ILC Detector Work

Dan Peterson

** Cornell/Purdue TPC development program

Large Detector Concept

TPC Detector Response Simulation and Track Reconstruction

World Wide Study Detector R&D Panel

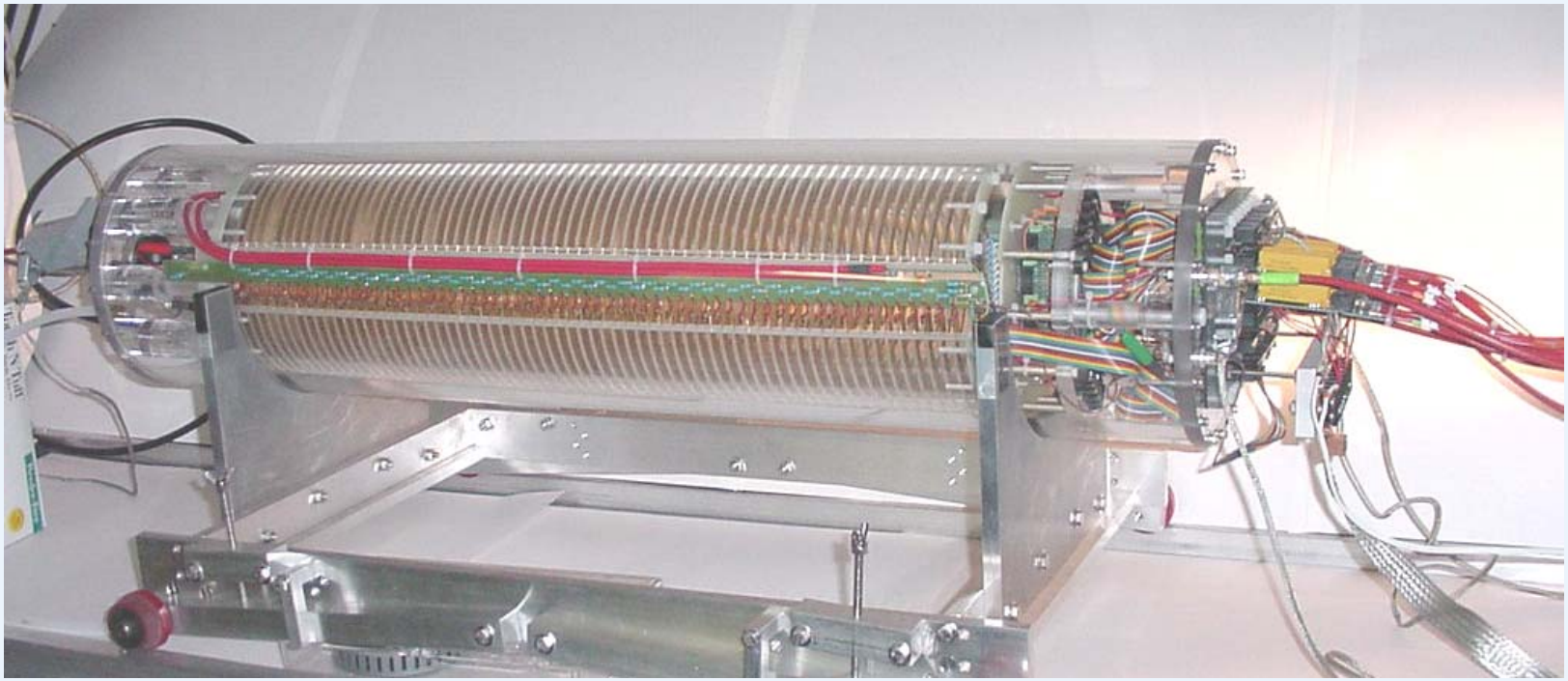
This project is supported by the US National Science Foundation (LEPP cooperative agreement) and by the US Department of Energy (Purdue base program)

TPC

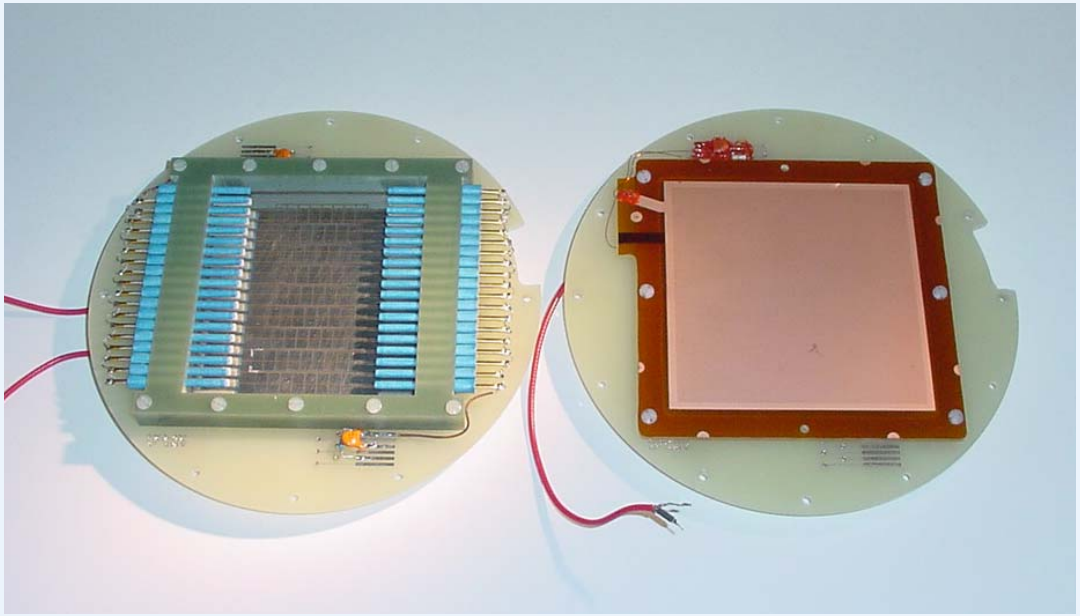
Cornell University	Purdue University
D. P. Peterson	G. Bolla
L. Fields	I. P. J. Shipsey
R. S. Galik	
P. Onyisi	

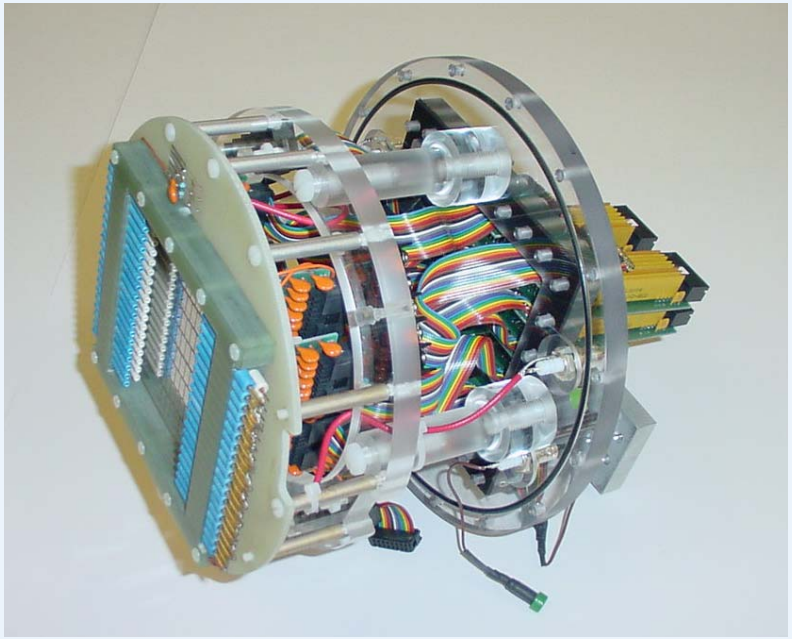
January 2005: construction completed, recorded first events

