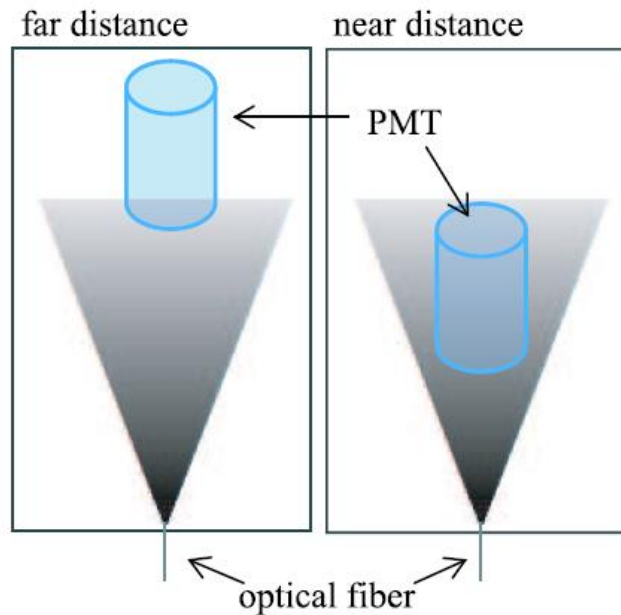


Linearity test method

- Linearity means the output signal of PMT should be linear to incident light

Bi-distance method

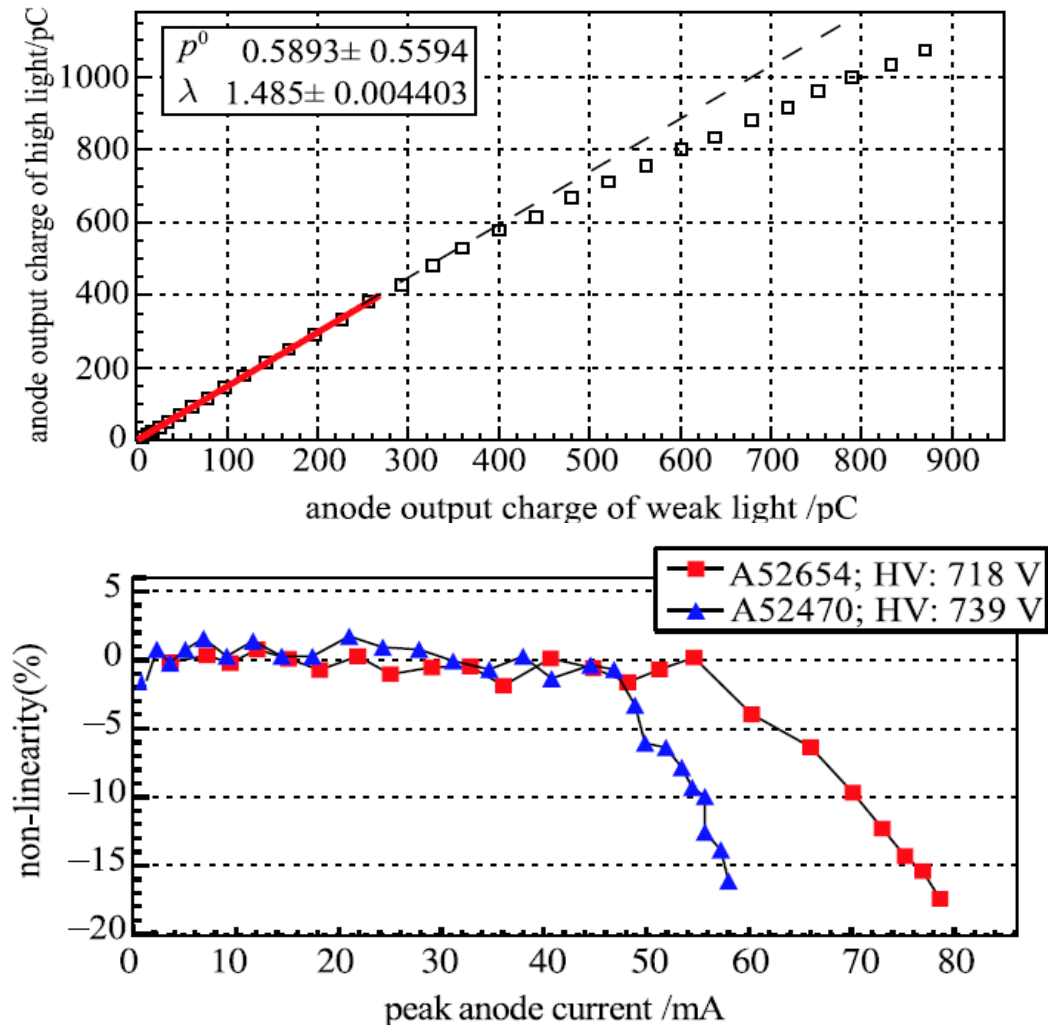


Linearity definition:

$$\text{non-linearity} = \left(\frac{S_{\text{near}}}{S_{\text{far}}} - \lambda \right) / \lambda$$

where S_{near} (S_{far}) is the output charge from the PMT anode, and λ is the slope fitted by first few points

