Status of GEM-TPC R&D at Victoria

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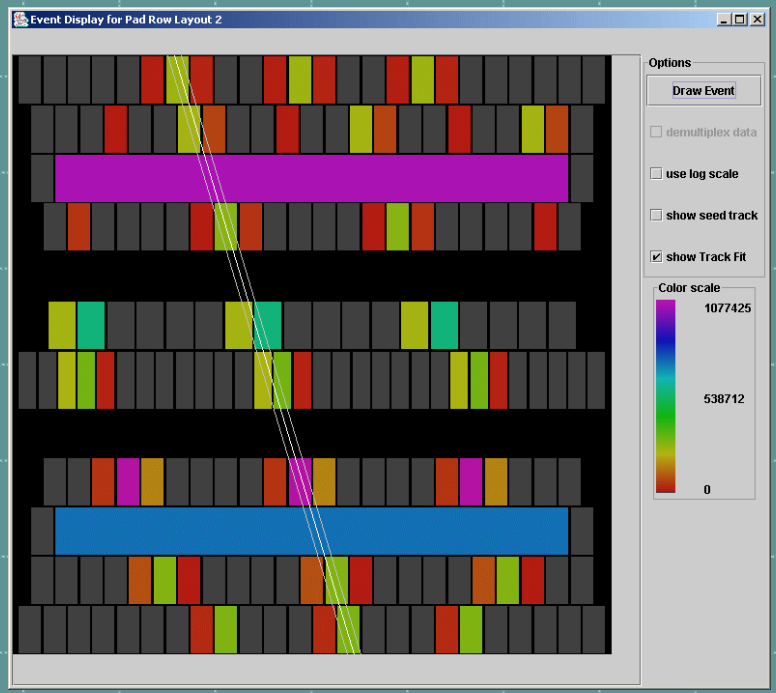
Outline

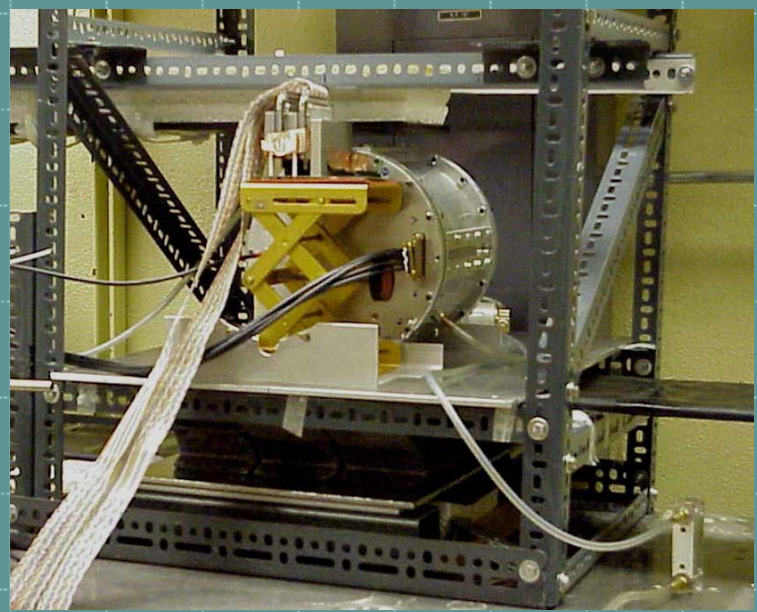
- Reminder of Canada-TPC1
- Construction of Canada-TPC2 (magnetic field tests)
- High voltage system
- Tektronics e-scope readout
  - first signals from cosmics
- Integration of STAR readout
  - first cosmic track events – analysis with jtpc package
  - I960 linux cross-compiler
- Plans

Canada – TPC1 Studies (Carleton)

- Outer 6 rows are used to define track parameters
  - inner two rows: resolution studies (fit for x_0 alone)
  - 2 mm x 6 mm / 3 mm x 5 mm pads

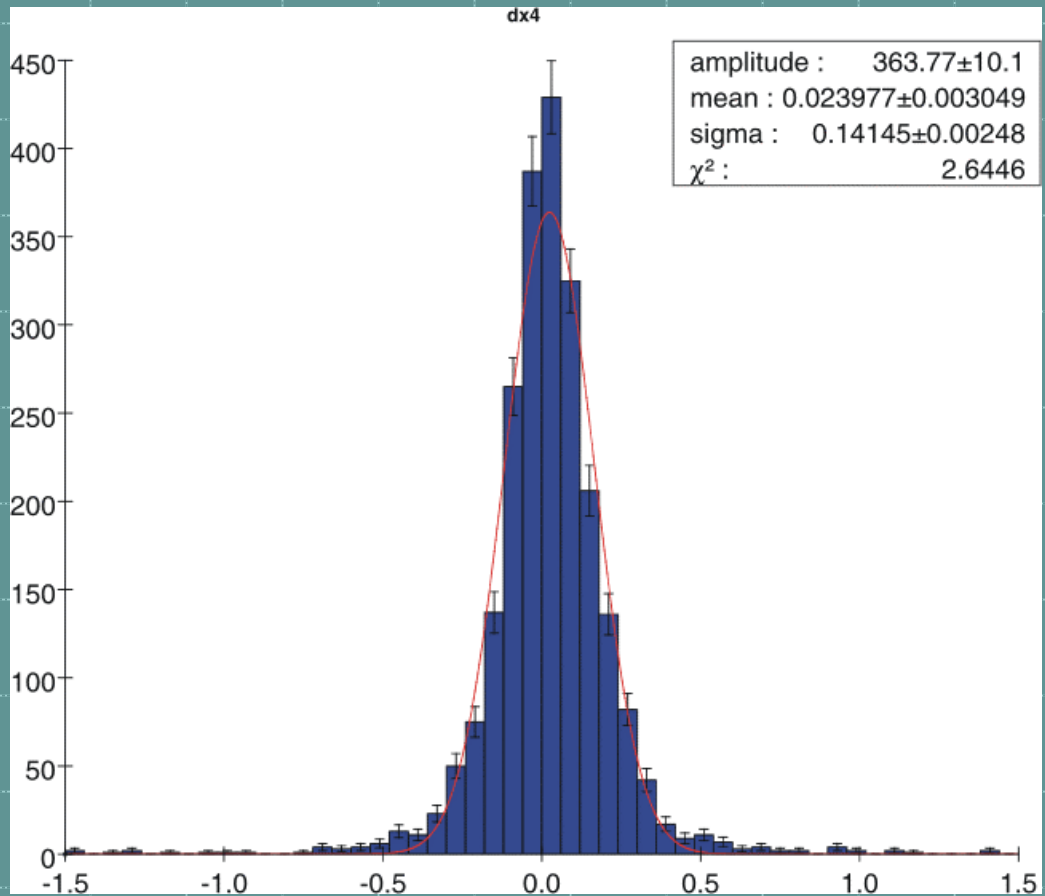


Carleton TPC

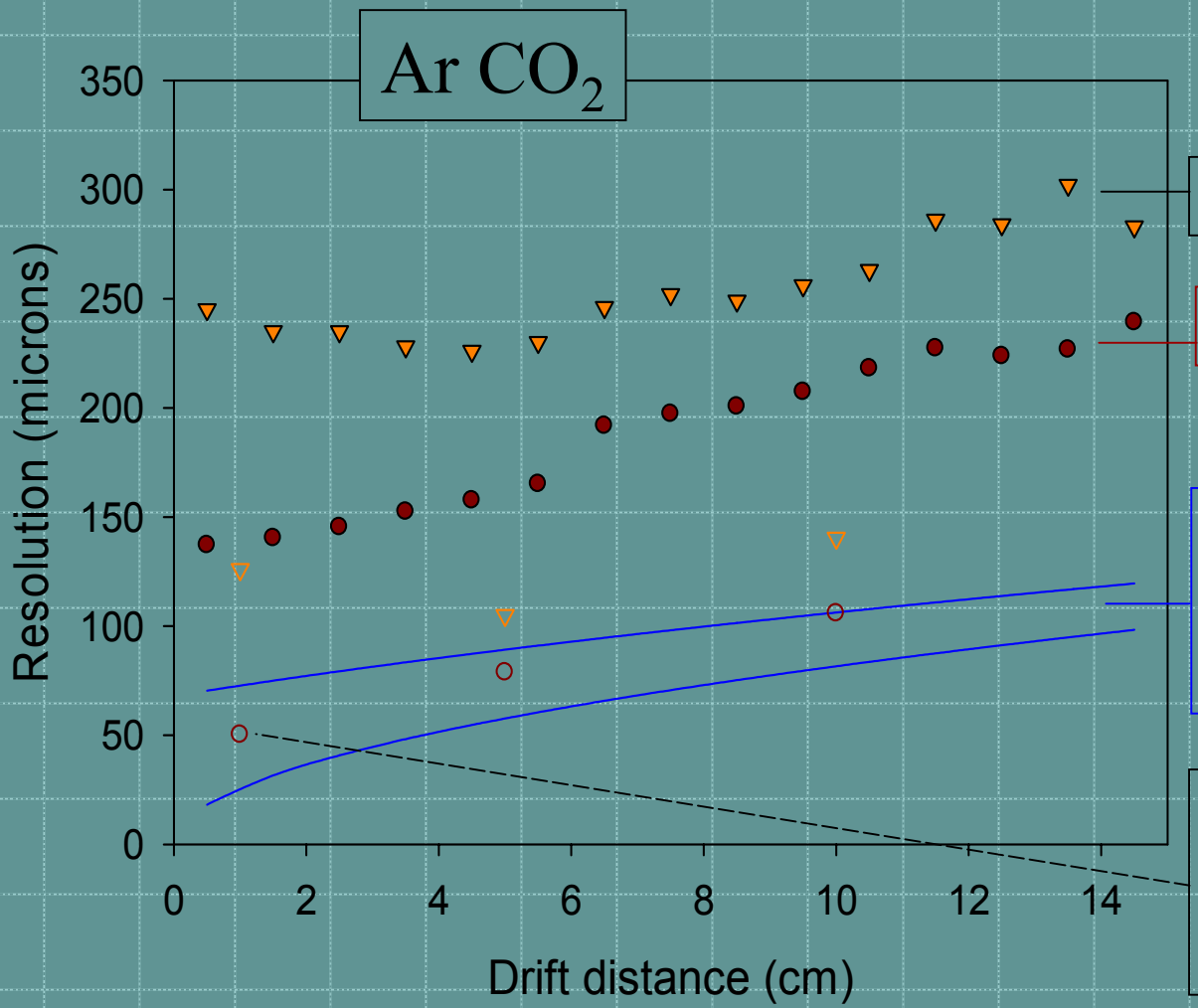


x_0 Resolution

- Example: for Ar CO_2 (90:10)
  - d < 2 cm
  - $|\phi|$ < 0.1 rad
  - pad width: 2 mm
  - $\langle\sigma\rangle$ = 0.5 mm
  - w/$\langle\sigma\rangle$ = 4
  - resolution: 140 μm