14.6 cm ID field cage - accommodates a 10 cm GEM
64 cm drift field length
22.2 cm OD outer structure (8.75 inch)



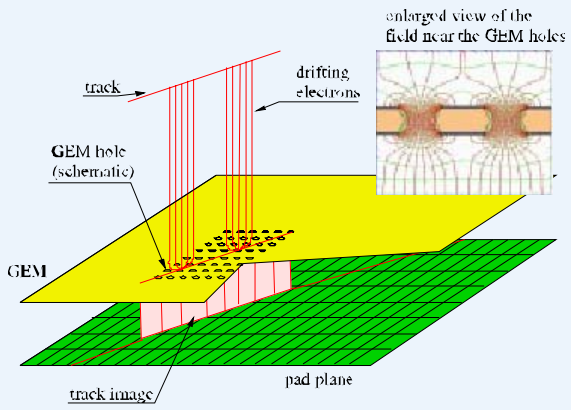
MPWC and GEM amplification





10 cm

The readout module including the amplification device mounted on pad board

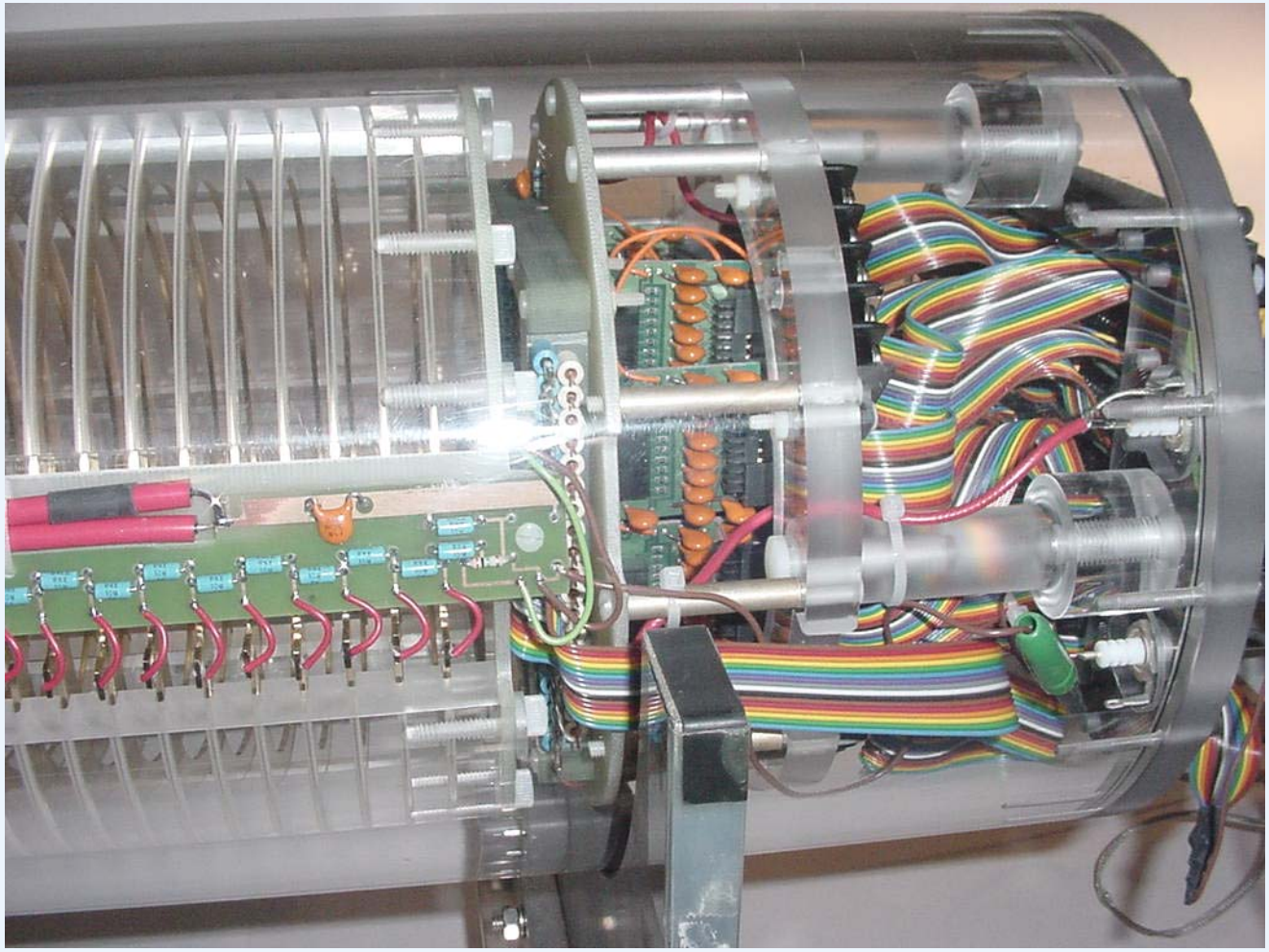


The instrumented readout area is
~2cm x7 cm , 32 pads.

The biased area is 10cm square.

(This pad board allows ~3 x 9 cm , 62 pads.)

TPC Readout End details



Visible:

field cage HV distribution
field cage termination
wire gas-amplification
pad board
pad biasing boards
signal ribbon cable

Biasing:

drift: 300V/cm
@ termination: -900V

(1.0 cm)

grid: -600V

(0.5 cm)

anode: +550V

(0.5 cm)

