Performance and applications of a μ-TPC

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1.Introduction

- μ-TPC : an "electric cloud chamber"

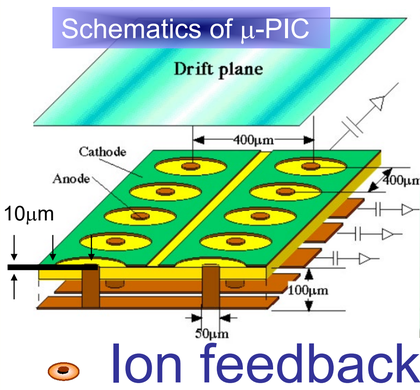
REQUIREMENTS
- Tracking minimum ionizing particles (MIPs)
- Fine (sub-millimeter) samplings
- Low ion-feedback

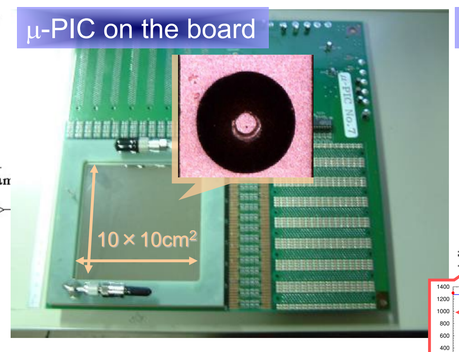
} Operation gain : >10000

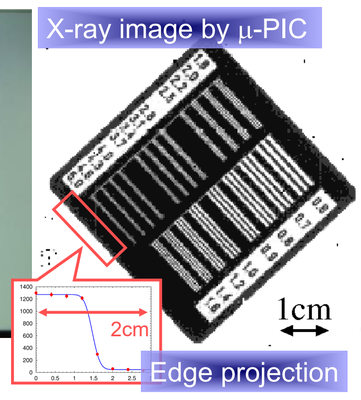
MIP's energy deposition: ~4 ion-e pairs/400μm (in Ar gas, 1atm)

2.μ-PIC

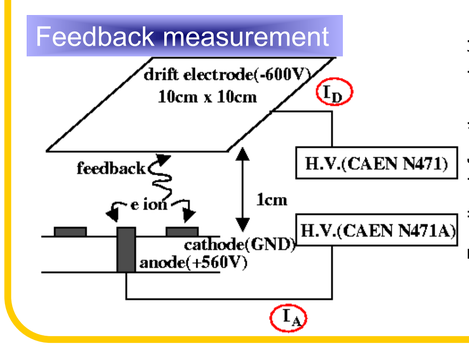
- μ–PIC[1] "2-D imaging detector"
  - 400 μm pitch, 120 μm 2-D spatial resolution
  - Maximum gain 16000, operation gain 6000 (>1000hours)
  - PCB technology for large area (10×10 cm^2 in operation, 30×30cm^2 in development)

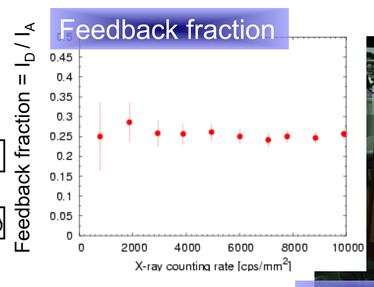






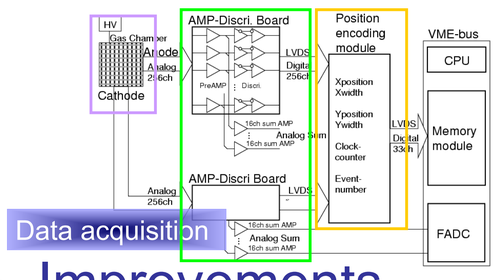
- Ion feedback
  - Less than 30% for 10^4cps/mm^2 X-ray (max 20keV)

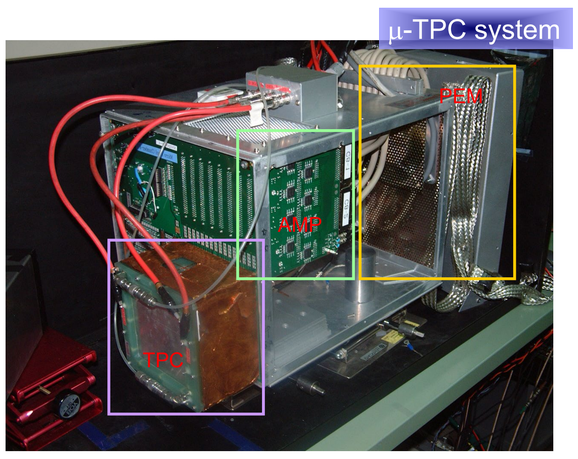




3. μ-TPC (gas-flow operation)

