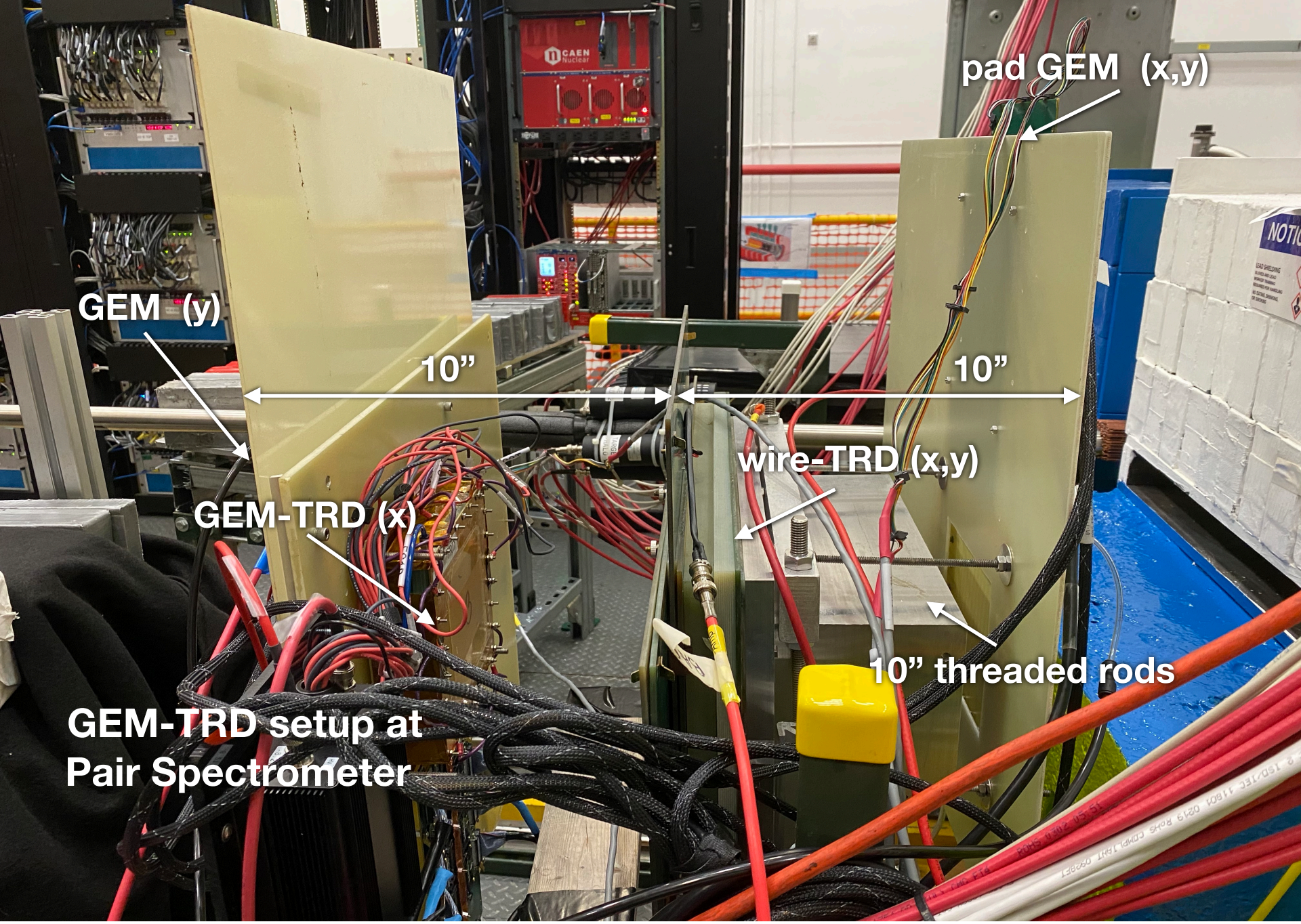
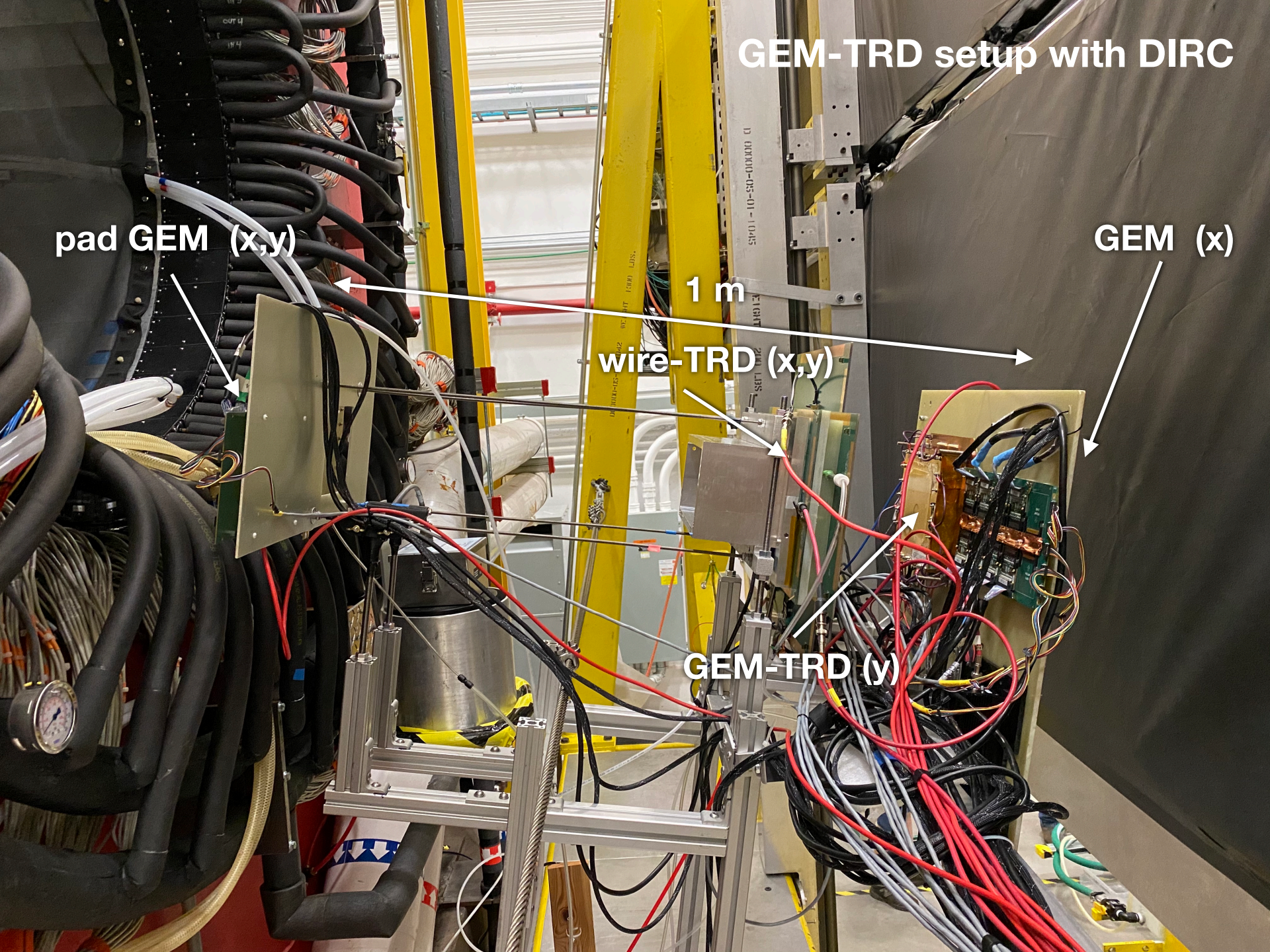
TRD (like TPC) tests with fast electronics

Lubomir Pentchev

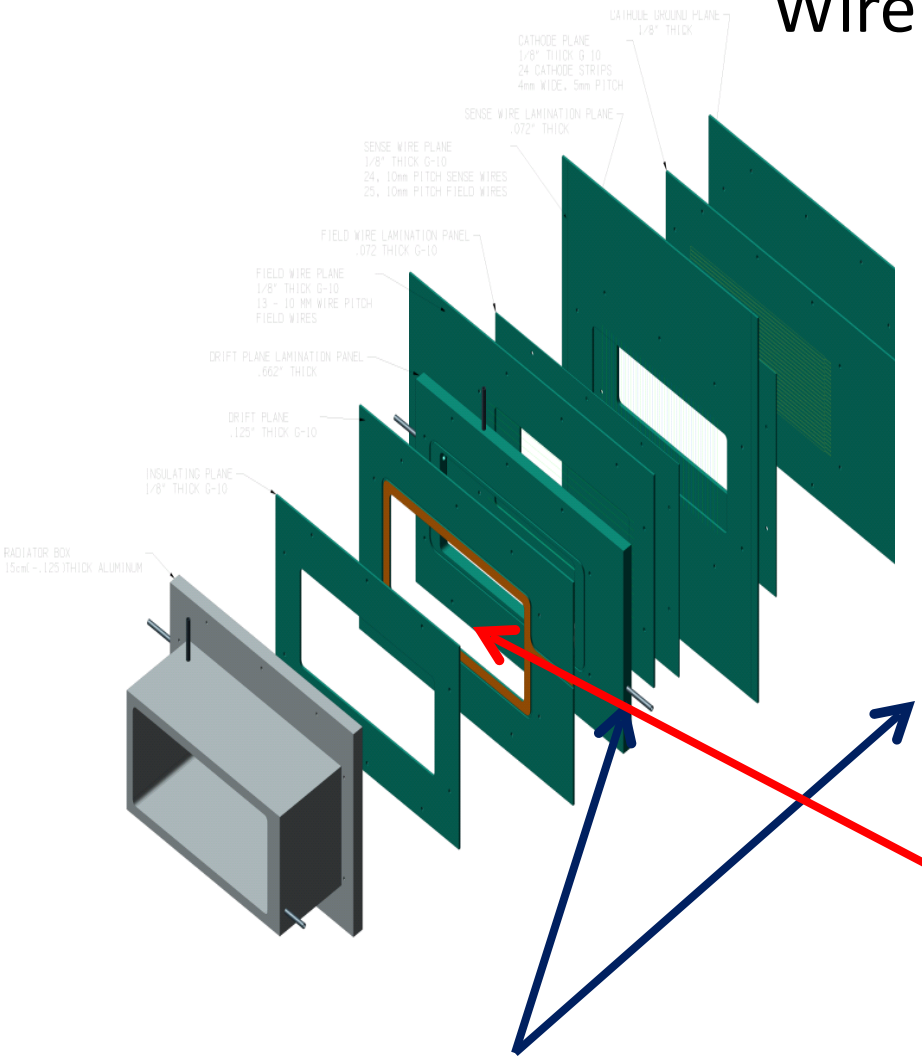
Tests done with TRD prototypes:

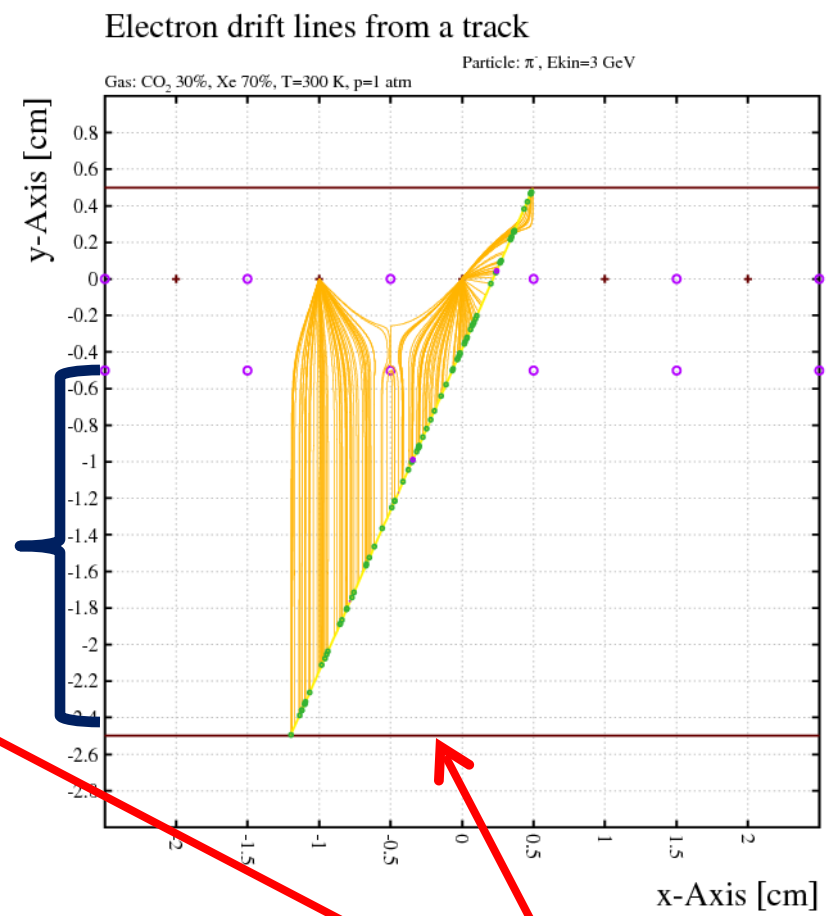
- testing setups in Hall D
- detectors - wire-TRD and GEM-TRD
- electronics - fast pre-amps and flash ADCs used for GlueX drift chambers
- some results: signal shapes, charge sharing (GEM), drift time spectra, TRD as TPC


pad GEM (x,y)
GEM (y)
10”
10”
wire-TRD (x,y)
GEM-TRD (x)
10” threaded rods
GEM-TRD setup at
Pair Spectrometer