pads: -2000V

single GEM

single GEM gas amplification

CERN GEM mounted, tested by Purdue

installed 11-March

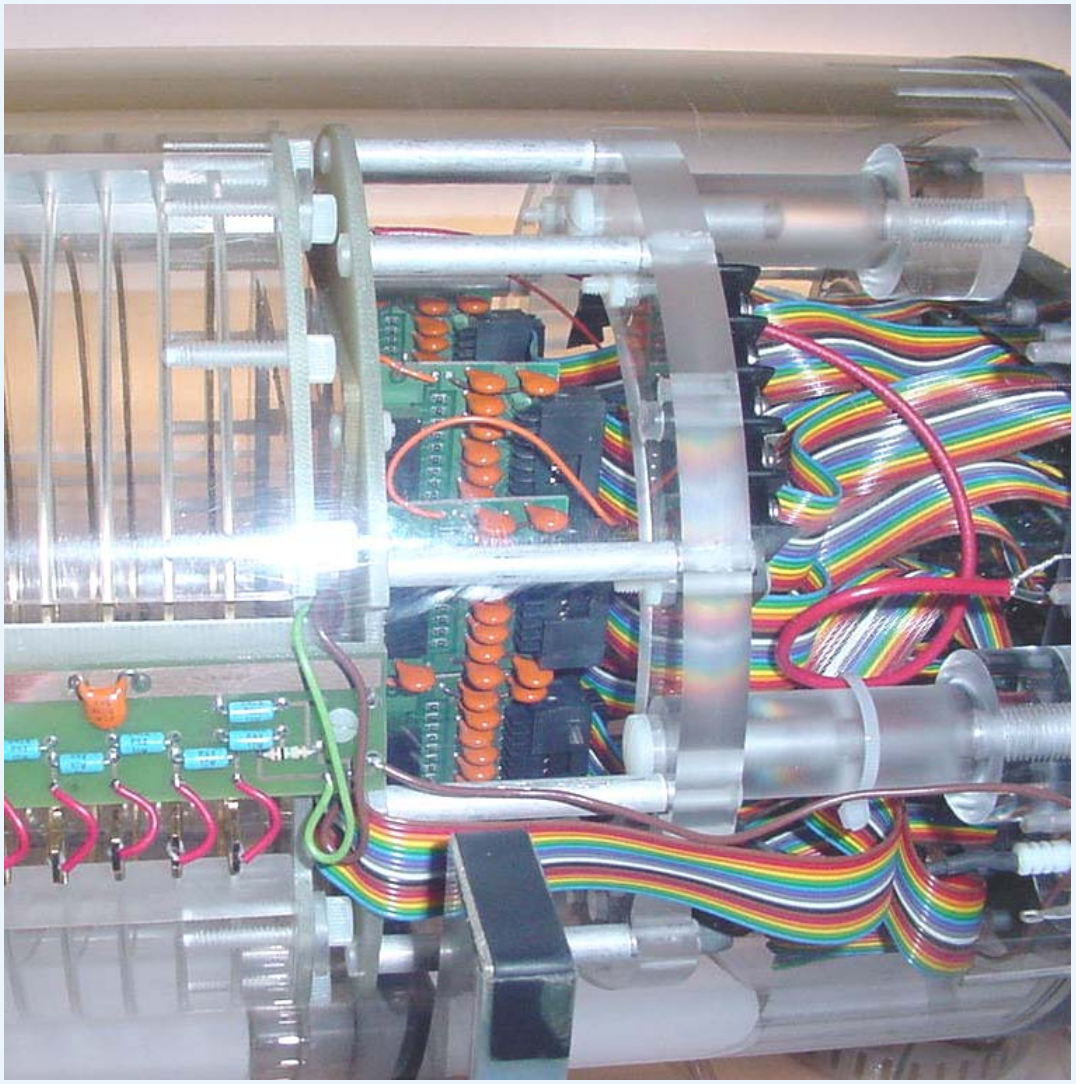
biasing:
field cage, -20kV, 300 V/cm
termination: -900V

GEM voltage: **-400V**
(GEM bottom: at ground)
(Gas amplification ~100.)

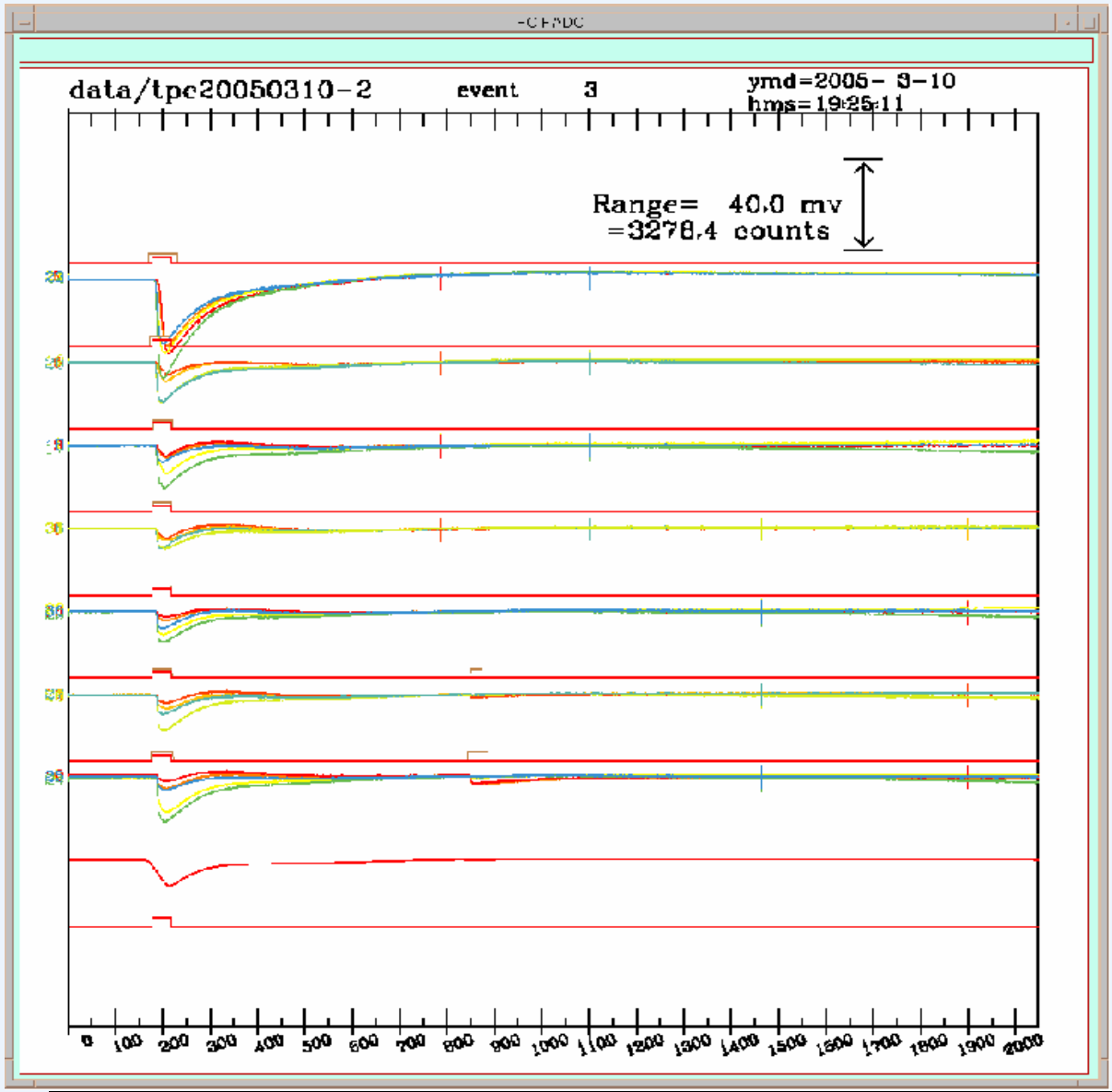
pads: +1500 V

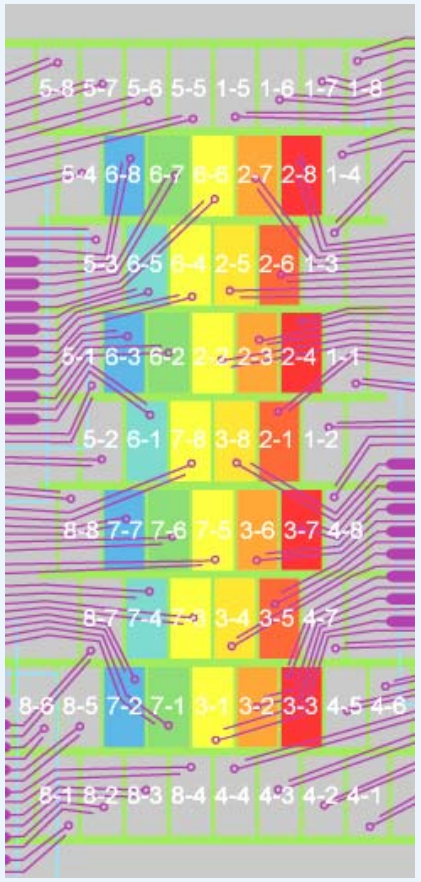
Electric fields:
field termination – GEM top: 0.5 cm ,
0.96 kV/cm

