Weekly Meeting

September 13 2017

DMC – MidasIO

- Pushed a version the new code to feature/midaio branch
- I haven’t gotten my questions answered by Jorge yet – but it shouldn’t affect the ability for the code to run properly (it follows closely what root writer does)
- cdms_iolibrary also packages and unpackages “DMCblock” for DMC specific information.
- It seems to work okay, but need to wait for midasio part to come in.

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?

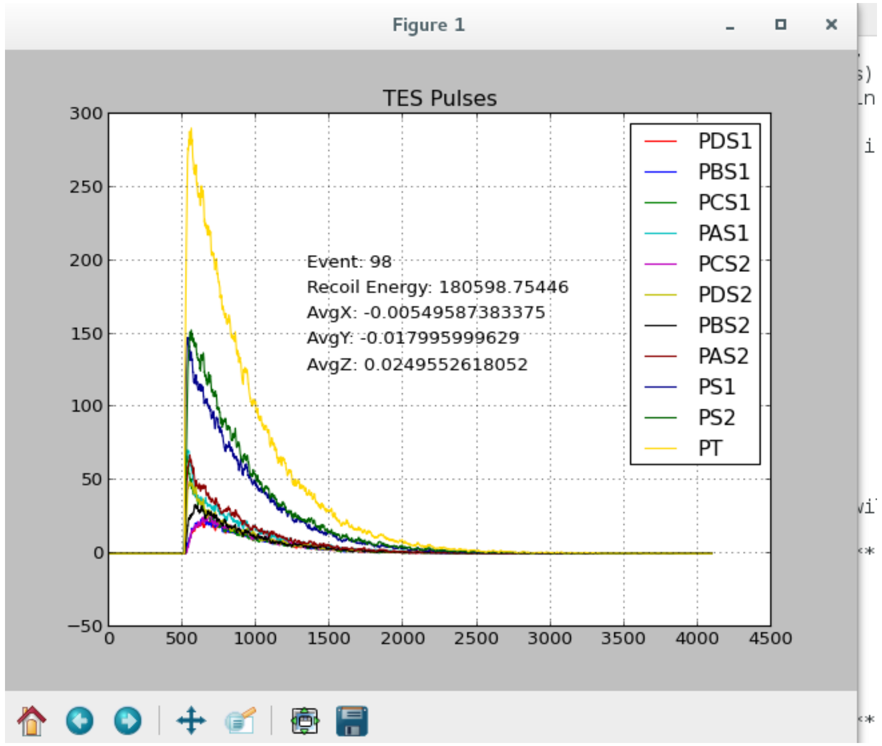
DMC – MidasIO

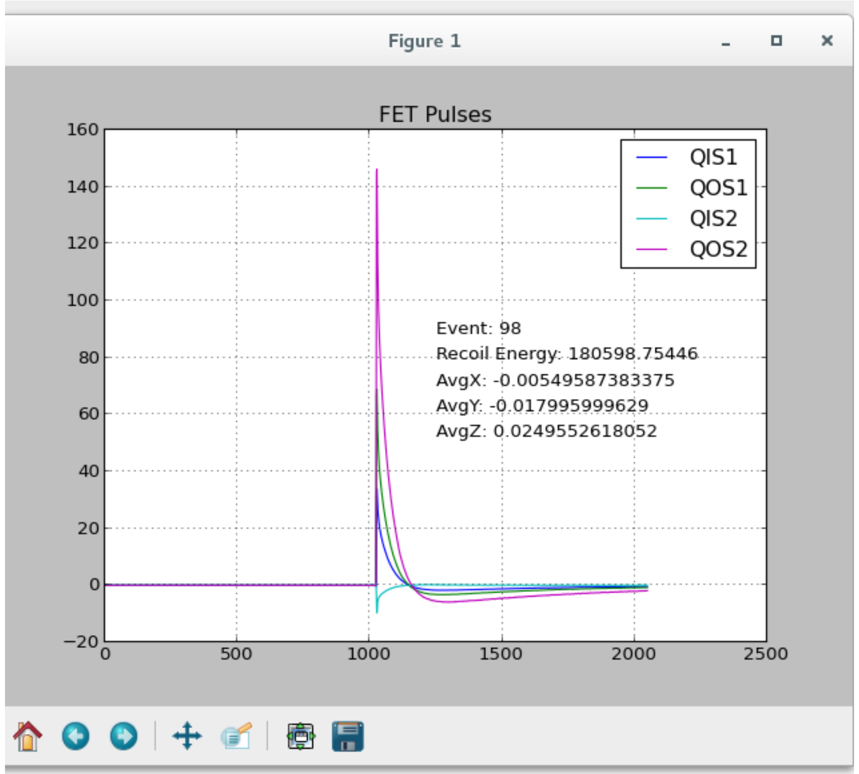
<table>
<tr><td colspan="35">Author and Contact: Matt Wilson, UofT</td></tr>
<tr><td colspan="35">DMC DATA FORMAT DRAFT V1: Created August 18 '17. Last updated: August 18 '17</td></tr>
<tr><td colspan="3">bits</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="3"></td><td colspan="4">0x1</td><td colspan="16">format version</td><td colspan="12">total n events</td></tr>
<tr><td rowspan="19">x N events</td><td colspan="2" rowspan="11"></td><td colspan="4">0x2</td><td colspan="28">SIM series number</td></tr>
<tr><td colspan="32">SIM event ID</td></tr>
<tr><td colspan="32">SIM recoil energy high</td></tr>
<tr><td colspan="32">SIM recoil energy low</td></tr>
<tr><td colspan="32">SIM avg x high</td></tr>
<tr><td colspan="32">SIM avg x low</td></tr>
<tr><td colspan="32">SIM avg y high</td></tr>
<tr><td colspan="32">SIM avg y low</td></tr>
<tr><td colspan="32">SIM avg z high</td></tr>
<tr><td colspan="32">SIM avg z low</td></tr>