Typical result



PMT in linearity test

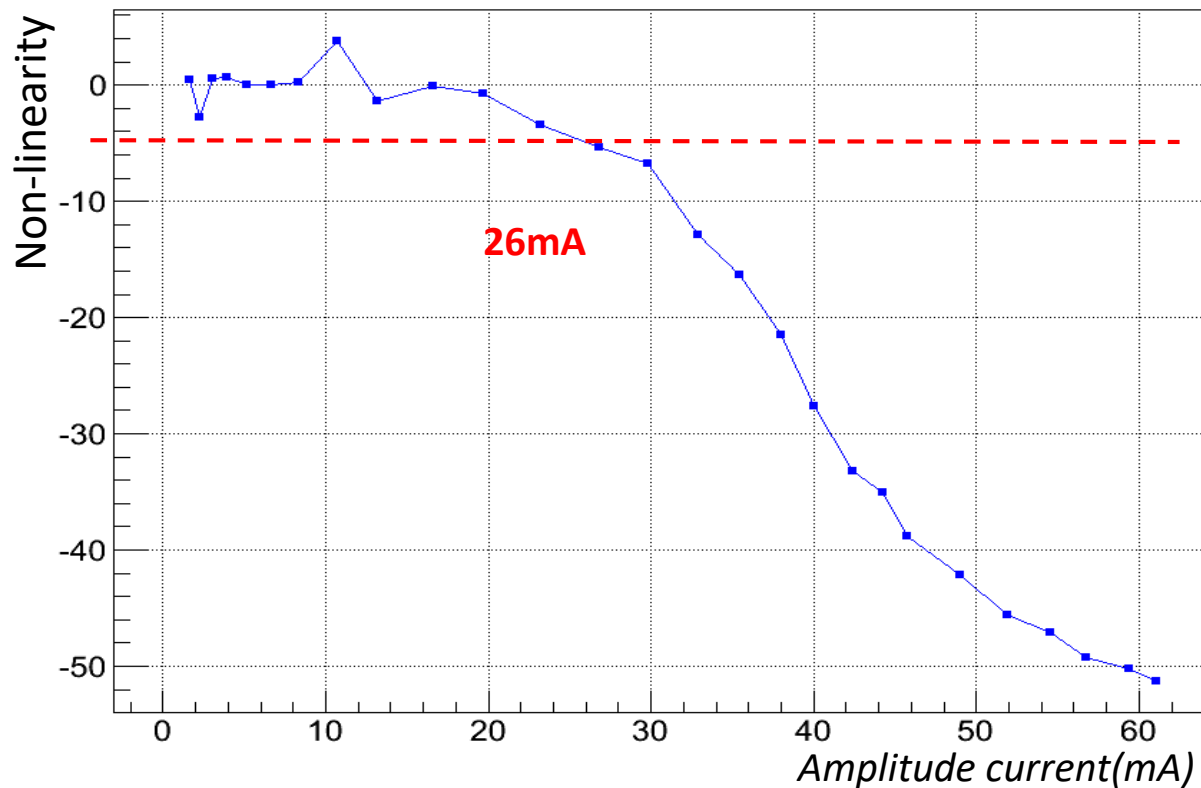
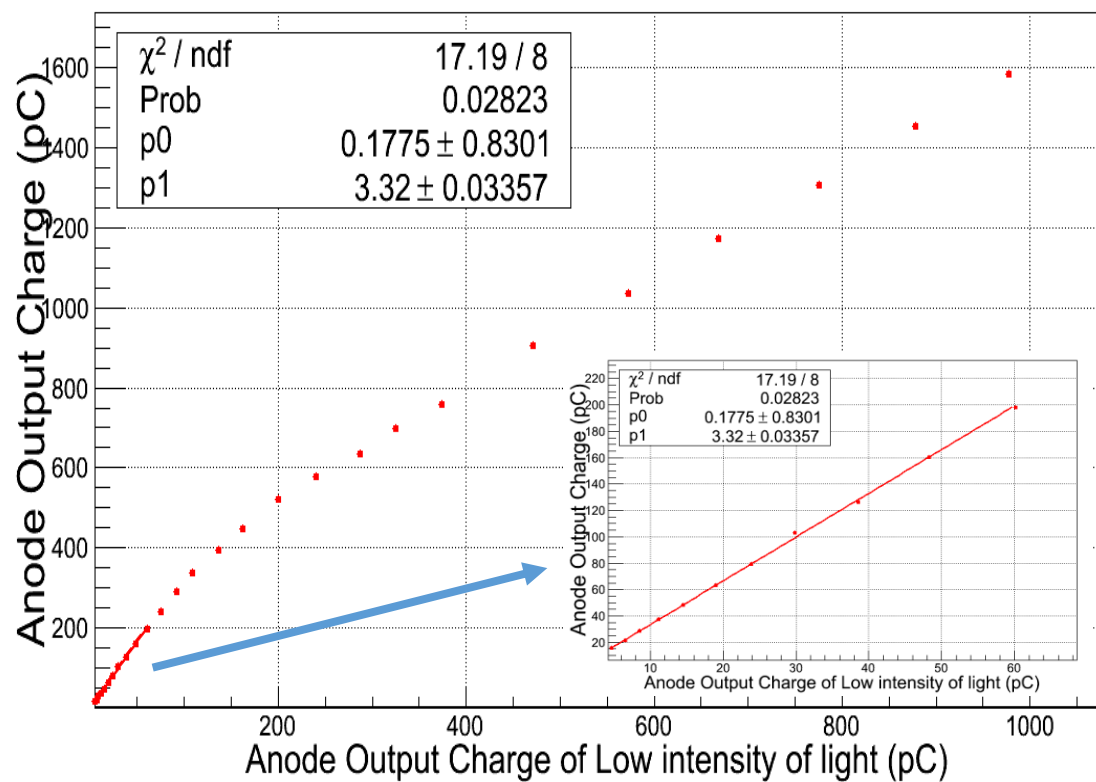
The PMT in test is 67749 (type CR284), and a non-linearity below 5% is considered as beyond the linear range.