Resolution vs. Drift Distance



$|\phi| < 0.1$

3 mm x 5 mm pads

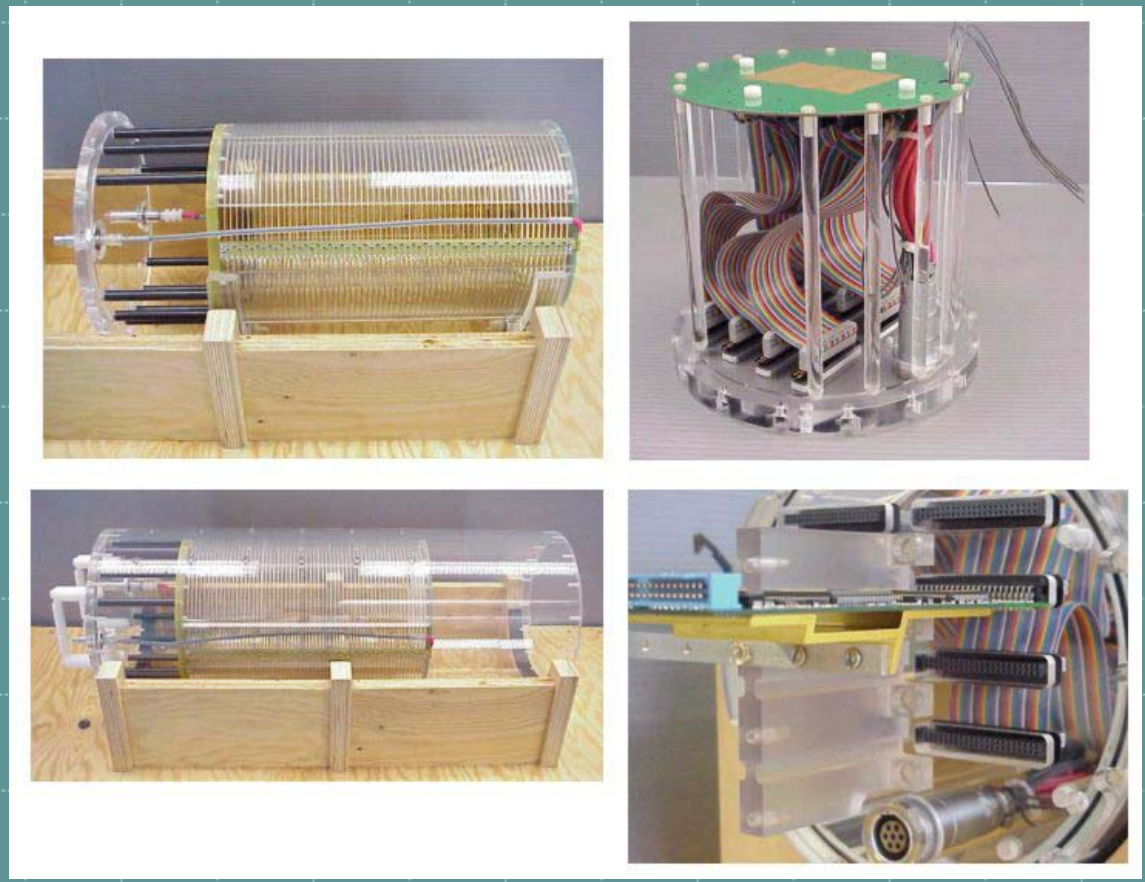
2 mm x 6 mm pads

Naïve optimum:
- all primaries collected
- upper: σ_0 before amp.
- lower: σ_0 after amp.

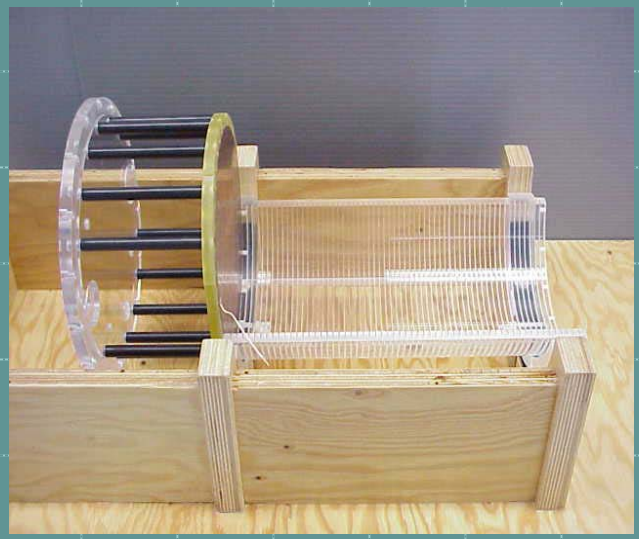
MC simulations:
- GEM efficiencies:
  collection 1.0
  extraction 0.7

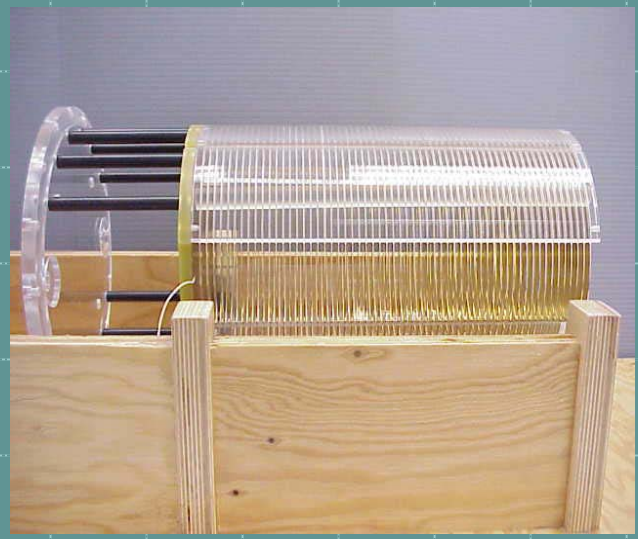
Construction of Canada-TPC2

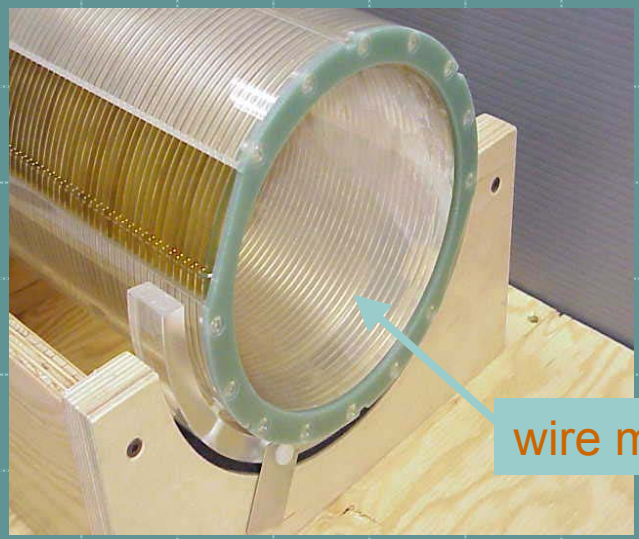
- Designed for tests in magnetic fields:
  - TRIUMF (1T)
  - DESY (5T)
- Drift and readout sections are separate
- Connections for STAR readout

