

A Large Volume micro-TPC

Kentaro Miuchi (Kyoto University)

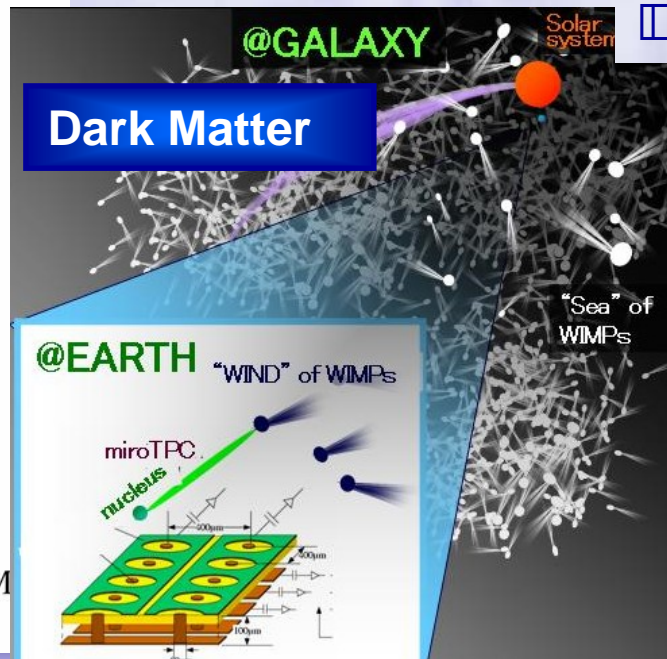
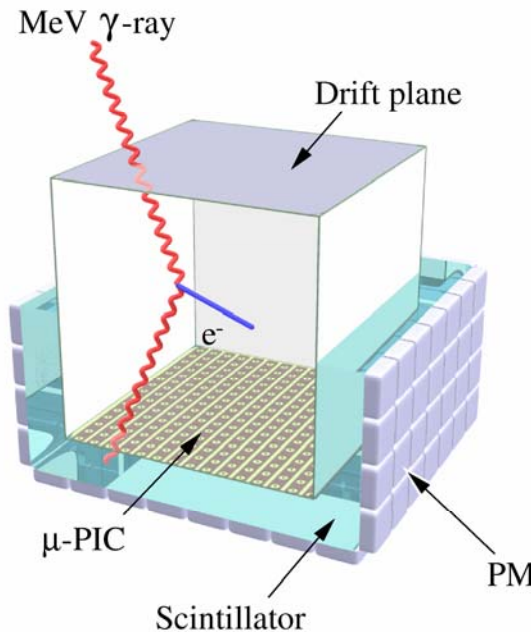
T. Tanimori, H. Kubo, S. Kabuki, K. Tsuchiya, A. Takada, Y. Okada,
H. Nishimura, K. Hattori, K. Ueno, S. Kurosawa