GEM-TRD setup with DIRC
pad GEM (x,y)
GEM (x)
1 m
wire-TRD (x,y)
GEM-TRD (y)

Wire TRD

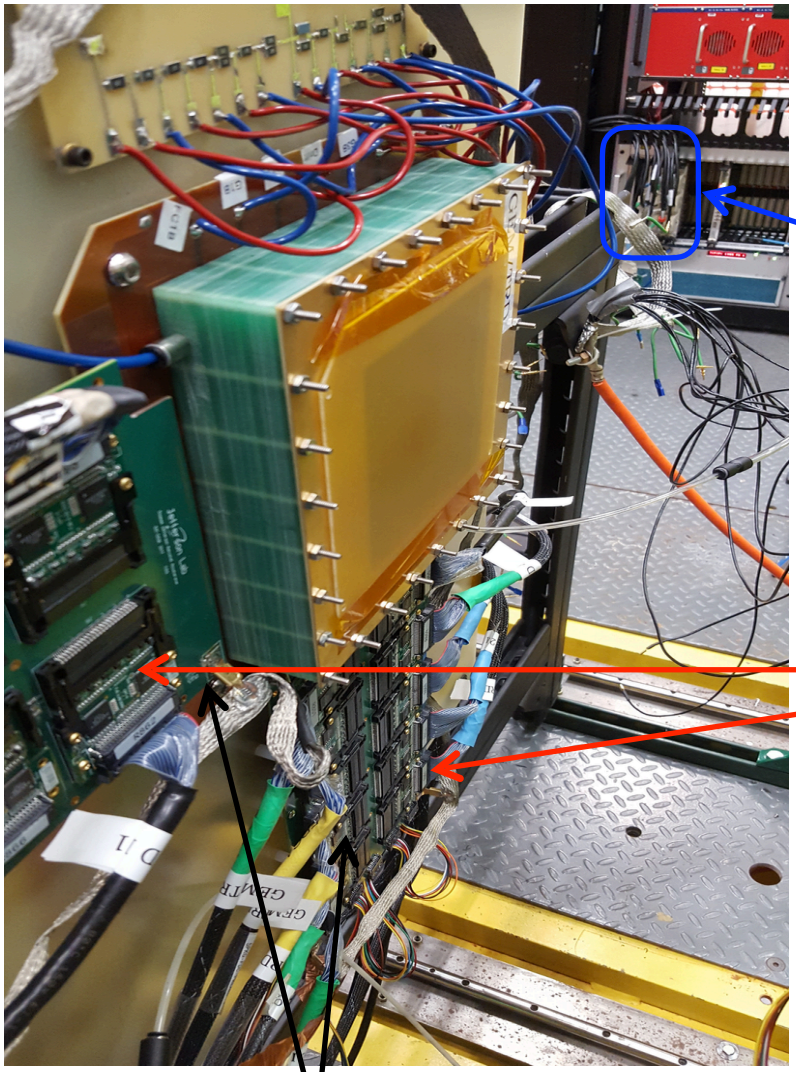




1. Drift distance increased from 2cm to 3cm – more TR photons will interact
2. Entrance cathode foil replaced: Aluminized (3μ Al) Kapton → Chromium (0.1μ)

GEM TRD with fast electronics

Standard 10x10cm² GEM with x/y-readout, with 21mm drift volume added



flashADC125

pre-amps (GAS-II ASIC)

adaptor boards

GlueX fast electronics for drift chambers

Pre-amps (3 x 8ch. GAS-II ASICs) Fernando Barbosa, GlueX Doc1364:

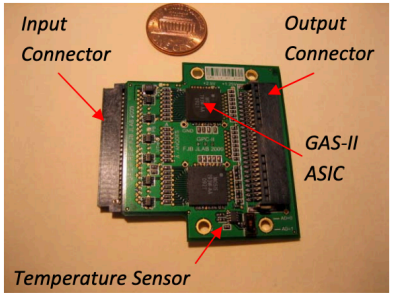


Figure 1: GPC-II – Top View.

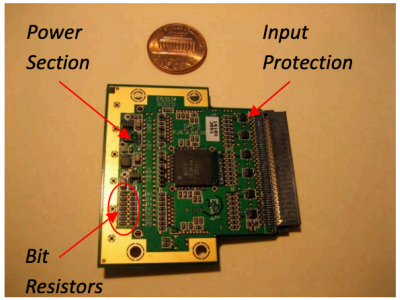


Figure 2: GPC-II – Bottom View.

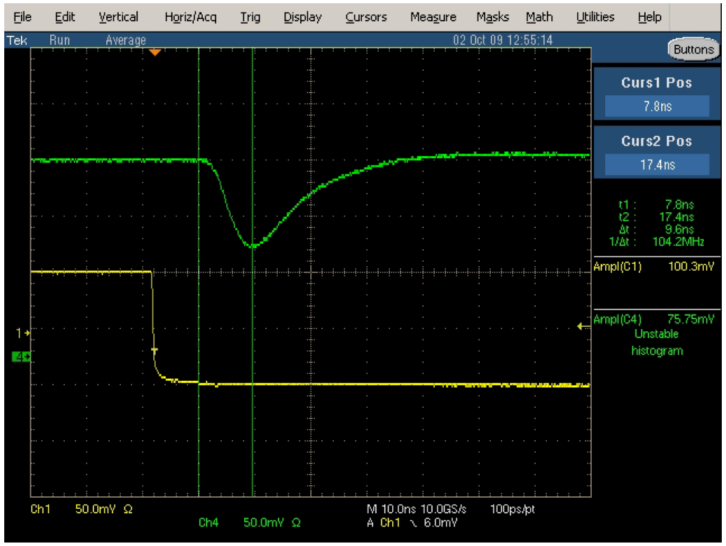


Figure 4: Impulse response to 100 fC.