HV	1000	1100	1200
Gain(10^6)	5.12	10.7	20.5

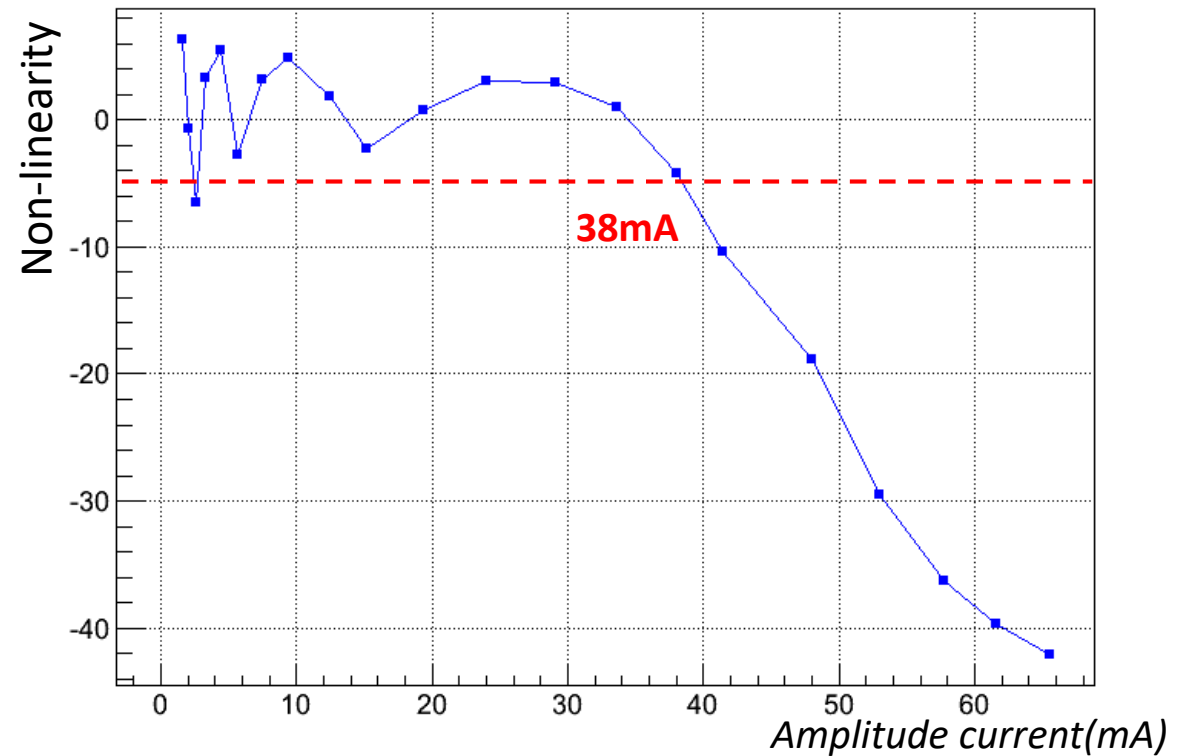
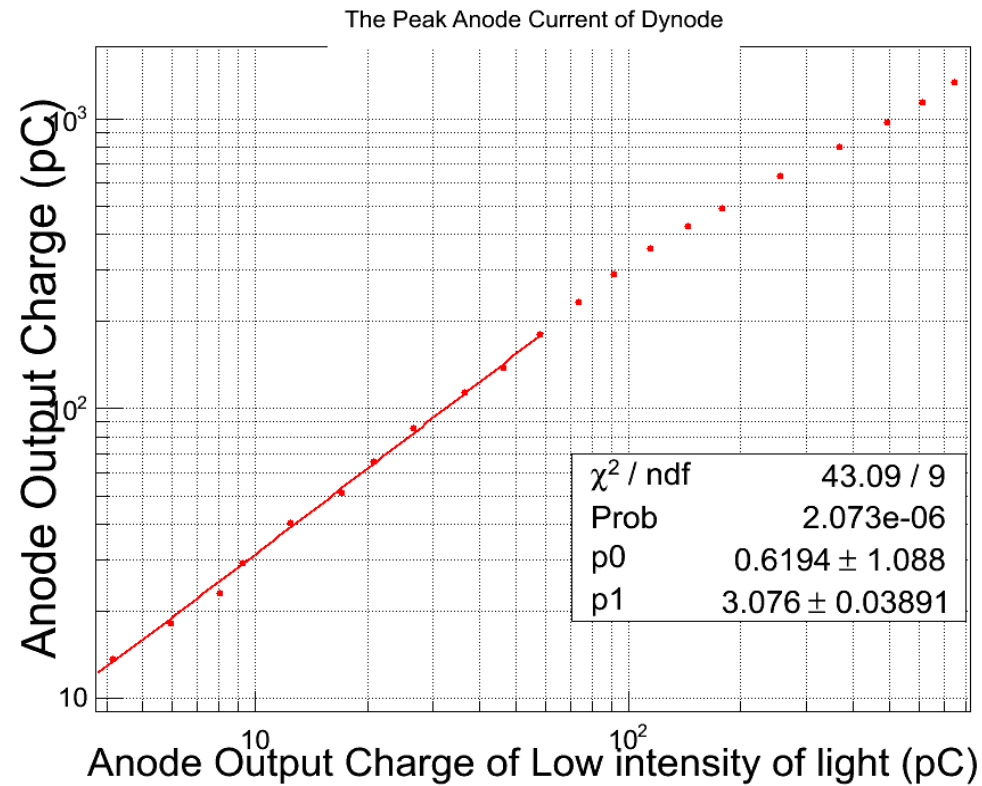
High voltage divider(average divider):