<tr><td colspan="4">0x3</td><td colspan="28">n detectors in event</td></tr>
<tr><td rowspan="8"></td><td rowspan="6"></td><td colspan="32">TotalTES - high</td></tr>
<tr><td colspan="32">TotalTES - low</td></tr>
<tr><td colspan="32">TotalFET - high</td></tr>
<tr><td colspan="32">TotalFET - low</td></tr>
<tr><td colspan="32">detector name (e.g. T1Z2)</td></tr>
<tr><td colspan="4">0x4</td><td colspan="28">n channels in detector</td></tr>
<tr><td rowspan="2">x N ch</td><td colspan="16">channel type</td><td colspan="16">channel num</td></tr>
<tr><td colspan="32">channel name (e.g. PAS1)</td></tr>
<tr><td colspan="3"></td><td colspan="4">0x5</td><td colspan="28">end</td></tr>
</table>

DMC – MidasIO

- I want to do a qualitative comparison between pulses from random events from DMCPreBats memory and after it does through CDMS IO/MIDAS IO
    - After packaging, unpackage data and look at pulses.
- Quantitative comparison will be hard, given that I force all the pulses data to be unsigned int variables, which will change how data looks.

DMC – MidasIO





These are from DMCPreBats memory – the pulses should look (qualitatively) the same after going through IO Libs

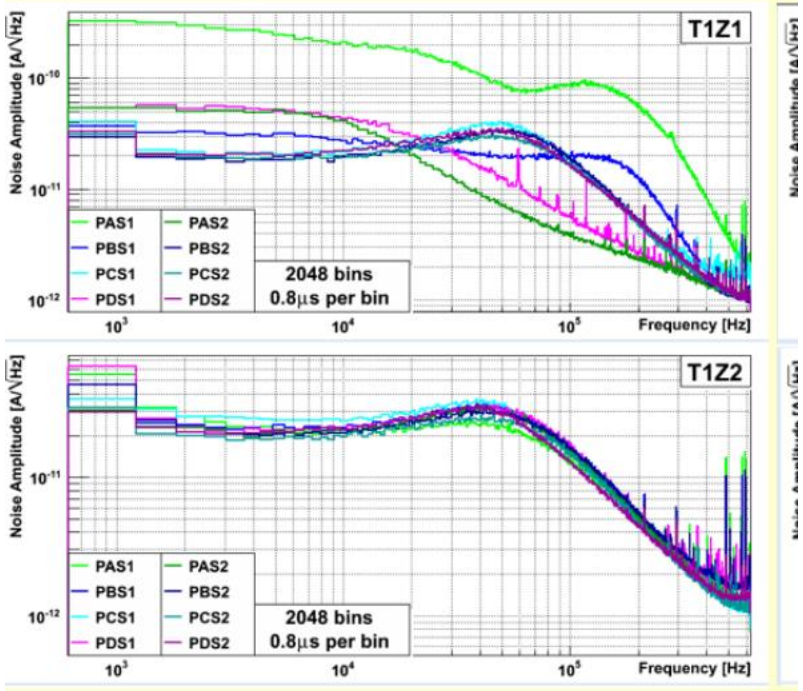
DMC – MidasIO

- Data doesn't seem to be read out properly – need to find out why.
- Unpackaged data has the right number of channels, but there is a problem with how the data is accessed.
- I determine between FET and TES pulses by looking at event.detectors[0].channels[i].channelType
    - I think the problem lies within this variable for some reason.