Scale 10ns, 50mV

Table 2 – Preamp Parameters

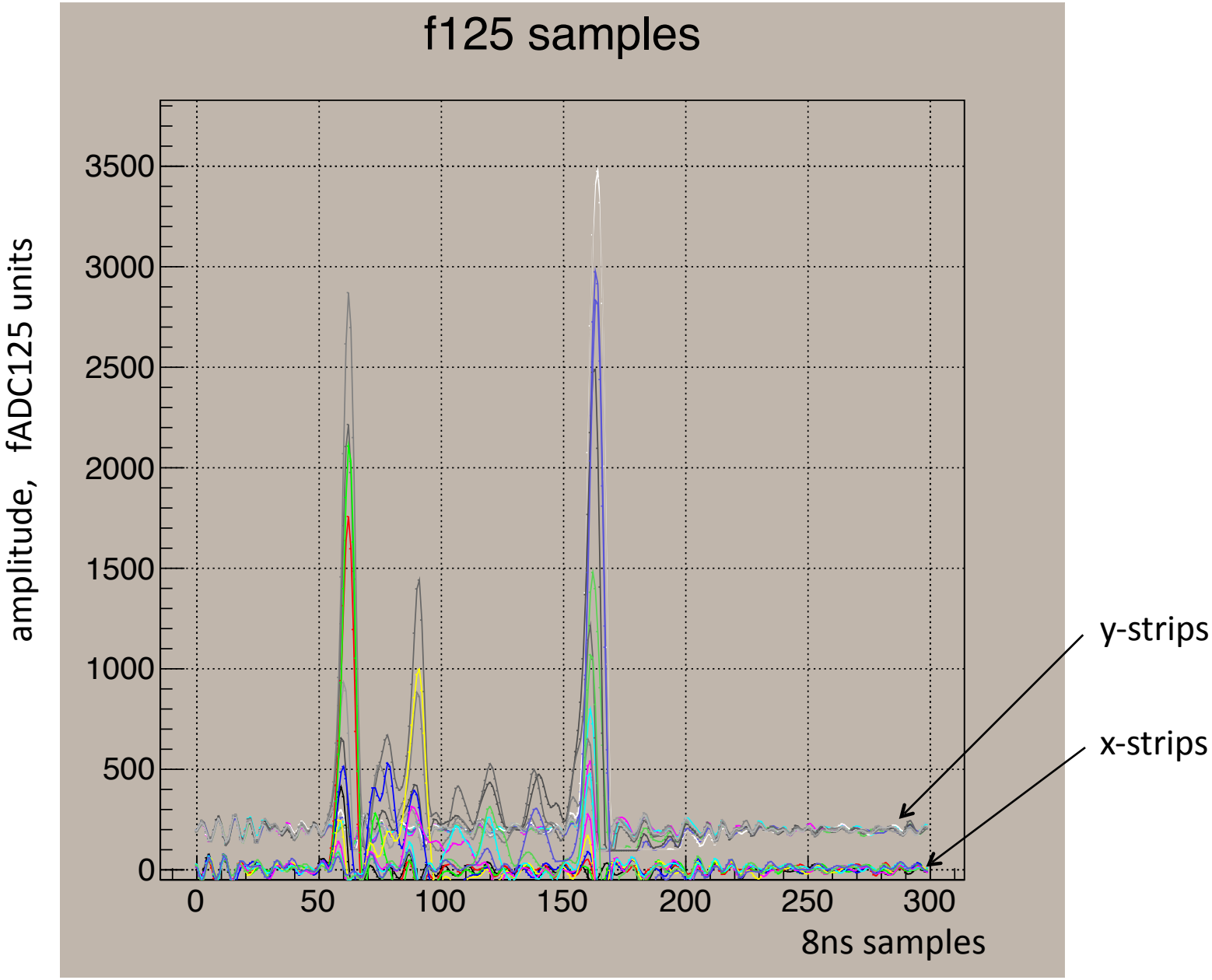
Bit Settings	Gain (mV/fC)	DR (fC)	Tp (ns)	P (mW)
0101000	0.77	260	9.6	49
0101100	0.57	380	12.0	49
0110000	0.85	260	8.0	54
0110100	0.62	320	11.0	54
0101010	3.2	110	10.8	49
0101110	2.6	130	13.8	49
0110010	3.6	100	10.2	57
0110110	2.9	120	13.0	57
0100000	0.69	230	9.6	46
0111000	0.91	260	8.6	56

fADC125 - Gerard Visser, Fernando Barbosa, Cody Dickover

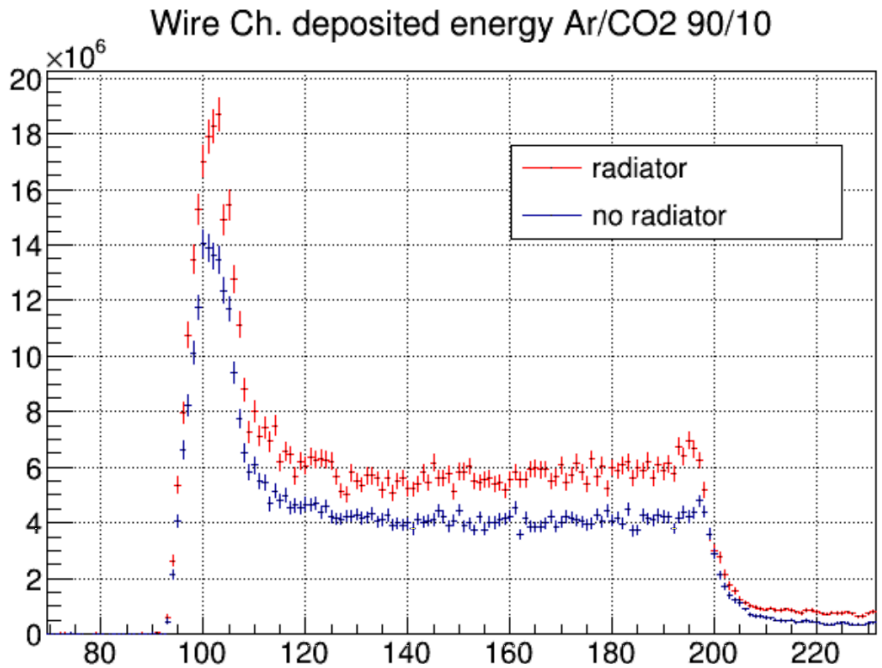
- 72 channel (3x24) , 125 MHz, 12 bit, VXS
- +/- 164 mV differential input, programable DC offset
- cable equalization, lowpass shaping/anti-alias filter
- trigger latency - max 13.5 us, practically <2.4 us
- firmware - pulse analysis: variety of pulse and raw modes

fADC125 specifications: https://halldweb.jlab.org/DocDB/0008/000855/002/Drifts_ADC_Specification_Document.pdf
fADC125 firmware: https://halldweb.jlab.org/DocDB/0022/002274/009/fADC125_DataFormat_v9.pdf
GlueX electronics overview: https://halldweb.jlab.org/DocDB/0025/002515/002/Electronics%20Overview%20-%20TCR.pdf

