

Status of Charge Dispersion TPC Readout Studies at Carleton

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Current Activities

Spatial resolution measurement using charge dispersion

- 2 x 6 mm pad readout structure
- GEM & Micromegas test cells with a resistive anode

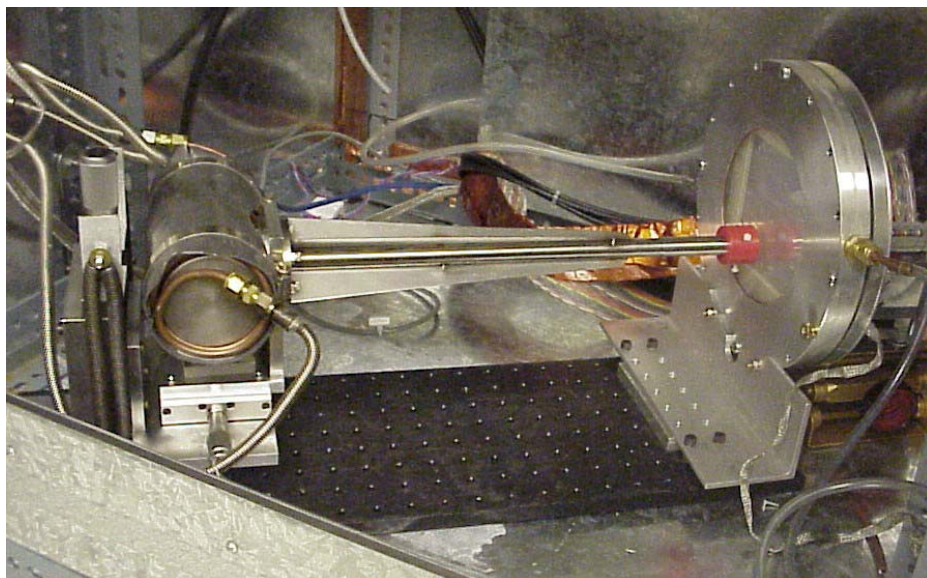
The measured resolution using charge dispersion technique is:

- 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

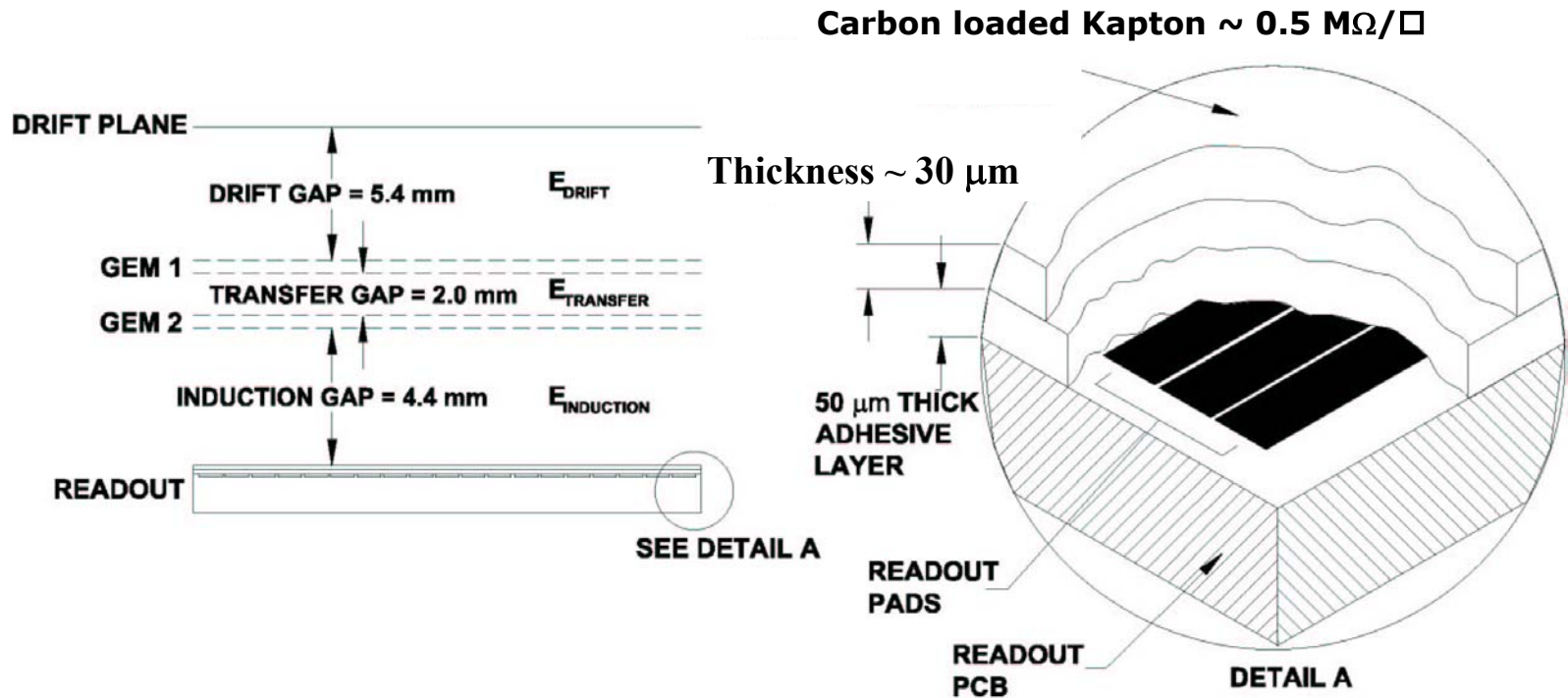


- ~4.5 keV low energy x-rays from a bremsstrahlung source
- X-ray spot ~50 μm
- Double GEM readout
- Ar:CO₂/90:10 gas
- 2 mm x 6 mm readout pads
- ~ 500 k-Ohms/sq resistive anode
- Aleph TPC charge preamplifiers
- 8 channels read out with Tektronix digitizing scopes

64	32	26	20	14	8	2
	31	25	19	13	7	
	30	24	18	12	6	
	29	23	17	11	5	
	28	22	16	10	4	
	27	21	15	9	3	
	63	57	51	45	39	
	62	56	50	44	38	
	61	55	49	43	37	
	60	54	48	42	36	
	59	53	47	41	35	
	58	52	46	40	34	

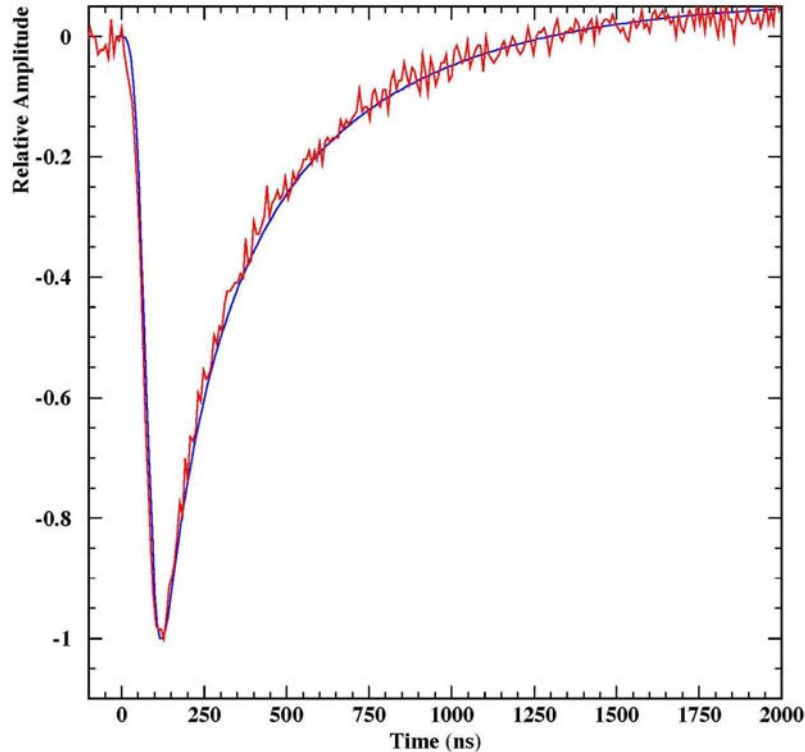
Setup for the GEM test cell with a resistive anode

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

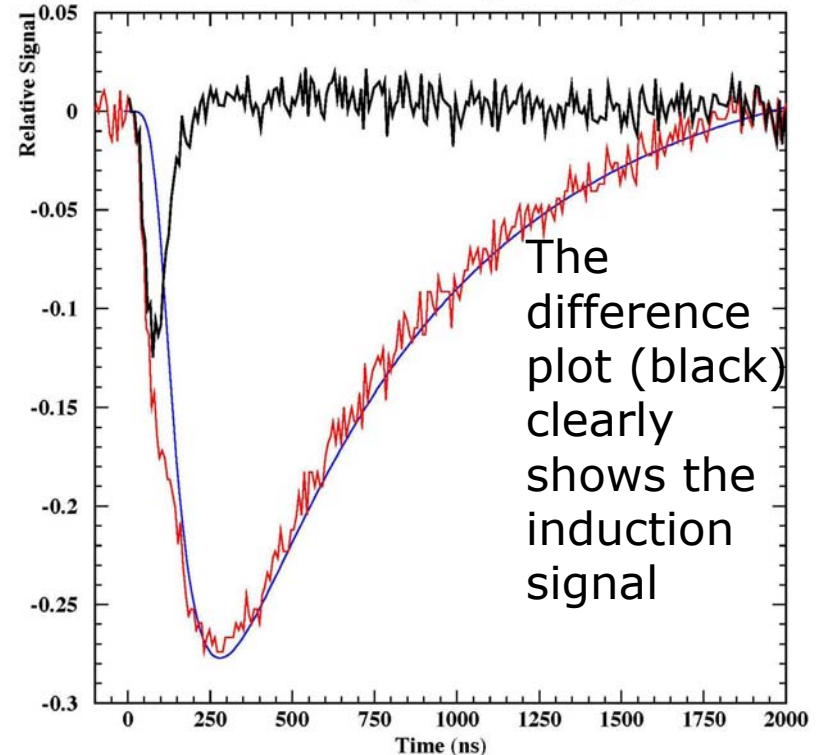


Comparison of measurement with Monte-Carlo simulation for the charge dispersion signal

50 μm x-ray spot on 2 mm x 6 mm pads



Main pad signal (x-ray spot in centre)

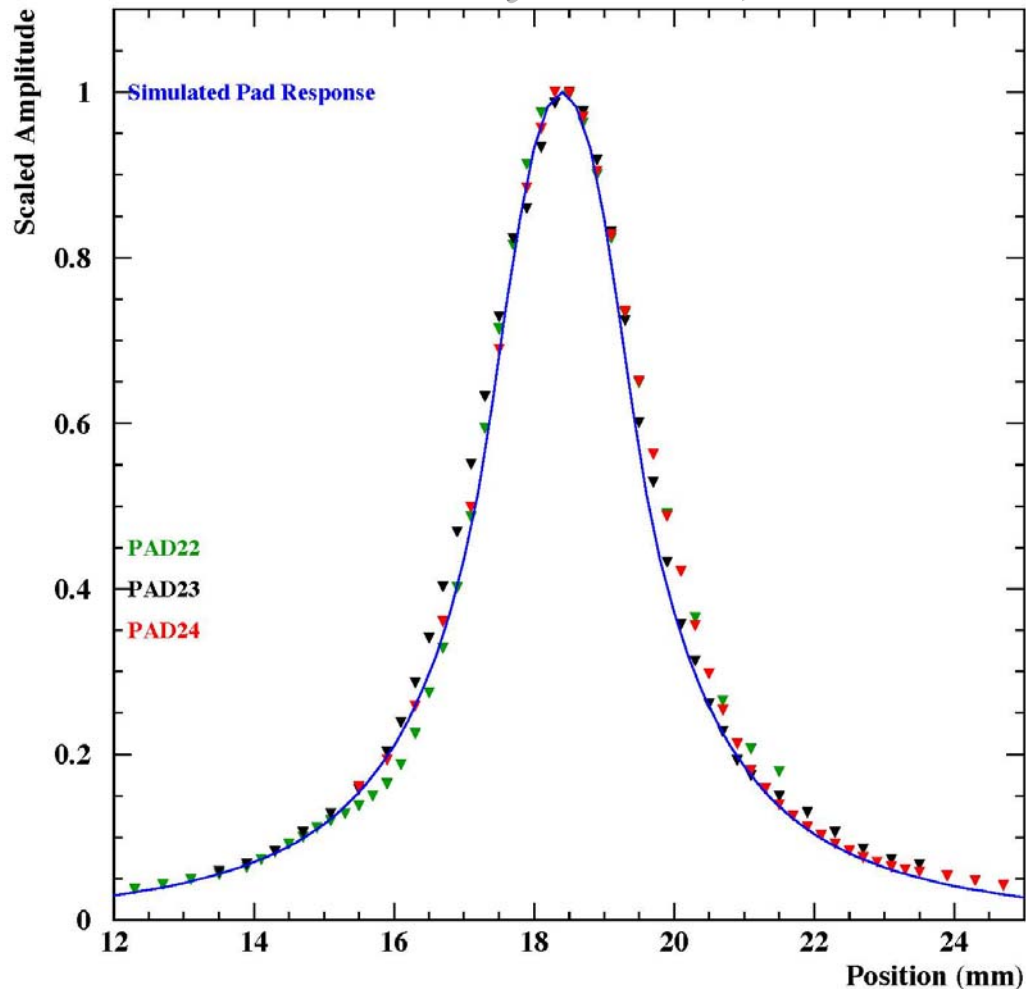


Signal on the adjacent pad

Measured experimental pulses in red. Theoretical simulation in blue

Measured Pad Response Function versus Simulation

(50 μm collimated x-ray source)



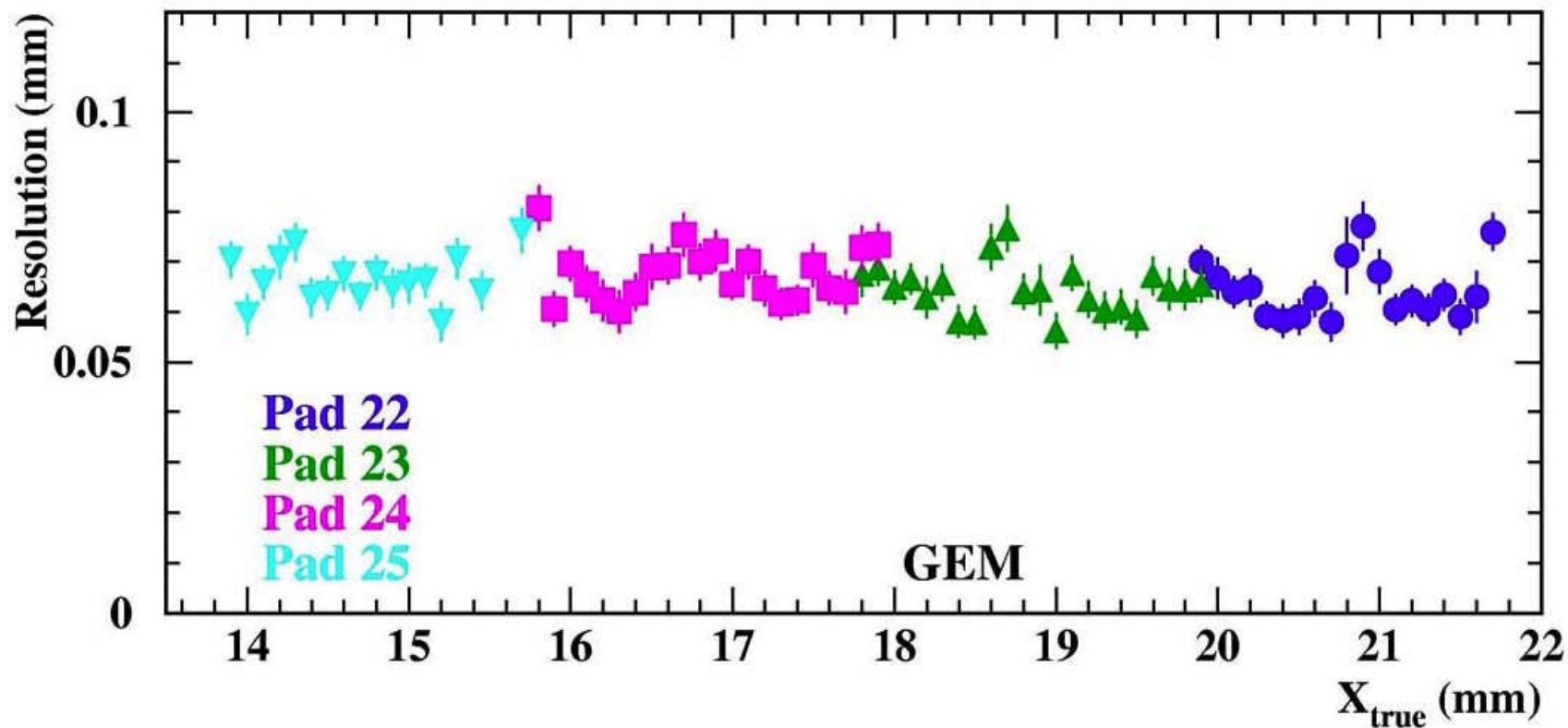
The solid line shows the simulated pad response function

Anode film resistivity
 ~ 530 k-Ohm/sq

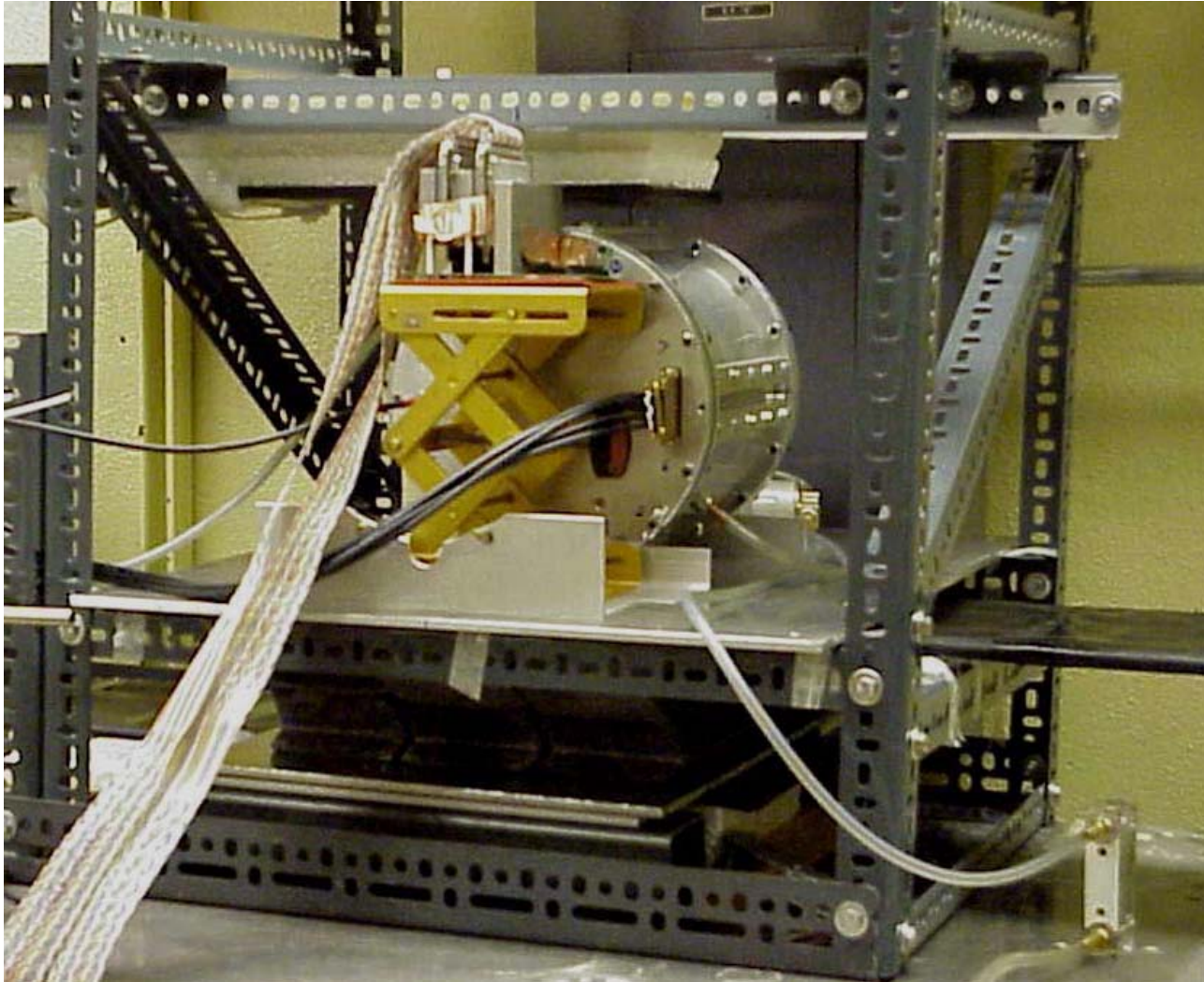
Anode readout pad insulating gap
 ~ 50 μm

Dielectric constant of insulating layer
 ~ 1.5

GEM space point resolution with a resistive anode
2 mm x 6 mm pads 50 μm x-ray spot



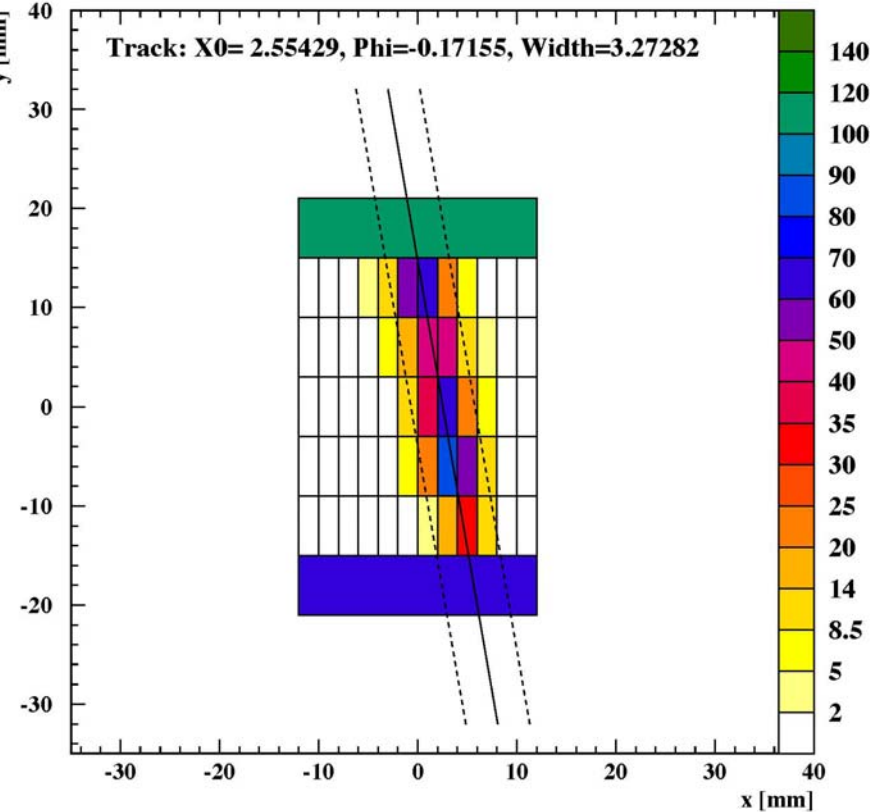
Setup for Cosmic Rays Tests of GEM-TPC with Charge Dispersion Readout