induction gap: 0.3 cm,
5 kV/cm



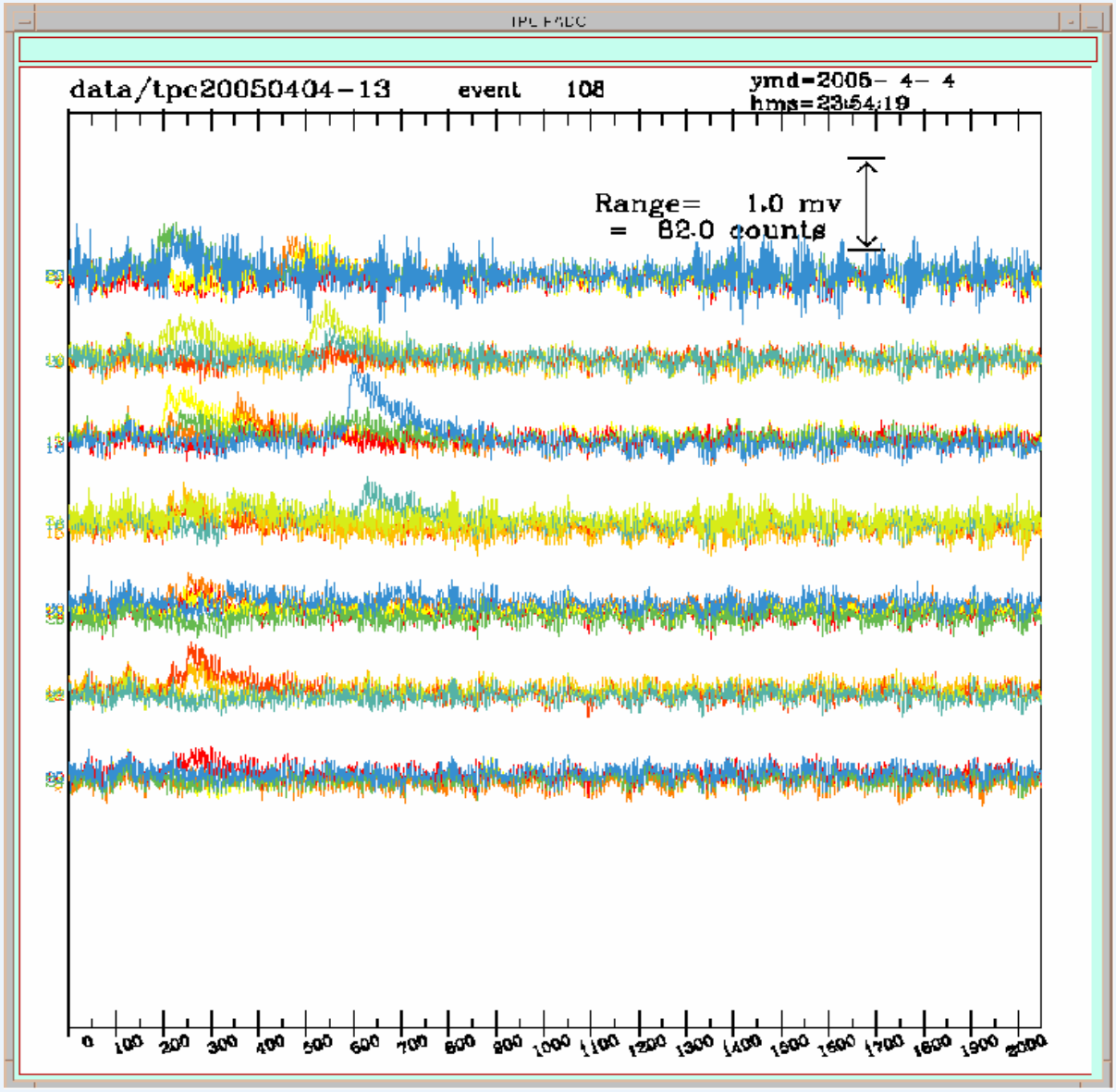
MWPC event (typical)



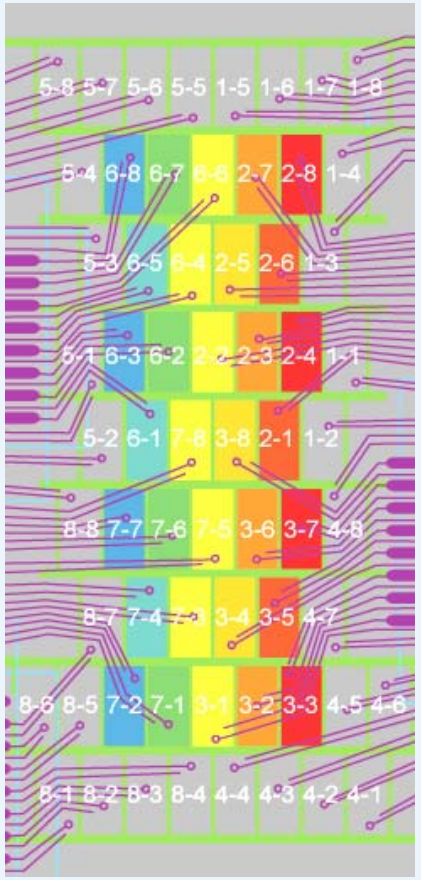


ArCO2 (10%) , 300V/cm
25 MHz , 40 ns
2048 time buckets (81.92 μs)