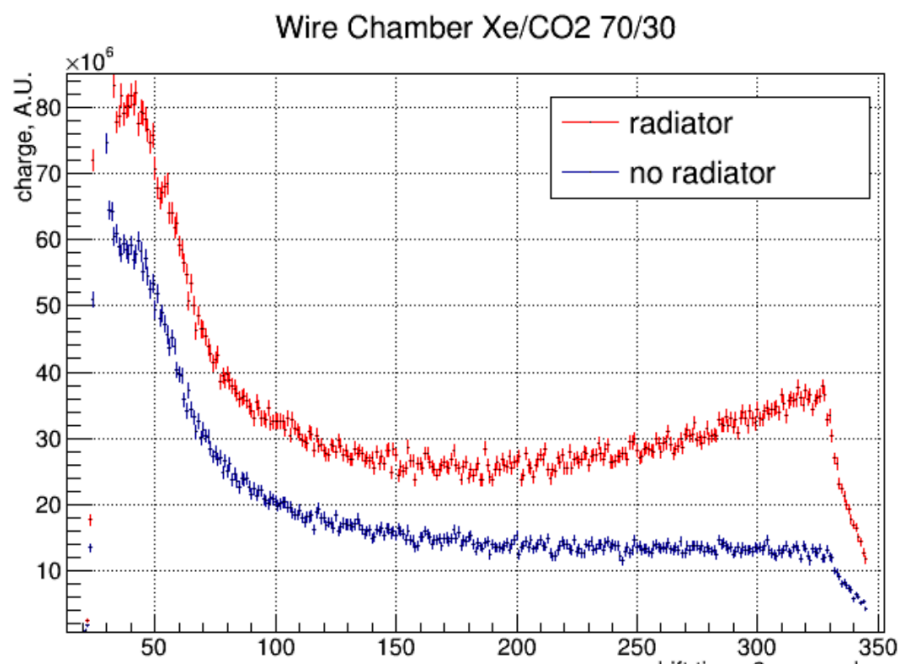
fADC125 - raw mode with GEM-TRD



wire-TRD with fast electronics



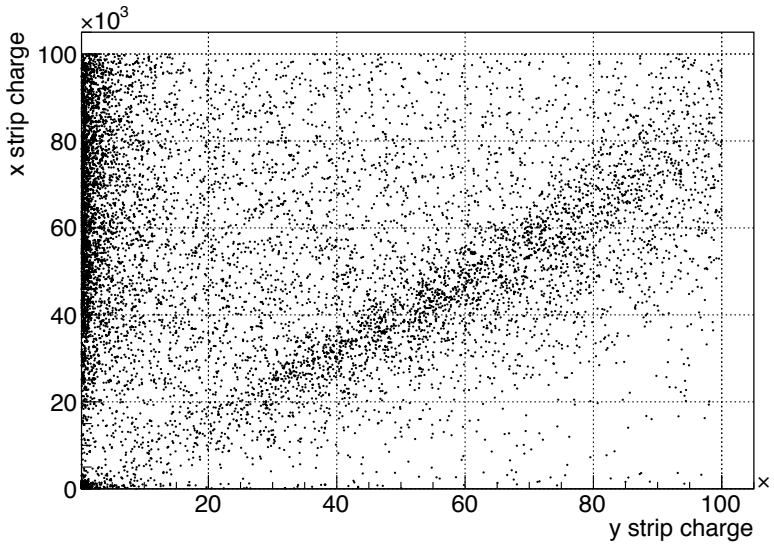
Drift time, 8ns samples

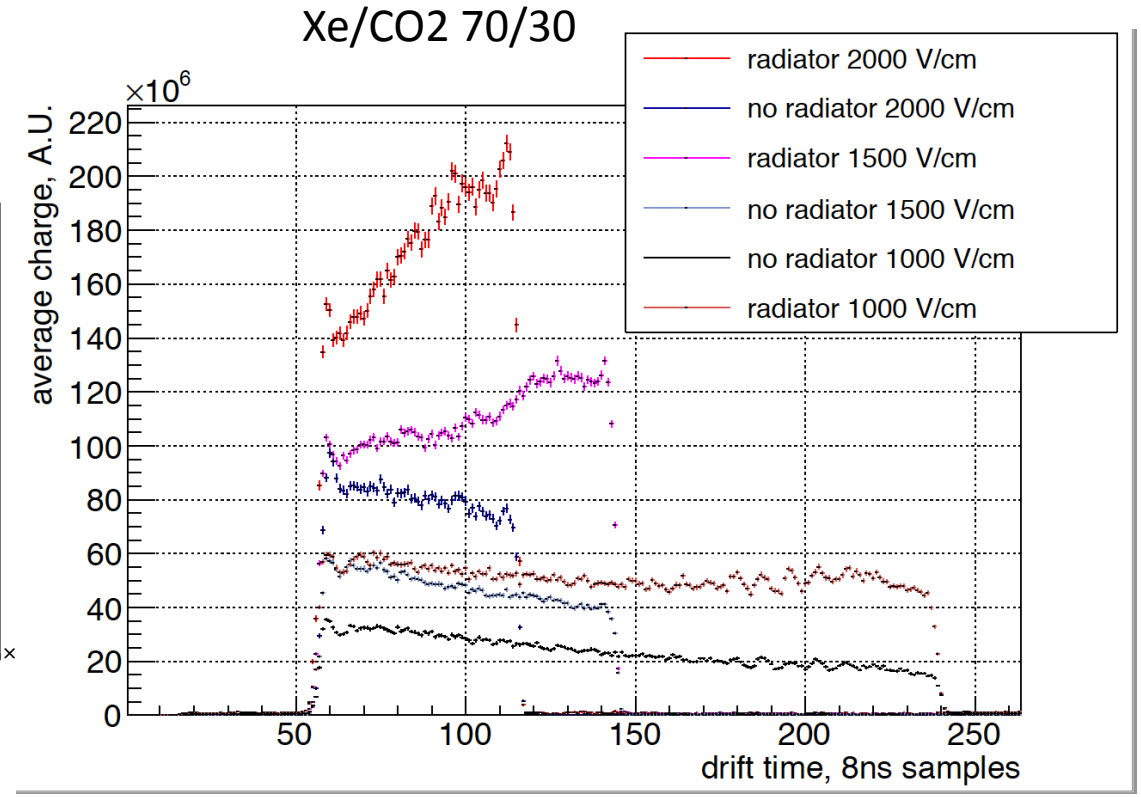


Drift time, 8ns samples

wire-TRD has 30mm drift gap

GEM-TRD with fast electronics

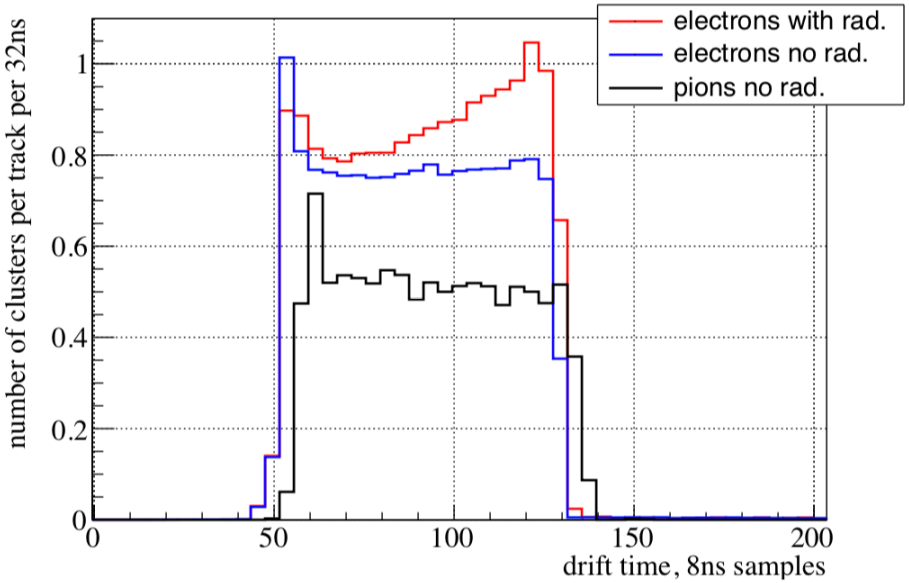


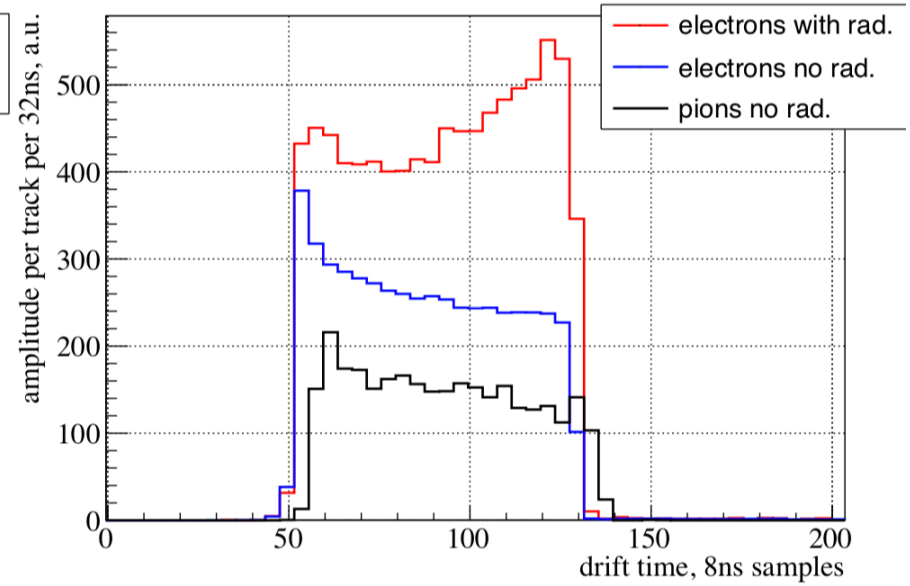