DQM - Plots made for Soudan

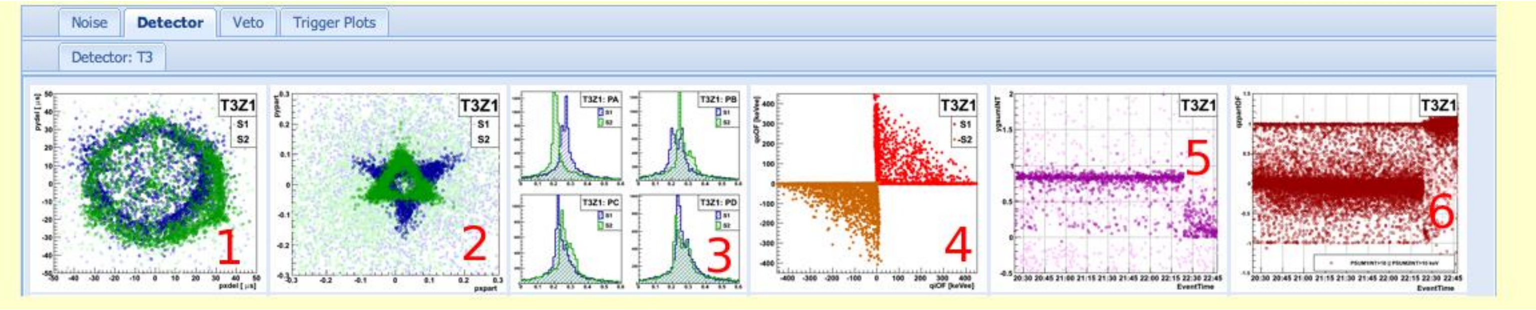
- Level 1: Noise – record random noise triggers, look at noise spectra for phonon and charge channels.

Figure 1. Phonon noise.



DQM - Plots made for Soudan

- Level 1: Detector plots
  - Delay plots: phonon X delay versus phonon Y delay. Phonon signal should reach the nearest phonon sensor before the farthest one
  - Partition plot: describes energy fractions – more of the energy should be deposited on to the closer sensors
  - Phonon Channel raw pulse heights
  - Charge channel amplitude outer versus inner electrode on both detectors sides: check whether the charge channels are working or not
  - Yield and charge Z partition versus time: monitor stability of variables – look for degradation of variables (detector not working properly)



DQM - Plots made for Soudan

- Level 1: VETO: monitors the largest adc value found in the entire veto trace

Figure 7. Veto amplitude (panel 11) for **low background** run.

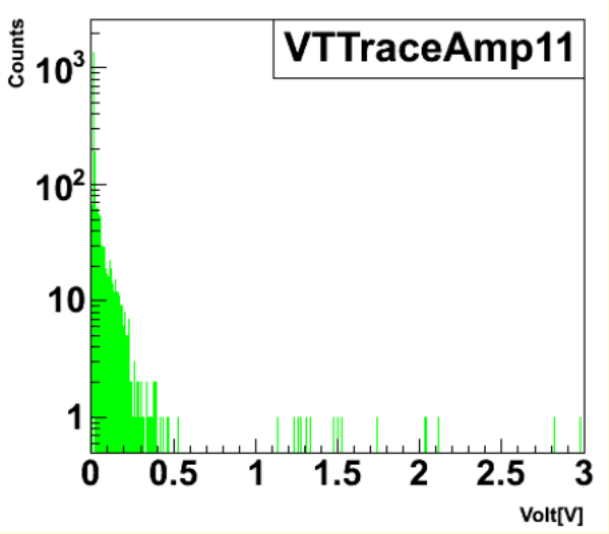
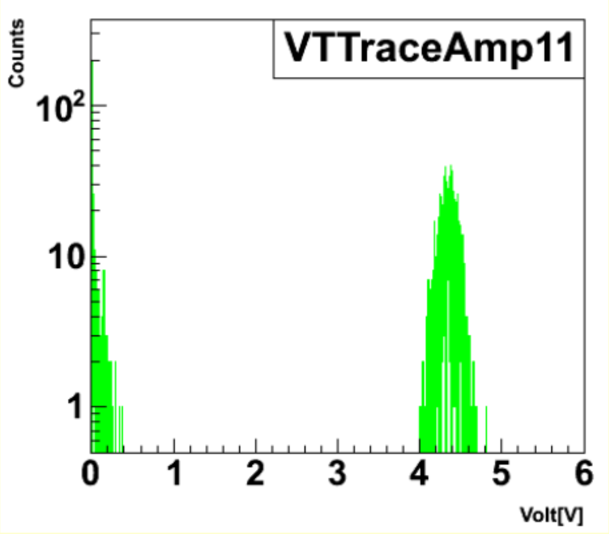


