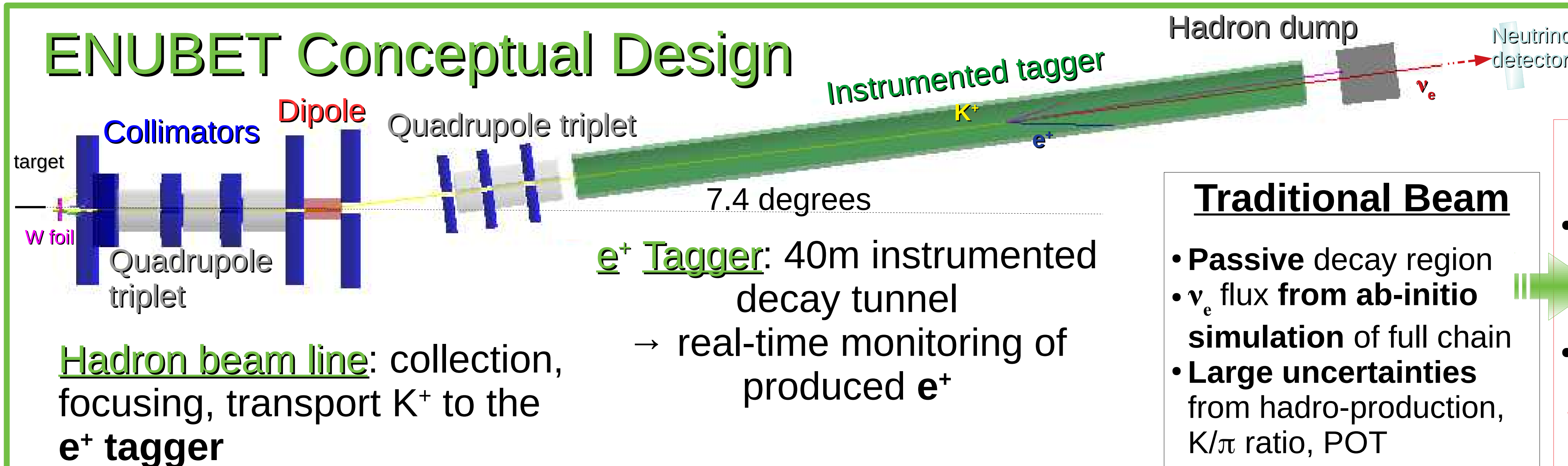


ENUBET (Enhanced NeUtrino BEams from kaon Tagging)

- A novel ν_e source from $K^+ \rightarrow e^+ \pi^0 \nu_e$ decays by tagging the e^+ in an instrumented decay tunnel
 - Reduce **systematics on neutrino flux to O(1%) level** by monitoring the positrons produced at large angle in the decay tunnel of conventional neutrino beams
- New generation of neutrino cross section experiments with unprecedented control on the flux
- First step towards **time-tagged ν -beam**: the ν at the detector is correlated with the lepton in the tunnel
- Highly beneficial to long baseline $\nu_\mu \rightarrow \nu_e$ programs