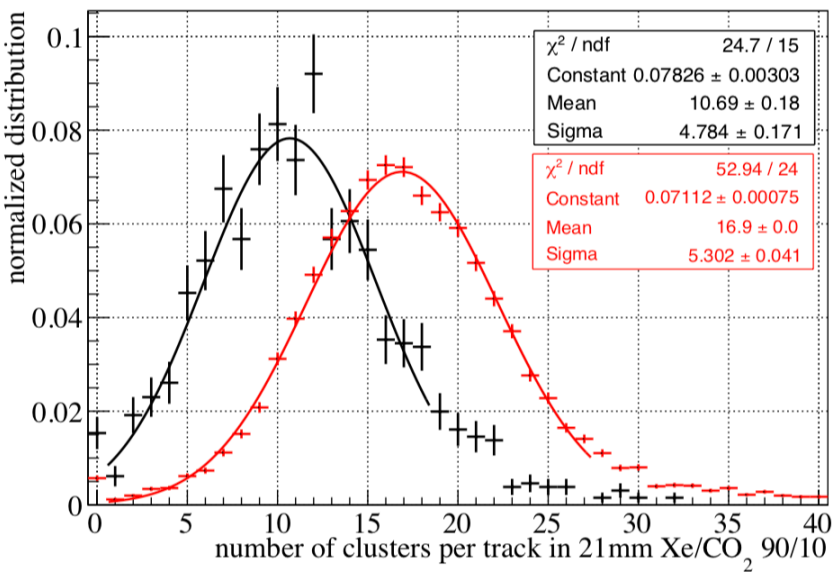
GEM-TRD has 21mm drift gap

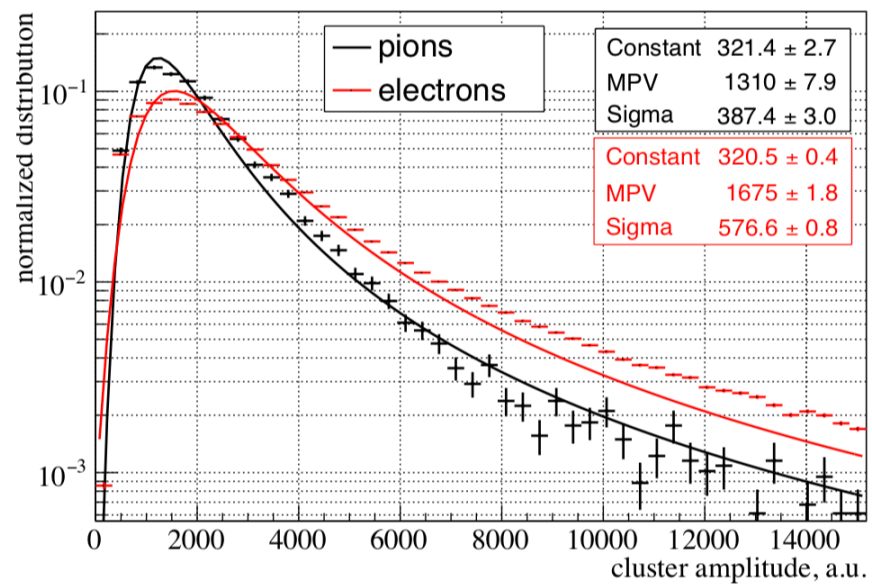
GEM-TRD with fast electronics

Xe/CO2 90/10

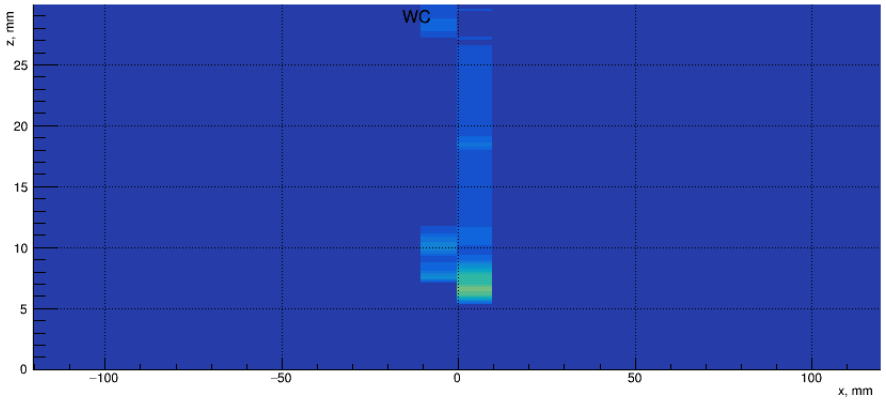


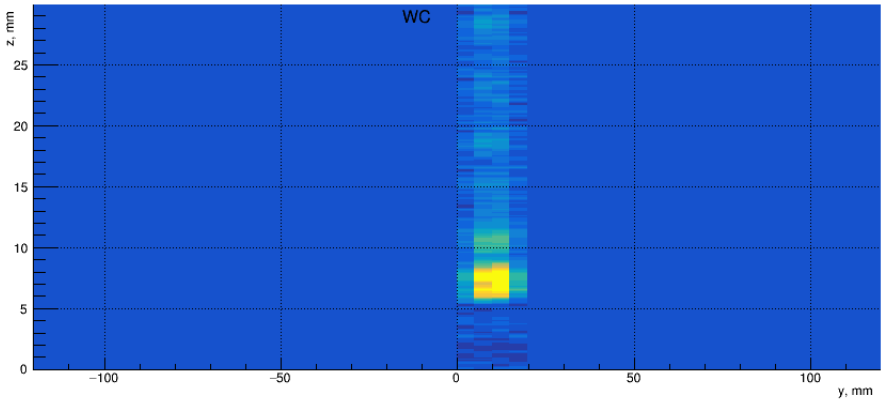


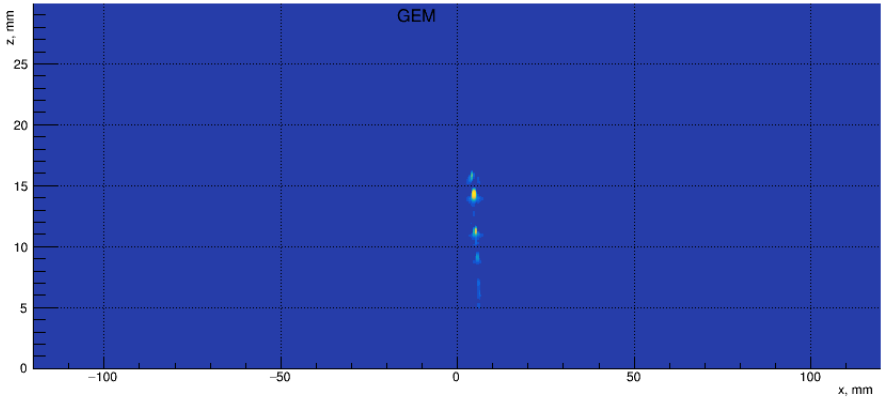


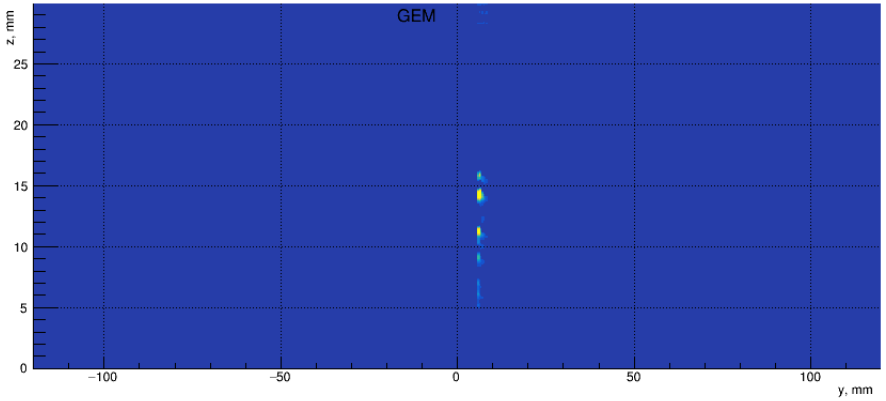


TRD asTPC

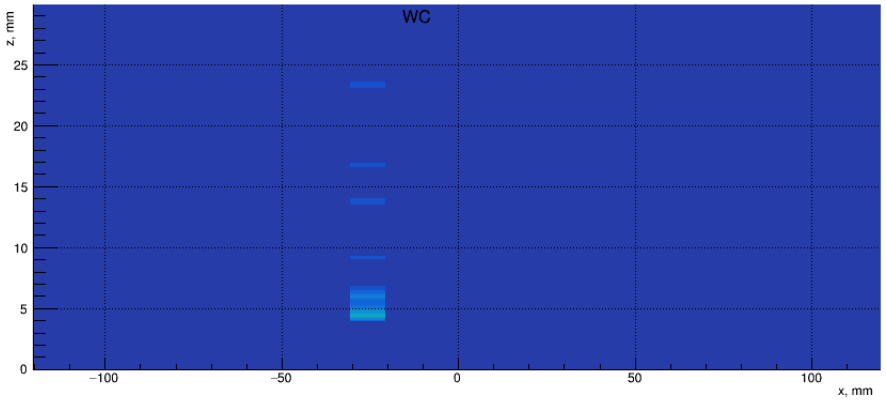


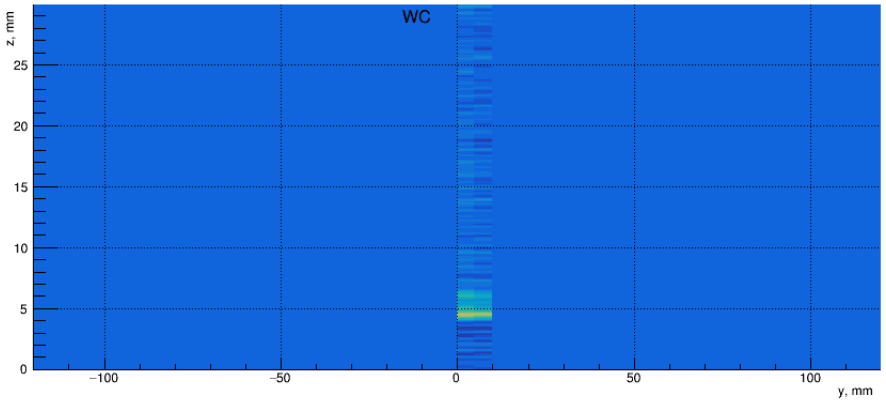