July 6 2006, IWORID8 PISA, ITALY

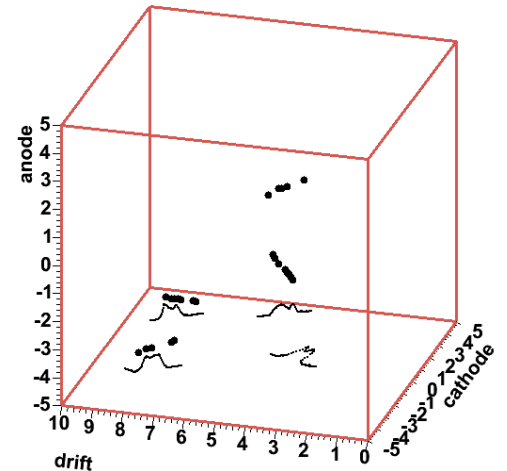
OUTLINE

- A Large Volume micro-TPC
- Performance
- Summary

Compton gamma-ray

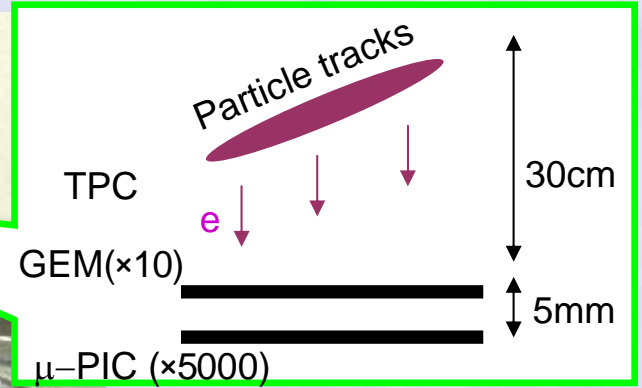
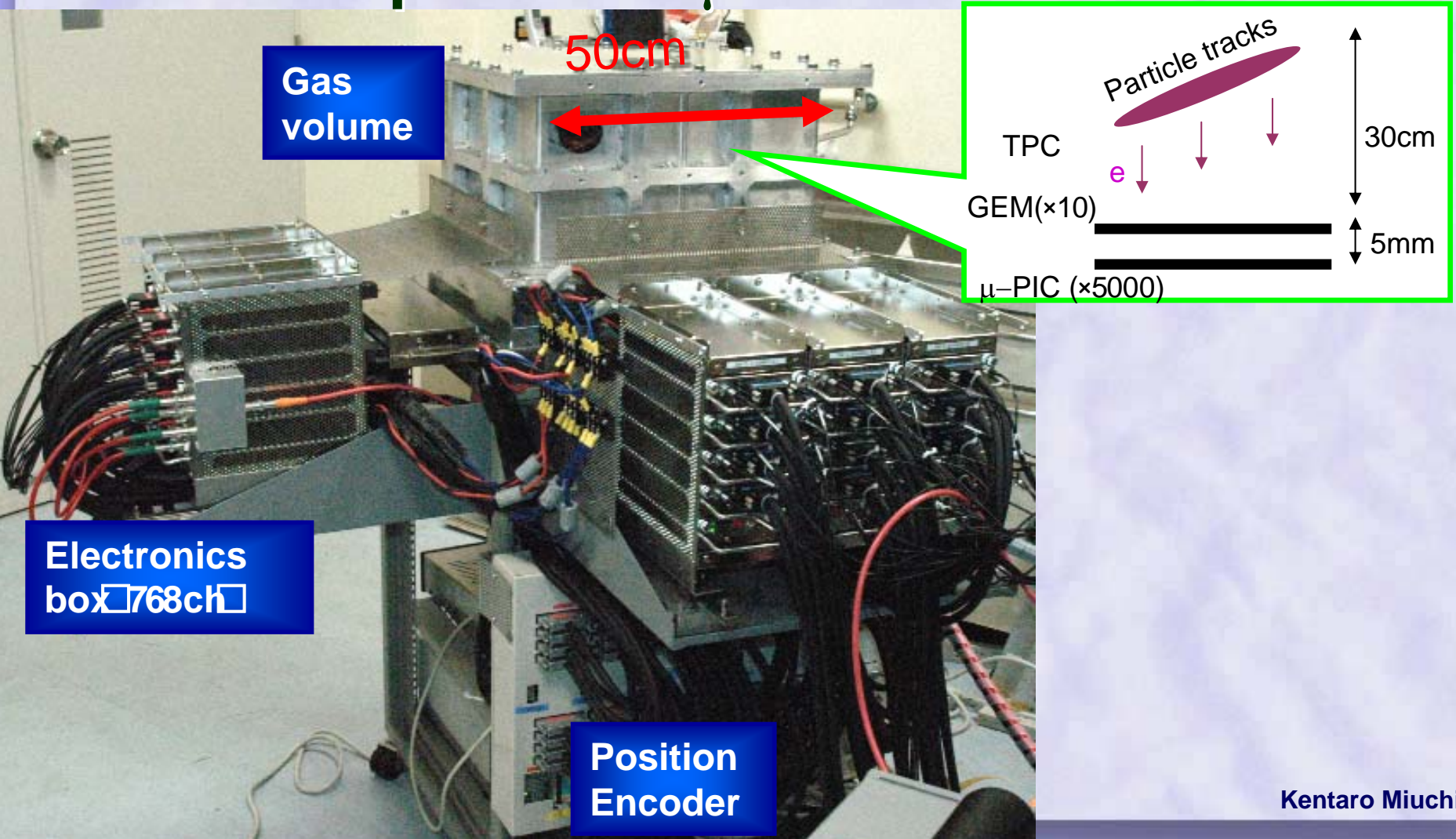


neutrons



1: A large volume micro-TPC

- ◆ Effective volume: $23 \times 28 \times 31 \text{cm}^3$
- ◆ Detector pitch: $400 \mu\text{m}$

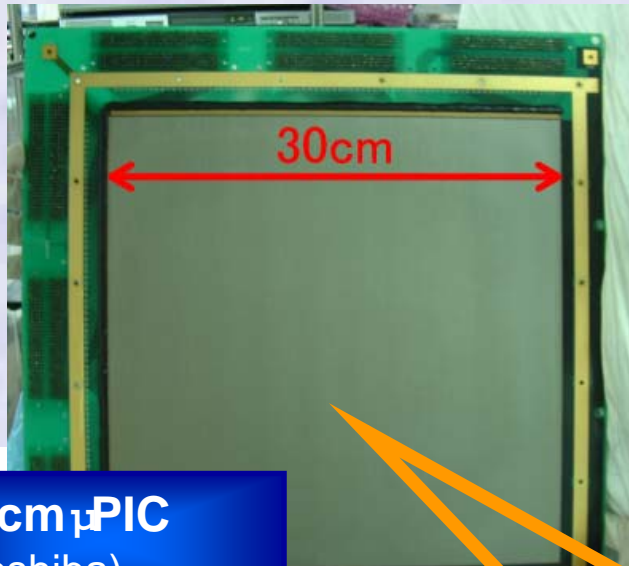
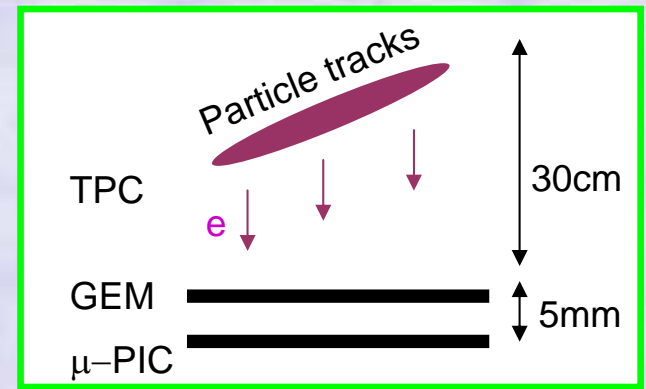


