Status of Charge Dispersion TPC
Readout Studies at Carleton

TPC R&D Telephone/VRVS Meeting
7 April 2004

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Current Activities

Spatial resolution measurement using charge dispersion
  • 2 x 6 mm pad readout structure
  • GEM & Micromega test cells with a resistive anode

The measured resolution using charge dispersion technique is:
  • Consistent with the x-ray spot size for the GEM
  • Ok for the Micromegas detector in the centre
  • The small frame size degrades Micromegas resolution as one gets closer to the frame

Monte-Carlo simulation of charge dispersion phenomena

Cosmic ray resolution studies of a small GEM-TPC with charge dispersion readout
Setup for the GEM test cell studies with charge dispersion readout

• ~4.5 keV low energy x-rays from a bremsstrahlung source
• X-ray spot ~50 µm
• Double GEM readout
• Ar:CO2/90:10 gas
• 2 mm x 6 mm readout pads
• ~ 500 k-Ohms/sq resistive anode
• Aleph TPC charge preamplifiers
• 8 channels read out with Tektronix digitizing scopes
Setup for the GEM test cell with a resistive anode

Resistive anode disperses the avalanche cluster charge
Position from centroid of dispersed charge sampled by several pads

Carbon loaded Kapton $\sim 0.5 \text{ M}\Omega/\square$

Thickness $\sim 30 \mu\text{m}$
Comparison of measurement with Monte-Carlo simulation for the charge dispersion signal

50 µm x-ray spot on 2 mm x 6 mm pads

Main pad signal (x-ray spot in centre)  Signal on the adjacent pad

Measured experimental pulses in red. Theoretical simulation in blue
Measured Pad Response Function versus Simulation 
(50 µm collimated x-ray source)

The solid line shows the simulated pad response function.

- Anode film resistivity: \( \sim 530 \text{ k-Ohm/sq} \)
- Anode readout pad insulating gap: \( \sim 50 \mu \text{m} \)
- Dielectric constant of insulating layer: \( \sim 1.5 \)
GEM space point resolution with a resistive anode

2 mm x 6 mm pads 50 µm x-ray spot
Setup for Cosmic Rays Tests of GEM-TPC with Charge Dispersion Readout

- Ar:CO2/90:10
- \(~ 530~\text{k-Ohms/sq}\) resistive anode
- 2 mm x 6 mm pad readout (the same as for x-ray tests)
- Aleph TPC charge preamplifiers
- Readout with 64 channels of 200 MHz FADCs
Charge dispersion GEM-TPC pad signals for cosmic rays

Resistive anode improves resolution over normal charge readout

Analysis in progress

Results will be presented at the Paris LCWS2004
**Plans**

*Short term:*

- Complete data taking and analysis of GEM TPC cosmic ray data with Ar/CO2 and with P10
- Development of the Monte-Carlo in the tracking framework
- A larger Micromegas readout endcap is being prepared in collaboration with the Saclay group for space point resolution tests and for cosmic ray tests

*Longer term:*

- Beam tests in a year for double track resolution tests with a charge dispersion readout
- Work with Saclay group on 50 cm diameter Micromegas TPC in a magnetic field
- Develop slow 25 MHz VME digitizer system to replace 200 MHz FADCs