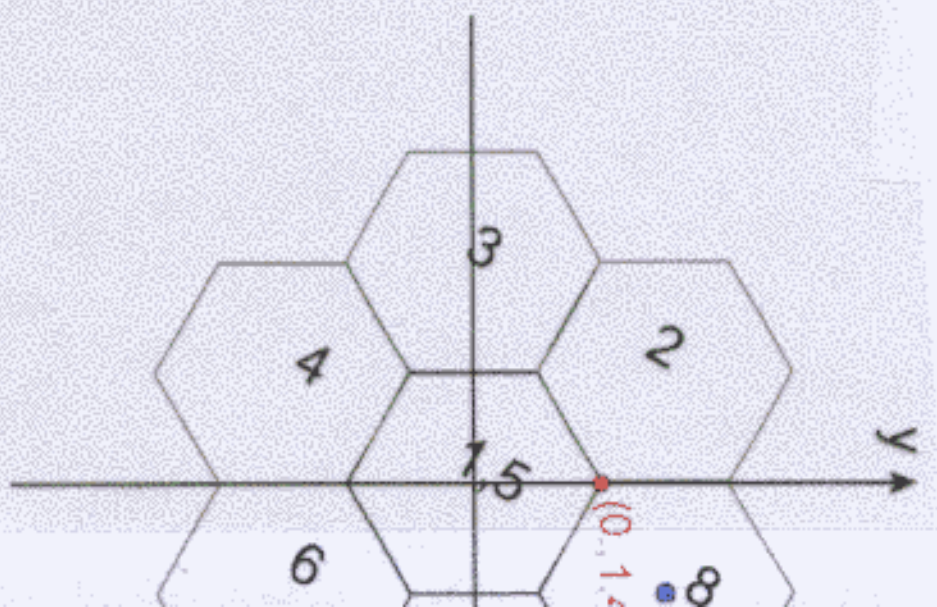
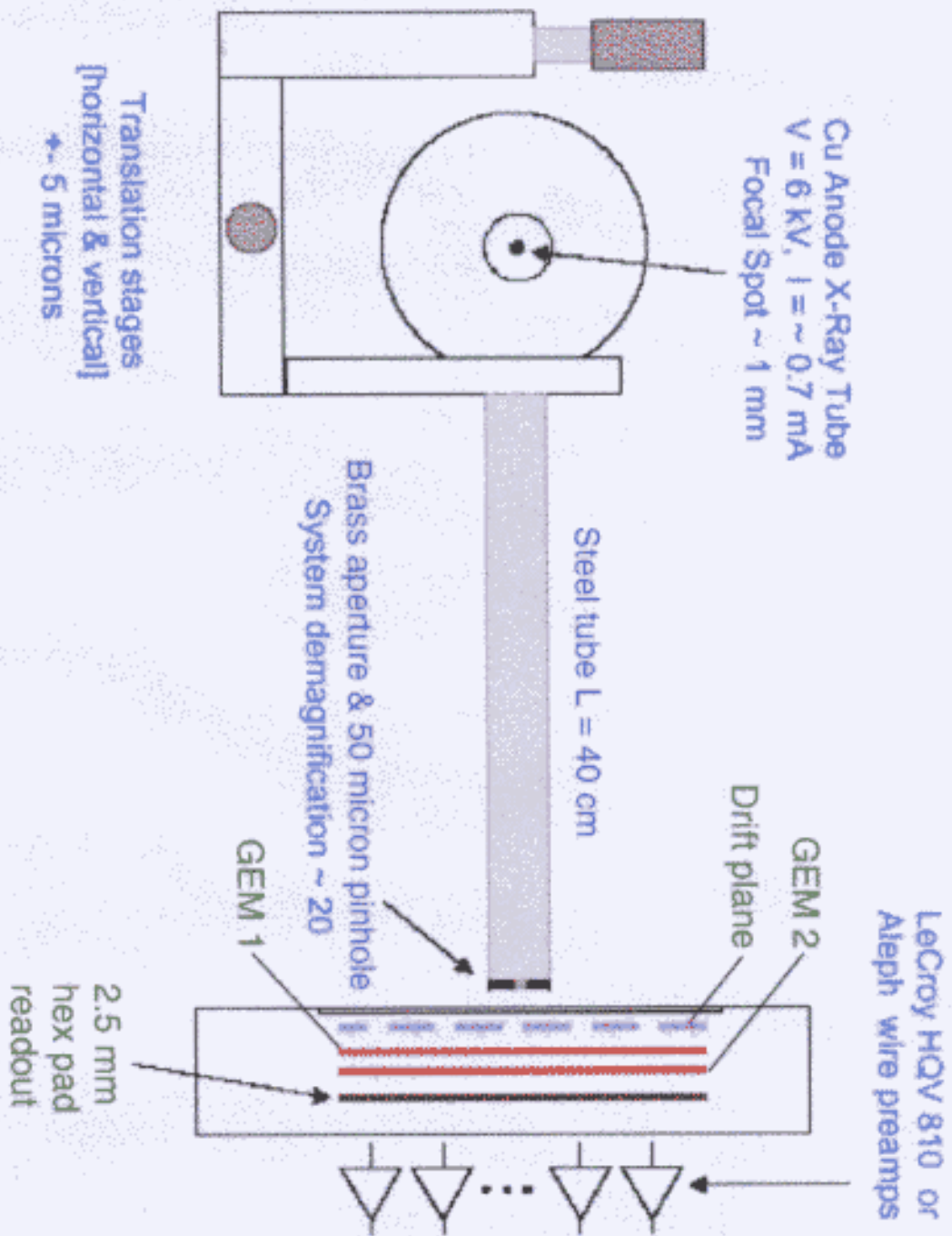


Measurement of Spatial Resolution in a GEM with Hexagonal Pads – Update on R&D at Carleton