2D imaging device

μ -PIC (gas gain 5000)

- 400 μ m pitch
- 589824 pixels
- 768+768 readout

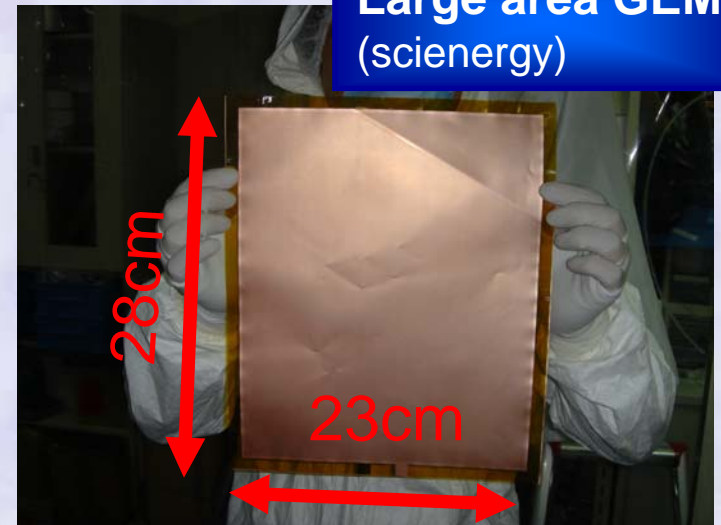
Takada et. Al.
PSD7



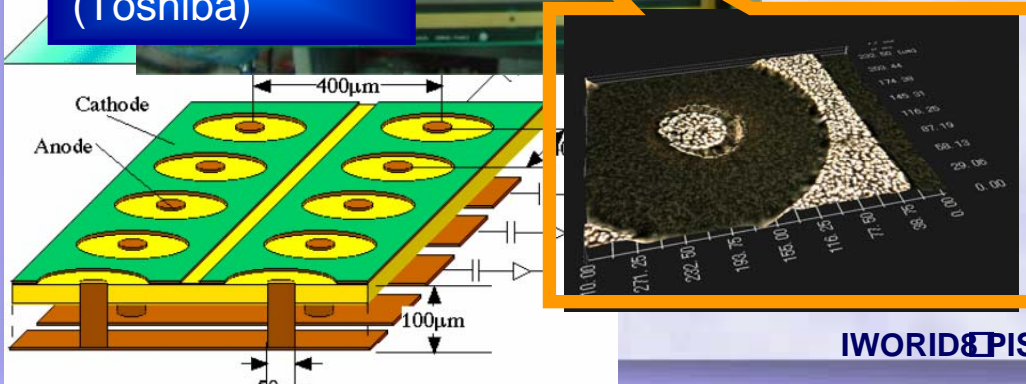
30cm μ PIC
(Toshiba)

GEM (gas gain 10)

- 140 μ m pitch
- 70 μ m diameter



Large area GEM
(scienergy)

