DRIFT Readout
R&D at MIT

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1. goals
2. plans
3. status
Goals for Readout
(from discussions with Oxy and UNM)

**physics**
- lower recoil energy threshold
- improve energy resolution (head/tail)
- address radon backgrounds

**technical**
- characterize electronics noise
- understand if/how ringers relate to electronics
- study electronics impact on pulse shape
energy measurement

threshold and resolution depend on signal–to–noise
  - is the noise consistent with the wire and preamp C?
  - multiplexing wires sums electronics noise: \( \frac{512}{8} = 64 \)

DRIFT can see 300 NIP events, but triggers at \( \sim 1000 \) NIPS
  - trigger level set by rate vs. threshold (\( \sim 10 \) Hz max)
  - therefore, reduce noise triggers and get rid of ringers
  - there is a gain to be made here!
Comments on Goals (2)

radon background

Rn222 to Po210 gives 3 ~5–7 MeV alphas originating from the same vertex in 3.8 days, 3min., and 47 min.
Comments on Goals (2)

radon background

Rn222 to Po210 gives 3 ~5–7 MeV alphas originating from the same vertex in 3.8 days, 3min., and 47 min.
- could veto with lookback if event vertices were known, with no deadtime
- without lookback, could veto a small area of the detector if event vertices known precisely, with deadtime

pre-ionization gammas are used to cut alphas
- longer trigger window before event would catch more gammas and increase the effectiveness of this cut
- triggering on the gammas “
- what are these?
Comments on Goals (3)

- **pulse shape**

  A number of physics effects scale with z:
  - drift time
  - lateral and longitudinal diffusion
  - ion tail

  Pulse shape analysis may be able to extract a measure of z:
  - e.g. SNO is working on PID with PSA
  - much harder after the signal goes through a shaper
R&D Plans

1. work with BU Electronics Shop (Eric Hazen, Bill Earle) to make prototype DRIFT readout electronics
   - sufficient gain for 300 NIP events
   - low noise, low power
   - comparable cost/channel to existing DRIFT electronics
   - no shaper

2. measure signal:noise vs. number of grouped wires
   - compare single-wire vs. multiplexed readout
   - compare measured noise with calculated noise
   - do these for CREMAT and BU prototype
Status

have well-understood single-wire proportional counter setup + electronics with Am alpha and 55Fe sources
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–Asher Kaboth (MIT grad. student) measuring gas gains

\[
\ln\left(\frac{\text{Gain}}{\text{Voltage}}\right) \times \ln\left(\frac{b}{a} \times p\right) vs \ln(\text{Voltage})
\]

\[
\chi^2 / \text{ndf } 10.29 / 7
\]

\[
\text{Prob} \quad 0.1728
\]

\[
p_0 \quad -0.2528 \pm 0.007208
\]

\[
p_1 \quad 0.0006026 \pm 0.02364
\]

\[
\ln(\text{Gain})/\text{Voltage} vs \ln(\text{Voltage})
\]

\[
\chi^2 / \text{ndf } 4.107 / 7
\]

\[
\text{Prob} \quad 0.7674
\]

\[
p_0 \quad 0.01056 \pm -0.4069
\]

\[
p_1 \quad 0.000804 \pm 0.03313
\]

\[
\ln(\text{Gain})/\text{Voltage} vs \ln(\text{Voltage})
\]

\[
\text{CF}_4, \ 250 \text{ mbar}
\]

\[
\text{ArCO}_2, \ 900 \text{ mbar}
\]
Status

have well-understood single-wire proportional counter setup + electronics with Am alpha and 55Fe sources
– Asher Kaboth (MIT grad. student) measuring gas gains
– Alastair Currie (Cambridge exchange student) measuring signal:noise with CREMAT preamp
Status

have electronics design for 16–channel prototype (Eric Hazen)
  - fabrication in progress
  - have vacuum chamber, outfitting in progress
  - working on gas system upgrade to handle CS2

have wire planes, 2.5 mm pitch, 50 and 30 um wire diameters
  - electric field cage and wire frame mechanical designs complete
  - frame electrical design in progress to use with 16–channel prototype (Hazen)
Outlook

Measurements of the CREMAT preamp performance with the single-wire chamber are underway.

The new vacuum chamber + wire frame for the 16-channel prototype will be on line by late April / early May.

The goal is to have the 16-channel electronics prototype with readout going in the MIT lab in May, with CF4 gas.

Unknown time scale for working with CS2.