Neutron Analysis for DIIa

MAKE TRACKS:

All hits that overlap in time and pass the following cuts are collected into the same track

• anode line threshold < -25 ADC
• veto threshold < 45 ADC
• FWHM > 25 micro-sec
• time of maximum > time of minimum

In addition to these hits, the wires on the edge of the track are analyzed for ionization that was too small to trigger as a hit. If either edge wire contains more than 75 NIPs, it is included in the track.

If all of the hits fall on adjacent wires, the following parameters are then defined for each track:

• anode charge - sum of all hits and edge wires
• sum sum - sum of anode sum line, between the two time that the waveform crosses the pedestal
• grid charge - sum of all grid lines, between the two times that the waveform crosses the pedestal
• track start - time at which anode sum line falls below the pedestal
• track end - time at which anode sum line crosses above the pedestal
• track length - difference between end and start of track
• nwires - number of anode wires counted in track, including hit and edge wires

• \( \Delta X (\text{cm}) = (0.2 \times \text{nwires}) - 0.1 \)
• \( \Delta Z (\text{cm}) = \text{length} \times 0.0057 \)
• \( R^2 = (X^2 + Z^2)^{1/2} \)
ANALYZE TRACKS: after tracks are found and characterized, they are subjected to the following cuts:

- zero NIPs cut: a track with anode charge=0 is cut
- start time < 0 AND end time > 0: track must cross the trigger time

**NEUTRON RUN**

**BACKGROUND RUN**

![Anode charge (NIPs) after zero-NIPs and trig-time cuts](chart1)

![R2 vs. Anode NIPs after zero-NIPs and trig-time cuts](chart2)
I also see the following distributions of grid/anode NIPs, and sumsum/anode NIPs:

**Ratio of Grid to Anode charge (NIPs)**

<table>
<thead>
<tr>
<th>GridVsAnode Entries</th>
<th>Mean</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GridVsAnode Entries</td>
<td>7295</td>
<td>1.212</td>
</tr>
</tbody>
</table>

**Ratio of Sum to Anode NIPs**

<table>
<thead>
<tr>
<th>SumRatio Entries</th>
<th>Mean</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SumRatio Entries</td>
<td>7295</td>
<td>1.116</td>
</tr>
</tbody>
</table>

**Ratio of Grid to Anode charge (NIPs)**

<table>
<thead>
<tr>
<th>GridVsAnode Entries</th>
<th>Mean</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GridVsAnode Entries</td>
<td>19091</td>
<td>1.758</td>
</tr>
</tbody>
</table>

**Ratio of Sum to Anode NIPs**

<table>
<thead>
<tr>
<th>SumRatio Entries</th>
<th>Mean</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SumRatio Entries</td>
<td>19091</td>
<td>1.407</td>
</tr>
</tbody>
</table>
So I implement these cuts:

- grid/anode NIPs = 1+-0.2 : NIPs on grid and anode must agree
- anode/sumsum = 1+-0.2:  missing NIPs cut - charge on anode sum must agree with charge counted from wires individually

Neutrons: 45% remaining
Background: 5.7% remaining

Anode charge (NIPs) after charge ratio cuts

R2 vs. Anode NIPs after charge ratio cuts

R2B
The last cut is the 8 wire cut, which leaves the following:

Neutrons: 45% remaining

Background: 5.7%
So, if I cut on:

- $-60 < \text{preI} < 120$ NIPs  \hspace{1em} (3 sigma)
- $65 < \text{length} < 140$ microseconds

Neutrons: 41% remaining

Background: 2.9% remaining
Comments:

• R2 - my R2 is consistently higher than Dan’s for two reasons. I use a drift velocity of 57 m/s, while Dan used 45 m/s. I also include the “edge” wires of the track in my delta-x, while Dan does not.

• There are events below the hardware trigger threshold of ~1000 NIPs. I believe this is because I have implemented an “other-side” cut, so it’s possible that some non-triggering events are being included.

• Cuts that Dan has, that I don’t: rise-time cut, other-side cut.

• Cuts are certainly not finalized, but the neutron spectrum and R2-NIPs are starting to look reasonable.
COMBINED ANALYSIS

Using exactly the same cuts except the trigger time cut, and require a background event to appear at the end of an alpha track, gives the following events: