Shashlik module and PMT test

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Outline

1. PMT in THU#2 linearity test
2. THU powder paint test
3. SDU#3 test with higher voltage
4. Shashlik cosmic ray test in JLab
SDU PMT(67748) in THU#2 linearity test (20ns LED pulse)

HV: 1100V (5.997*10^6)

The Photon Number of Non-linearity

The charge of Non-linearity

χ² / ndf = 0.3234 / 3
Prob = 0.9556
p0 = -1.156 ± 0.2707
p1 = 3.101 ± 0.01264
$HV: 1000V \left(2.9 \times 10^6\right)$
HV: 900V(1.295*10^6)
The max current (calculated from amplitude)

900V

-20mA

1000V

24mA

1100V

26mA
Problems in linearity test:

- All HVs has the max charge 250pC (-5%), the max NPEs are only influenced by the gain
- For 1100V, 300 photon electrons would exceed linearity range, not corresponding to Chendi’s result
- The width of LED pulse will influence the linearity range

The problems will be check soon
THU powder paint reflectivity test

Receive three layers of powder paint from THU, test with similar test setup as previous five layers test (only 4 scintillator layers in test now).

Test setup
comparing with same setup that only powder paint layer replaced with Tyvek-lead-tyvek
Test Result

<table>
<thead>
<tr>
<th>Material</th>
<th>PMT</th>
<th>HV(V)</th>
<th>Gain*10^6</th>
<th>Charge</th>
<th>NPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>powder paint</td>
<td>67702</td>
<td>1100</td>
<td>5.40</td>
<td>40.1</td>
<td>46.3</td>
</tr>
<tr>
<td>tyvek</td>
<td>67749</td>
<td>1000</td>
<td>5.12</td>
<td>27.8</td>
<td>33.9</td>
</tr>
</tbody>
</table>

Assuming:
Power paint reflectivity = b
Tyvek reflectivity = a
We get:
\[
\frac{2a + 6b}{8a} = \frac{46.3}{33.9}
\]
So: \( \frac{b}{a} = 1.475 \)

Which improve much comparing with SDU modules.
## SDU#3 Higher HV test

<table>
<thead>
<tr>
<th>HV</th>
<th>Gain($10^6$)</th>
<th>Charge(pC)</th>
<th>NPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>1.35</td>
<td>106.1</td>
<td>491.2</td>
</tr>
<tr>
<td>950</td>
<td>2.01</td>
<td>155.4</td>
<td>483.2</td>
</tr>
<tr>
<td>1000</td>
<td>2.93</td>
<td>223.9</td>
<td>477.6</td>
</tr>
<tr>
<td>1100</td>
<td>5.4</td>
<td>427.3</td>
<td>494</td>
</tr>
<tr>
<td>1200</td>
<td>9.995</td>
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<td></td>
</tr>
</tbody>
</table>

**1100V**

- Data may have problem

**1200V**

- Data may have problem
Shashlik signal in JLab cosmic test

<table>
<thead>
<tr>
<th>Shashlik Module</th>
<th>HV(start from run 1140)</th>
<th>Gain($10^6$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>THU</td>
<td>1700</td>
<td>?</td>
</tr>
<tr>
<td>SDU#1</td>
<td>1453</td>
<td>5</td>
</tr>
<tr>
<td>SDU#2</td>
<td>1294</td>
<td>5</td>
</tr>
</tbody>
</table>

THU (low signal)

SDU#1

SDU#2