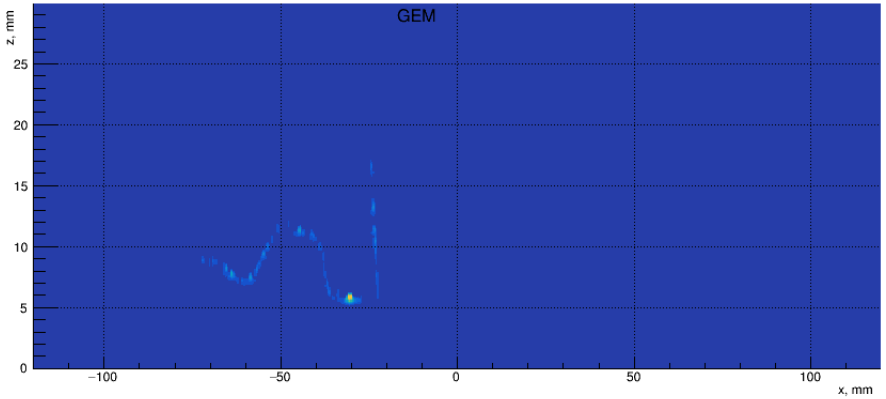


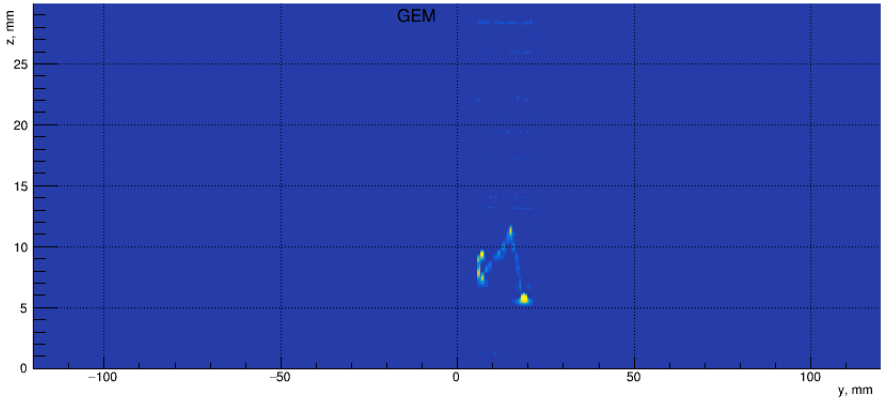


TRD as TPC

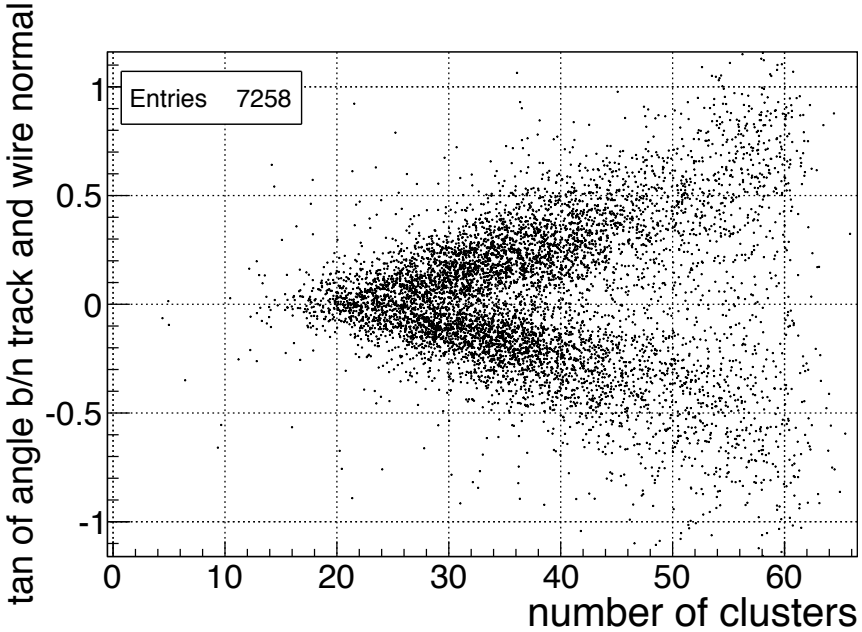








Final remarks

- GEM the best choice for TPC (TRD) - no space charge effects as in WC
- Using GlueX fast electronics with GEMs (compared to APV) requires significant grounding efforts as a results of x/y-strip capacitance (no problems with only x or y strips)
- Price per channel for GlueX drift chambers: $55 (including all electronics)
- Cody, Fernando, Sergey Furletov working on streaming readout version; cheaper as no VXS required
- Fernando working on replacing the adapter boards (with pre-amps on it) with a single preamp board connected directly to GEM connectors

space charge effects with comics (same track) in WC with 30mm drift gap