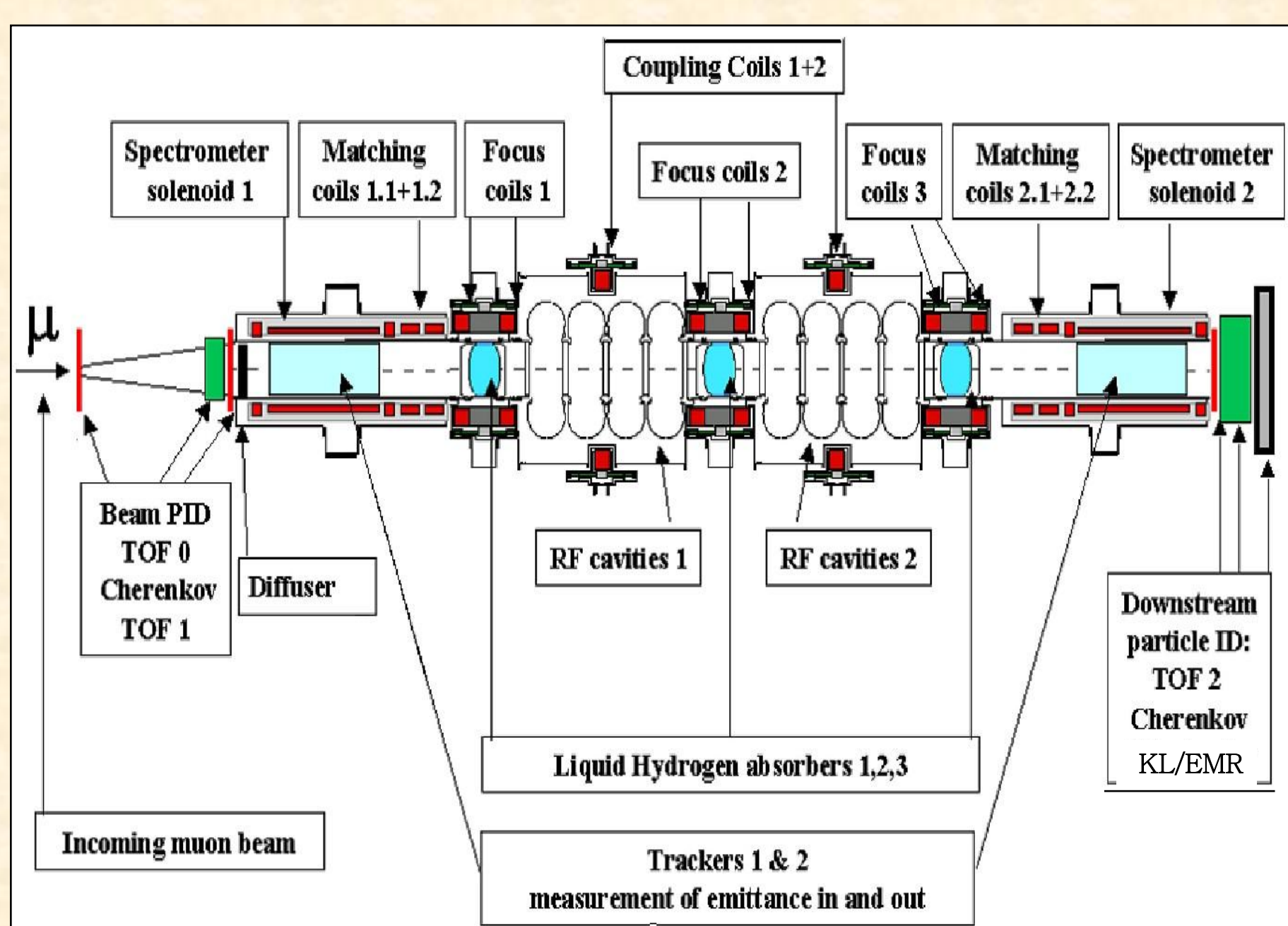


MICE Particle Identification System

M. Bogomilov, INFN Roma Tre, for the MICE Collaboration

Introduction

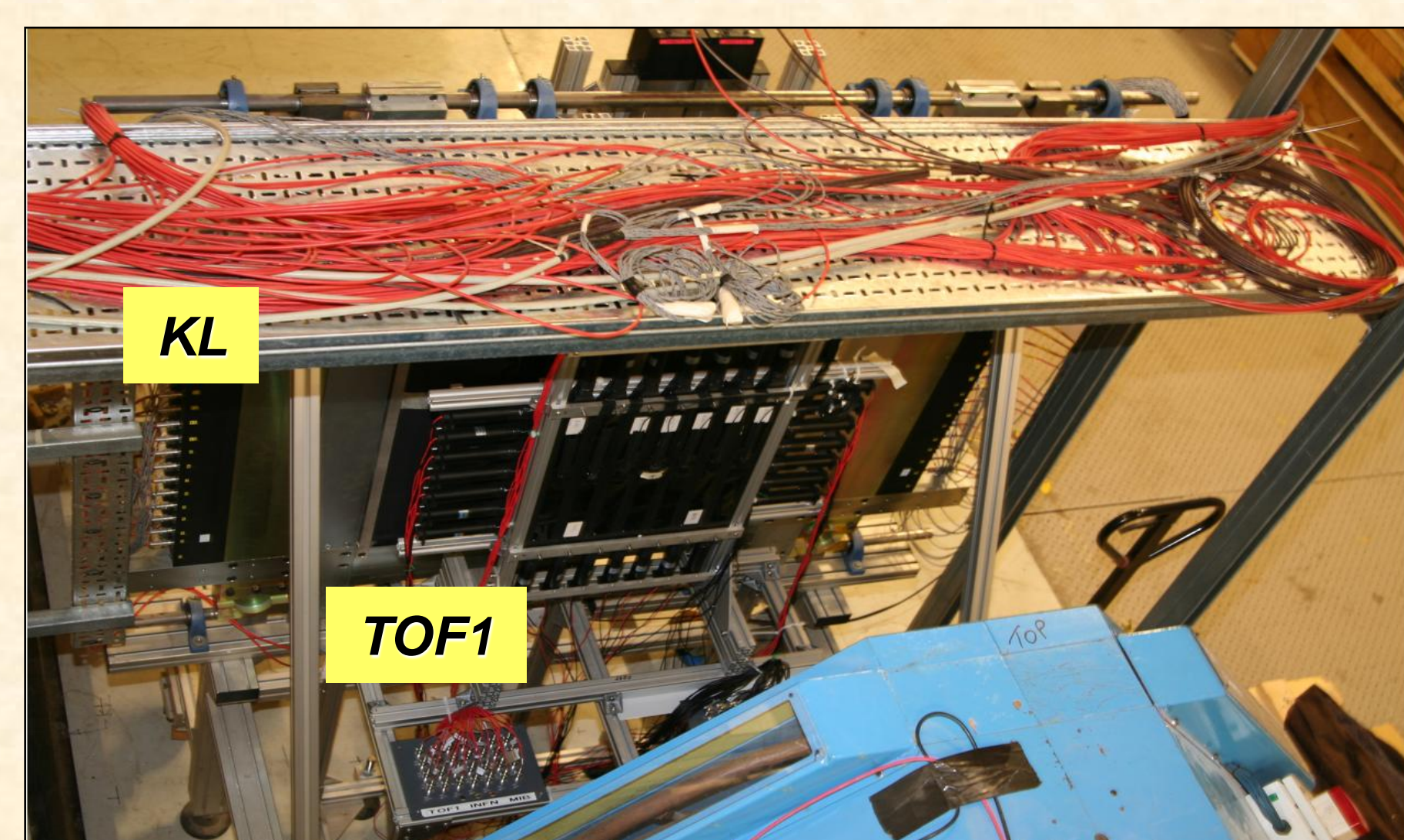
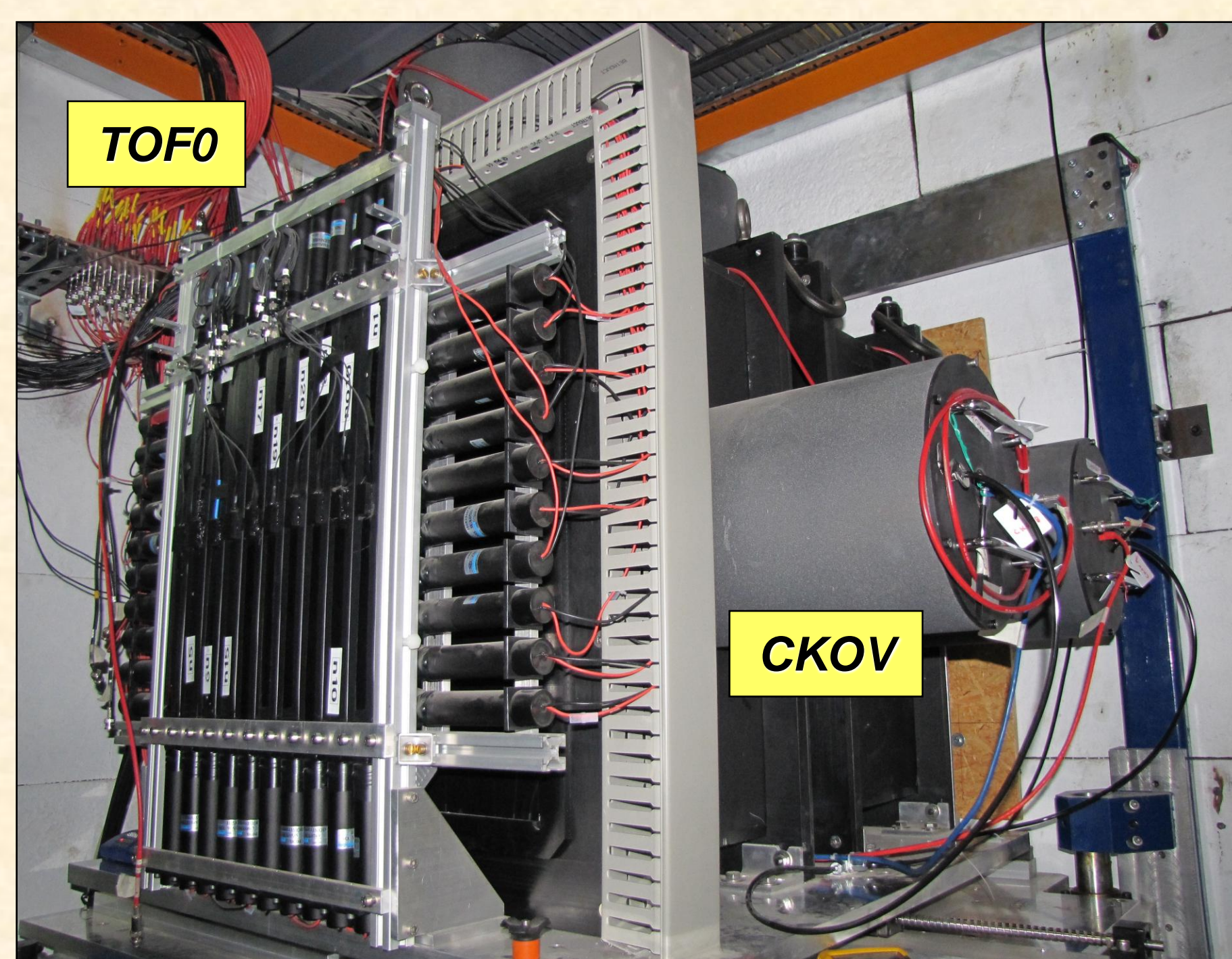
- MICE is a Muon Ionization Cooling Experiment running at the Rutherford-Appleton Laboratory, Chilton UK.
- Cooled muon beams will be a major technological step towards the development of a "neutrino factory" and "muon collider".
- A minimum ionizing muon beam will be transversely cooled by stages of $-dE/dx$ in LH absorbers and longitudinal energy restoration in 201MHz RF cavities.
- The 6D emittance reduction is measured before and after the cooling stage by tracking individual muons through the system.
- Muon purity is assured by **three Time-of-Flight (TOF)** measurements, **two threshold Cherenkovs (μ/π)**, and a **low energy muon/electron ranger KL/EMR (μ/e)**.



