

## Present Status of GEM Detector Development at RCNP

at site with the

12 21008 20805 13800 18000 5600

Kunihiro Fujita RCNP, Osaka Univ.

## **Physics Motivation**

- Physics goal
  - study short range correlation of the nuclear interaction  $\Rightarrow$  1p exchange + 1r exchange + g'(short range)
  - Landau-Migdal parameters g' (g'<sub>NN</sub>, g'<sub>N</sub>, g'
    - D-hole residual interaction



own No information

- $g'_{DD}$  extraction from Coherent Pion Production  $p + A \rightarrow n + p^+ + A$  (ground state)
- Peak position of p coincidence spectrum : DE

~ sensitive to 
$$g'_{DD}$$

• 
$$\Delta E \approx g'_{DD}(hct_{pND}/m_p^2)\Gamma_0$$





## **Detector Requirement**

- Motivation
  - Tracking of low energy (< few hundred MeV) charged particle
- Requirements ( why GEM? )
  - high position and angle resolution
    - spatial : <100um & angle: < 2 mrad
  - rate capability : >100kcps
  - can be operated under high magnetic field: <0.5T



## **Detector specification**

- To Get position information for Two layers
- Component
  - Cascade GEM structure ~ Three layers
  - Two dimensional Readout Board
  - Charge Information : Multi channel ADC





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## GEM

50

307.2



H.V.

#### • **CERN-GEM** (supplied by GDD group)

- Active Area: 307.2x50 mm
- Segmented by two area
  - protection from discharge
- Standard Material & Size
  - Cu-PI-Cu 5-50-5mm
  - hole 70mm, pitch 140mm



## Readout Board and Connector

#### Readout Board

- Same size with GEM
- Base : G10 50mm
- Cu-PI-Cu : 5-25-5 mm
- Strip width
  - horizontal (x) : 80 mm
  - vertical (y) : 340 mm
- pitch: 400 mm

#### • Connection

- Flexible Cable
- Sandwiched Structure : GND-Signal-GND





## **Readout Electronics**

- Analog
  - VA: amp, sample/hold, serialize
  - TA: self trigger (32ch OR)
  - Dynamic range : ~ 140 fC
  - 256ch outputs are multiplexed
- Digital
  - ADC: 12-bit
  - Serial Data Transfer (LVDS)
  - Sparse Data Scan : Skip un-triggered chip

#### • Data Transfer Rate ~ should be checked



## Beam Test



- Experiment was performed in December 2005
- Beam:
  - particle: alpha
  - energy:  $\sim 100 \text{MeV/A}$
  - rate : <1k count / sec</pre>
- Detector Setting
  - Gas : Ar/CO2 (7:3)
  - DVgem : ~ 410V (gain ~12k)
- 480ch readout was tested. (Total channel is 1776ch)



## MWDC x 2

#### Scintillator x 2

# Scattered Particle

DAQ PC



► blank area

## Result (1) ~ tracking

hit\_strip1

- Position information was observed in each layer.
- With two position information, position on focal plane is calculated.
- Problem
  - efficiency has position dependence

L1 > L2

- hit information has structure

• Beam profile is not flat?

**FPC** 

• Is gain fluctuate by FPC length?



hit\_strip2

## Result (2) ~ charge collection

#### • Charge information

- Cluster size (cls)
  - ~ Nominal event has 5~15 cls
- ADC spectrum with different  $DV_{gem}$ 
  - ~ Gain dependence is shown
- ADC had overflowed.
- Gain is large enough?









## Next Plan

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- Full setup
  - Test experiment ~ performance check more in detail
  - CPP experiment
- Low materialize
  - Reduce GEM layer : triple  $\rightarrow$  double
    - ~ need enough gain
  - Replace G10 (base of ROB) to PI
  - "Al" GEM ~ collaborate with M. Tanaka (KEK)



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## SUMMARY

- 02
- We developed GEM detector for nuclear experiment.
- Large size GEM is made.
- Two dimensional Readout Board is made.
- ADC data is acquired by serial data transfer system with VA chip.
- Beam test was performed, and position information was acquired successfully.