Figure 8. Veto amplitude (panel 11) for **pulser** run.



DQM - Plots made for Soudan

- Level 1: Trigger: number of triggers in each detector, total trigger rate

Figure 9. Number of trigger - **BAD**

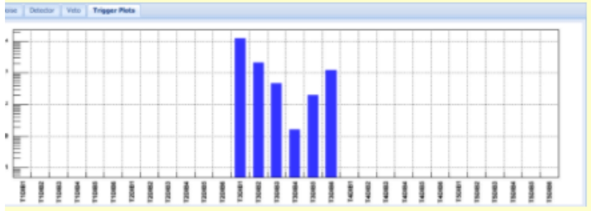


Figure 10. Number of trigger - **GOOD**

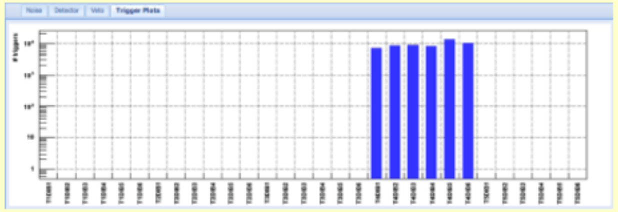


Figure 11. Ba calibration run - trigger rate 50Hz

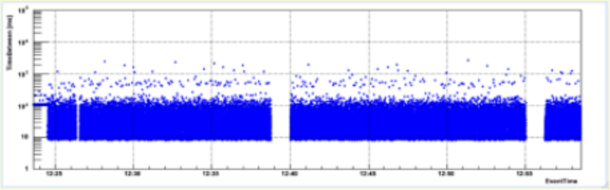
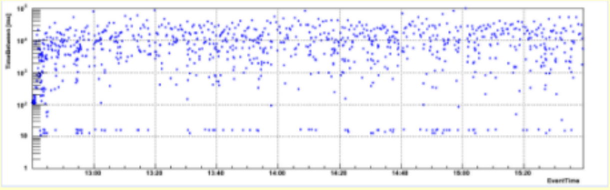
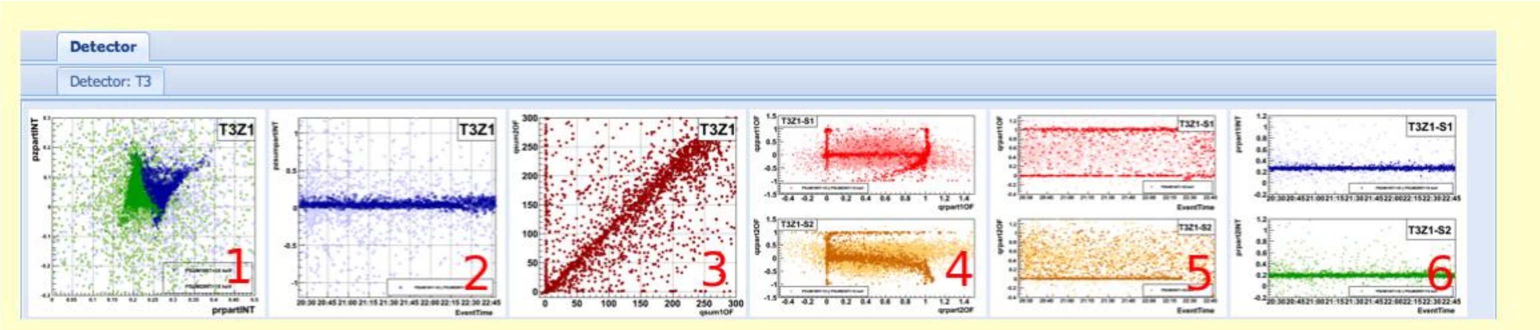