Time of Flight System

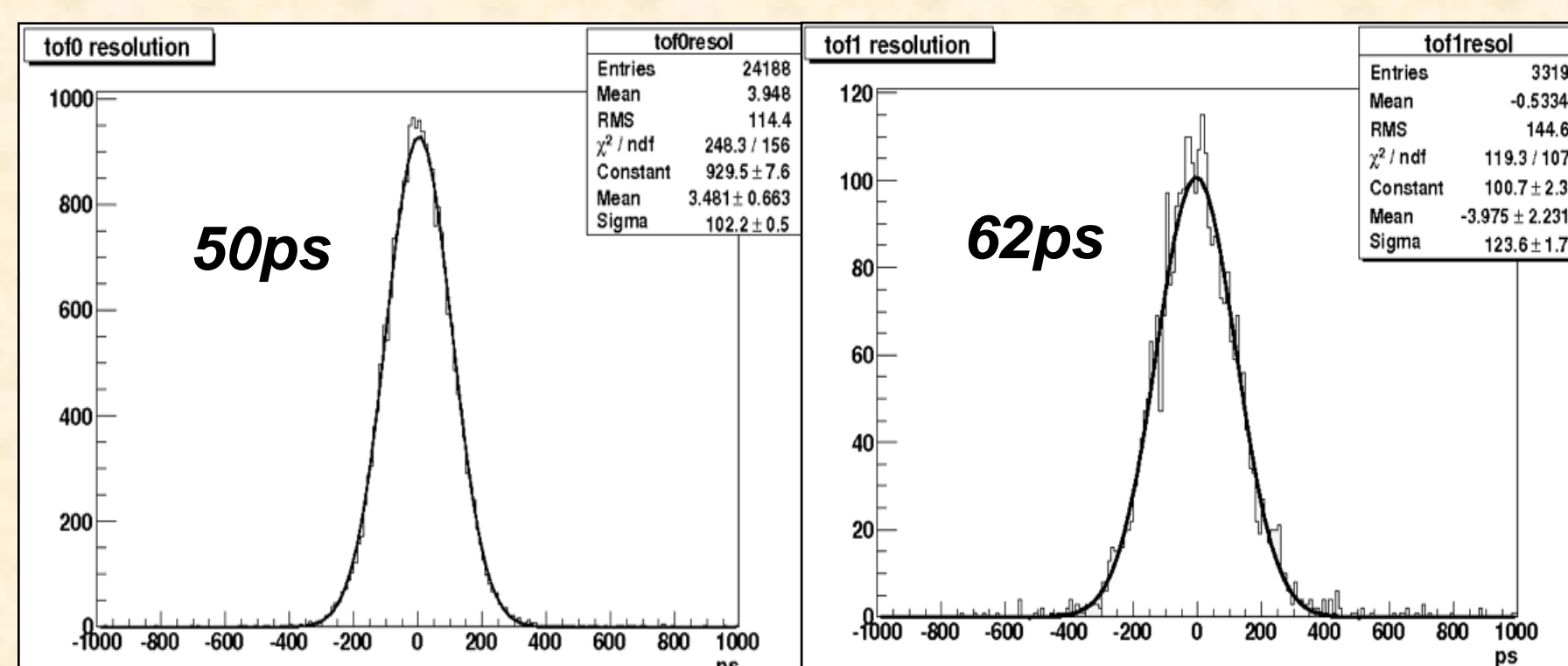
- TOF0,1,2** - Three time of flight stations ($\sim 40 \times 40 \text{ cm}^2$, $42 \times 42 \text{ cm}^2$, $60 \times 60 \text{ cm}^2$) are positioned in the MICE channel at the start (TOF0), mid (TOF1), and rear (TOF2) positions.
- TOF0(1,2) station consists of a 10(7,10)X and 10(7,10)Y array constructed of BC404(420) scintillator bar assemblies with dual R4998 PMT readout with modified high rate active HV divider. Each assembly gives typically $\Delta t_0 = 55 \text{ ps}$ timing resolution.
- The expected TOF resolution between 2 stations is

$$\Delta \text{TOF}^2 \sim 2 \Delta t_0^2 + \sigma_{\text{calib}}^2 \leq (75 \text{ ps})^2$$

