Readiness of the PHENIX Muon Identifier for Au+Au and Polarized p+p Collisions at RHIC

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for the PHENIX Collaboration

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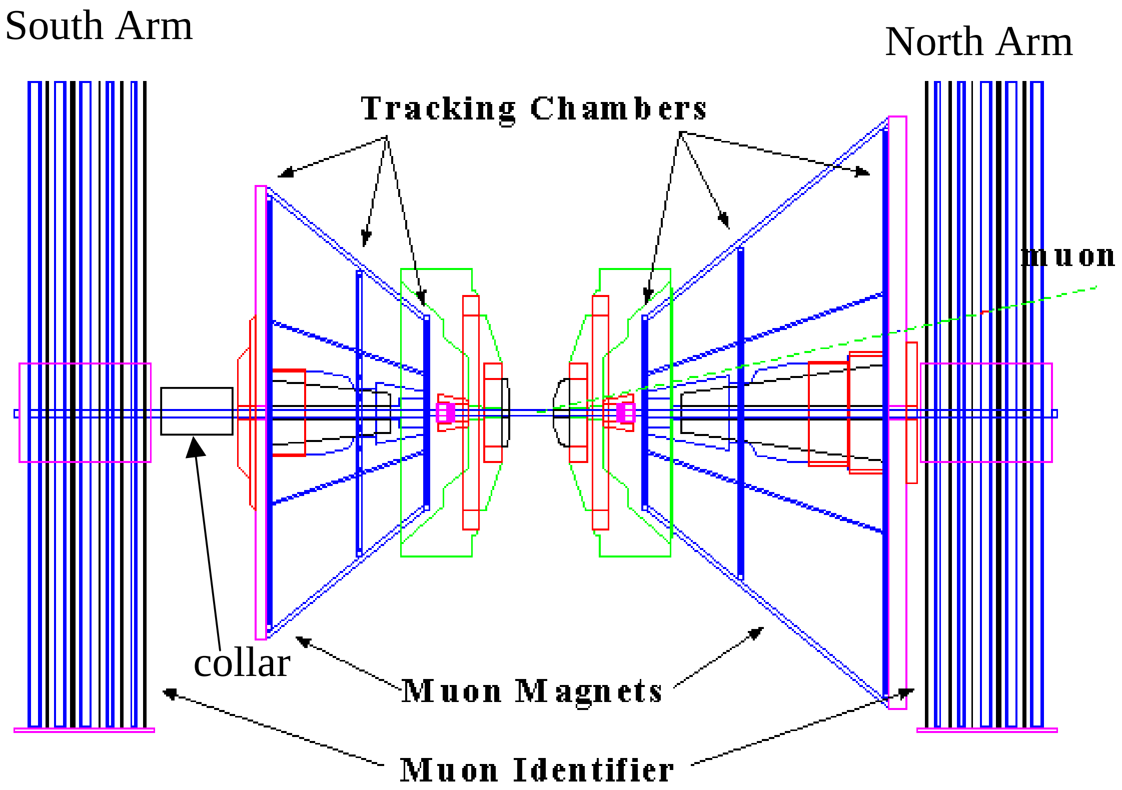
- Physics with the PHENIX Muon Arms
- Muon Arm and Muon Identifier
- MuID performance
- MuID commissioning in year 2000
- Status and summary

Physics with the PHENIX Muon Arms

- QGP signals with Au+Au collisions
  - J/ψ suppression ⎫
  - ϕ mass shift ⎭ ← μμ
  - Charm enhancement ← μ, *e*μ
- Proton spin structure with polarized p+p collisions
  - Double-longitudinal spin asymmetry for J/ψ and open heavy flavor production → $\Delta G(x)$
  - Parity violating spin asymmetry for *W* boson production → $\Delta\bar{q}(x)$

PHENIX Muon Arms



Acceptance $1.2 < |\eta| < 2.4$

total absorber ~10 λ_{int}

Momentum cut ~ 2GeV/*c*

2001 South Muon Arm operation starts

2002~ Both Arms operation

Muon Tracker (MuTr)

- Cathode-readout strip chambers at three stations
- σ_x ~ 100μm → $\Delta p/p$~3%@3~10GeV/*c*

Muon Identifier (MuID)

- 5 layers of chambers (Iarocci tubes) sandwiched in steel
- used as a trigger counter