single-GEM event

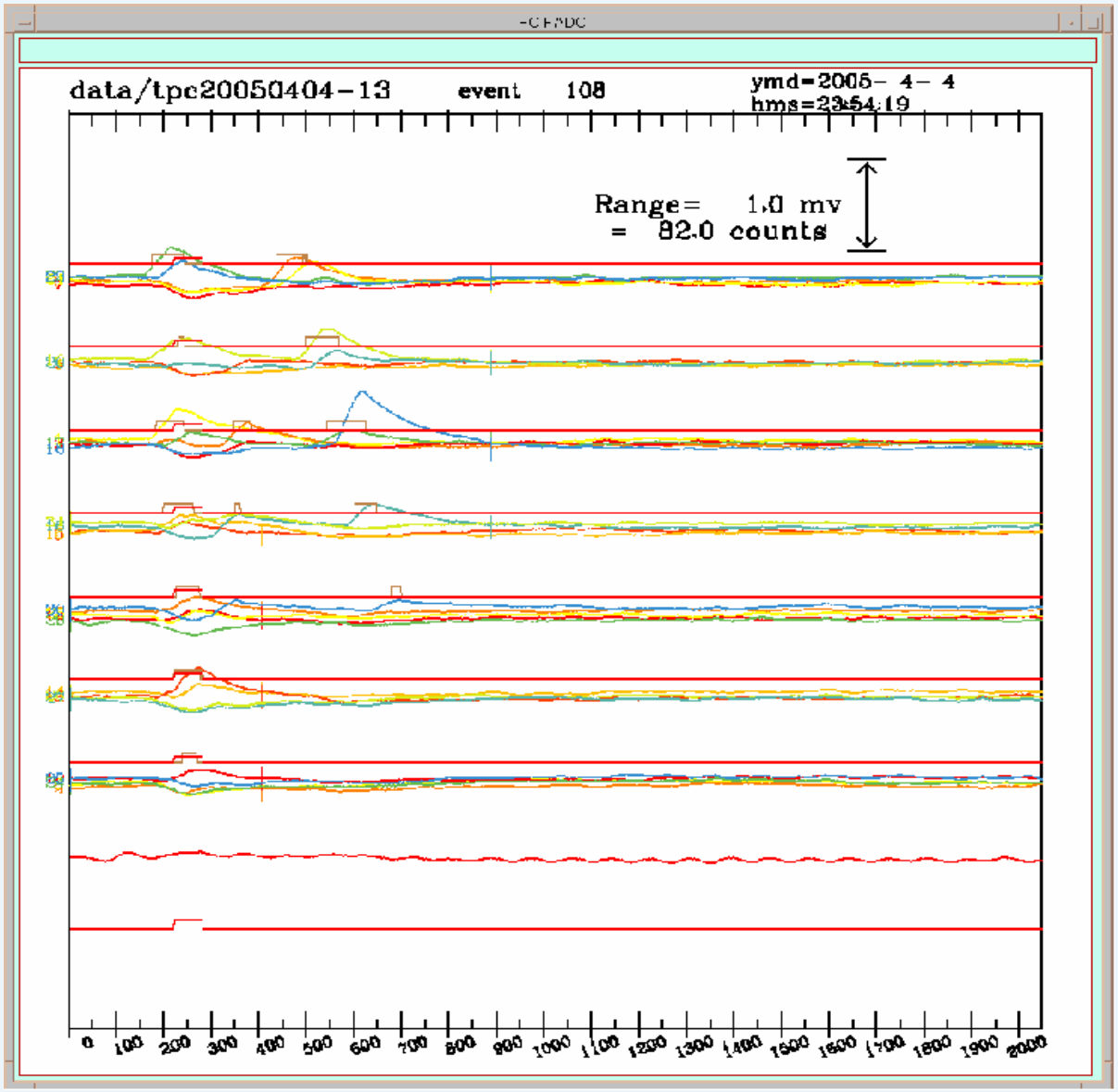


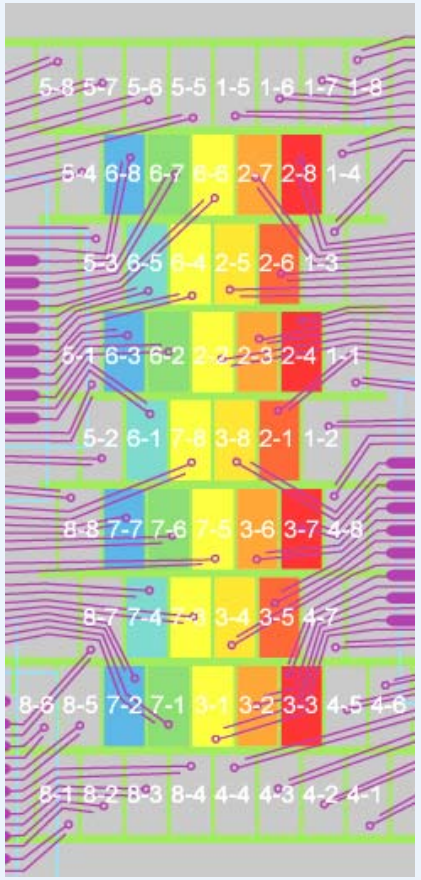
Note the 1 mv scale.
Gas amplification is about 100



ArCO2 (10%) , 300V/cm
25 MHz , 40 ns
2048 time buckets (81.92 μs)

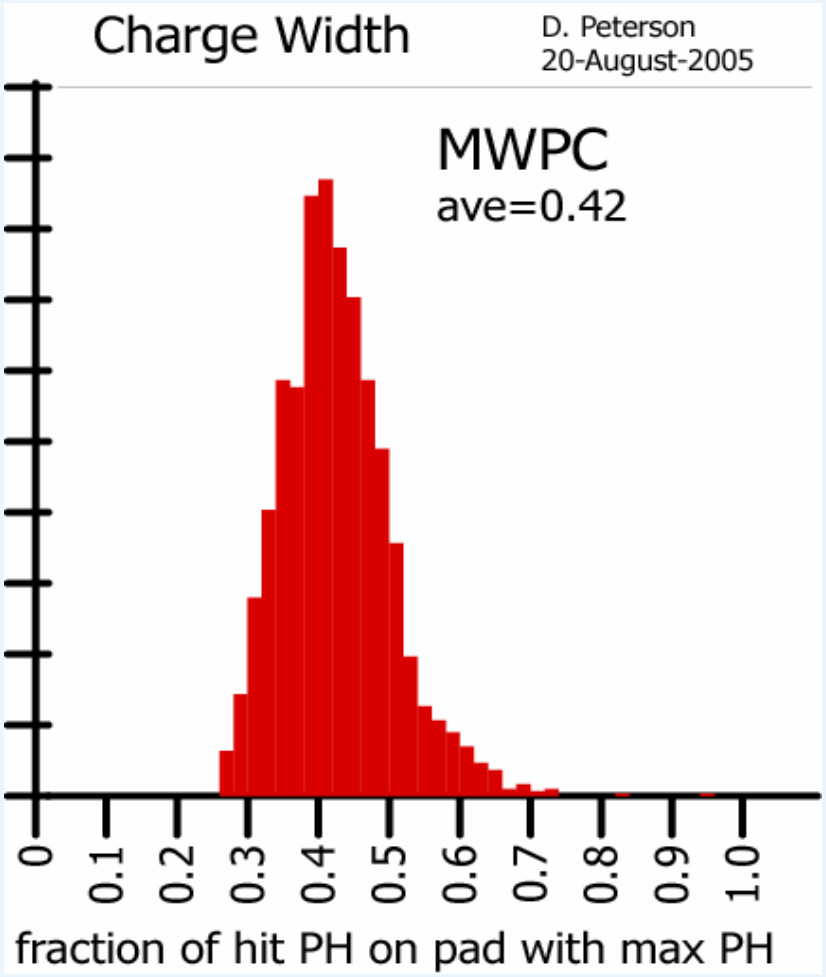
GEM event after smoothing and common noise subtraction