ENUBET Conceptual Design

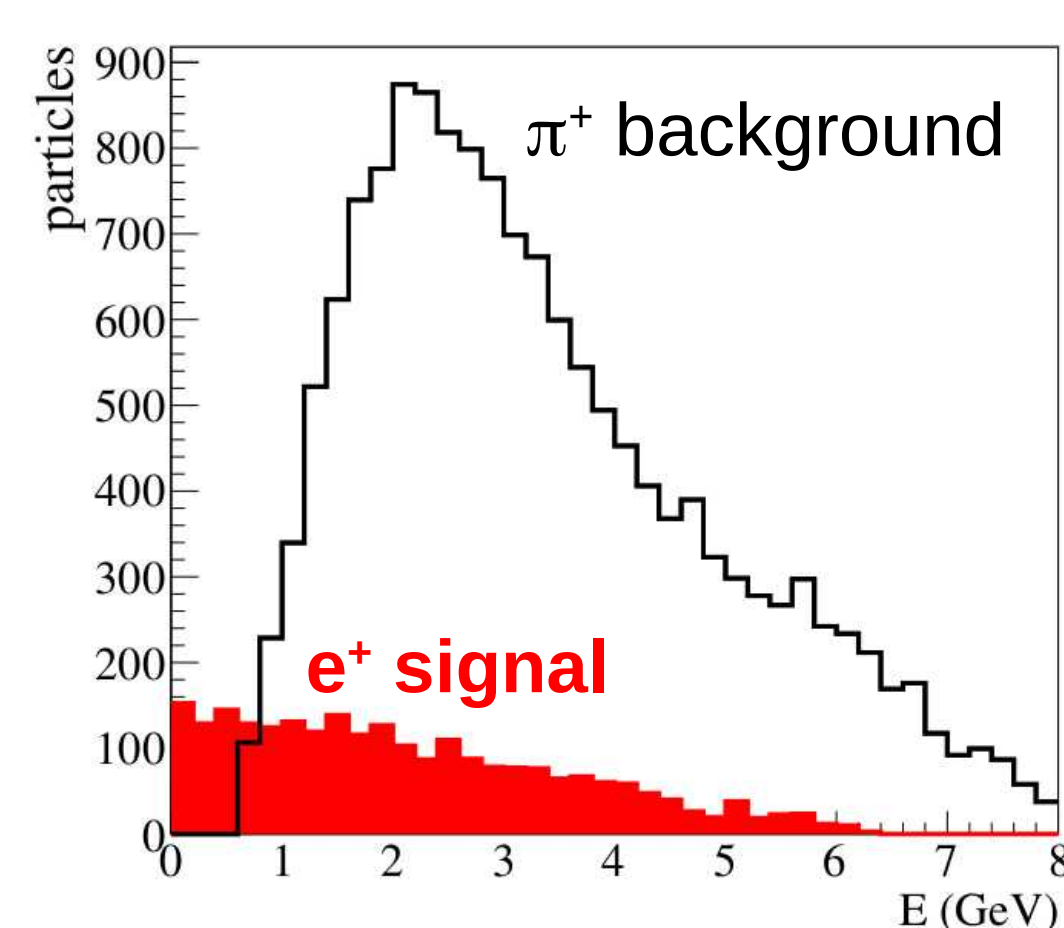


The positron tagger

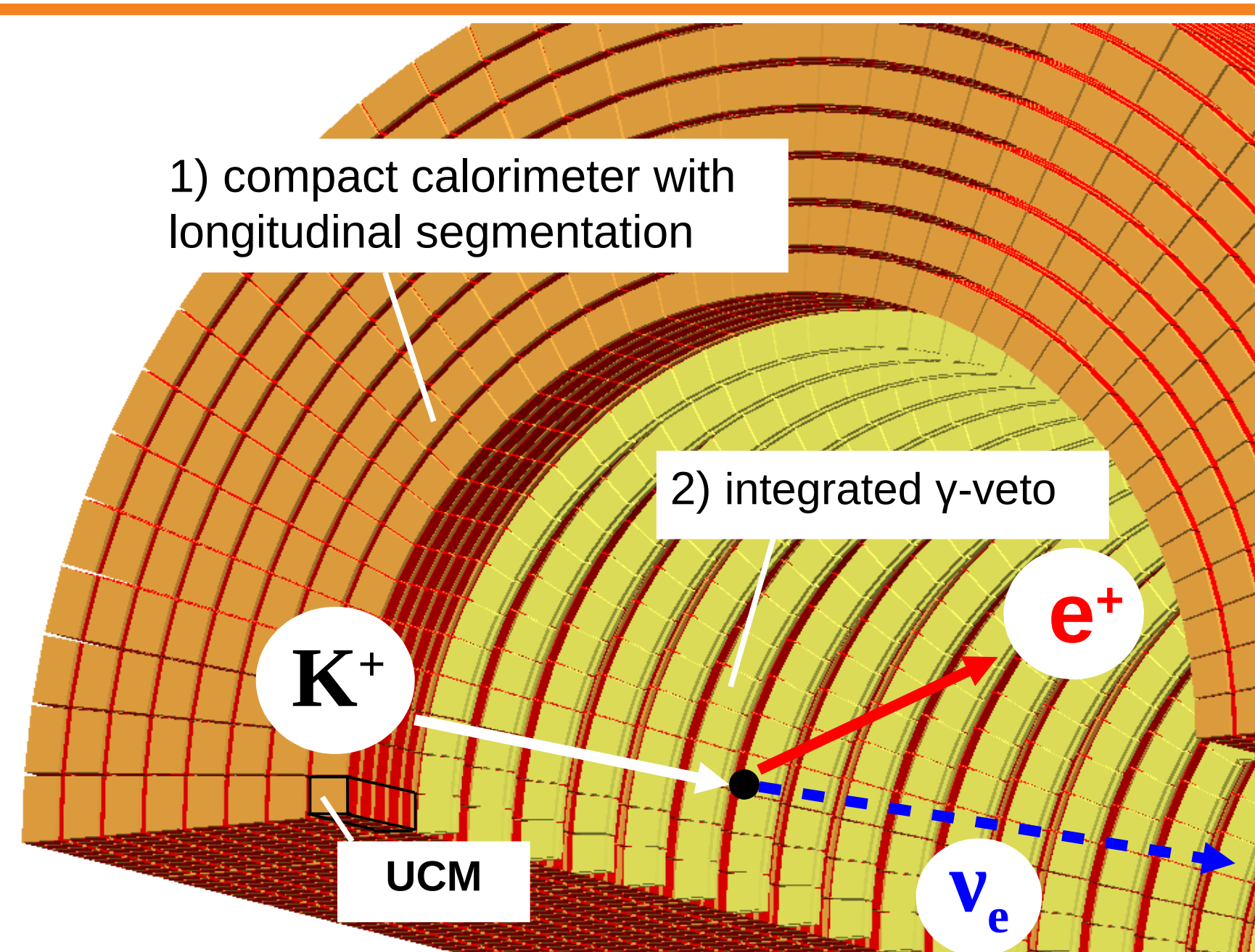
The decay tunnel

a harsh environment:

- Particle rates > 200 kHz/cm²
- backgrounds: pions from K^+ decays



- Extended source of ~ 50 m
- Spread in the initial direction

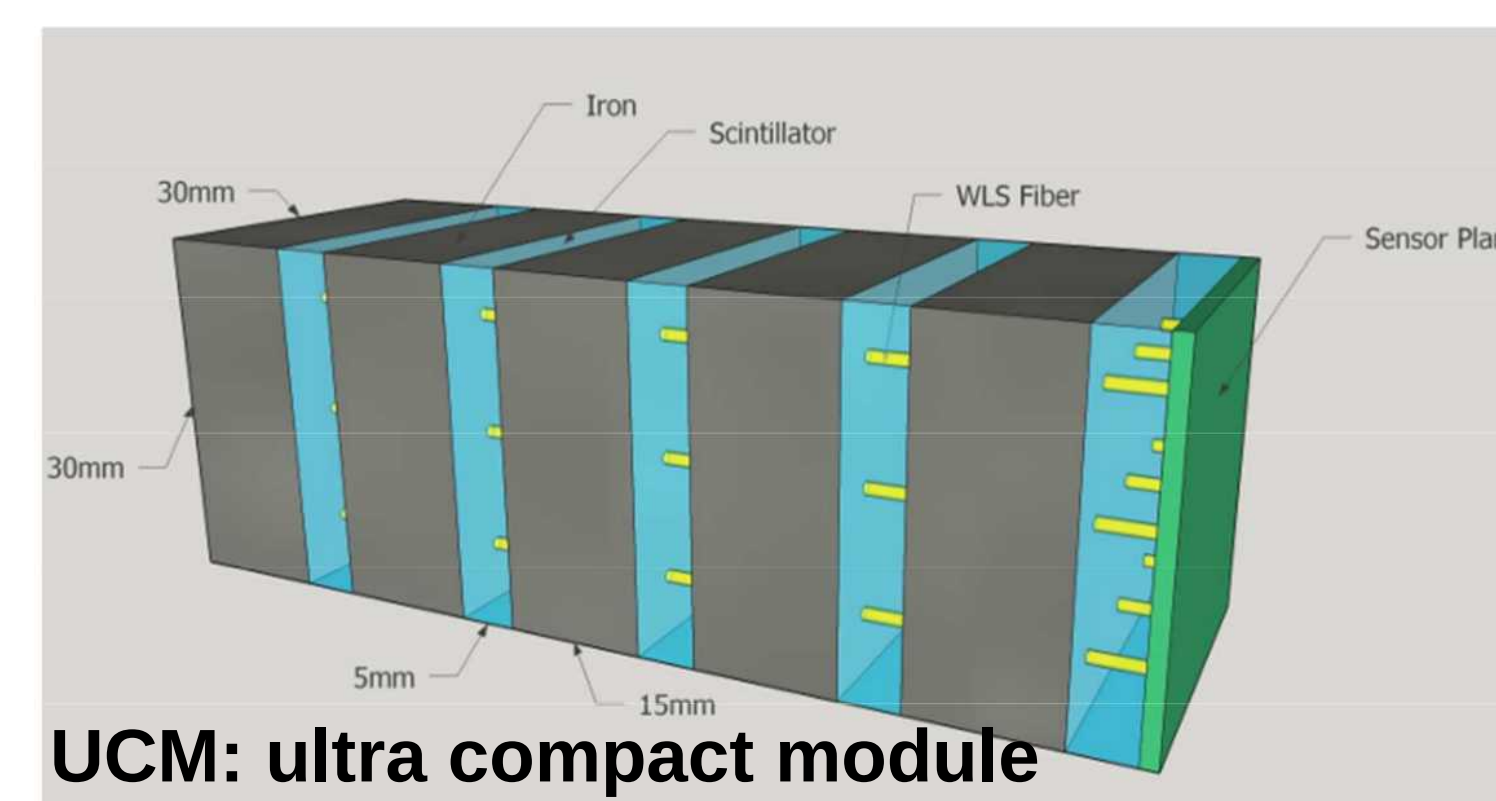


Conventional beam-pipe replaced by active instrumentation:

- longitudinal sampling
- good uniformity
- radiation hardness
- cost effectiveness