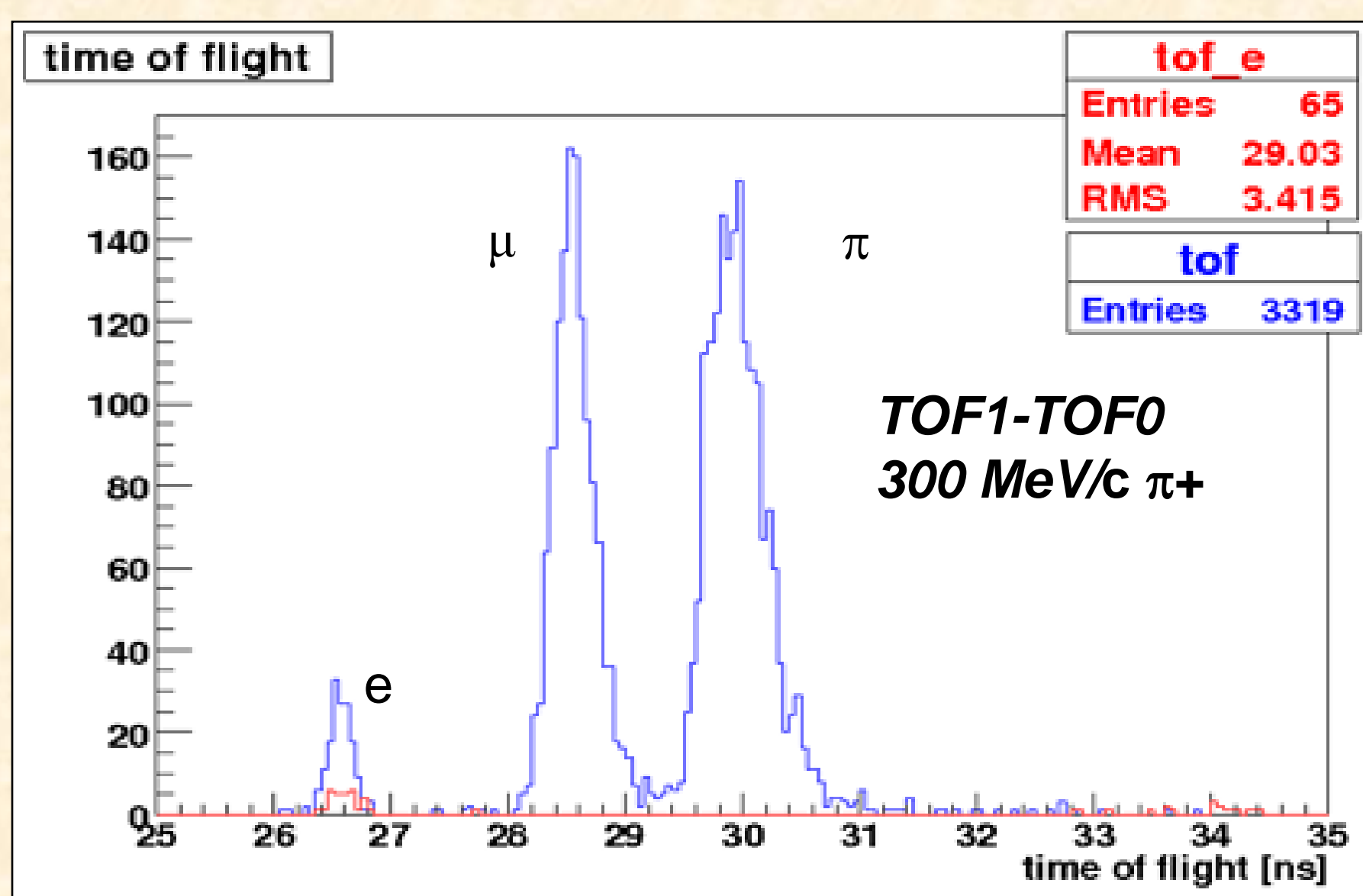


TOF Beam Measurements

- TOF0 and TOF1 assembly resolutions measured in 300 MeV/c MICE pion beam 2008. (Preliminary)
- Intrinsic time resolutions of 50 and 62 ps measured.