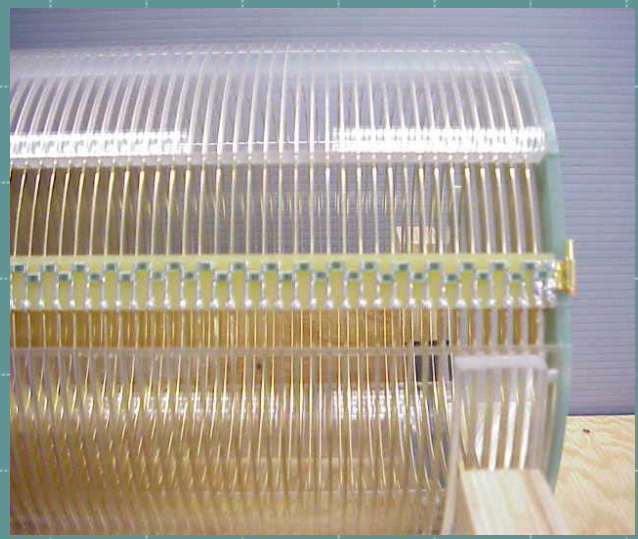


Detail of drift volume



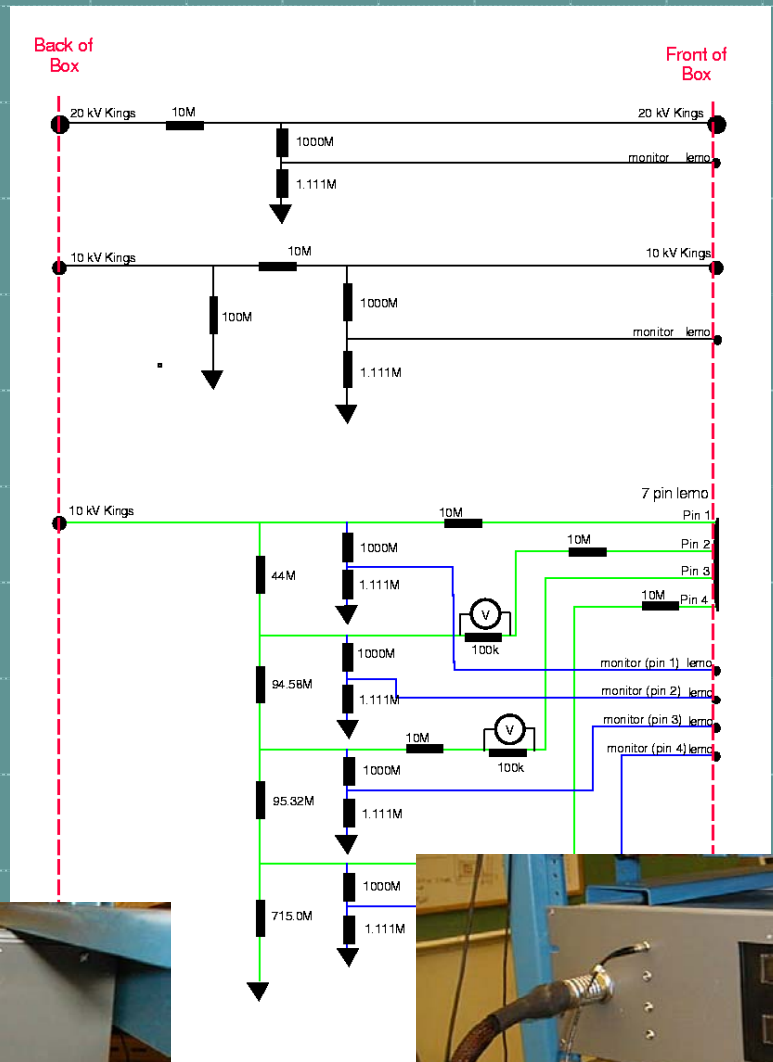






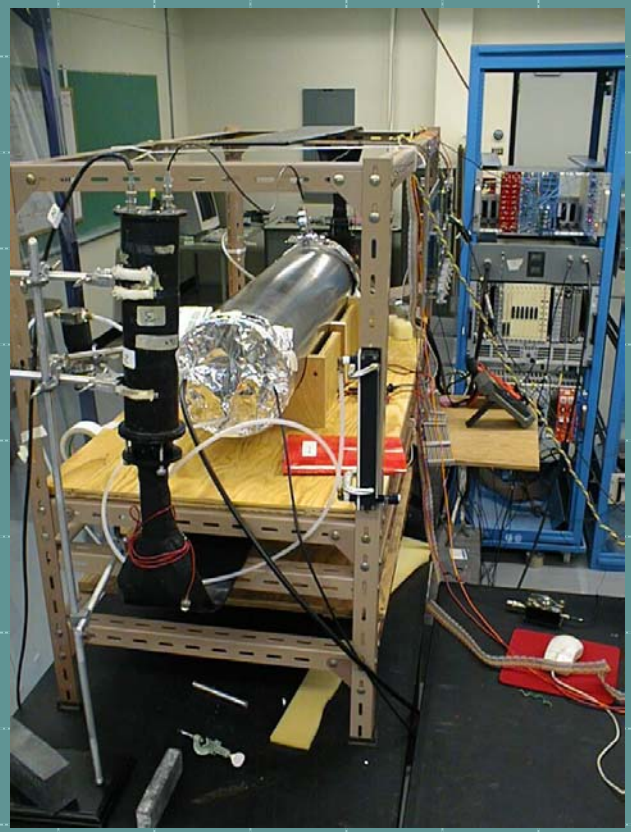
High Voltage System

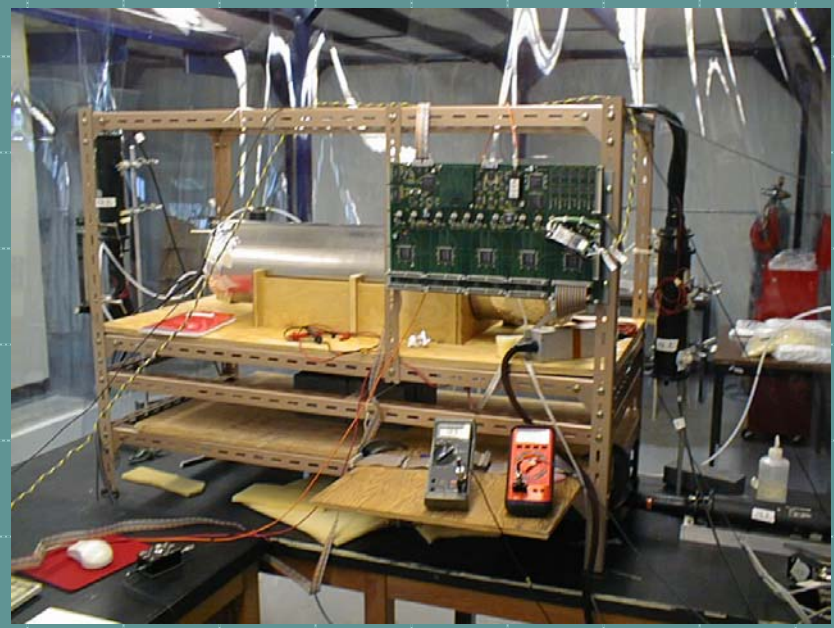
- Separate divider chain for drift and GEM stages
- Drain on drift-low allows drift field to be changed independently of GEM
- Current through GEMs monitored by voltage across shunt resistor: 1 nA precision
- HV monitor connections