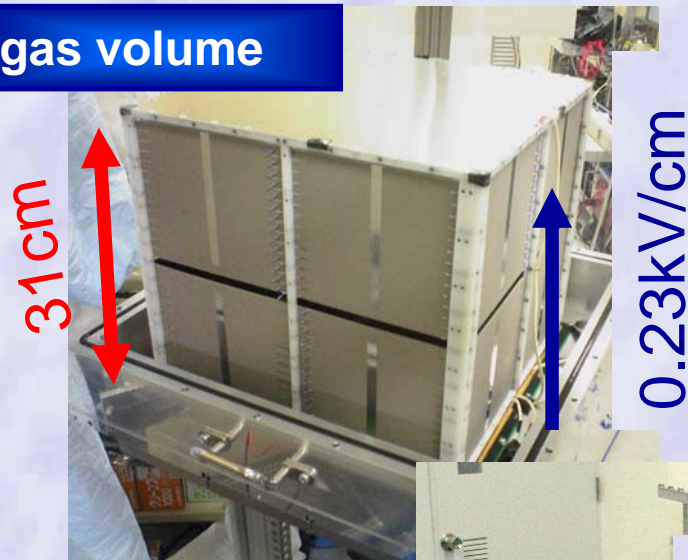


TPC system

Gas volume

- DRIFT length 31cm
- Ar + C2H6 (90:10) gas

gas volume

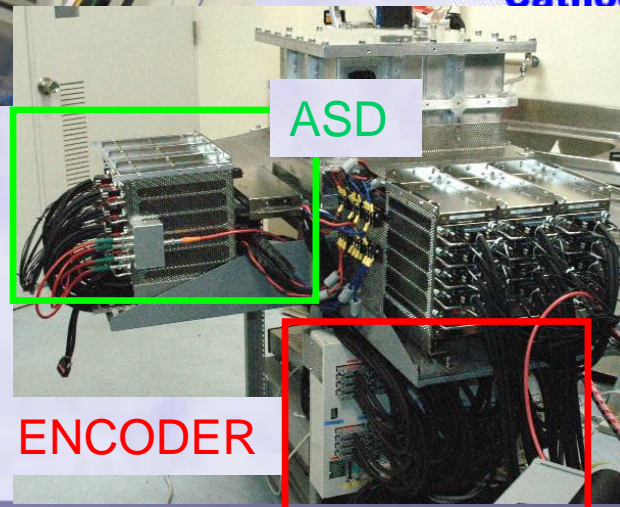
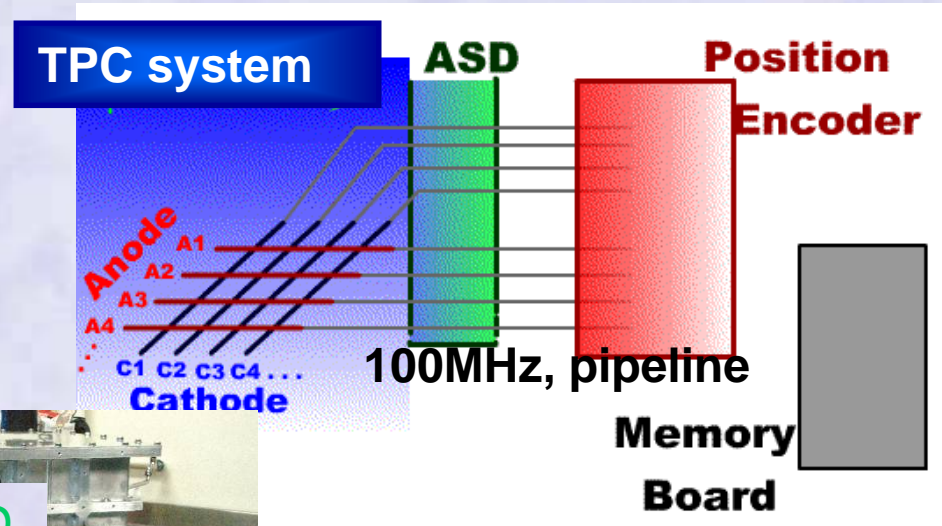


Readout electronics

Kubo et. al.
IEEE/NSS 2005

- 768 anode + 768 cathode
- Digital (LVDS) signals at ASD
- (X,Y,T) at the position encoder