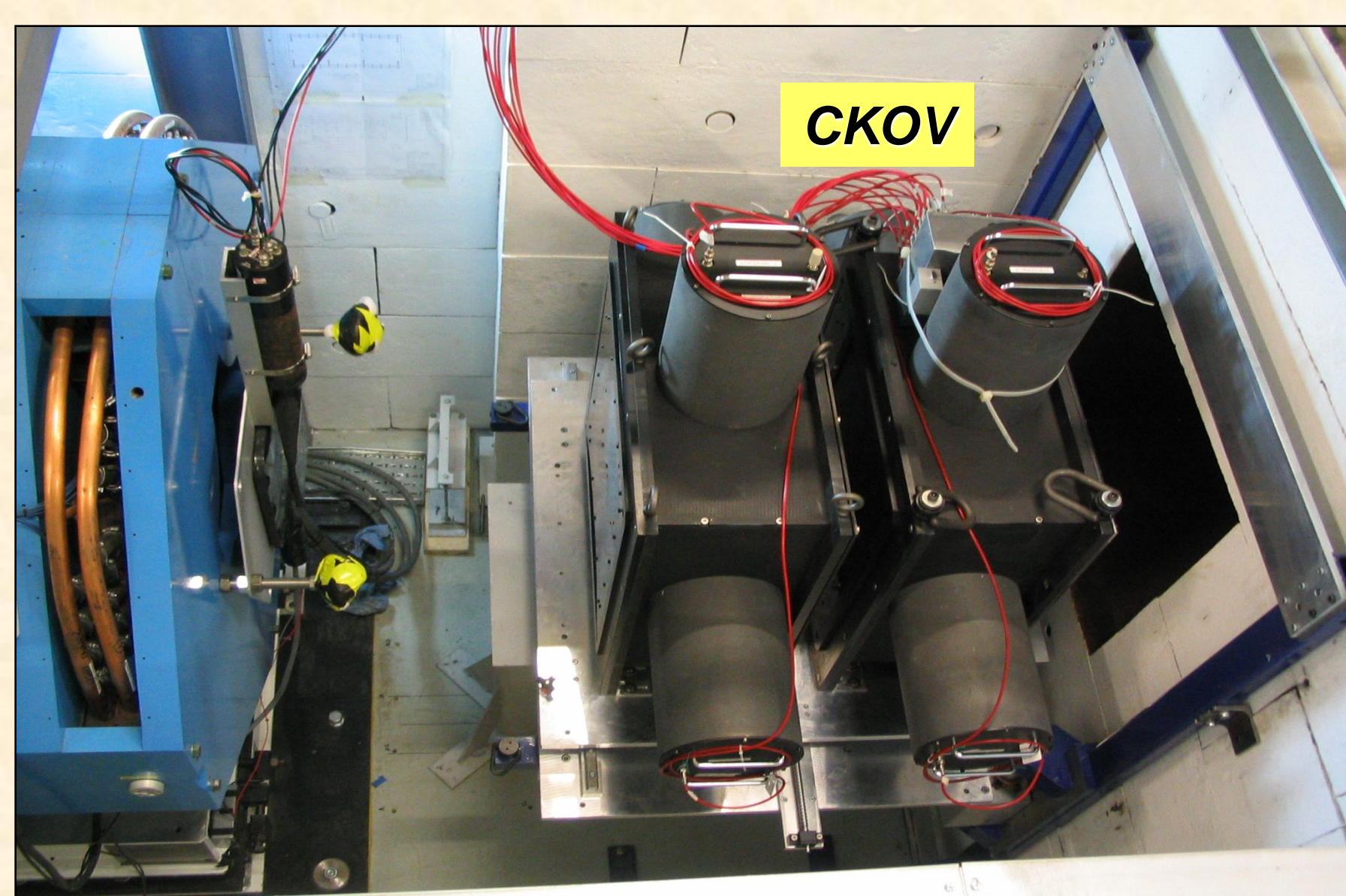
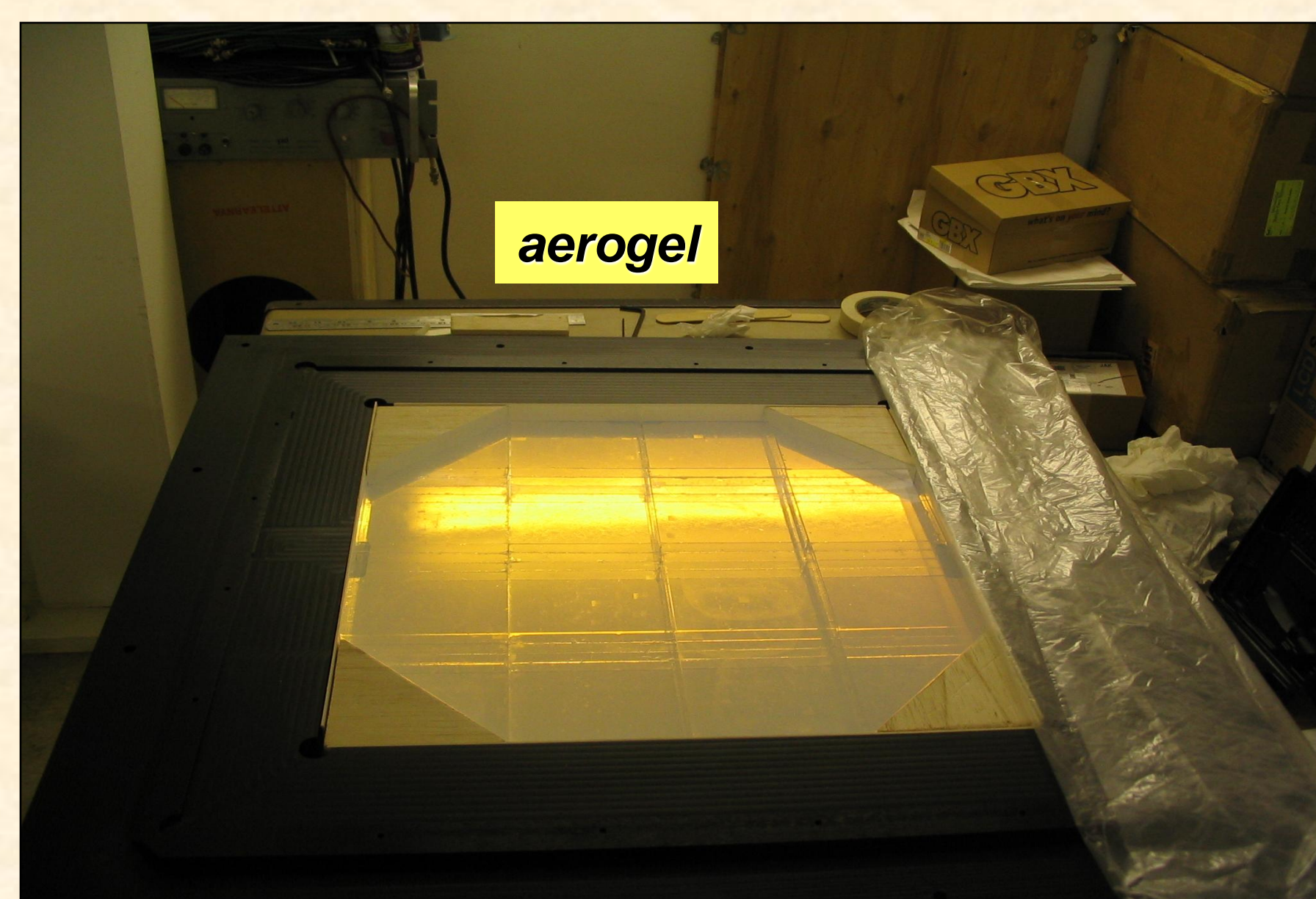
- TOF0-TOF1 μ/π separation in commissioning stage.
- Muon and electron peaks from in-flight π decays



