Deadtime Analysis Progress

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Trigger Setup

Left High Resolution Spectrometer (LHRS)

\( S_2 \& \& \text{CER} \)

Master OR Live (scaler/counter)

ARS Valid

Deadtime Computations

• Looking at scaler rates: live and raw

\[
\text{Raw rate} = \text{Live rate} \cdot \frac{1}{1 - \text{Deadtime}}
\]

• Livetime and deadtime:

\[
\text{Livetime} = \frac{\text{Live Scaler Rate}}{\text{Raw Scaler Rate}}
\]

\[
\text{Deadtime} = 1 - \text{Livetime}
\]
Run#: 13418 (2016)

- Example of a scaler histogram:

- Run 13418 was taken at 3 different currents, 10, 15, 20 μA
- Took mean of each histogram to get live/raw rates
Live and Scaler rates

• Livetime Computations:

<table>
<thead>
<tr>
<th>I (uA)</th>
<th>S2M LT</th>
<th>So LT</th>
<th>S2M&amp;Cer LT</th>
<th>Master OR LT</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.61</td>
<td>0.985</td>
<td>0.984</td>
<td>0.983</td>
<td>0.983</td>
</tr>
<tr>
<td>15.32</td>
<td>0.976</td>
<td>0.975</td>
<td>0.973</td>
<td>0.972</td>
</tr>
<tr>
<td>20.53</td>
<td>0.965</td>
<td>0.963</td>
<td>0.963</td>
<td>0.963</td>
</tr>
</tbody>
</table>

• Observations: Increasing deadtime with increasing current.

• Found current normalized raw rates..and current dependence is present in S2m&CER, Master OR.

<table>
<thead>
<tr>
<th>I(uA)</th>
<th>S2m raw norm (Hz/uA)</th>
<th>So norm raw (Hz/uA)</th>
<th>s2m&amp;Cer raw norm (Hz/uA)</th>
<th>Master OR raw norm (Hz/uA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>212 Hz</td>
<td>101.8 Hz</td>
<td>13.9 Hz</td>
<td>23.4 Hz</td>
</tr>
<tr>
<td>10.61</td>
<td>592</td>
<td>186</td>
<td>11.6</td>
<td>11.5</td>
</tr>
<tr>
<td>15.32</td>
<td>591</td>
<td>187</td>
<td>12.1</td>
<td>12.4</td>
</tr>
<tr>
<td>20.53</td>
<td>591</td>
<td>186</td>
<td>12.6</td>
<td>12.9</td>
</tr>
</tbody>
</table>

• First row is pedestal rate which is not normalized, and every other rate is pedestal subtracted.
Current normalized rates still current dependent, so looking at full CODA events now.

<table>
<thead>
<tr>
<th>I (uA)</th>
<th>S2M &amp;Cer LT</th>
<th>CODA event rate: no cuts(Hz/uA)</th>
<th>Master OR Raw norm (Hz/uA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.997</td>
<td>16.26 Hz</td>
<td>23.4 Hz</td>
</tr>
<tr>
<td>10.61</td>
<td>0.985</td>
<td>9.27</td>
<td>11.5</td>
</tr>
<tr>
<td>15.32</td>
<td>0.976</td>
<td>10.26</td>
<td>12.4</td>
</tr>
<tr>
<td>20.53</td>
<td>0.965</td>
<td>11.26</td>
<td>12.9</td>
</tr>
</tbody>
</table>

An explanation for this may be the randomly-counting scalers.
Randomly-counting scalers

- Example of a scan of a scaler, “S2M&&Cer live” randomly counting from run 13418.
- Need to look at more live scalers to see if problem persists.
Checking Live Scalers: well behaved scaler

- Checking how much live scalers change from one CODA event to the next

Histogram showing the behavior of scaler “cpt_Clock_scaled” by binning the number of entries as a function of the scaler increments.

- One of the well behaved scalers, most likely due to the prescaling.
Checking Live Scalers: random scalers

- Histogram showing the behavior of scaler “cptS2M_CER_Scaled_Live” by binning the number of entries as a function of the scaler increments.
- One of the many random counting scalers.
## Normalized DVCS and DIS rates

### Normalized Rates (Hz/uA)

<table>
<thead>
<tr>
<th>(uA)</th>
<th>S2M &amp; Cer LT</th>
<th>No cuts</th>
<th>Trk</th>
<th>Trk &amp; TDC &amp; Cer</th>
<th>Trk &amp; TDC &amp; Cer &amp; DIS</th>
<th>DIS</th>
<th>S2M &amp; CER LT</th>
<th>Trk &amp; TDC &amp; Cer &amp; DVCS</th>
<th>S/S2M &amp; CER LT</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.61</td>
<td>0.985</td>
<td>9.27</td>
<td>5.783</td>
<td>5.719</td>
<td>5.138</td>
<td>3.365</td>
<td>3.422</td>
<td>5.134</td>
<td>5.212</td>
</tr>
<tr>
<td>15.32</td>
<td>0.976</td>
<td>10.26</td>
<td>6.192</td>
<td>6.117</td>
<td>5.484</td>
<td>3.356</td>
<td>3.450</td>
<td>5.480</td>
<td>5.615</td>
</tr>
</tbody>
</table>

- Rates given in Hz/uA, with the following cuts:
  - Trk: tracking cut, given by “L.tr.n” >0
  - TDC: Time-to-Digital Converter, given by tdc_val[27]-tdc_val[7]/10<=-24
  - CER: Cerenkov cut, given by “L.cer >500”
  - DIS: given by “triggerPatternWord&0x00080”
  - DVCS: given by “triggerPatternWord&0x00100”

Current dependence goes away..

..but for DVCS it does not.

Possible solution: look into random coincidences between the calorimeter and spectrometer.