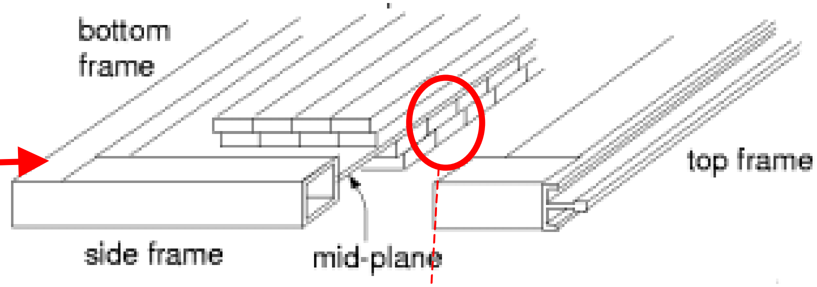
MuID Requirement

- Minimizing hadron punch-through background while maximizing efficiency for ϕ and J/ψ → 5 layers of steel and chamber sandwich
- Enough channel segmentation for matching a road in MuID with a track in MuTr.
- p+p collision rate is about once a crossing at the design luminosity → Width of the signal time distribution should be smaller than the beam crossing interval (106nsec)
- Covers a large area (13m×10m) and long time (~10 years) operation → use low cost and robust chambers (Iarocci tubes)

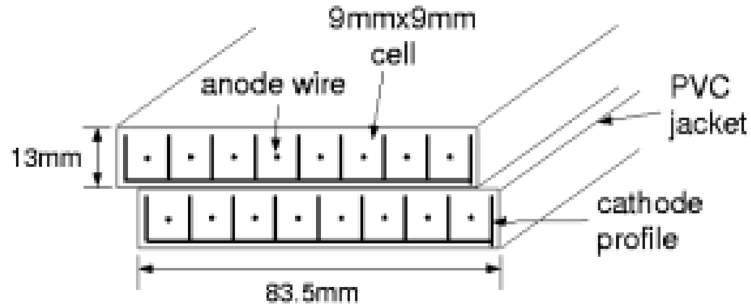
MuID Structure

Large panel Small panel

South Muon Arm



Cross section of the MuID panel

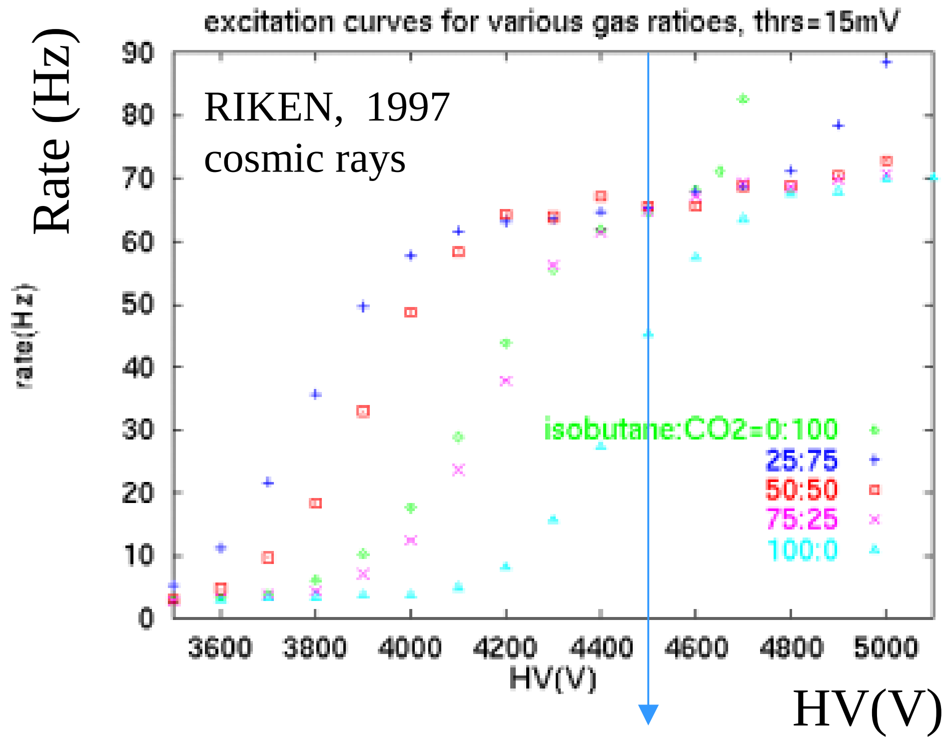


Cross section of the plastic tube(2-pack)