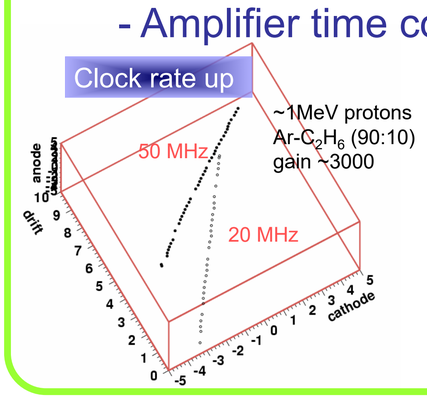
- Development [2,3]
  - μ-PIC+ 8cm drift length
  - Digital-based electronics

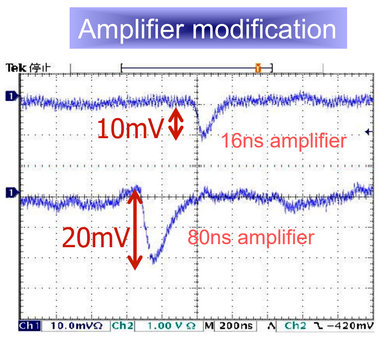


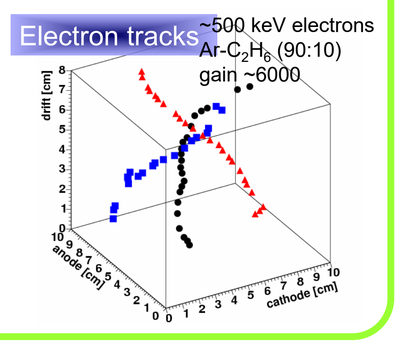


- Improvements
  - DAQ Clock rate 20MHz to 50MHz
  - Amplifier time constant 16ns to 80ns

➡ sampling ×2, S/N ×2

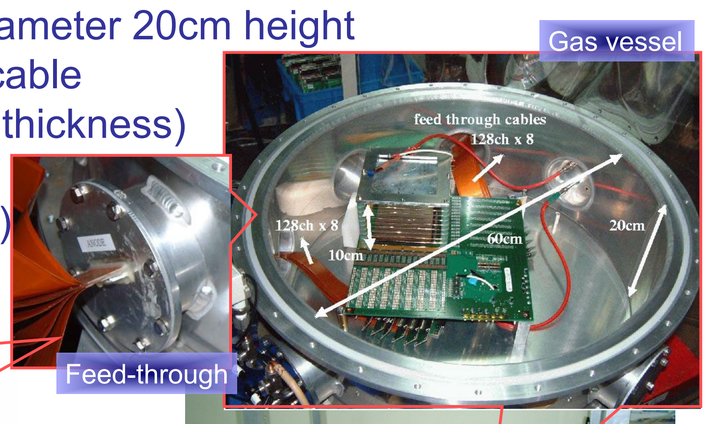


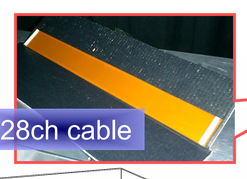


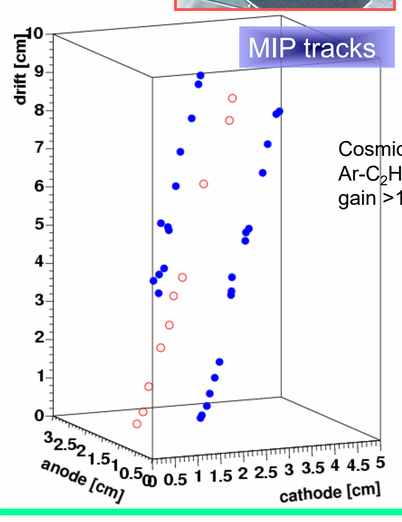


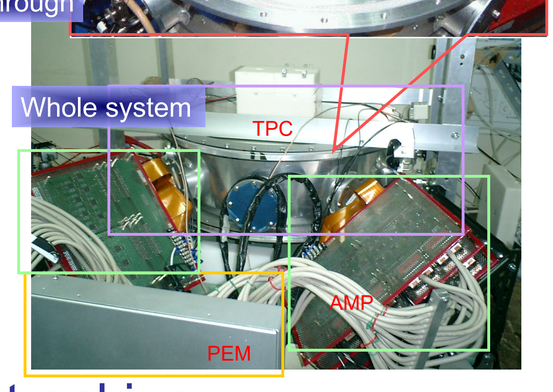
4. μ-TPC (gas-filled operation)