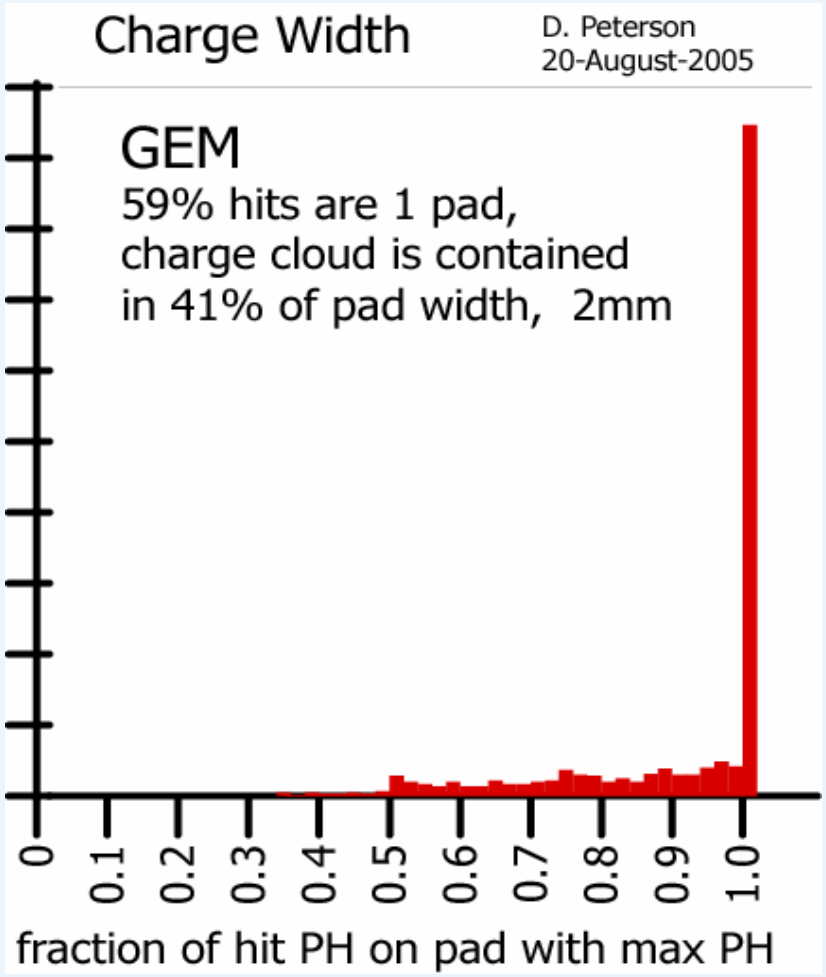




ArCO2 (10%) , 300V/cm
25 MHz , 40 ns
2048 time buckets (81.92 μs)

charge width





This is influenced by the common “noise” subtraction.)

hit resolution (5mm pad)

find tracks - require coincident signals in 6 layers

locate maximum PH pad in each layer

find PH center using maximum PH pad
plus nearest neighbors

(2 or 3 pads in the “hit”)

require the hit pulse height sum to have
70% of layer pulse height sum

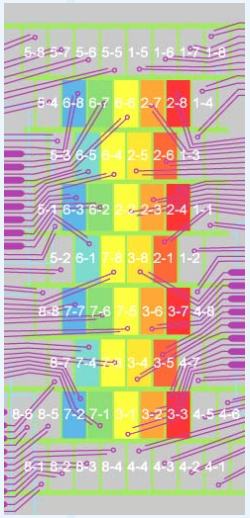
require 5 layers with interior hits
(Max. ph pad is NOT on the edge.)

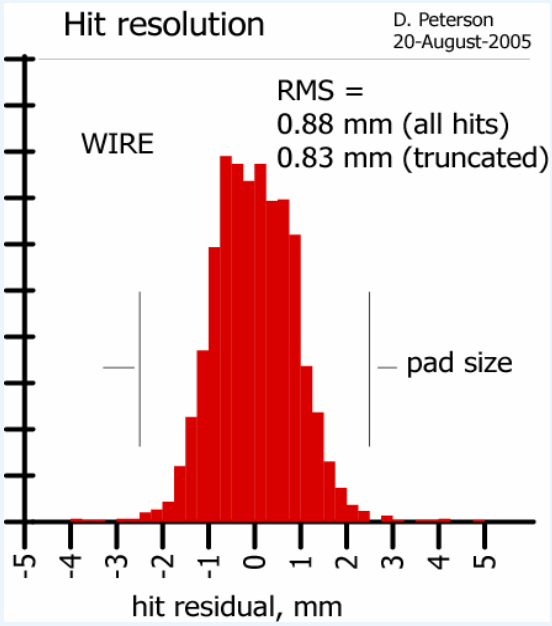
fit to a line

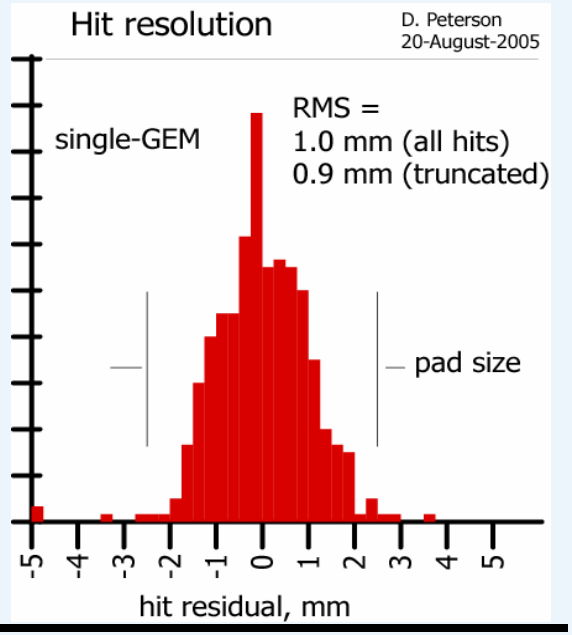
may eliminate 1 hit with residual > 2.5mm
(Still require 5 layers with interior hits.)