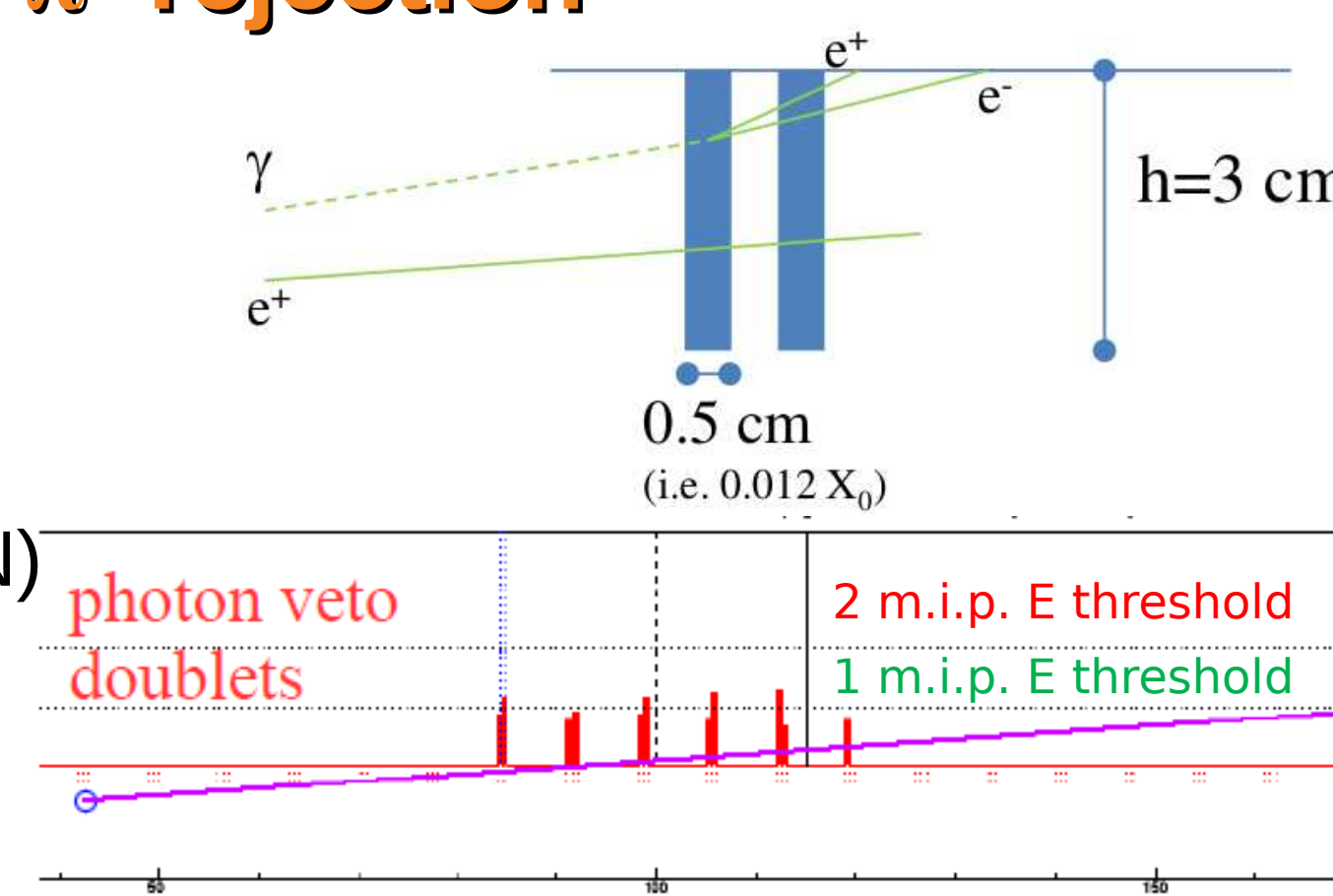
1) Calorimeter ("shashlik") → π^+ rejection

- UCM (4 X_0 thick) read-out by SiPM directly coupled to WLS fibres
- Longitudinal sampling without dead zones
- Cheap, fast (< 10 ns time), rad. hard