- System
  - Gas vessel: 60cm, diameter 20cm height
  - 128ch feed-through cable (5cm width, 0.3mm thickness)
  - 10cm drift length (1mm copper wires)







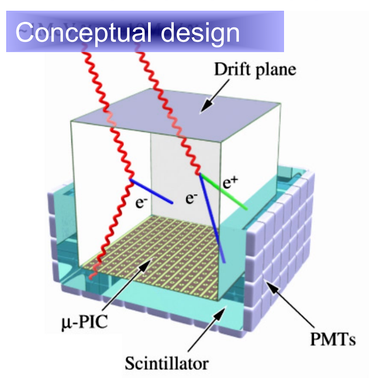


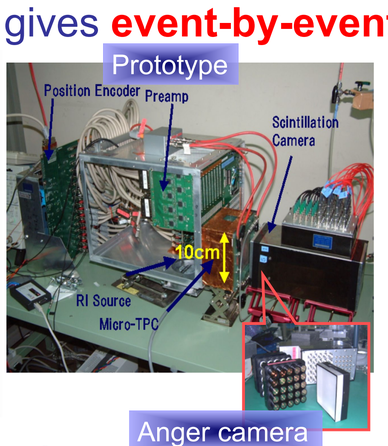
- MIP tracking
  - Ar-C_2H_6 (80:20), 2atm
  - **First "MIP tracks" were detected**

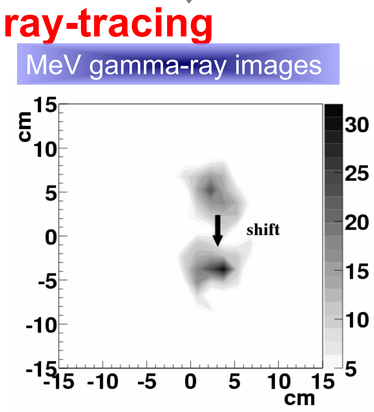
5. Applications

- MeV gamma-ray camera [4,5]
  - μ-TPC (recoil electron) + Scintillator (scattered gamma)
  - "electron track" gives **event-by-event ray-tracing**

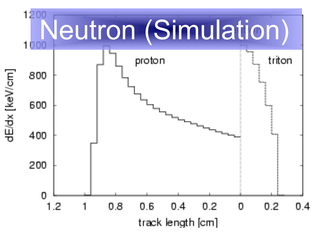
only "event circle" by conventional Compton cameras

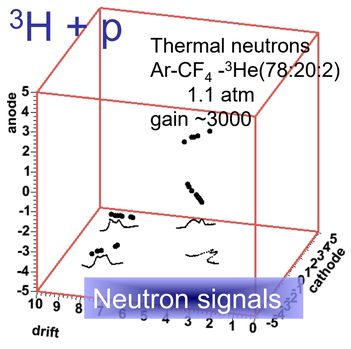


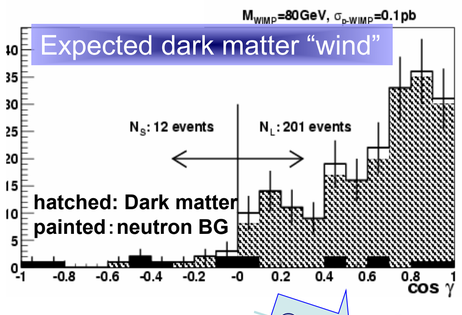


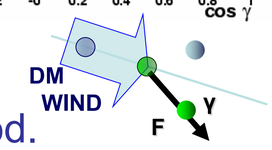


- Time-resolved neutron imaging[6]
  - n + ^{3}He → ^{3}H + p









- Dark matter experiment[7]
  - TPC is thought to be a very reliable method.
  - Low pressure operation: to be examined

6.Conclusions

- μ-TPC : an "electric cloud chamber"

DEVELOPMENT
- $10 \times 10 \times 10$ cm^3 detection volume
- Fine tracking of proton, electron were shown.
- First MIP tracks were detected.
- Now we are entering the phase for "Applications"

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