Figure 12. Low Background run - trigger ra



DQM - Plots made for Soudan

- Level 2 Plots:
  - Phonon partition plot (phonon Z versus R partition for both sides of detector) – describes energy fractions amongst channels
  - Phonon Z partition versus time - Monitors stability and changes of variable. Degradation means detector is not working properly
  - Sum of charge energy on outer versus inner electrodes – from thickness of 45 degree population can roughly estimate charge reolution
  - Charge R versus Z partition – same as phonon but for charge channels
  - Charge R partition versus time
  - Phonon R partition versus time



Photoelectric cross sections in G4

- G4 lists two processes involving photoelectric effect:
  - G4PolarizedPhotoElectricEffect
  - G4PhotoElectricEffect
- Found equations they use to calculate cross section of photoelectric cross sections:

$$\sigma(Z,E_\gamma) = \frac{a(Z,E_\gamma)}{E_\gamma} + \frac{b(Z,E_\gamma)}{E_\gamma^2} + \frac{c(Z,E_\gamma)}{E_\gamma^3} + \frac{d(Z,E_\gamma)}{E_\gamma^4} \quad (($$

ing the least-squares method, a separate fit of each of the coefficients a, b, c, d to the experimental data was performed in several energy intervals [2]. As a rule, the boundaries of these ervals were equal to the corresponding photoabsorption edges.

a given material the mean free path, λ, for a photon to interact via the photoelectric effect is given by :

$$\lambda(E_\gamma) = \left(\sum_i n_{ati} \cdot \sigma(Z_i, E_\gamma)\right)^{-1} \quad (($$

Photoelectric cross sections in G4

SUMMARY OF THE EXPERIMENTAL TOTAL CROSS SECTION DATA USED IN THE VALIDATION ANALYSIS

Atomic Number	Element	Energy range (keV)	Sample size	References
1	H	0.0136 - 0.020	27	[102]–[104]
2	He	0.025 - 0.277	320	[105]–[112]
3	Li	0.046 - 0.400	93	[113]–[116]
7	N	0.015 - 0.4	73	[117], [118]
8	O	0.013 - 0.28	215	[103], [119]–[121]
10	Ne	0.022 - 2.952	448	[108], [110]–[112], [117], [122]
11	Na	0.046 - 0.246	17	[123]
13	Al	145.4	1	[124]
17	Cl	0.016 - 0.078	25	[125]
18	Ar	0.016 - 6	487	[105], [110]–[112], [117], [126]–[130]
19	K	0.004 - 0.005	12	[131]
22	Ti	59.54	1	[132]
23	V	59.54	1	[132]
24	Cr	59.54	1	[132]
25	Mn	59.54	1	[132]
26	Fe	0.008 - 59.54	25	[132]–[134]
27	Co	59.54	1	[132]
28	Ni	1.487 - 59.54	17	[132], [133]
29	Cu	59.54 - 661.6	9	[124], [132], [135]–[138]
30	Zn	59.54	1	[132]
33	As	59.54	1	[132]
34	Se	59.54	1	[132]
36	Kr	0.015 - 1.626	357	[105], [110], [112], [139], [140]
37	Rb	0.004 - 0.010	4	[141]
38	Sr	59.54	1	[132]
39	Y	279.2 - 661.6	2	[142]
40	Zr	59.54 - 661.6	7	[124], [135]–[137], [143]
41	Nb	59.54	2	[143]
42	Mo	59.54 - 661.6	7	[132], [138], [143]
43	Tc	59.54	1	[143]
44	Ru	59.54	1	[143]
45	Rh	59.54	1	[143]
46	Pd	59.54	1	[143]
47	Ag	1.487 - 661.6	13	[124], [?], [135]–[137], [143]–[146]
48	Cd	59.54	2	[132], [143]
49	In	59.54	2	[143]
50	Sn	1 - 661.6	31	[124], [133], [135]–[137], [143], [144], [146]
51	Sb	59.54	1	[143]
52	Te	59.54	2	[143]
54	Xe	0.013 - 6	657	[110], [122], [128], [130], [147]
55	Cs	0.004 - 59.54	14	[132], [141], [148]
57	La	59.54	1	[149]
58	Ce	59.54 - 661.6	6	[142], [149]–[152]
59	Pr	59.54 - 661.6	3	[150], [152]

No Si, no Ge, need to keep digging