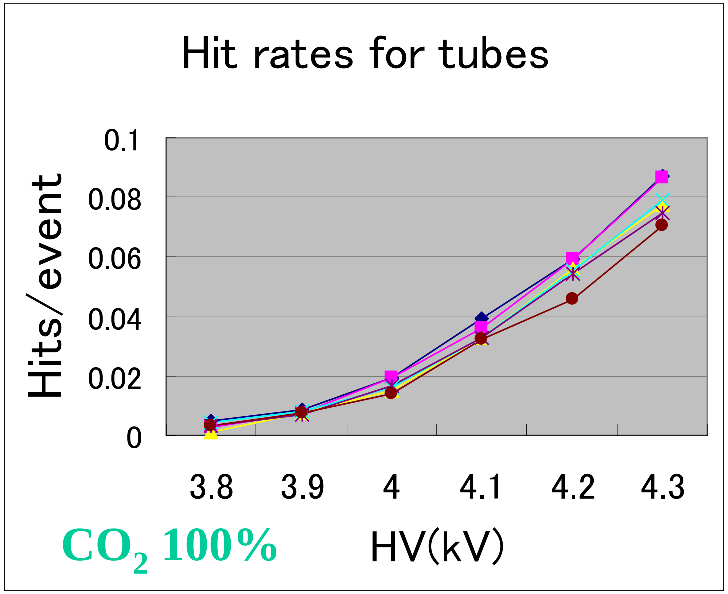
- 4 large panels and 2 small panels in one layer (gap)
- In a panel, Iarocci tubes with 2.5~5.6m length and 8.4cm width run both horizontally and vertically
- 6340 tubes (3170 channels)/Arm

- One channel consists of two staggered tubes for better efficiency (~97%) and drift time
- Those two layers are in different HV and gas segments to minimize dead channels

MuID Tube Operation



Operation Voltage ~ 4500V
(proportional mode → longevity)



MuID commissioning, 2000

isobutane → low ionizing level
CO_2 → develop gas multiplication

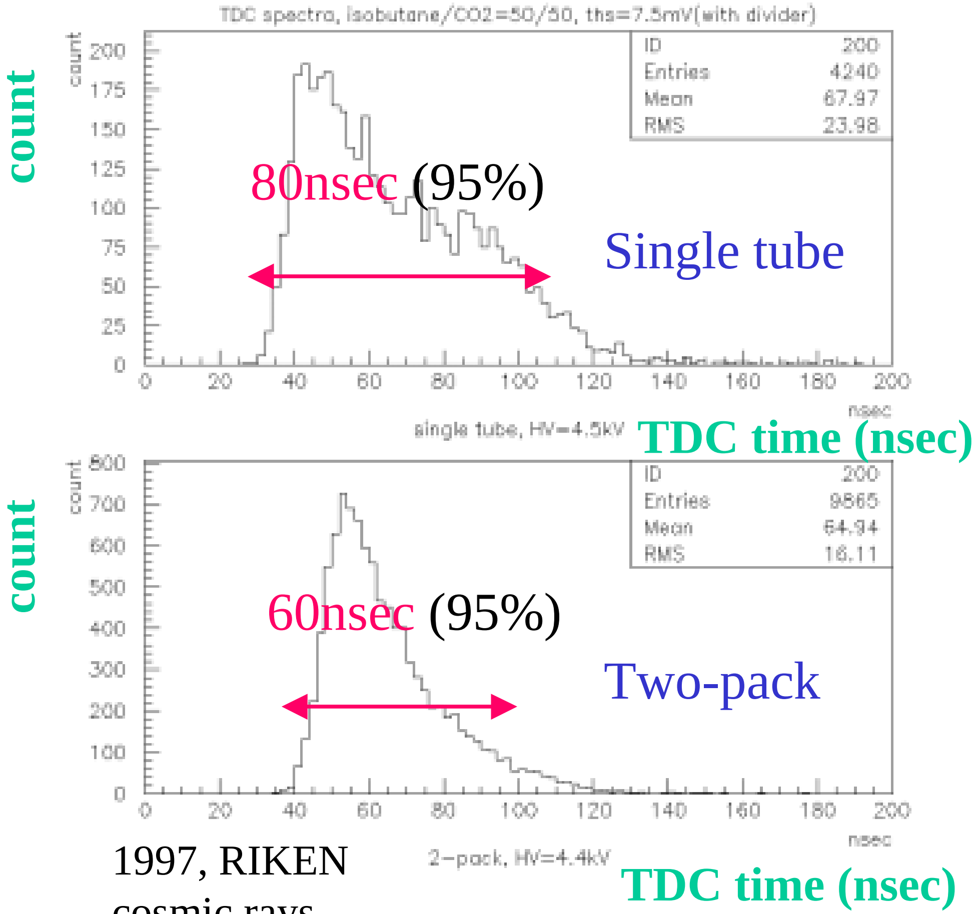
↓

Isobutane : CO_2 ~25 : 75 is optimal

- In actual operation, 0 ~ 25% isobutane
- 9.3% isobutane for this year (non-flammable limit)