Cosmic trigger

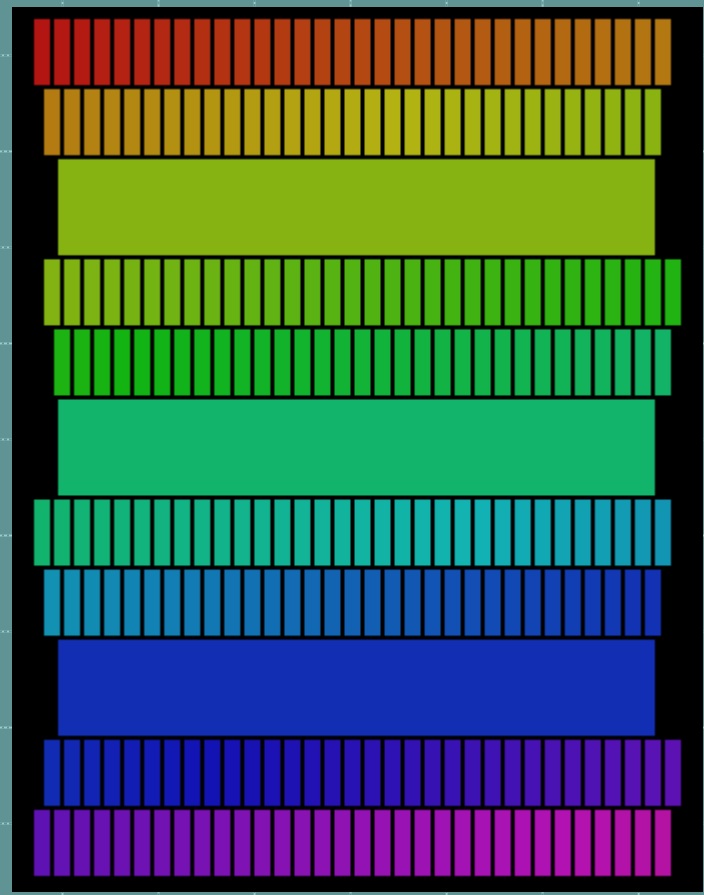
- 3 scintillator paddles in coincidence





Pad Layout – TPC2

- 256 readout channels:
  - 253 pads: 2mm x 7mm
  - 3 strips: 60mm x 10mm
- no multiplexing
  - each row connected to one STAR readout card
  - strips connected to STAR readout of rows with 31 pads

