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
Example: for Ar CO₂ (90:10)

\[ d < 2 \text{ cm} \]
\[ |\phi| < 0.1 \text{ rad} \]

\[ \text{pad width: 2 mm} \]
\[ \langle \sigma \rangle = 0.5 \text{ mm} \]
\[ w/\langle \sigma \rangle = 4 \]

\[ \text{resolution: 140 } \mu\text{m} \]
Resolution vs. Drift Distance

Ar CO₂

|φ| < 0.1

3 mm x 5 mm pads

2 mm x 6 mm pads

Naïve optimum:
- all primaries collected
- upper: $\sigma_0$ before amp.
- lower: $\sigma_0$ 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
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
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

pulse height

pulse time
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
Some distributions...

Amplitude

Time

Track Fit Results:

$X_0$

$\phi$

April 2003
Transverse diffusion

\[
\langle \sigma^2 \rangle_t \quad \text{time bin (50 ns bins)}
\]
**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…)

April 2003
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