for tracking

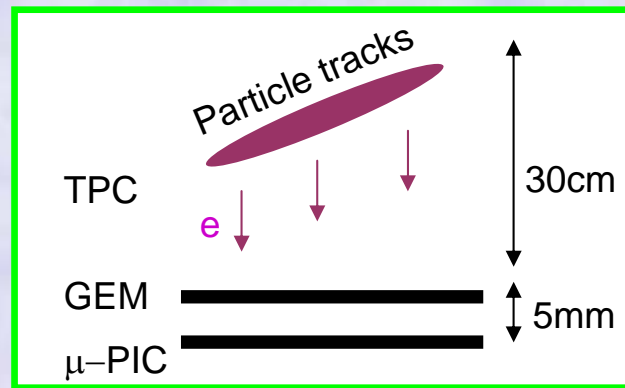


+
Summed analog signal
for energy

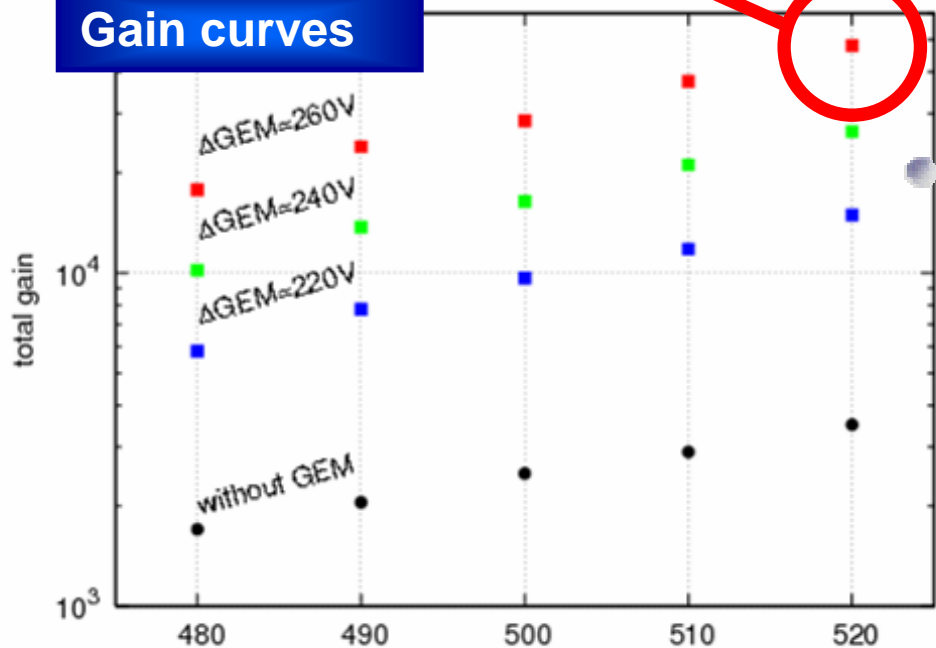
2: Performance

Gas gains

- operation gain for MIPs $\sim 50,000$



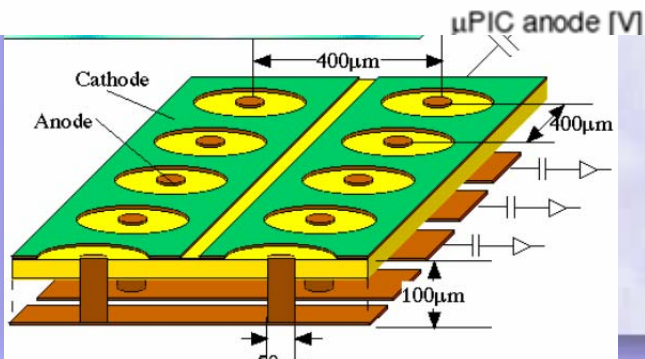
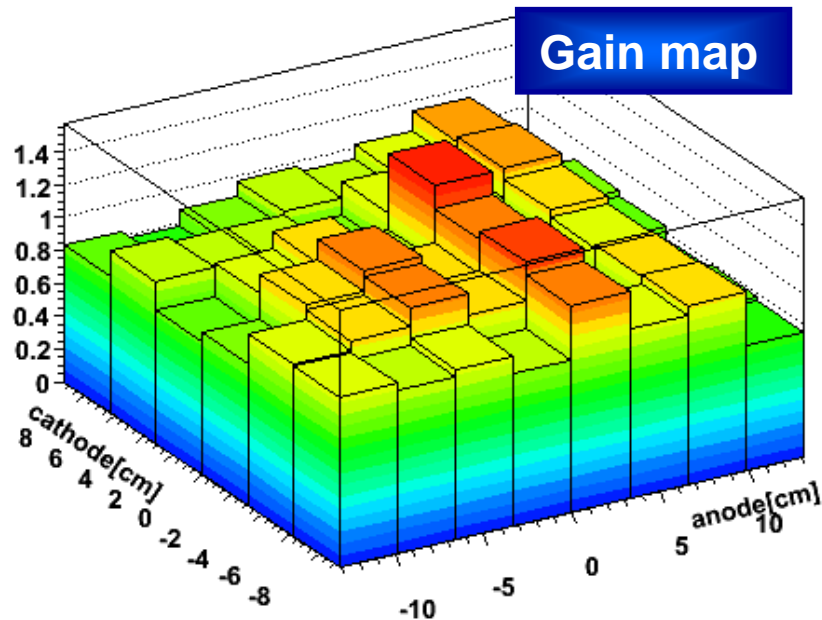
Gain curves



Gain uniformity

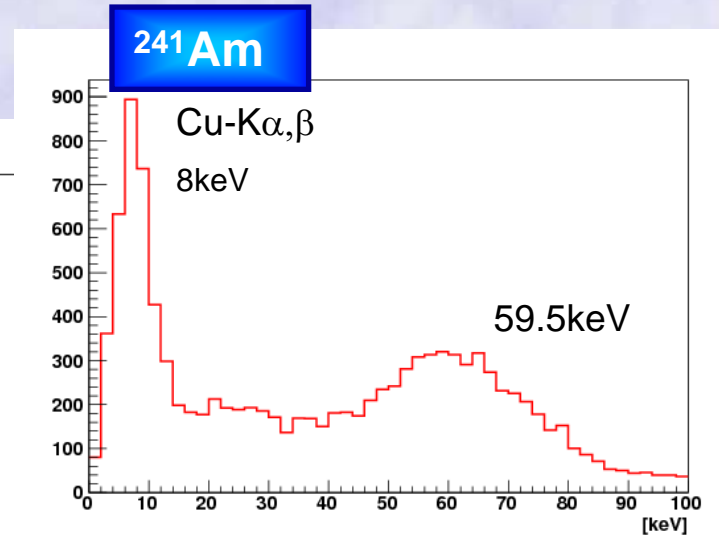
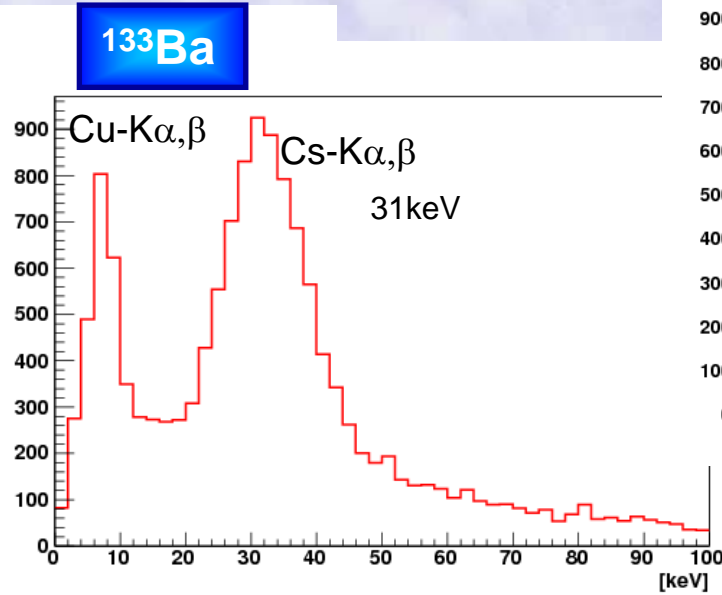
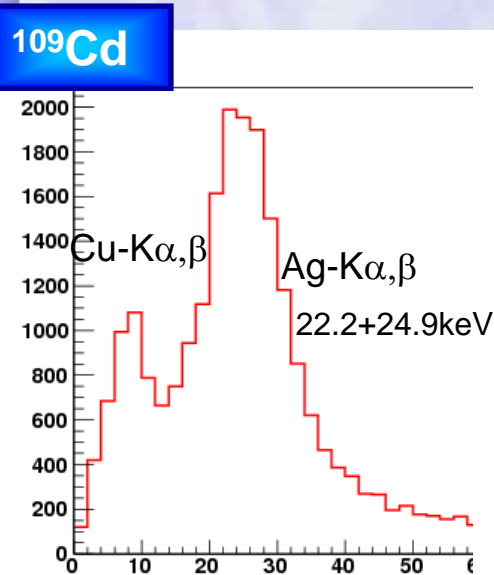
- Maximum / minimum = 2.2