MuID Tube Drift Time

Drift time distributions



1997, RIKEN
cosmic rays

Drift time width ~ 60nsec

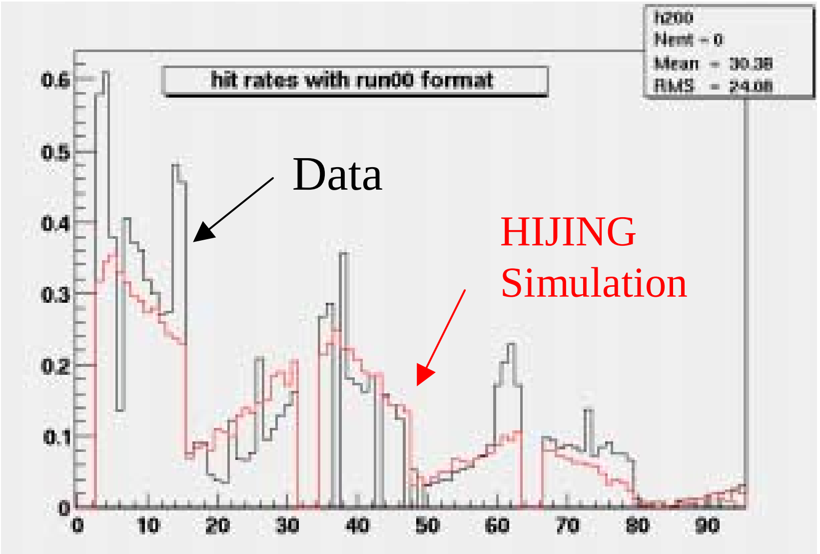
< bunch crossing (106nsec)

→ good enough for a trigger counter（confirmed by the timing scan last year)

MuID Commissioning with Au+Au Collisions in Year 2000

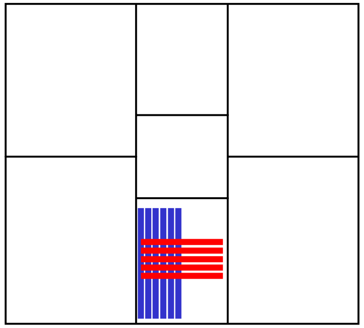
Use 87 channels in Gap 2, 3, and 5 in the South Arm (about 3% of total)

Hit rate of each channel

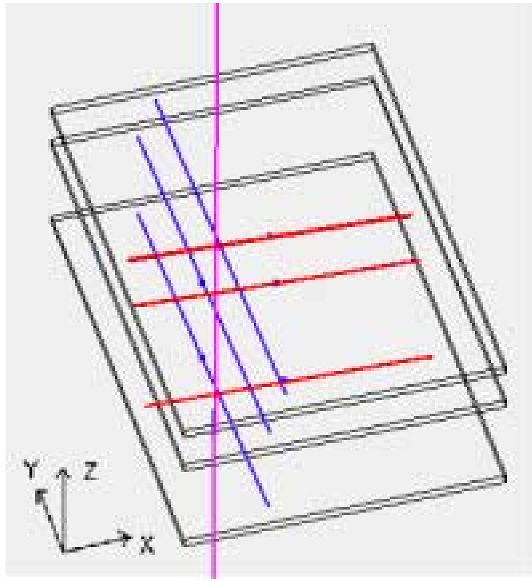


Gap2 Vert. | Gap2 Horiz. | Gap3 Vert. | Gap3 Horiz. | Gap5 Vert. | Gap5 Horiz.

Many secondary particles from the beam pipe (should be reduced this year with the beam collar)



Positions of tubes used



A reconstructed track with offline software

- Chambers, gas system, electronics and DAQ system were operated normally
- Hit rates agreed with simulation
- Tracks were reconstructed

Summary

- PHENIX MuID fulfills requirements for both high-multiplicity Au+Au collisions and high-luminosity p+p collisions at RHIC
- South MuID was successfully commissioned in the last year and ready for data taking for Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV starting in a month.

MuID Related Talks

- Electronics - Andrew Glenn (V10.007)
- Triggers - Jason Newby (V10.008)
- Offline Software - Yajun Mao (V10.004)