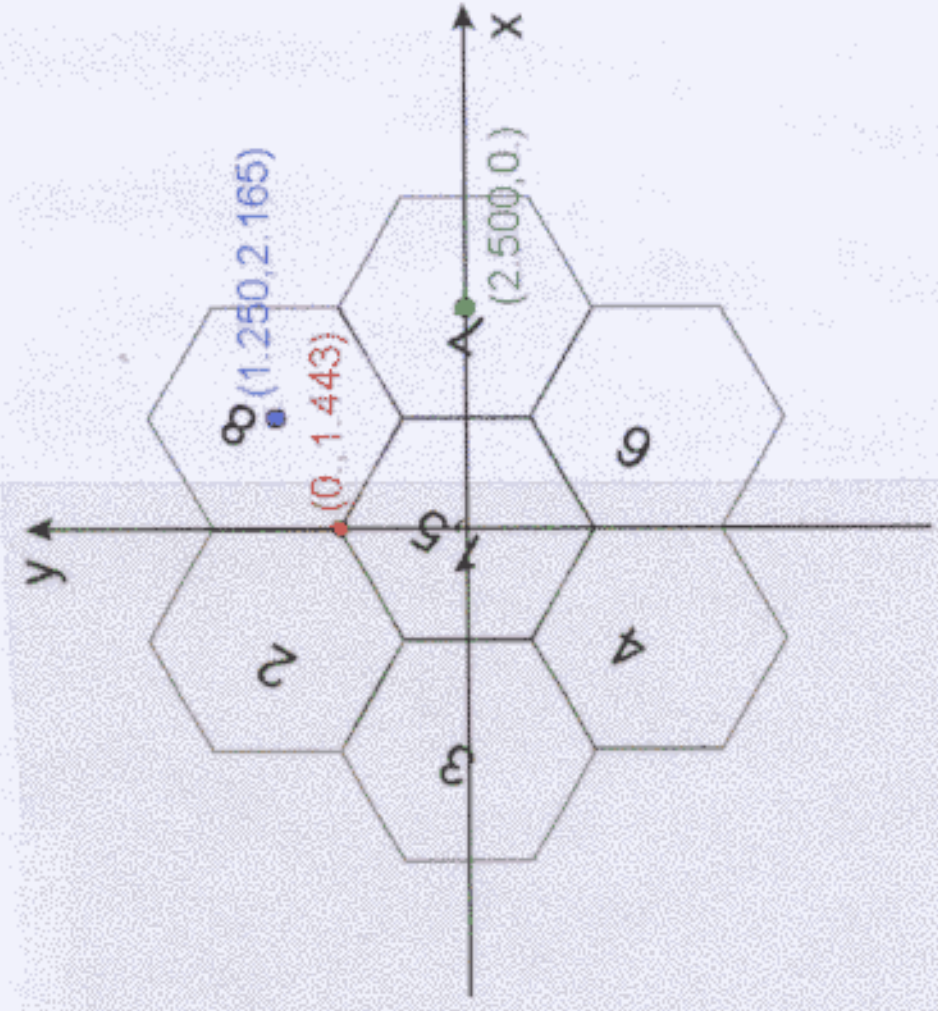
*R. Carnegie, M. Dixit, J. Dubeau, D. Karlen,
A. Kristoffersen, H. Mes and J. Mottershead*

- ◆ Measurements with point x-ray source
- ◆ Data analysis
- ◆ Results summary and status
- ◆ Plans

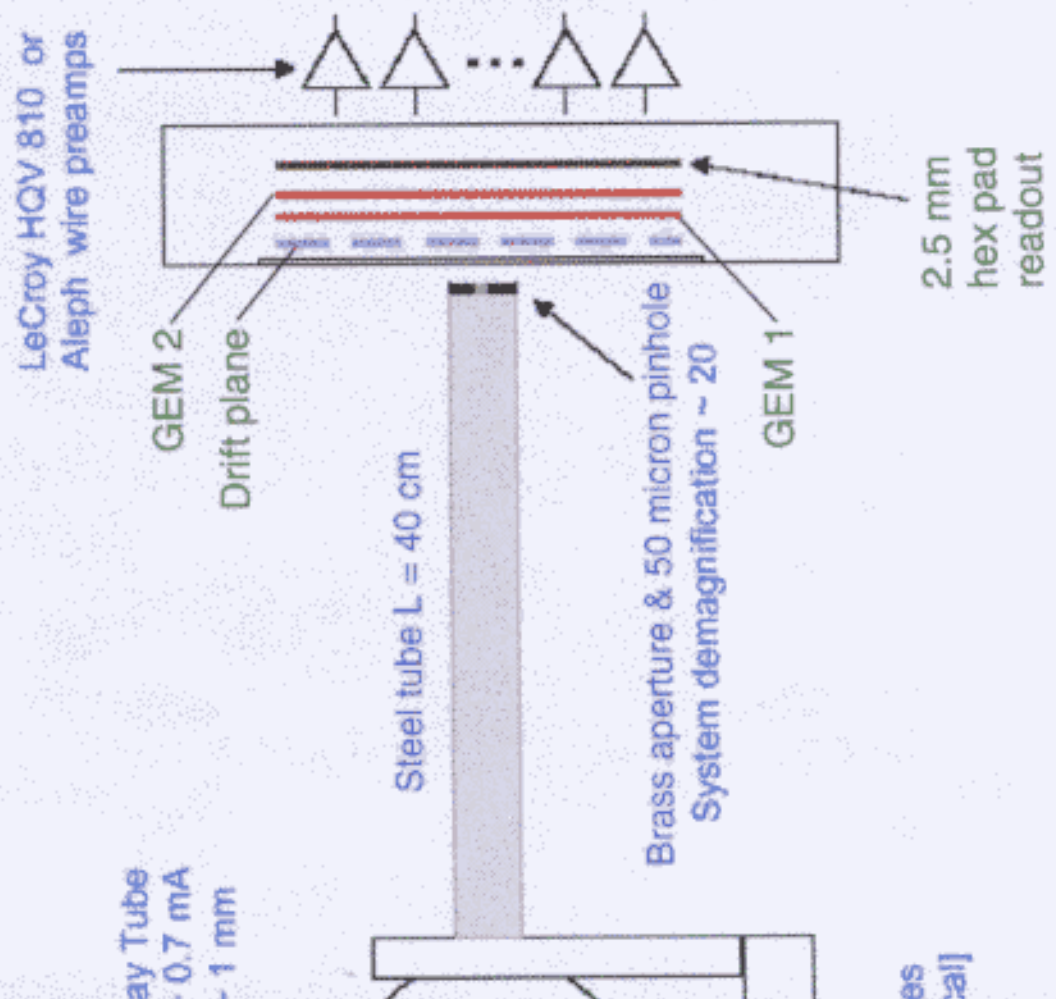


The pads and co-ordinates for

Setup for Pad Response Function Measurement with 4.5 keV Point X-Ray Source



Readout - Tektronix 500 MHz Digitizing Scope



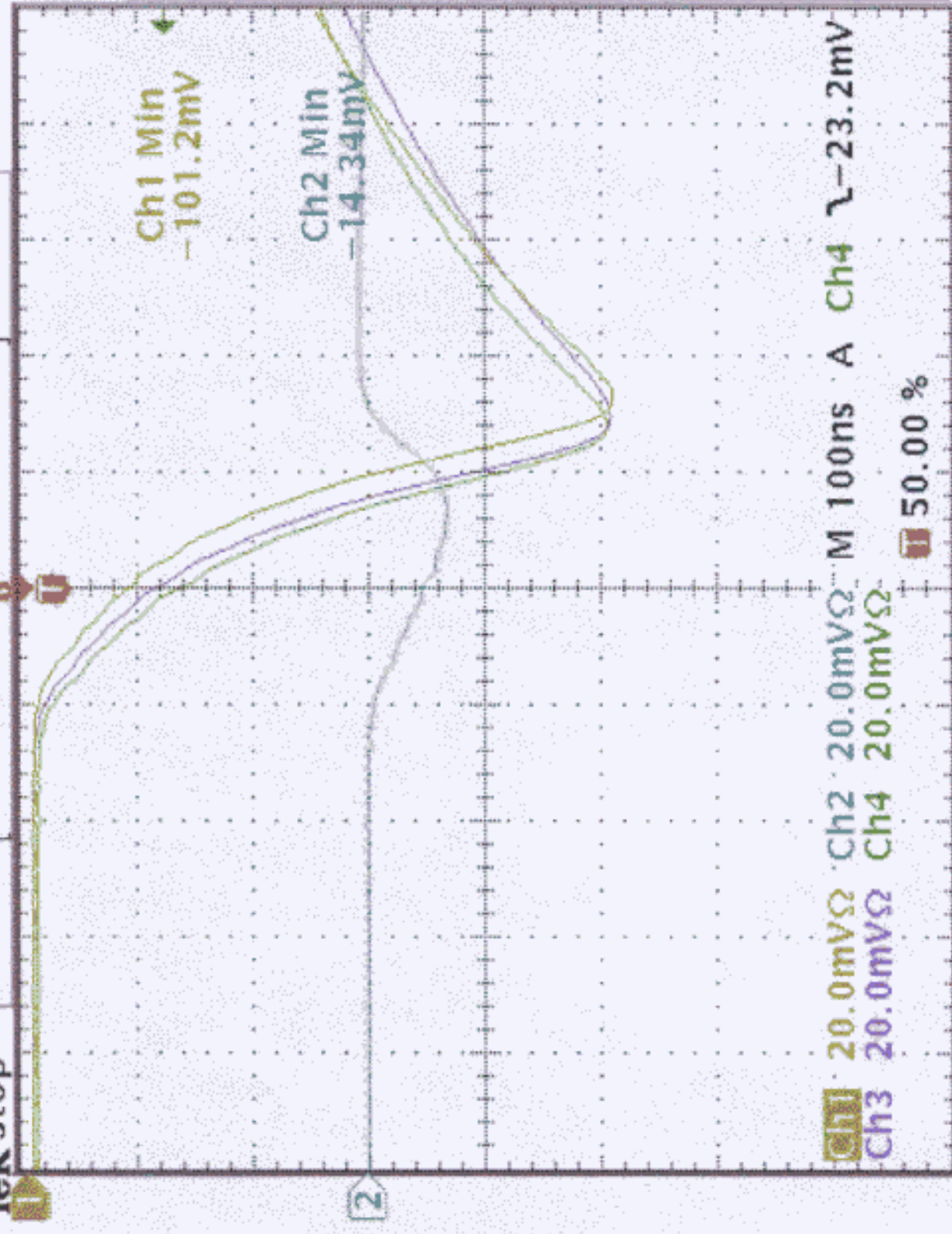
The pads and co-ordinates for resolution studies

Response Function Measurement with 4.5 keV Point X-Ray Source

es
cal]

P10 Gas, X Rays Centred at 3 Pad Vertex - Average of 512 Pulses

Tek Stop



Save waveform



To File

To Ref1
ALEPH
7-Jul-2000
14:17:34

To Ref2

To Ref3

To Ref4

5-Jul-2000
13:57:56

Save Current Setup

Recall Saved Setup

Recall Factory Setup

Save waveform Ch1

Recall waveform

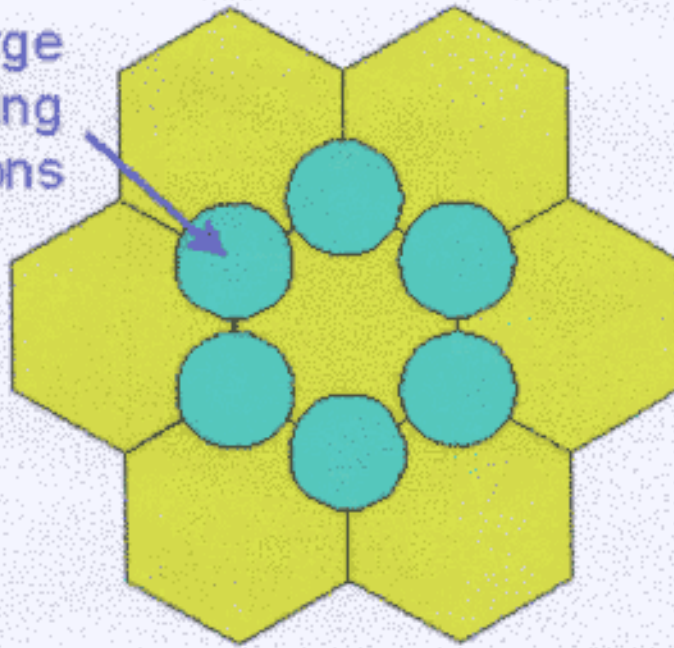
File Utilities

Labels

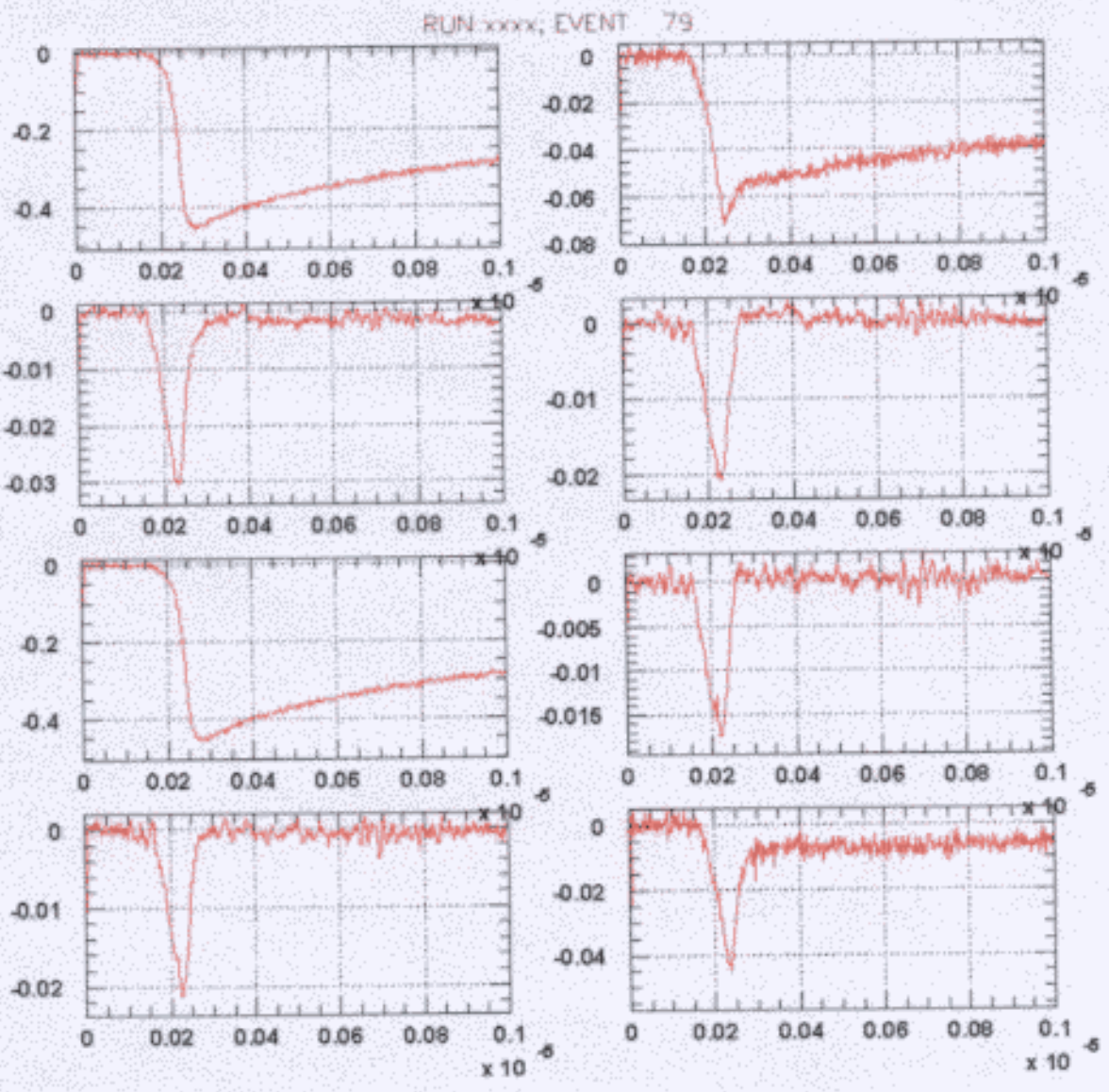
Data Analysis

- ◆ Spatial resolution by 2 methods depending on x-ray spot position relative to the pad centre,
- ◆ Resolution from charge sharing
- ◆ Resolution from induction signal

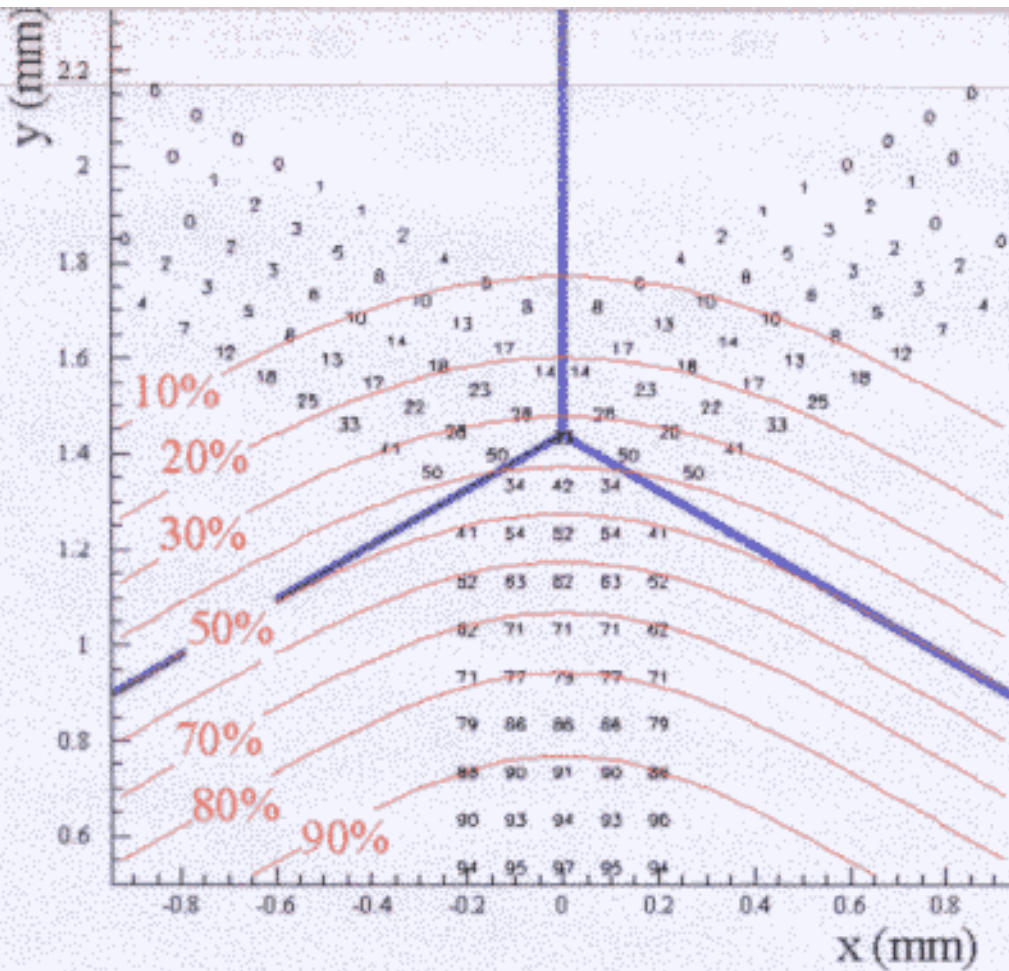
Charge sharing regions



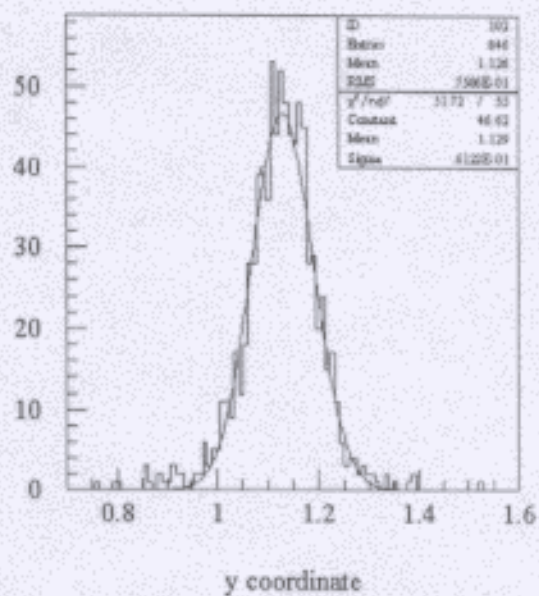
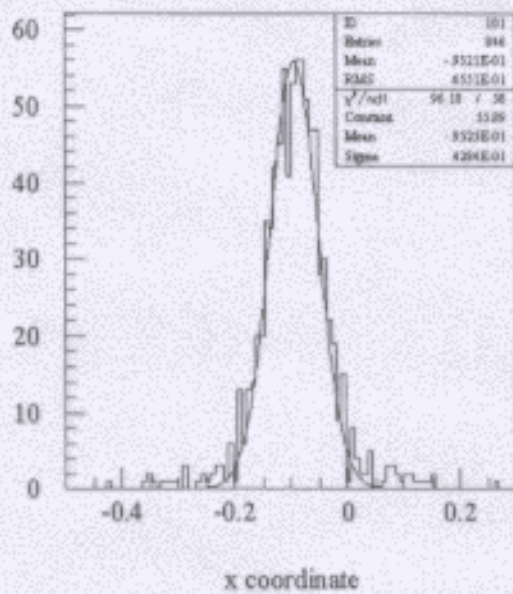
High efficiency regions for charge sharing resolution



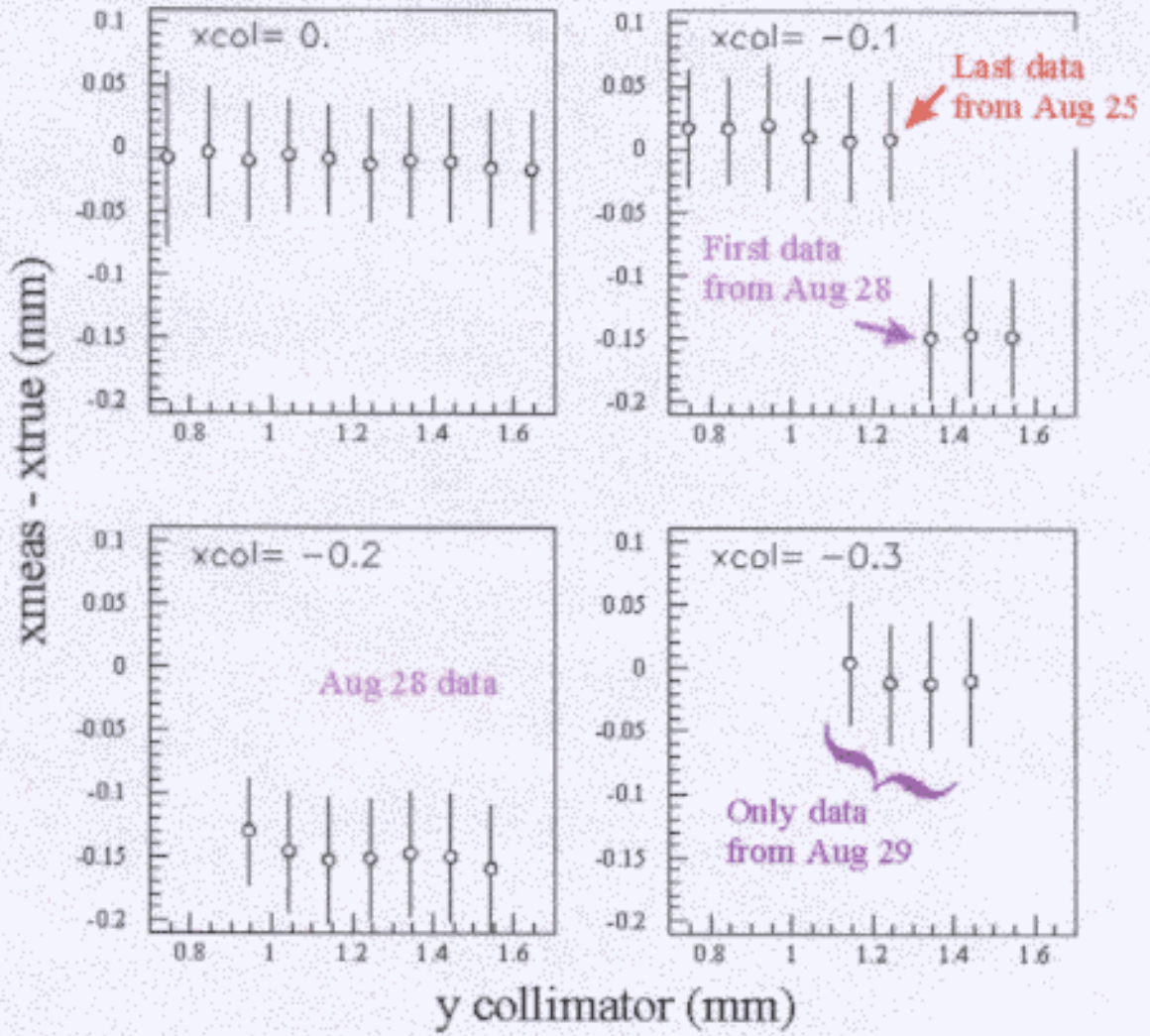
A typical event, not used for charged sharing analysis