2) Integrated γ -veto → π^0 rejection

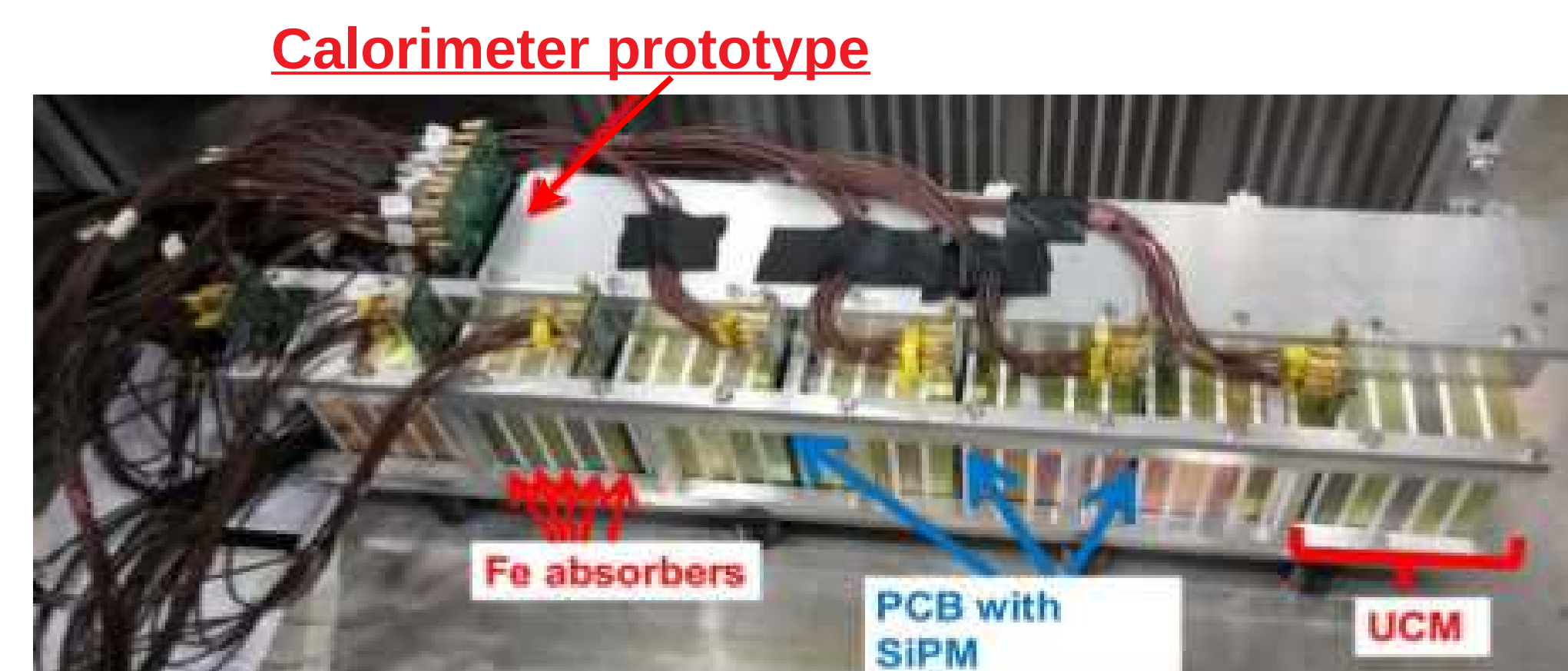
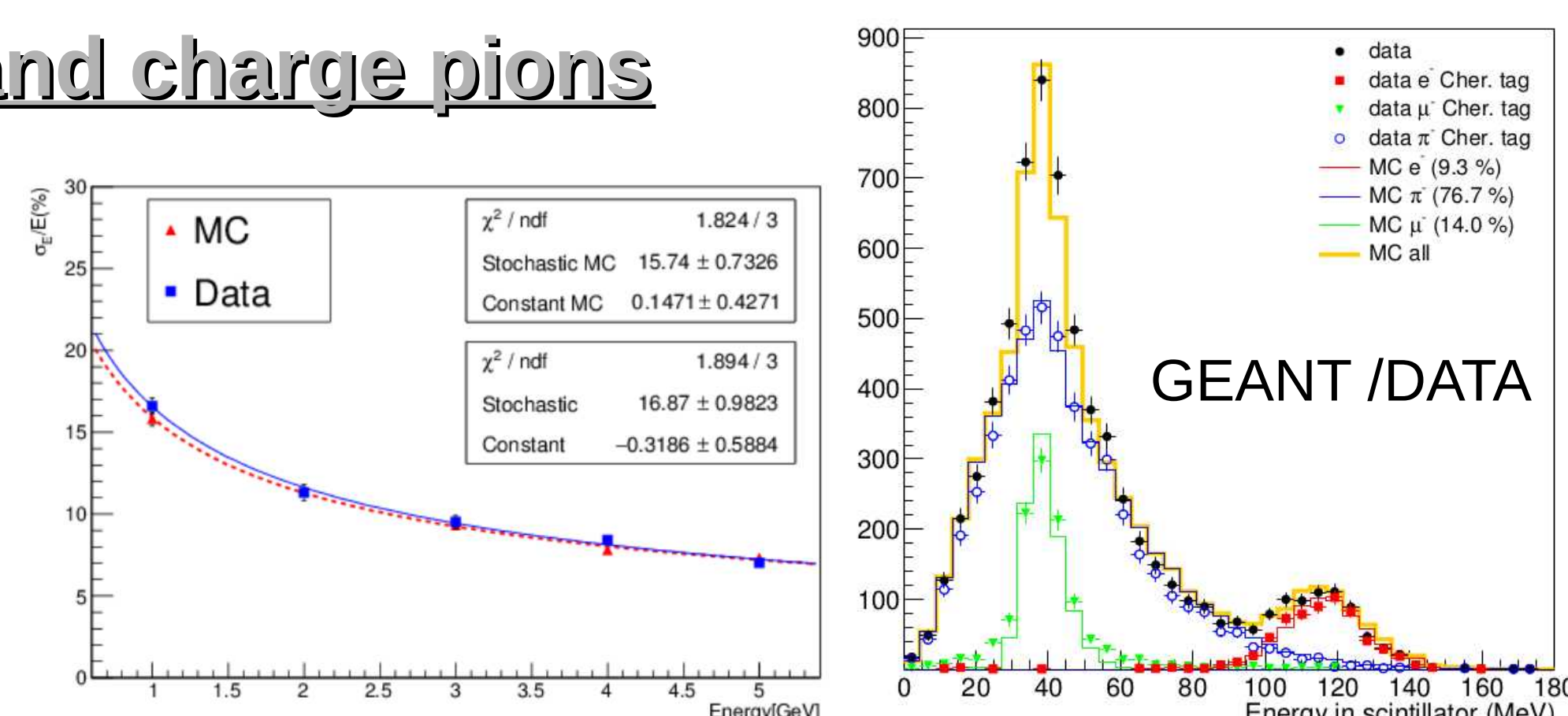
- Rings of 3x3 cm² pads of plastic scintillator
- 1mip/2mip separation (successfully tested @ CERN)