Gain map

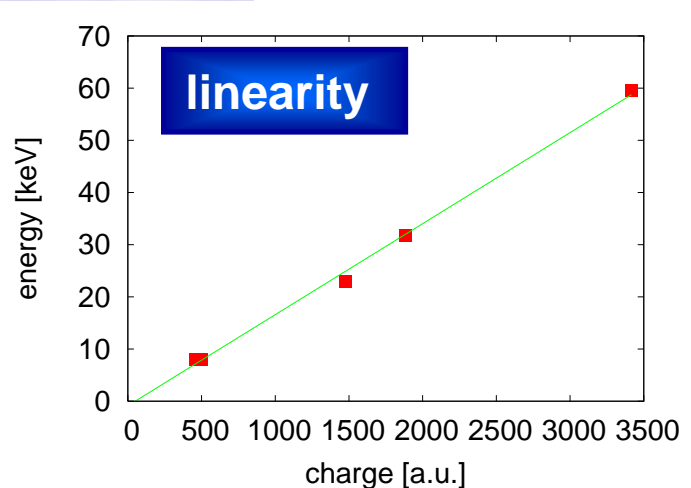
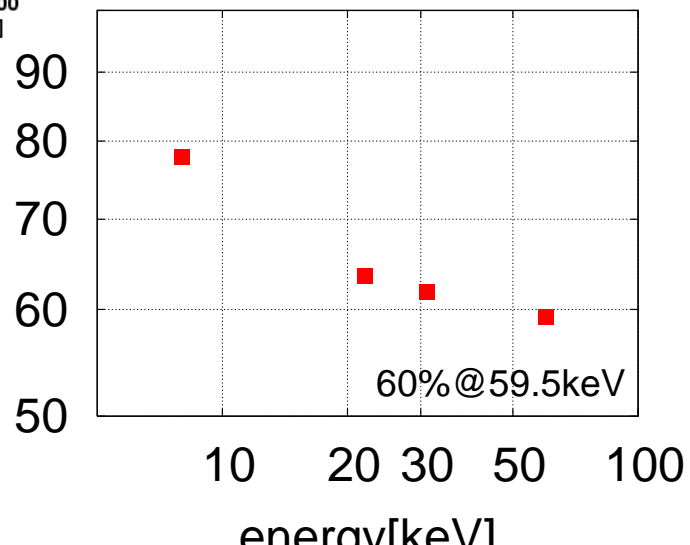


Spectrometry

- Energy spectra from the whole volume (with energy corrections)