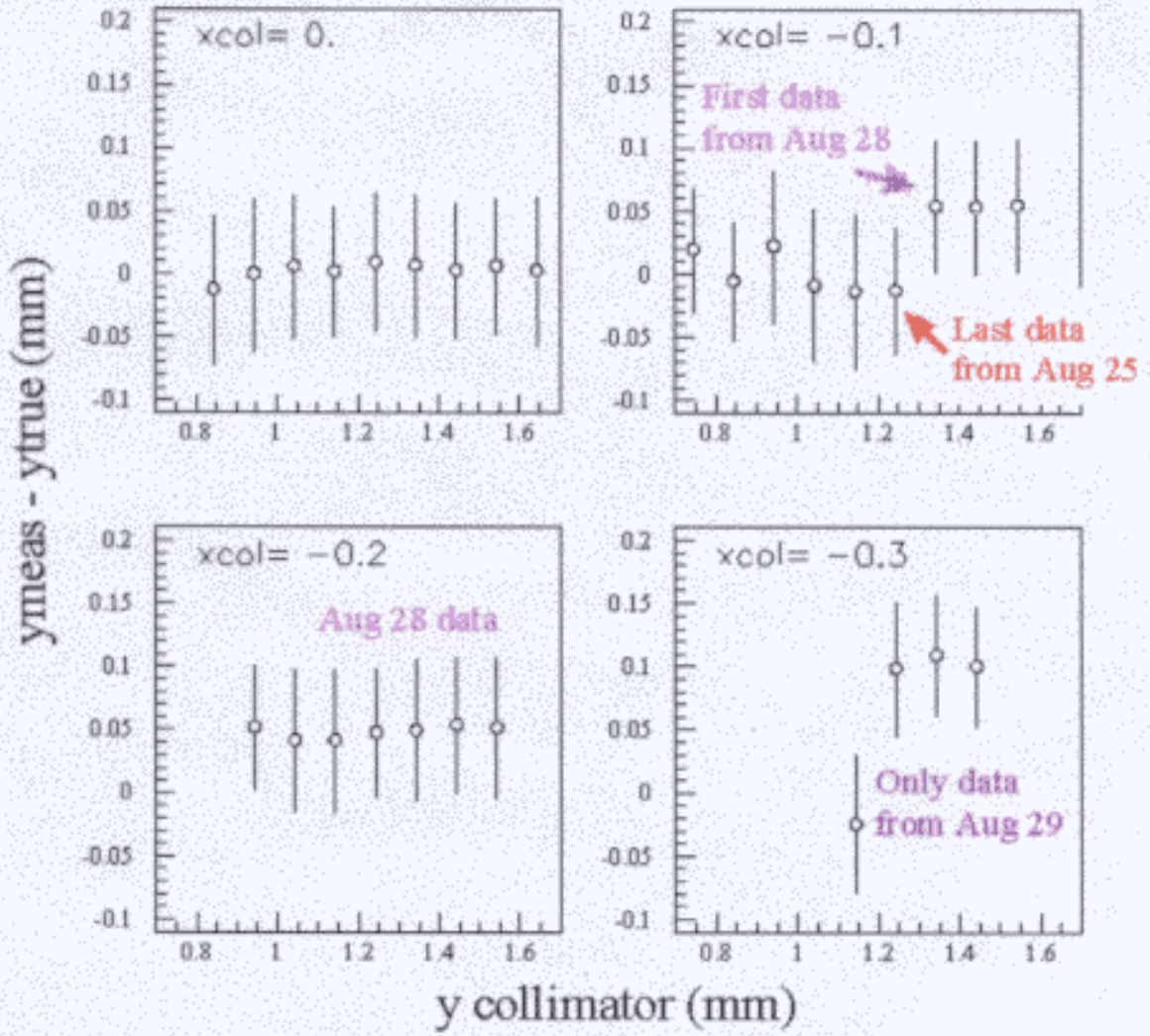
Data compared to computed charge fraction for the centre pad as a function of x-ray spot position for a Gaussian charge cloud of $\sigma = 370 \mu\text{m}$



Measured x and y charge sharing resolutions for
x-ray spot at $x = -0.100$ mm and $y = 1.143$ mm