R&D Activities - Tagger Prototype Test @ CERN

Tested response to MIP, electrons and charge pions

- em energy res 17%/ \sqrt{E} (GeV)
- Linearity $< 3\%$ in 1-5 GeV
- From 0 to 200mrad tilts tested → no significant differences
- MC/data already in good agreement, longitudinal profiles of partially contained π reproduced by MC @ 10% precision



References

- <http://enubet.pd.infn.it>
- [1] Eur. Phys. J. C (2015) 75:155
A novel technique for the measurement of the electron neutrino cross section. A. Longhin, L. Ludovici, F. Terranova
- [2] CERN-SPSC-2016-036 ; SPSC-EOI-014
Enabling precise measurements of flux in accelerator neutrino beams: the ENUBET project ENUBET Collaboration
- [3] NIM A, 2016.05.123 arXiv:1605.09630
A compact light readout system for longitudinally segmented shashlik calorimeters. A. Berra et al
- [4] IEEE Trans.Nucl.Sci. 64 (2017) no.4, 1056-1061
Shashlik Calorimeters with embedded SiPM for Longitudinal Segmentation, ENUBET Collaboration.
- [5] JINST 13 (2018) P01028
Testbeam performance of a shashlik calorimeter with fine-grained longitudinal segmentation, Ballerini et al.

Expected Rates

Expected Hadronic rates @ Tunnel Entrance

In parenthesis (ENUBET EPJ [1] initial estimate)

	π^+/pot (10^{-3})	K^+/pot (10^{-3})	Increase factor wrt [1]
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)	3-5

Expected Neutrino rates @ ν Detector

ν -CC rates expected from ENUBET beam line @ ν detector for 120 GeV (ν_e) and 400 GeV (ν_μ) protons with HK and DUNE r.o.i.