Cherenkov Particle Identification

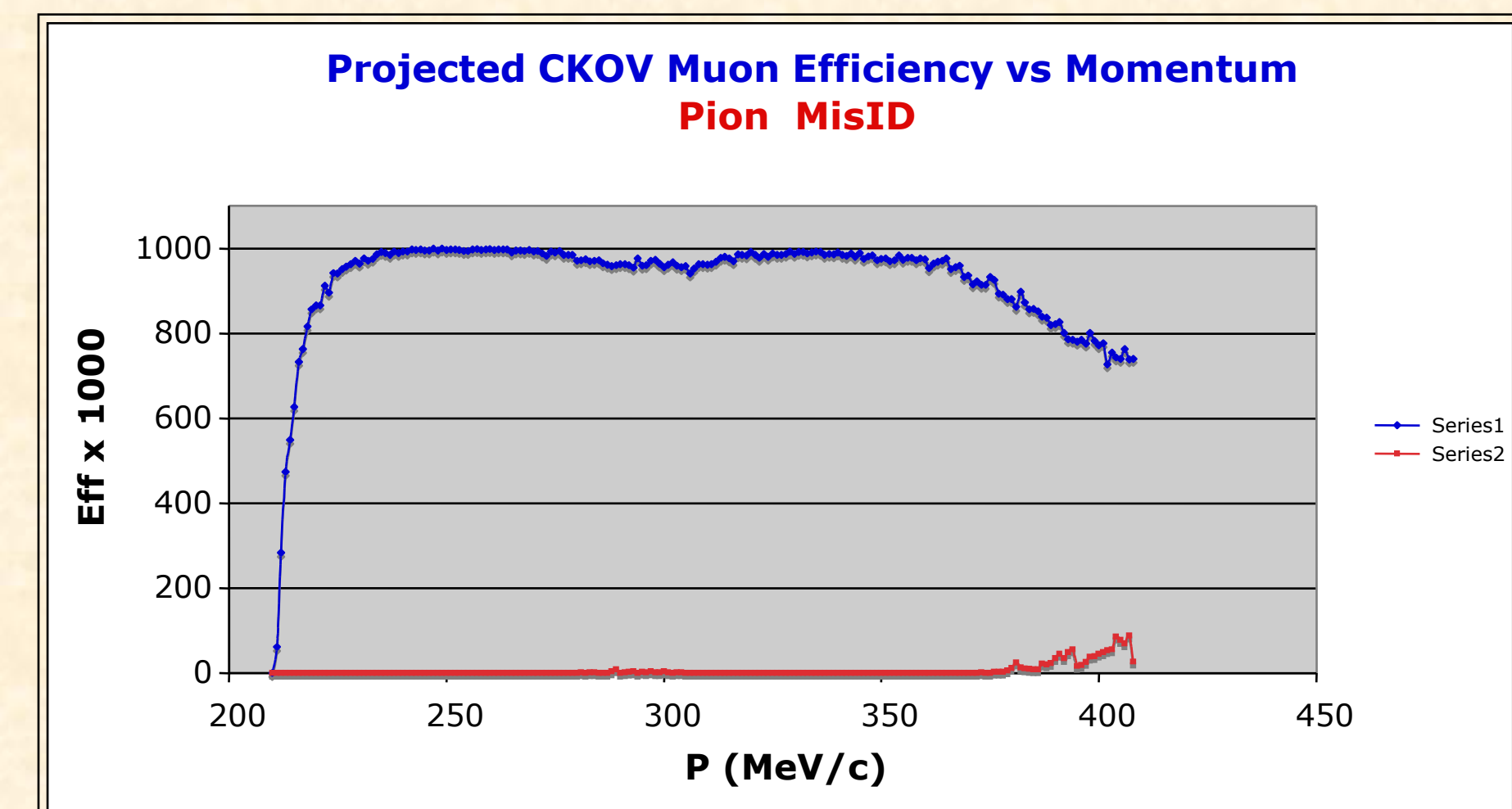
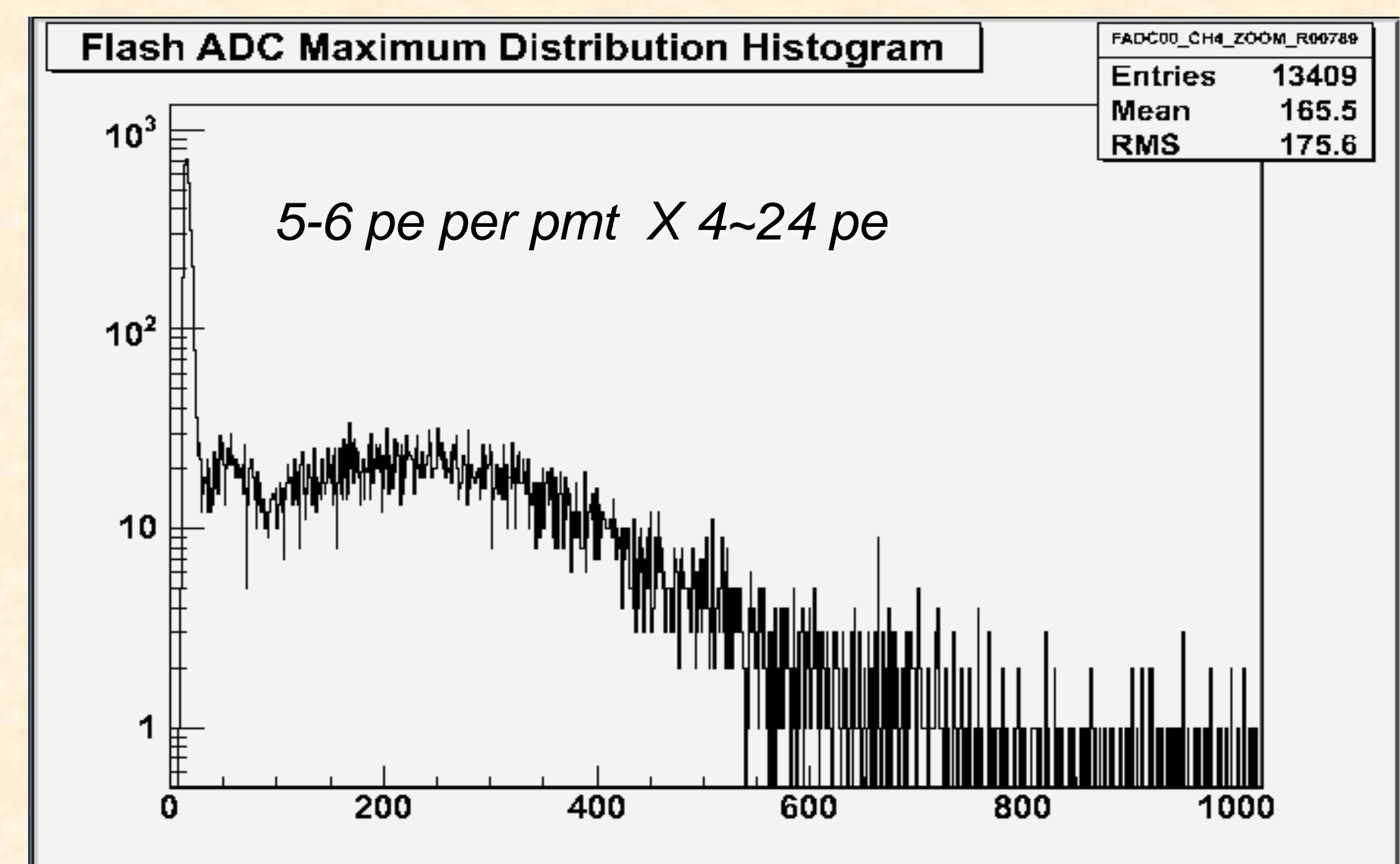
- CKOVab** - Two threshold Cherenkov detectors positively identify muons from pions in the upstream MICE beamline.
- High density aerogels of $n=1.12$ and $n=1.07$ were chosen with momentum thresholds for muon L_d between 220-360 MeV/c.