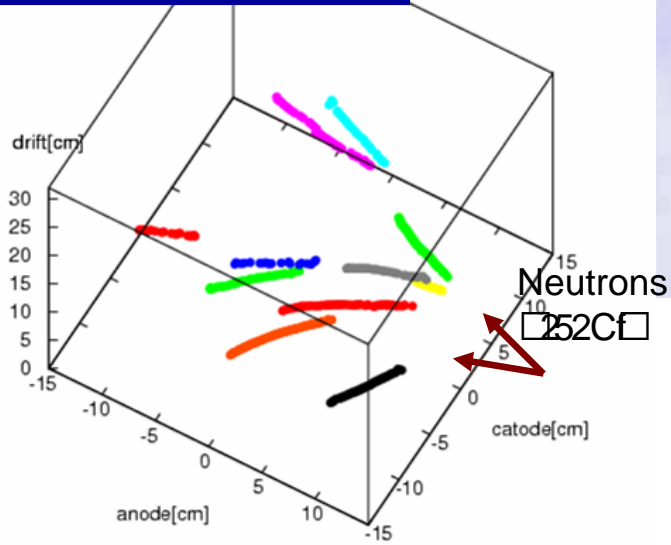


Energy resolution



Particle Tracking

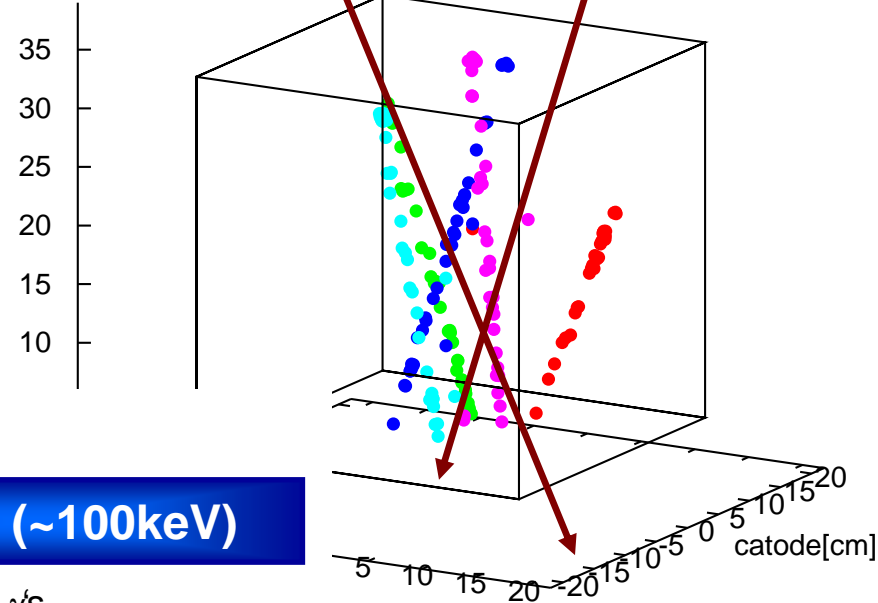
Protons (~2MeV)



drift[cm]

Cosmic ray muons

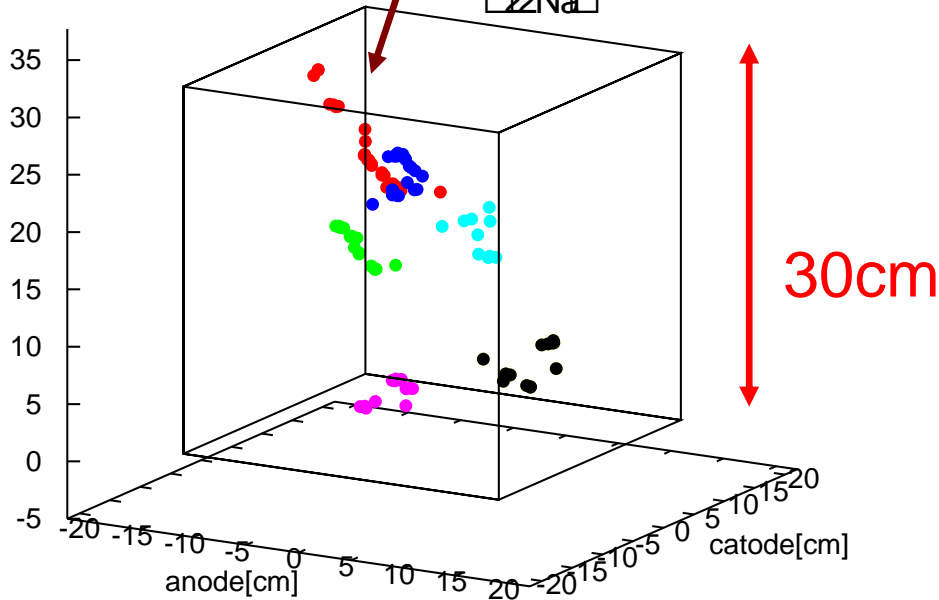
muons



Electrons (~100keV)

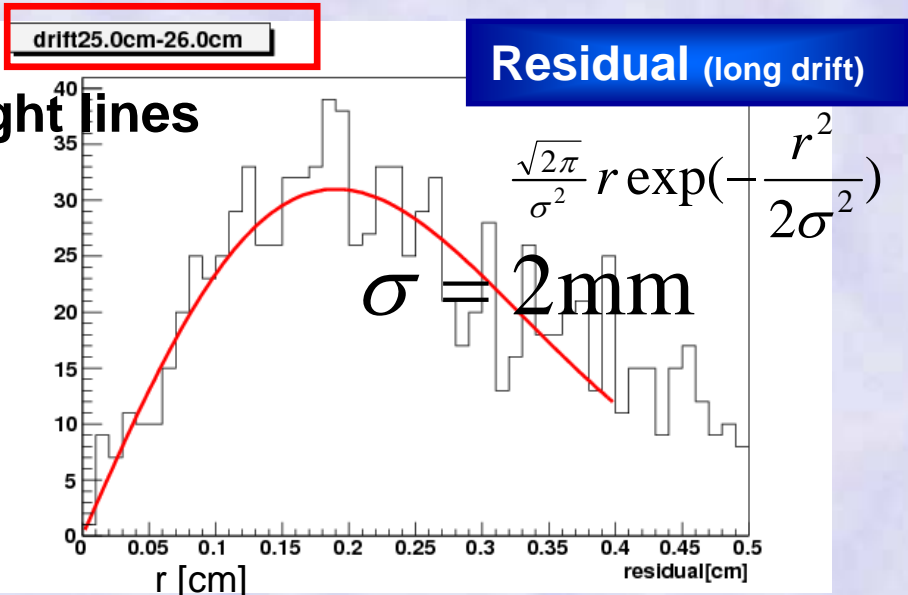
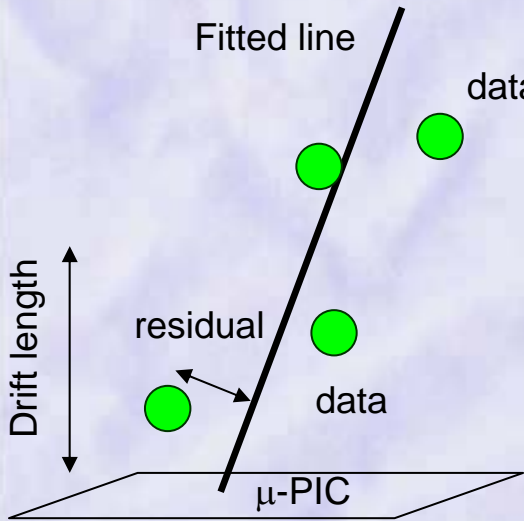
511keV γ s