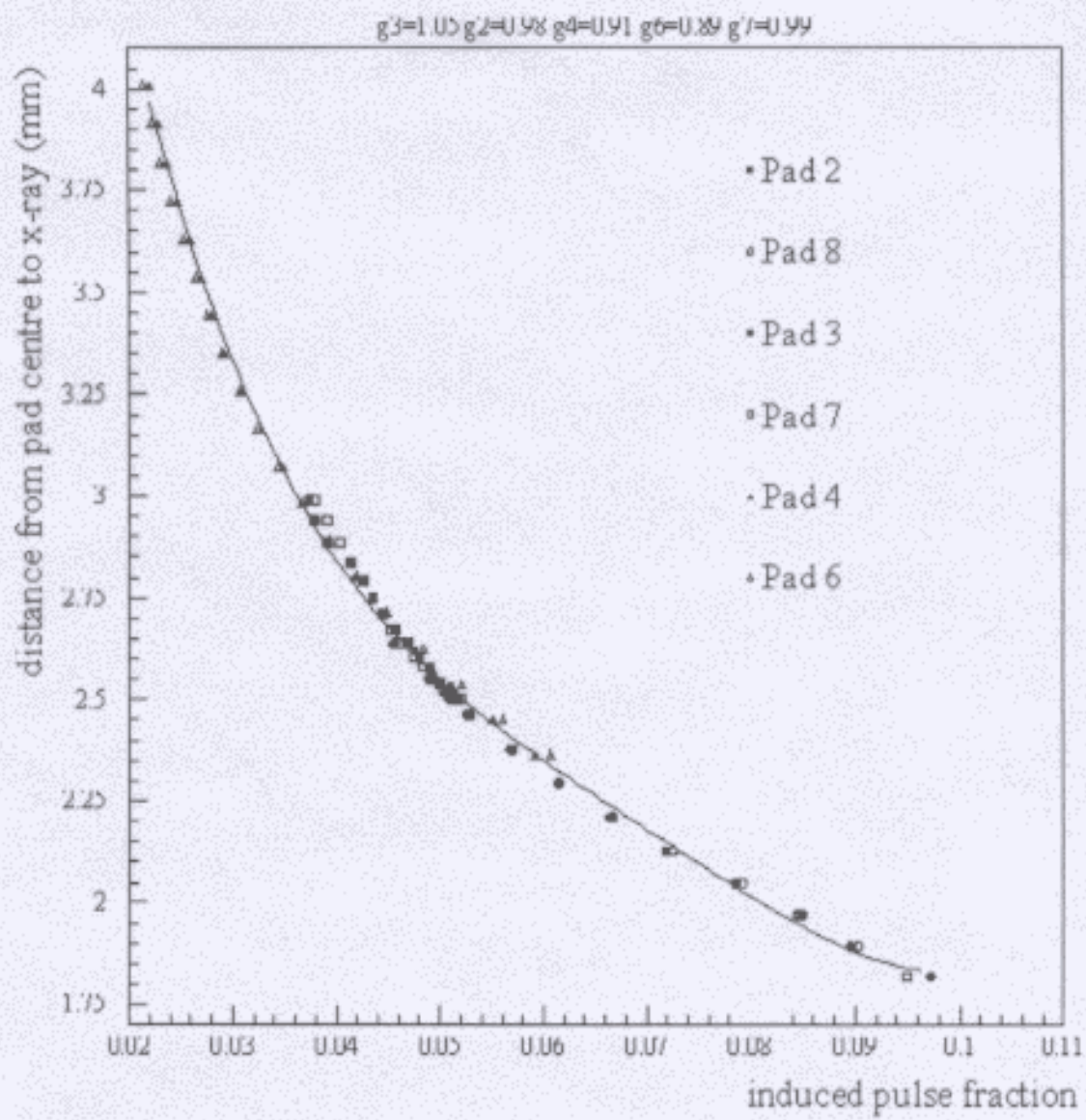
Charge sharing x resolution versus y for all scans



Charge sharing y resolution versus y for all scans

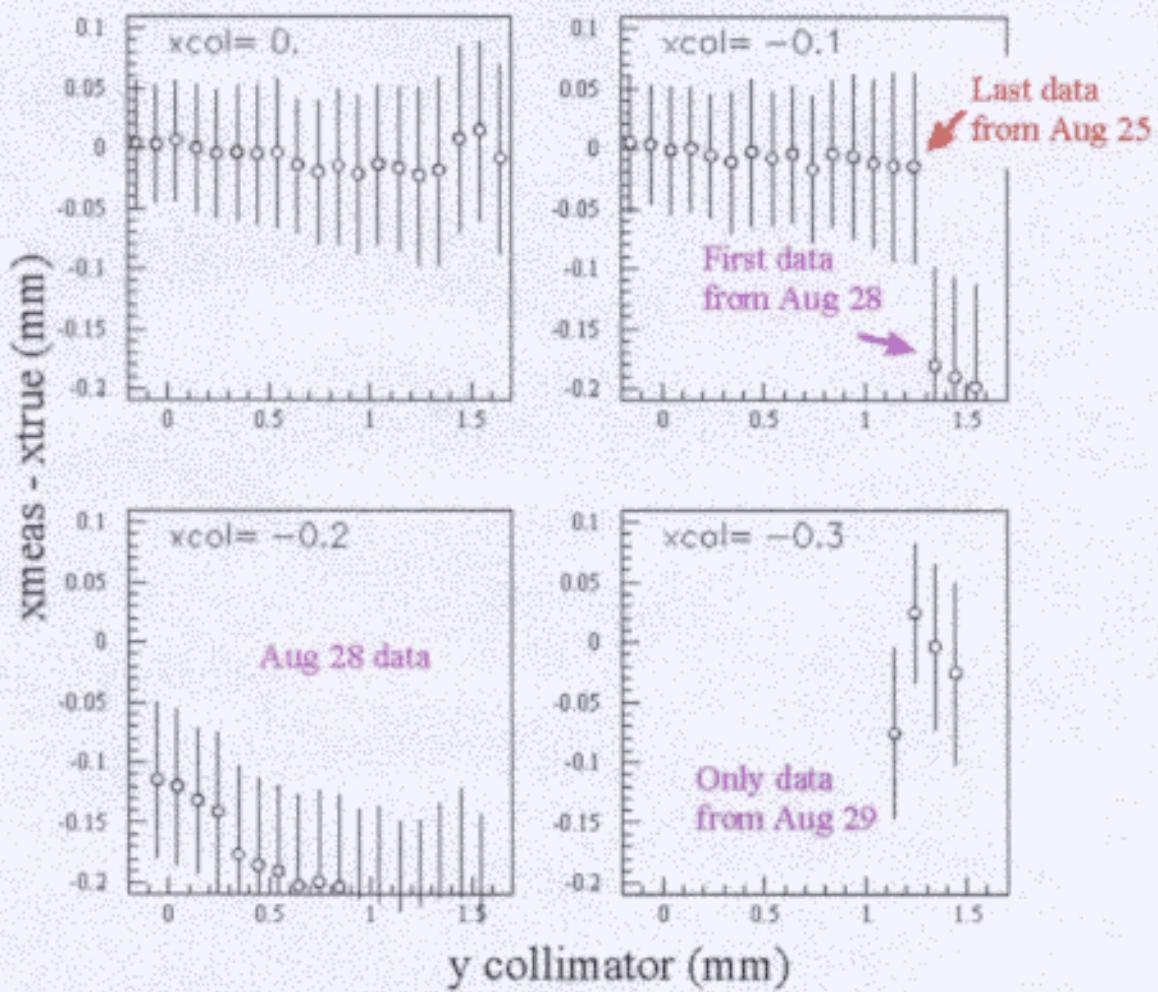
Spatial Resolution Measurement from Induction Signals