	$P^{\text{th}}_{\mu}(\text{MeV}/c)$	$P^{\text{th}}_{\pi}(\text{MeV}/c)$
Aerogel 1.12	220	280
Aerogel 107	280	360



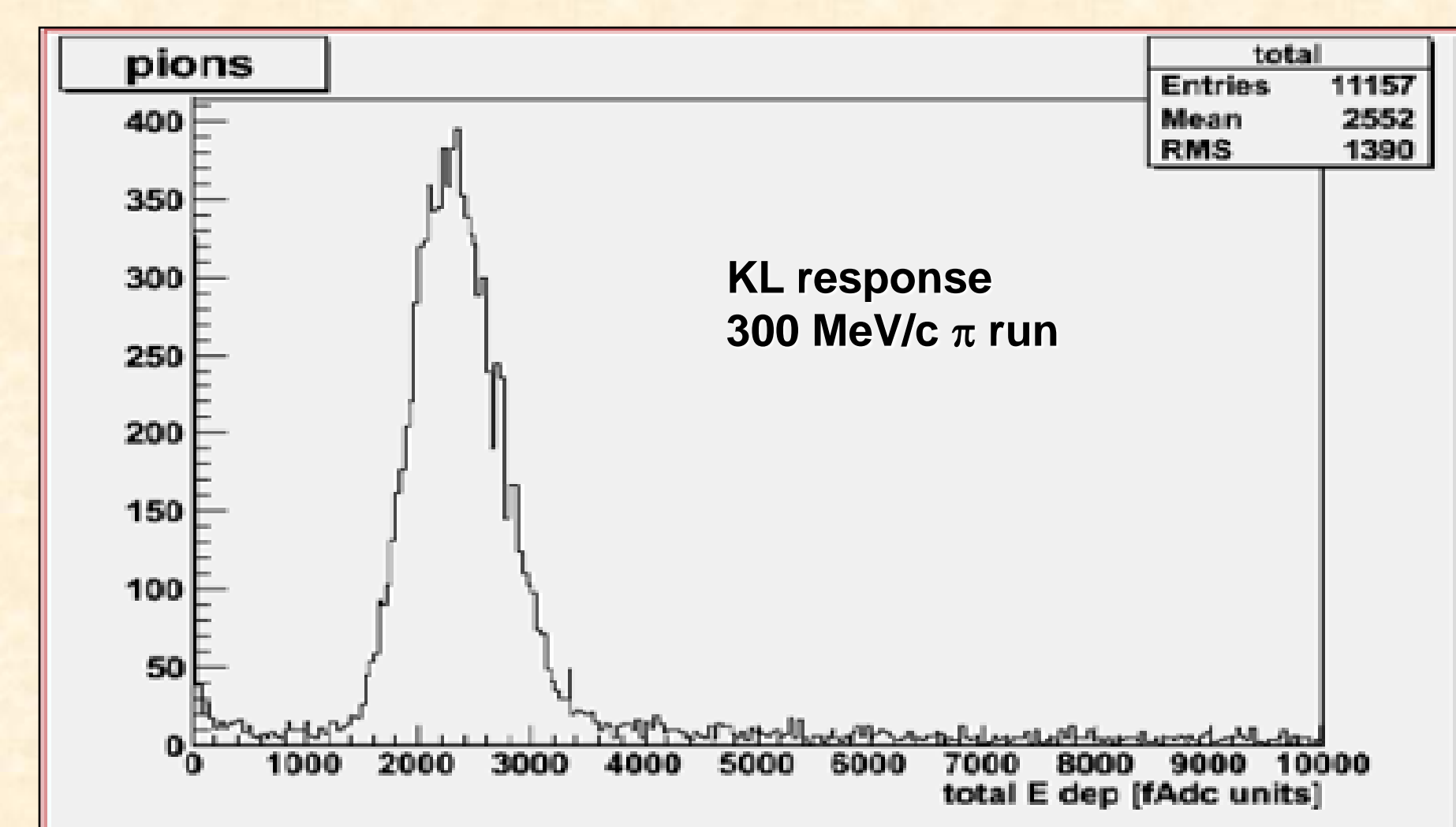
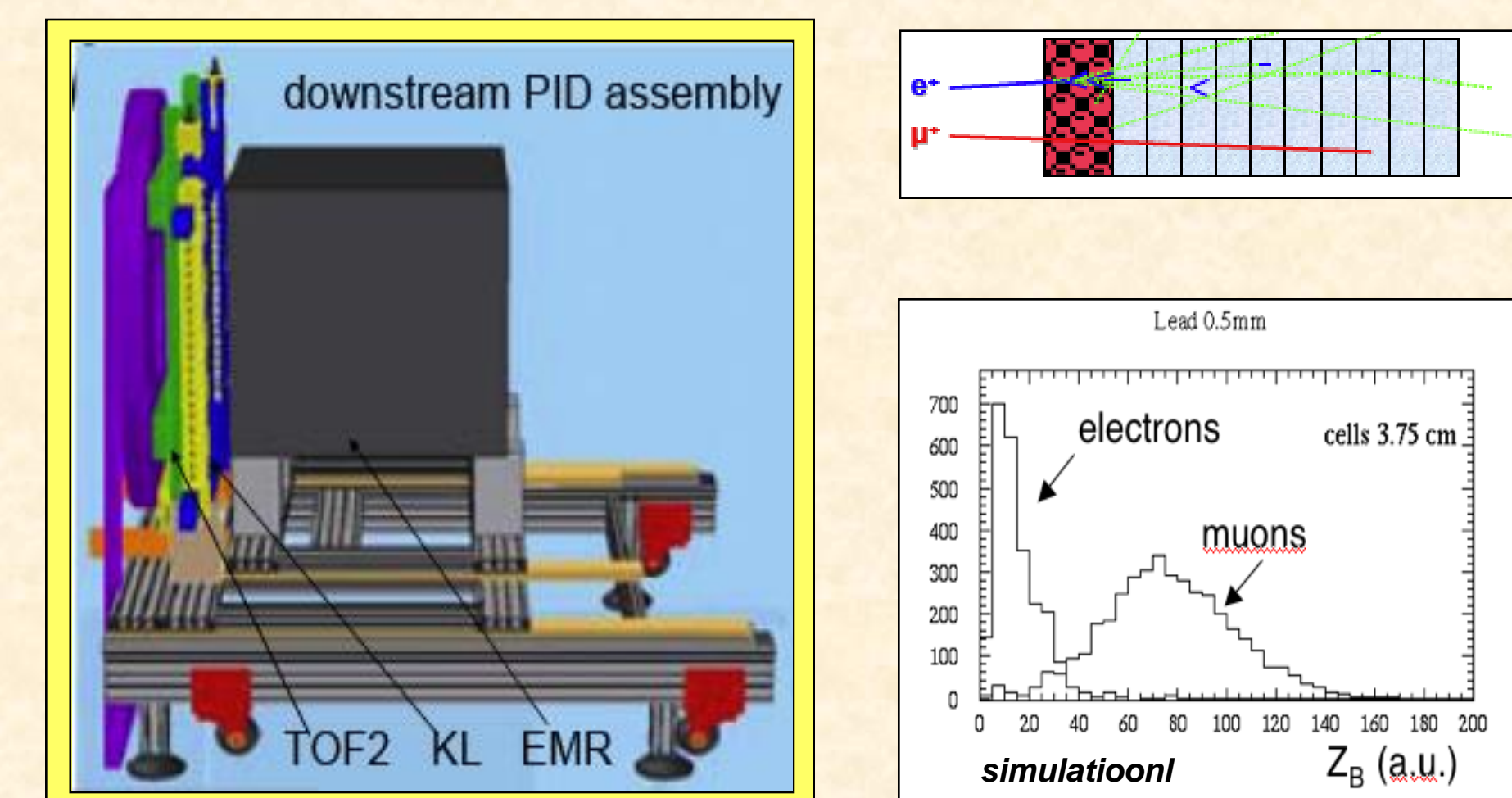
<http://mice.iit.edu/>

Cherenkov Electron Response



KL/EMR

- KL*/EMR** - electron preshower+electron-muon ranger. (*KLOE - Nucl.Instrum.Meth.A598:239-243,2009)
- KL** - preshower constructed of 0.3mmPb+BF12 fiber ($2.5 X_0$, $\Delta E=7\%/\sqrt{E}$, $\Delta t \sim 70 \text{ ps}/\sqrt{E}$)
- EMR** - 70cm active scintillator w WLS+MAPMT readout ($58 \text{ bars} \times 40 \text{ layers} = 680 \text{ mm}$, 2360 ch)



Electronics