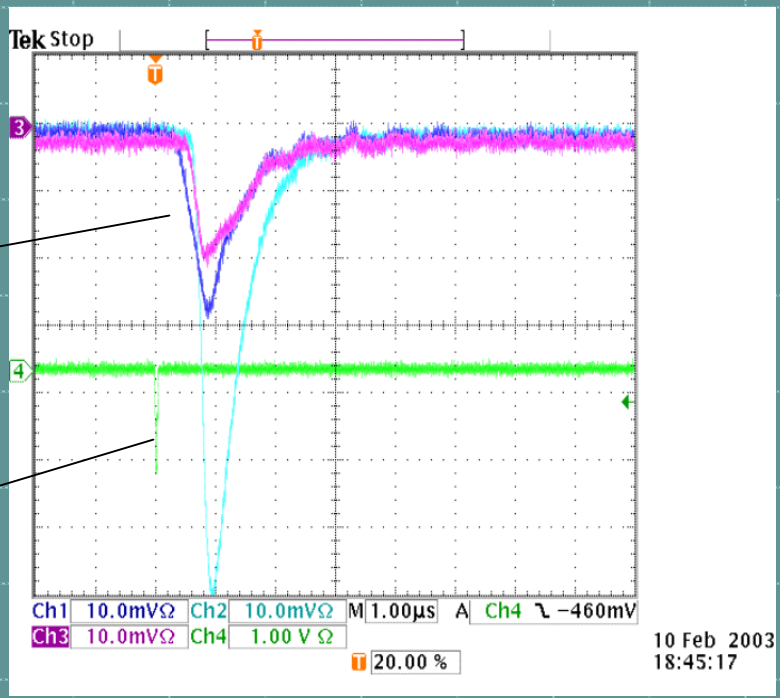


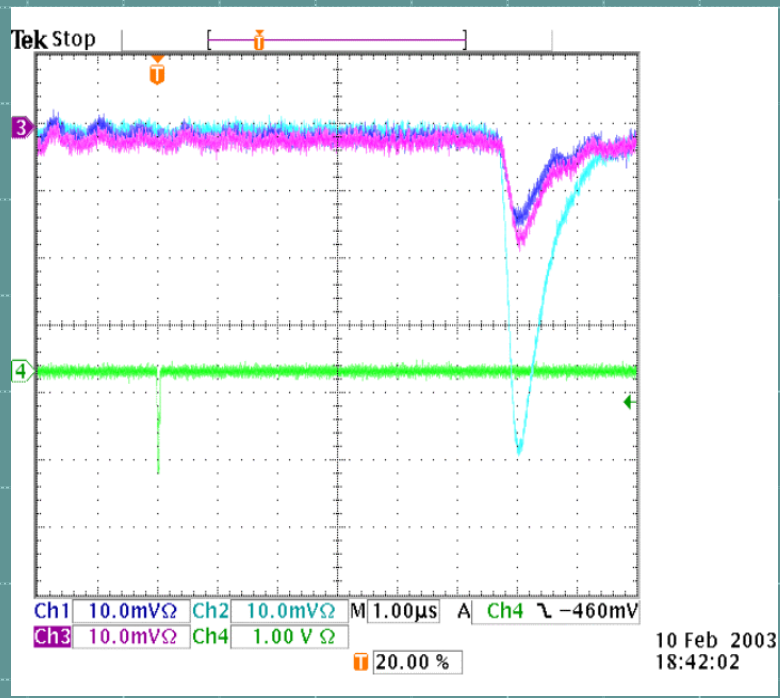
Tektronics scope readout

- Use 3 Ortec-142 pre-amps to readout long strips
- TPC operated with P10 gas

strip signals

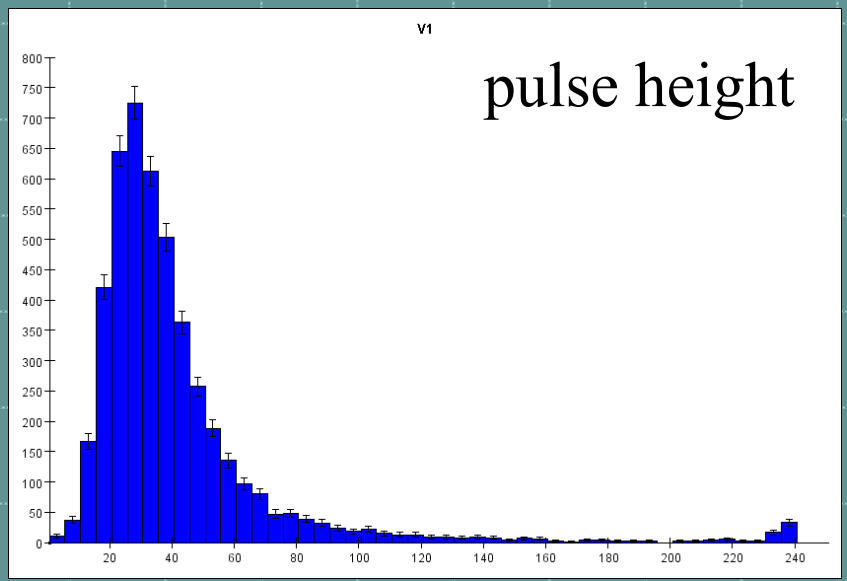
cosmic trigger

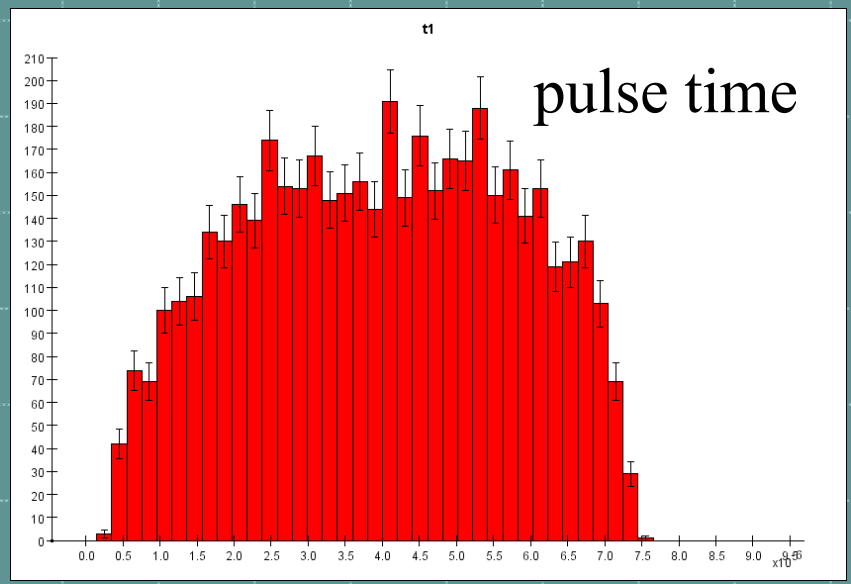




Tektronics e-scope readout

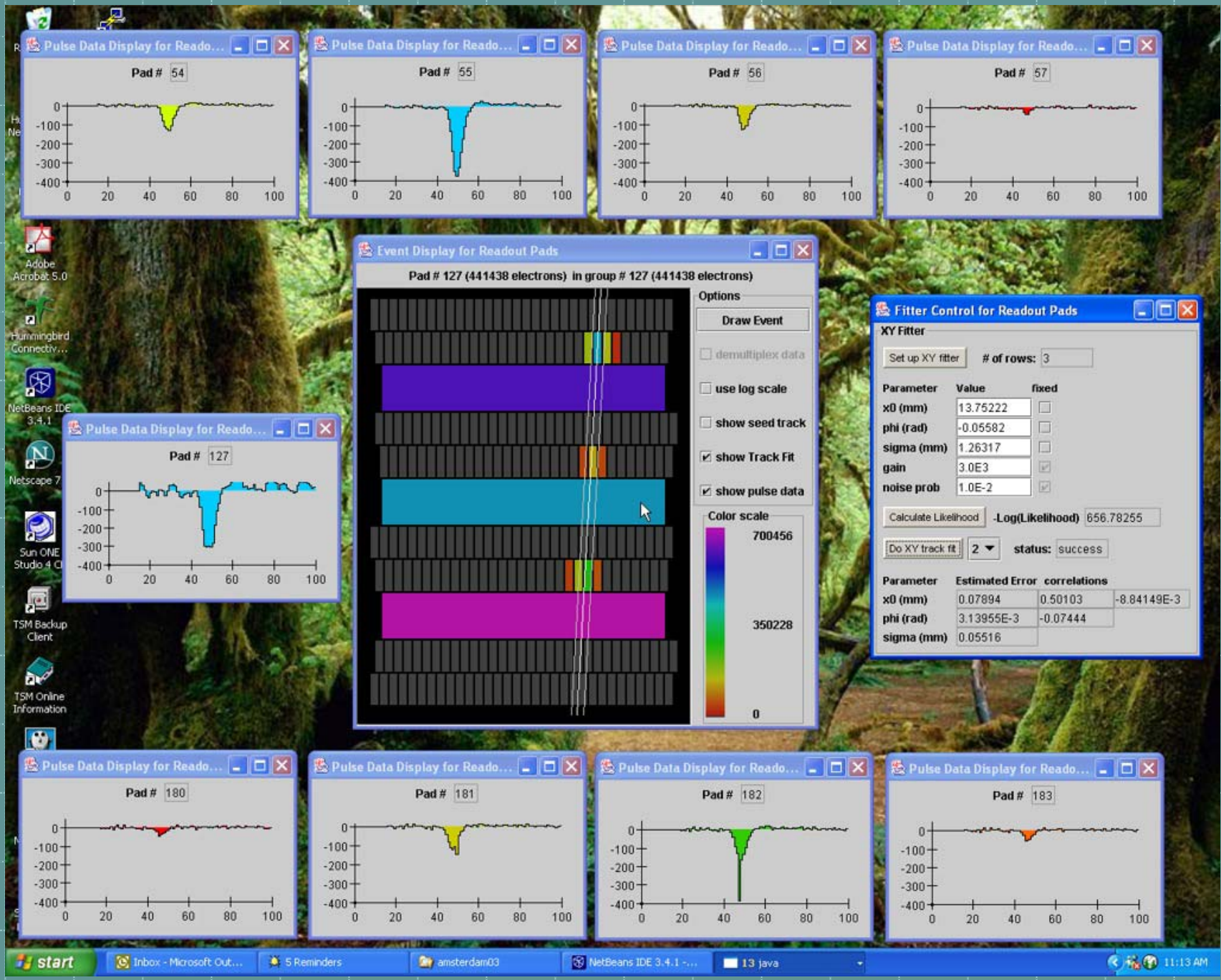
- Newest Tek scopes have ethernet connections
  - web server + data acquisition over ethernet
- Mini-DAQ setup for recording events
- Amplitude/time of middle strip hits with cuts on outer



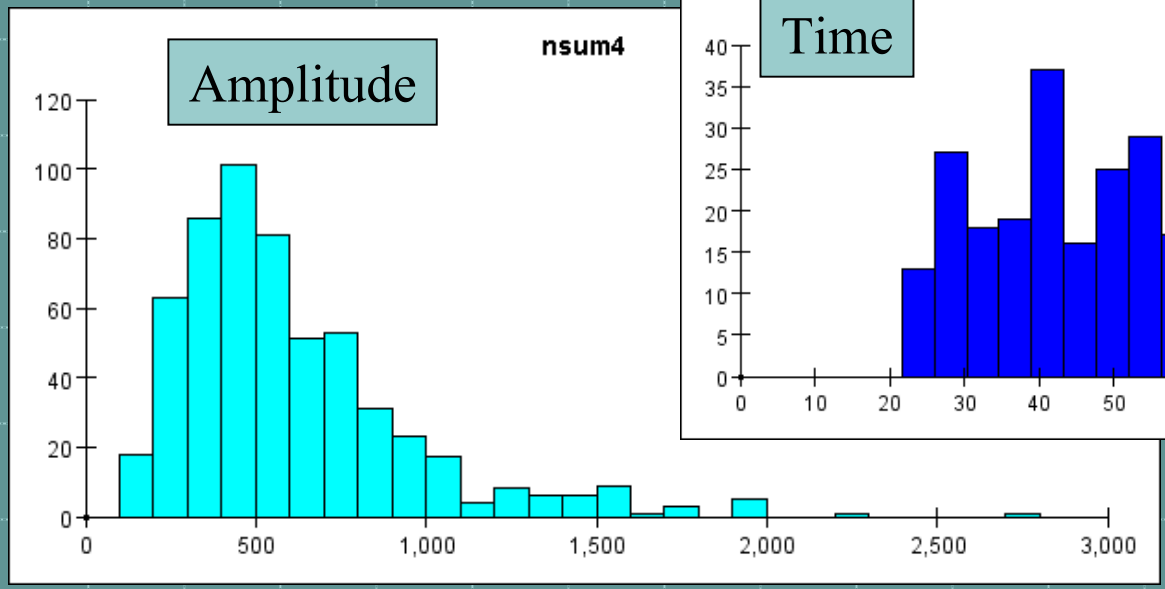


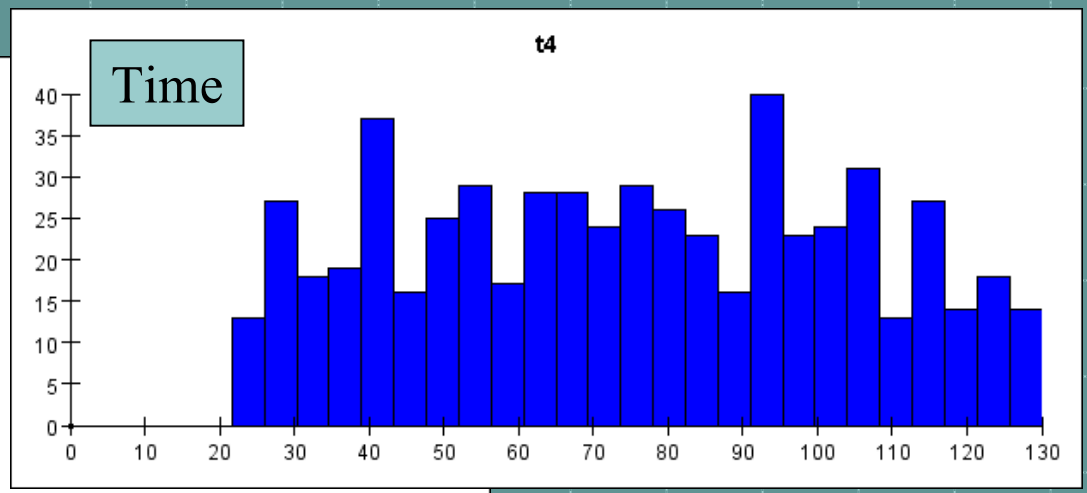
Integration of STAR readout

- Several STAR readout cards had defects: returned to LBNL for repair/replacement
- Remainder modified according to E. Neuhiemer scheme to get nearly 10 bits dynamic range for negative pulses
- Attempts to improve basic DAQ program (sq_irq)
  - build of cross-compiler on linux for Intel-960 successful
  - need some header files to compile STAR readout code
- Modified jtpc analysis package to accept .irq format
  - single event files concatenated to make run file

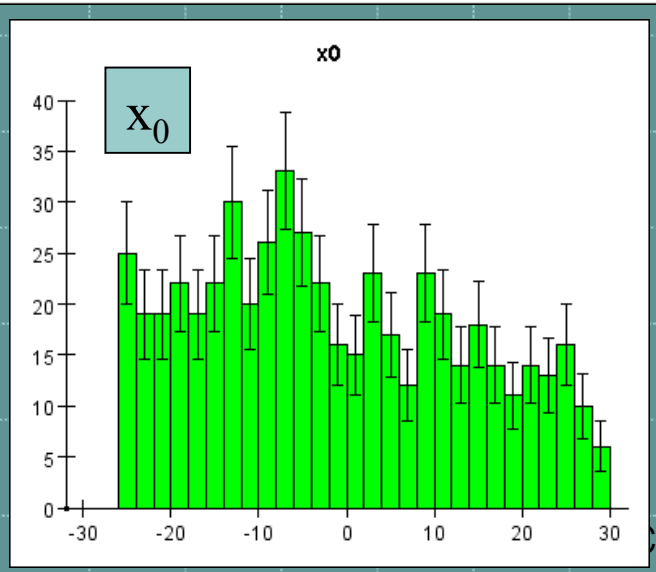

Pulse Data Display for Reado...
Pad # 54
Pulse Data Display for Reado...
Pad # 55
Pulse Data Display for Reado...
Pad # 56
Pulse Data Display for Reado...
Pad # 57
Event Display for Readout Pads
Pad # 127 (441438 electrons) in group # 127 (441438 electrons)
Options
Draw Event
demultiplex data
use log scale
show seed track
show Track Fit
show pulse data
Color scale
700456
350228
0
Fitter Control for Readout Pads
XY Fitter
Set up XY fitter
# of rows: 3
Parameter Value fixed
x0 (mm) 13.75222
phi (rad) -0.05582
sigma (mm) 1.26317
gain 3.0E3
noise prob 1.0E-2
Calculate Likelihood
-Log(Likelihood) 656.78255
Do XY track fit
2
status: success
Parameter Estimated Error correlations
x0 (mm) 0.07894 0.50103 -8.84149E-3
phi (rad) 3.13955E-3 -0.07444
sigma (mm) 0.05516
Pulse Data Display for Reado...
Pad # 127
Pulse Data Display for Reado...
Pad # 180
Pulse Data Display for Reado...
Pad # 181
Pulse Data Display for Reado...
Pad # 182
Pulse Data Display for Reado...
Pad # 183
Adobe Acrobat 5.0
Hummingbird Connectiv...
NetBeans IDE 3.4.1
Netscape 7
Sun ONE Studio 4 C...
TSM Backup Client
TSM Online Information
start
Inbox - Microsoft Out...
5 Reminders
amsterdam03
NetBeans IDE 3.4.1 -...
13 java
11:13 AM

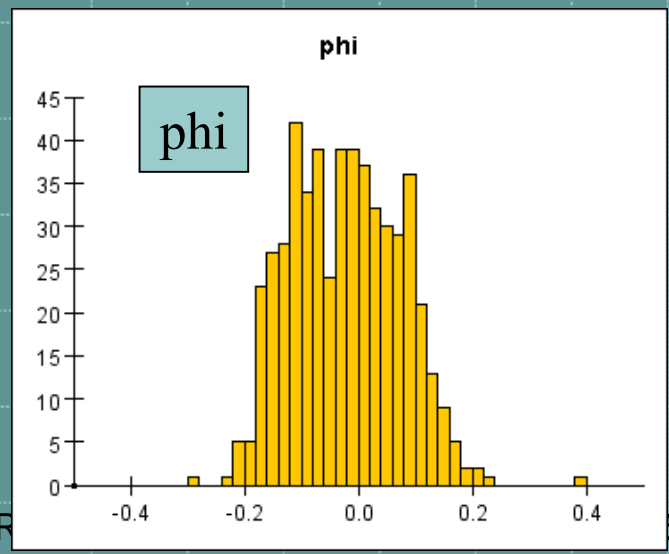
Some distributions…



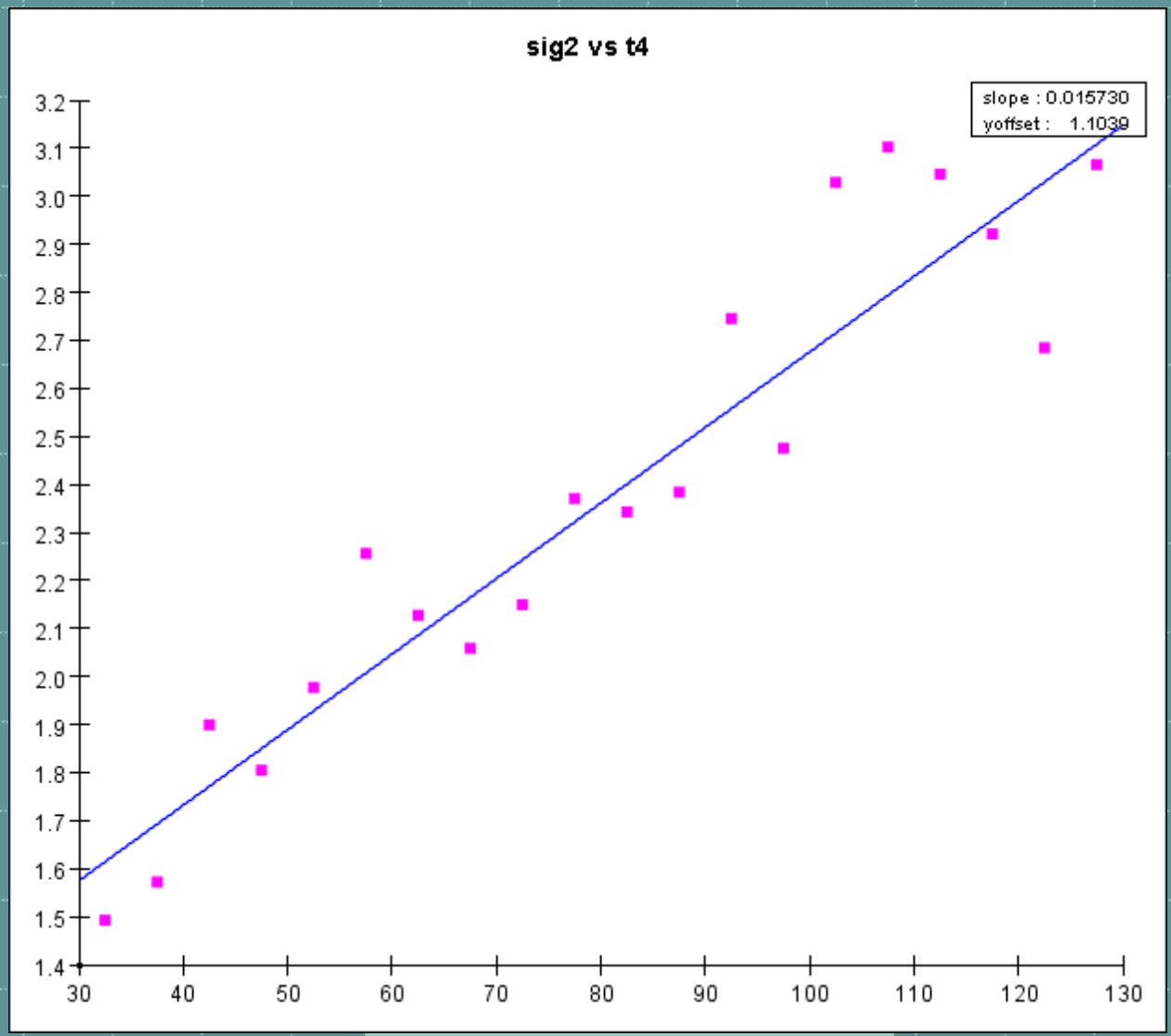


Track Fit Results:





Transverse diffusion



<sigma>^{2} (mm^2)

time bin (50 ns bins)

Plans

- Need remaining STAR FEE cards to read out all 256 channels
  - modify the simple sq_irq DAQ system (speed)
  - will adopt MIDAS integration when available
- Collect large cosmic sample without magnetic field to optimize running conditions
  - perform resolution studies with existing analysis code
- Operate in 1 Tesla field at TRIUMF (May-June?)
- Operate in 5 Tesla field at DESY (later…)