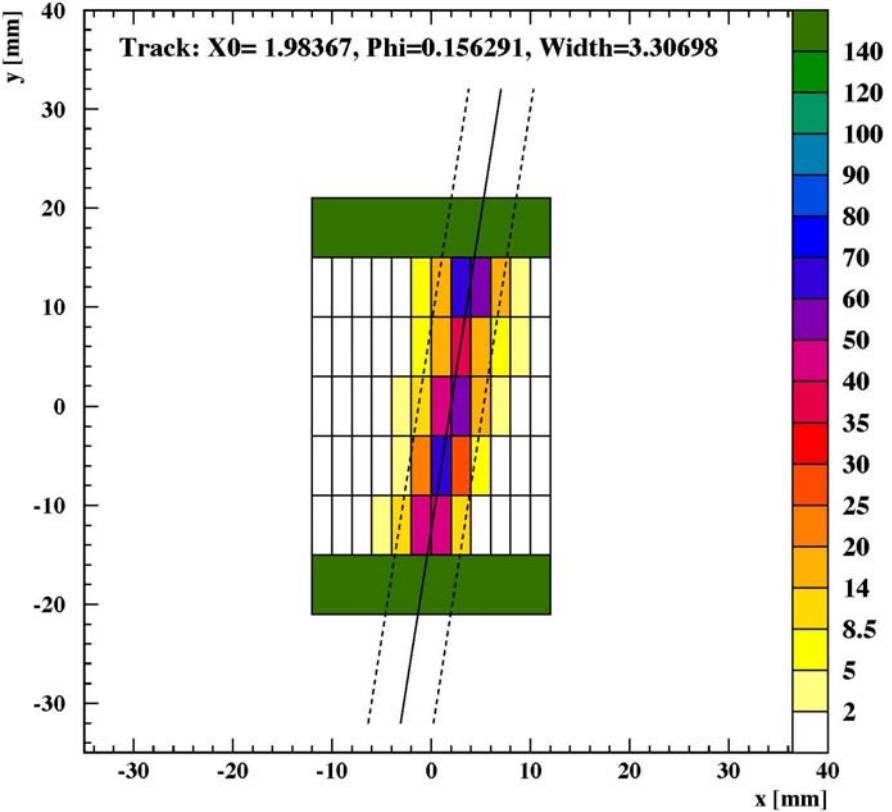
- Ar:CO₂/90:10
- ~ 530 k-Ohms/sq resistive anode
- 2 mm x 6 mm pad readout (the same as for x-ray tests)
- Aleph TPC charge preamplifiers
- Readout with 64 channels of 200 MHz FADCs

Charge dispersion GEM-TPC pad signals for cosmic rays

Run 101, Event 332



Run 101, Event 542



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