^{22}Na

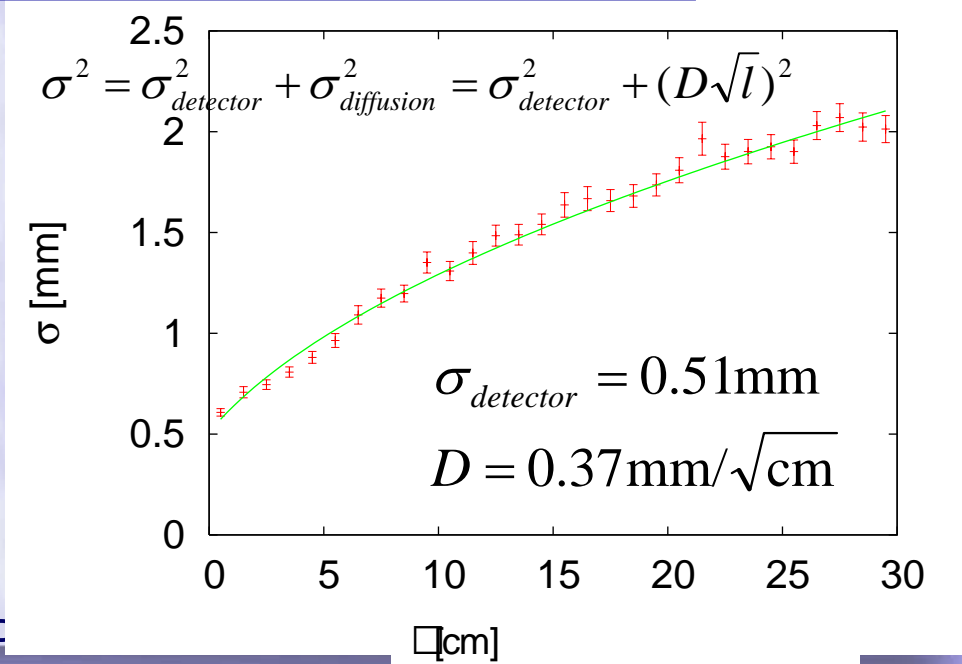
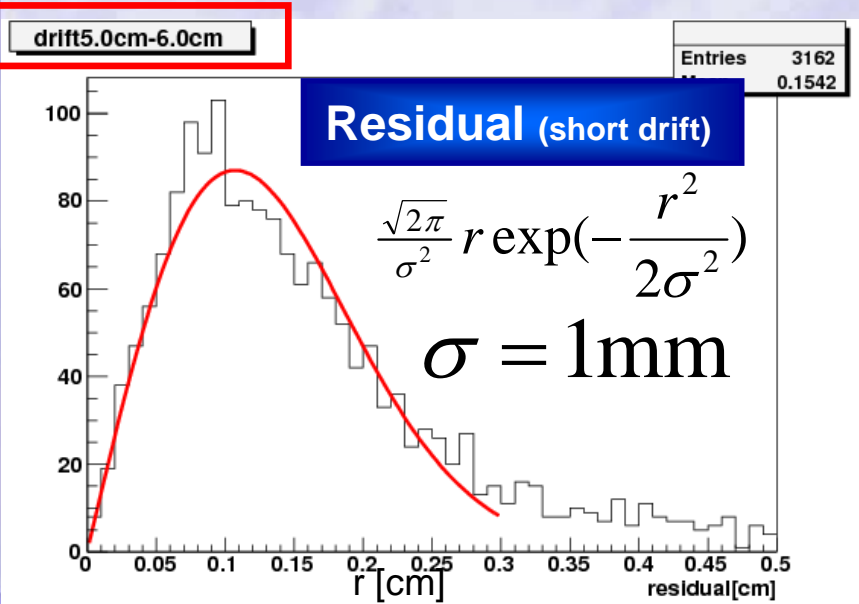


3D Spatial resolution

- Fit muon tracks with straight lines
- plot the residuals



σ dependence on drift length



Summary & Future

- Large volume Micro-TPC $\square 23 \times 28 \times 31 \text{ cm}^3$
 - $\mu\text{-PIC} + \text{GEM}$
- Fundamental performance was measured
 - Operation gas gain 50000
 - Energy $\square 20 \sim 60 \text{ keV}$ peaks observed
 - \square Spatial resolution \square
 - 0.5mm (drift 0cm) $\sim 2(\text{drift } 30\text{cm})\text{mm}$

energy resolution,
energy range

Spatial
resolution

^3He TPC gas