- ◆ Induction signal pad response function from induction pulses with negligible charge amplitude. Use $x = 0$ data
- ◆ Pad induction amplitude proportional to total event charge and function of distance 'r' from charge cloud centroid
- ◆ Some inconsistencies, unequal amplifier gains, cross talk?
- ◆ Parameterize induced pulse height to total charge ratio as a function of 'r' [4th order polynomial fit]
- ◆ Induction pulse resolution 50 μm (best near pad centre)



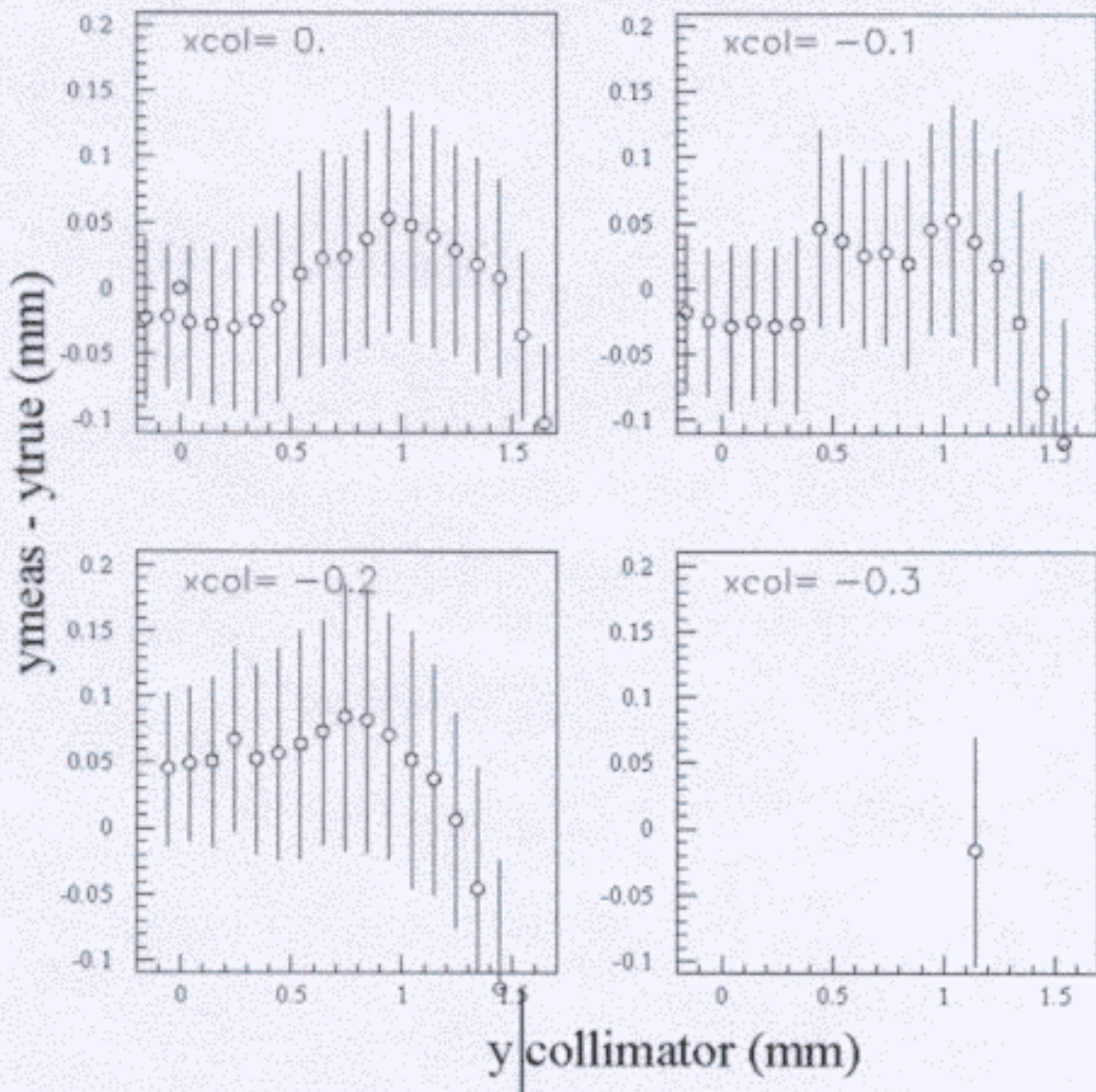
Normalized induction response for induced pulses

induction measurements



X-resolution from induction pulses

induction measurements



Y-resolution from induction pulses

Results Summary & Status

- ◆ Encouraging results ~ 50 - 60 μm spatial resolution for 4.5 keV x rays with 2.5 mm hex pads over the pad area using charge sharing and induction signals
- ◆ Some problems:
 - Gain variations (gas mixing, leaks?)
 - GEM susceptible to damage
 - Some inconsistencies in induction pad response (cross talk, electronics problems?)

Plans

- ◆ Better gain control using premix
- ◆ Better GEM handling and mounting procedures
- ◆ Improve electronics for equal preamp gains and reduced cross talk.
- ◆ Combined charge sharing and induction analysis
- ◆ Triple GEM for additional robustness
- ◆ Cosmic ray spatial resolution for MIP resolution will require 32 + FADC channels, mini TPC and DAQ.
- ◆ 8 channels of prototype 200 MHz FADCs operational (J.-P.Martin, Montreal), additional channels can be fabricated
- ◆ More fast preamps needed. Use Aleph wire preamps in the mean time.