refit

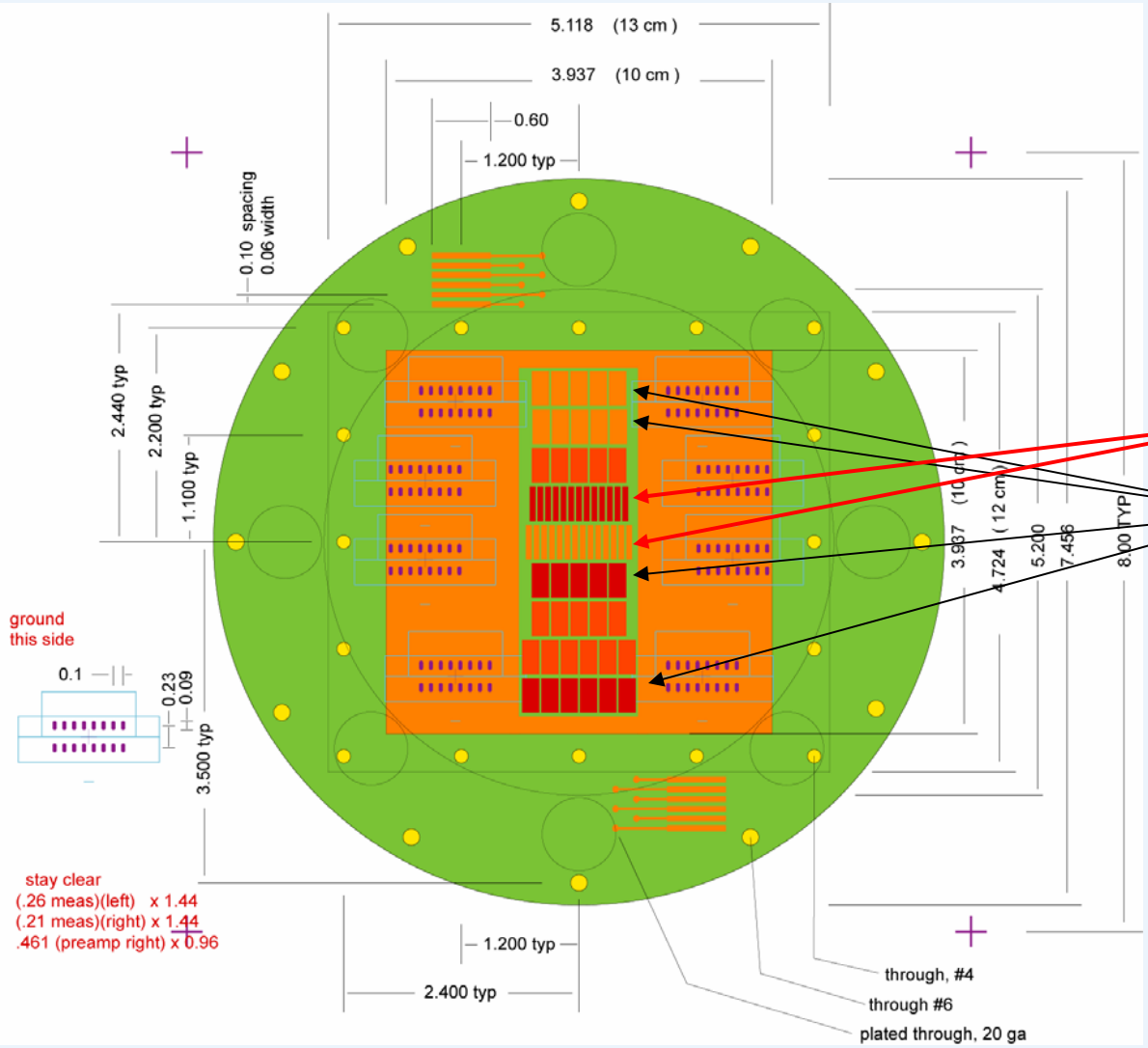
resolution is ~ 900 μm, 0 to 40cm drift







Future: Fine Segmentation Pad Board



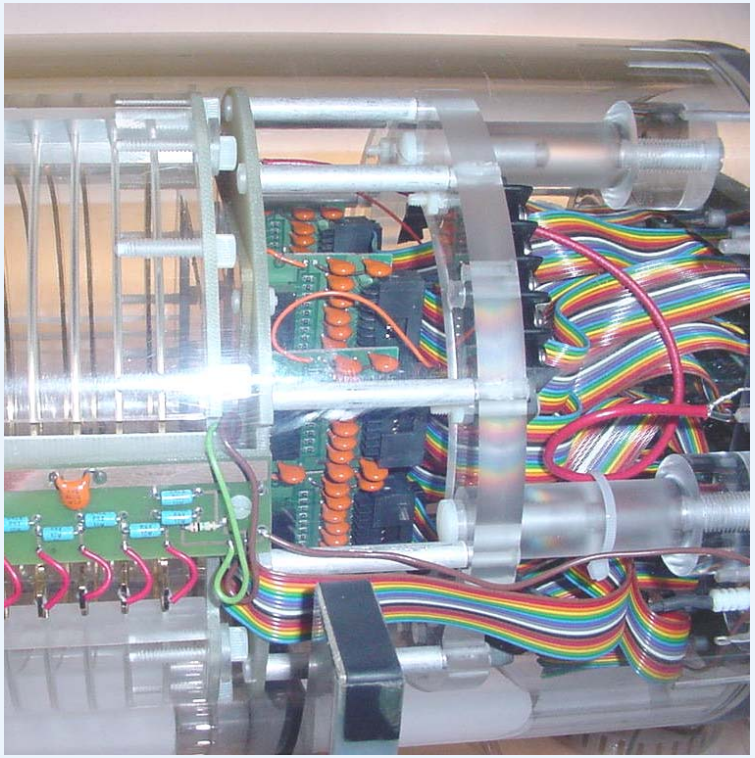
We will increase the DAQ by 16 channels.

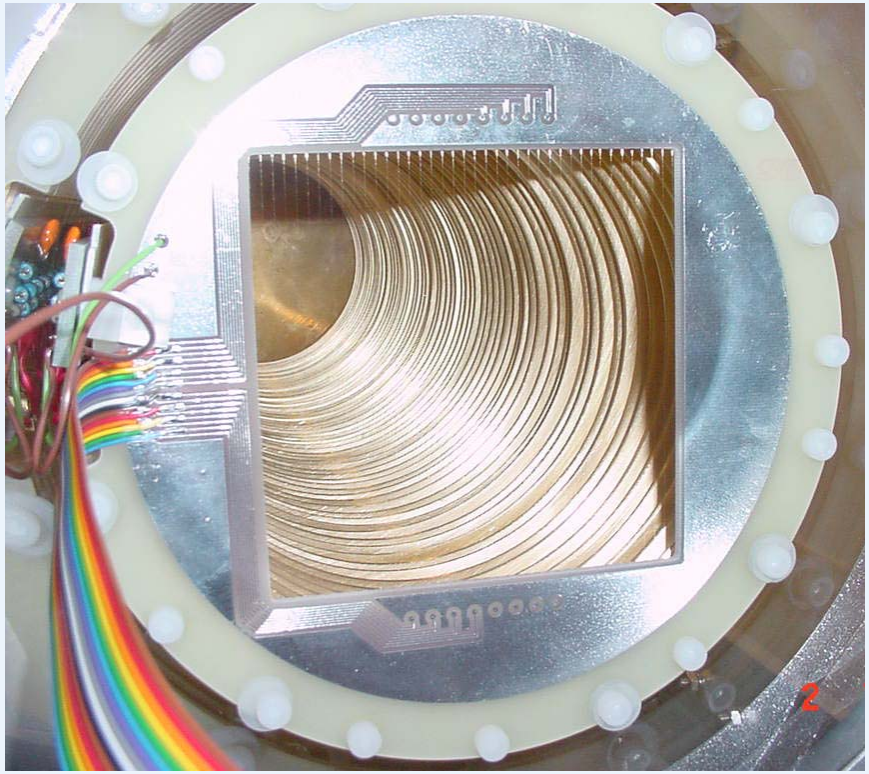
48 channels will allow …
2 rows of 2mm pads
plus
4 rows of 5mm pads
for track definition

Or..

1 row of 2mm pads
4 rows of 5mm pads
8 channels
for positive ion measurement

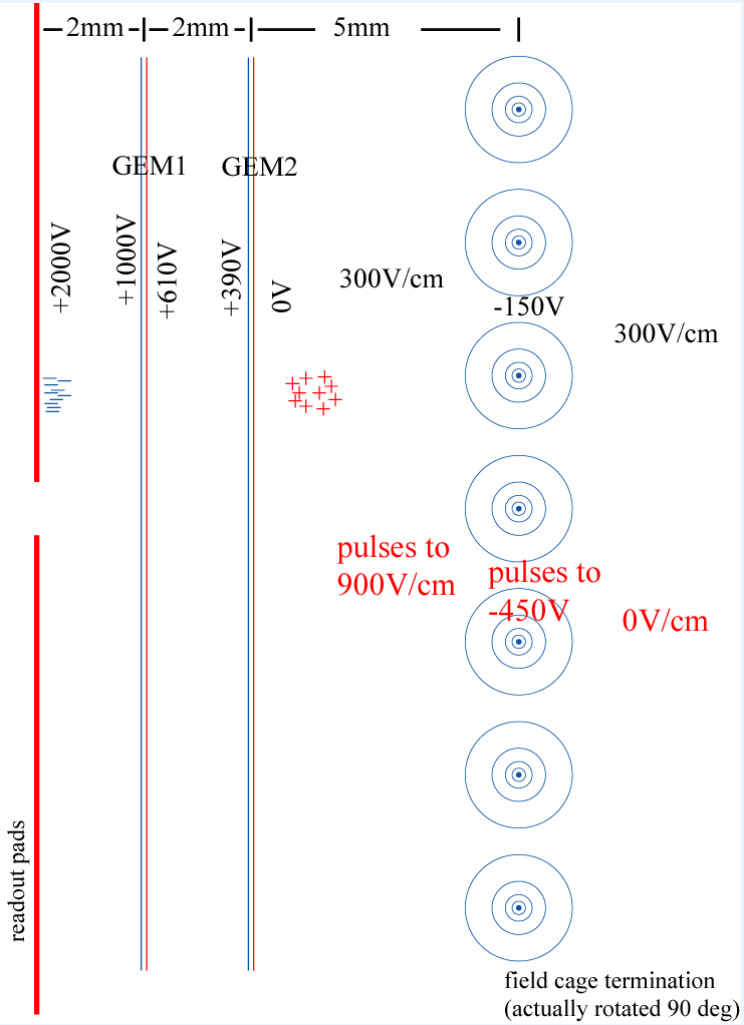
Future: Ion Feedback Measurement

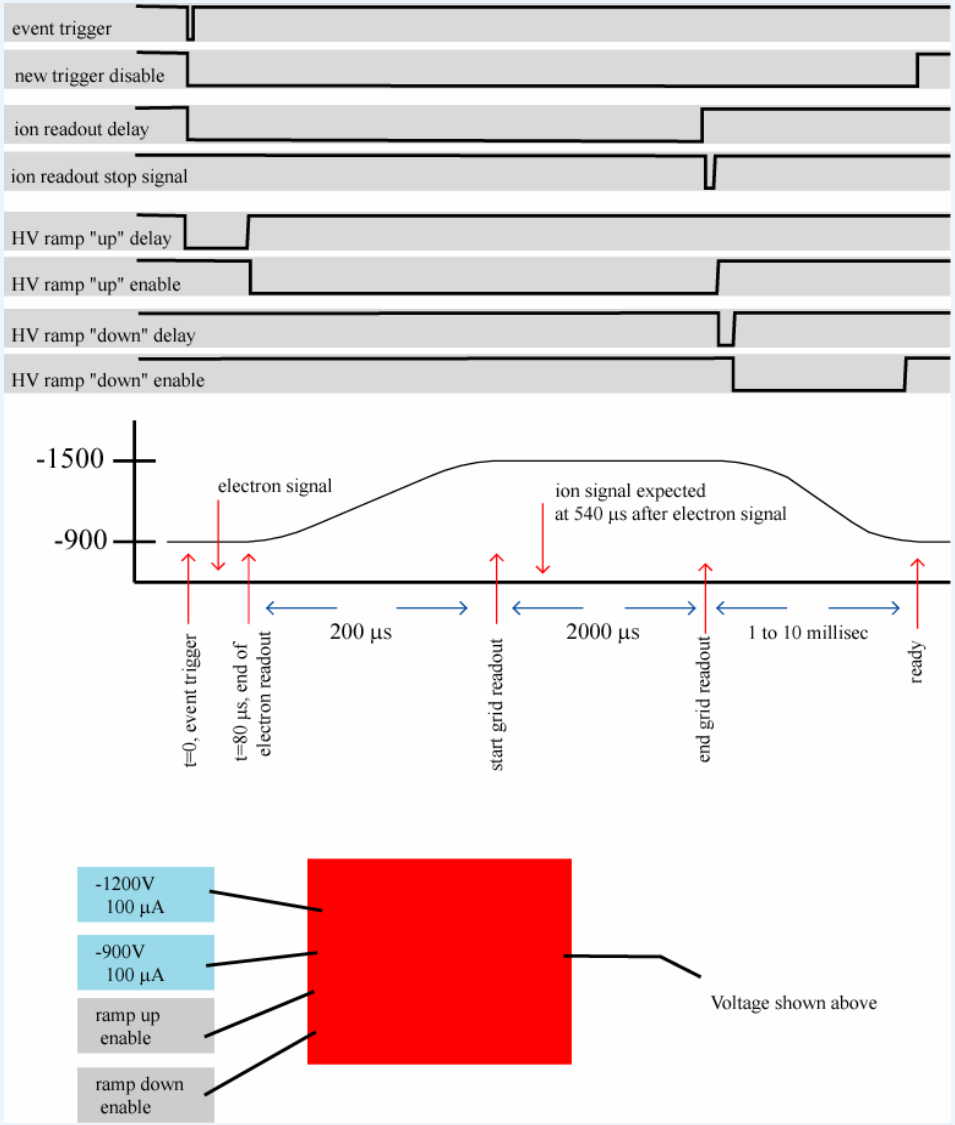




Positive ions are created in the amplification and drift back into the field cage.
This is bad because the positive ions in the field cage can distort the drift field.
The GEMs and MicroMegas should have reduced fraction of feedback.
Measurements have been made using the current at the cathode.
We would collect the positive signal on the field cage termination.

Ion Feedback Measurement





Other Activity

the WWSOC Detector R&D Panel
an international panel of 9 people
on which I agreed to serve
(I should have taken B.D.'s advice.)

https://wiki.lepp.cornell.edu/wws/bin/view/Projects/WebHome

the Large Detector Concept concept,
one of the 3 concepts recognized by the GDE.

thinking about magnetic field measurement requirements
$< 10^{-5}$

I agreed to
"take charge of the section on tracking performance".
(Again, I ignored B.D. and will pay for it.)

"TPC response simulation and reconstruction efficiency"
- running DOIT on 3 million hits per event.