K: DY1: DY2: DY3: DY4: DY5: DY6: DY7: DY8: DY9: DY10: P=2:1:1:1:1:1:1:1:1:1:1:1

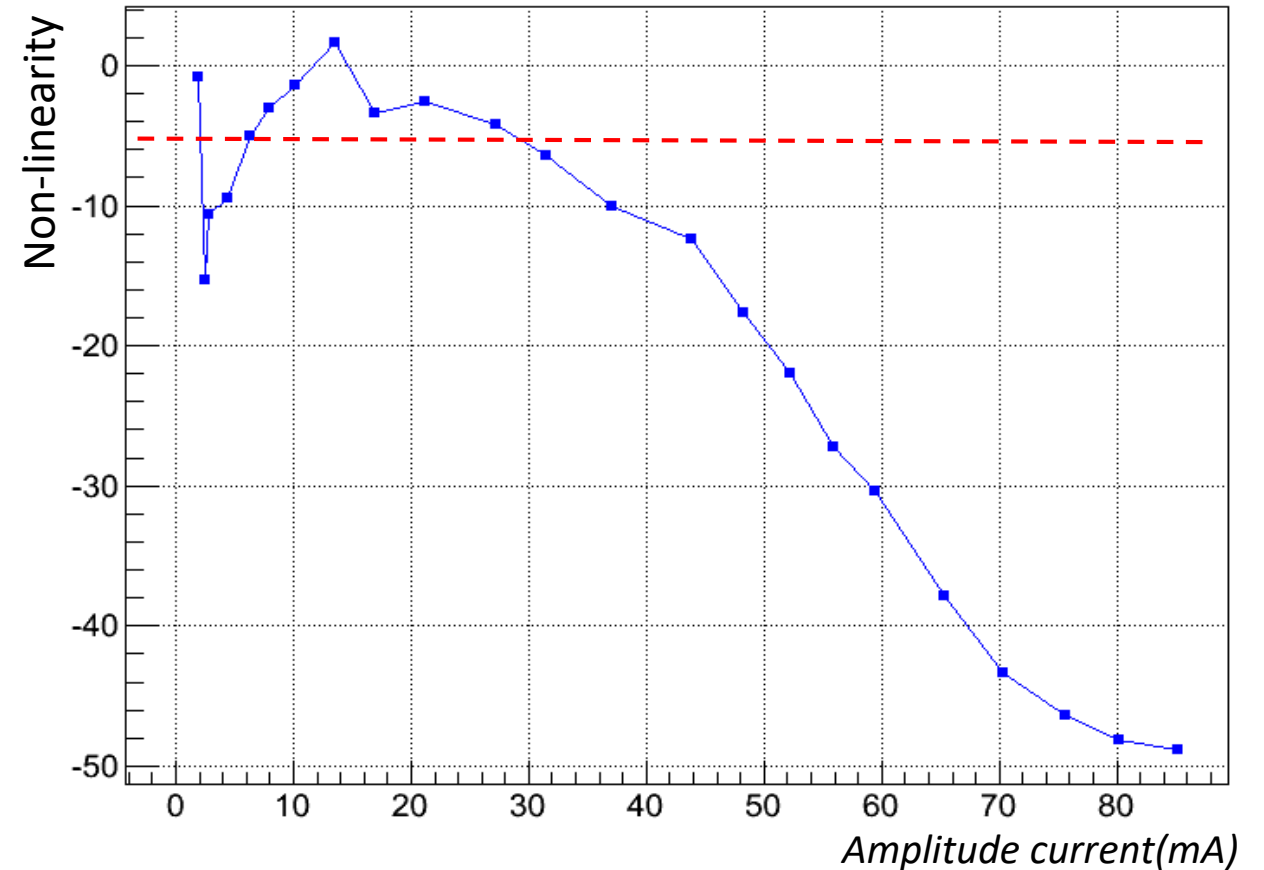
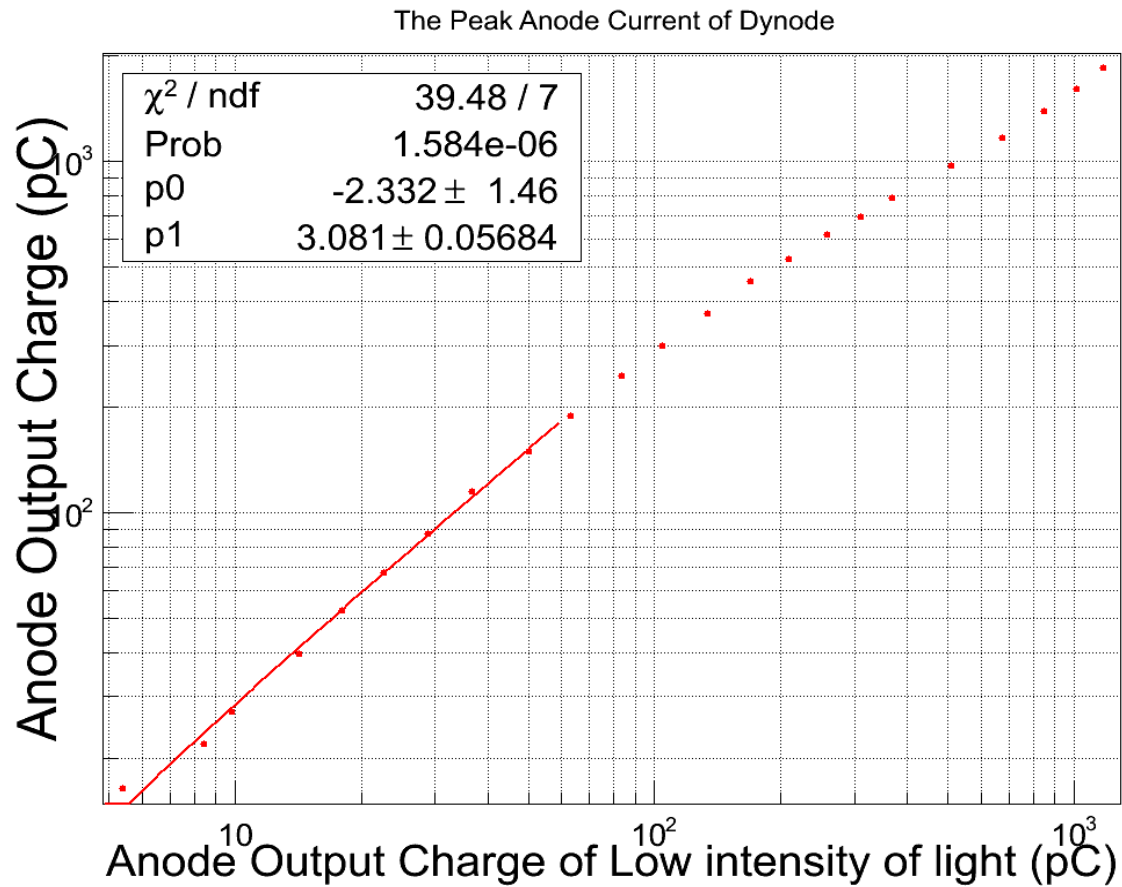
1000V linearity result



1100V linearity result



1200V linearity result



Conclusion

- Supposing the full width of Shashlik signal is 40ns, and for HV 1000V with max 26mA(1.3V amplitude) linear current,

The max valid NPE is:

$$NPE \times Gain \times e = 30ns \times 26mA \times 0.5(\text{triangle})$$

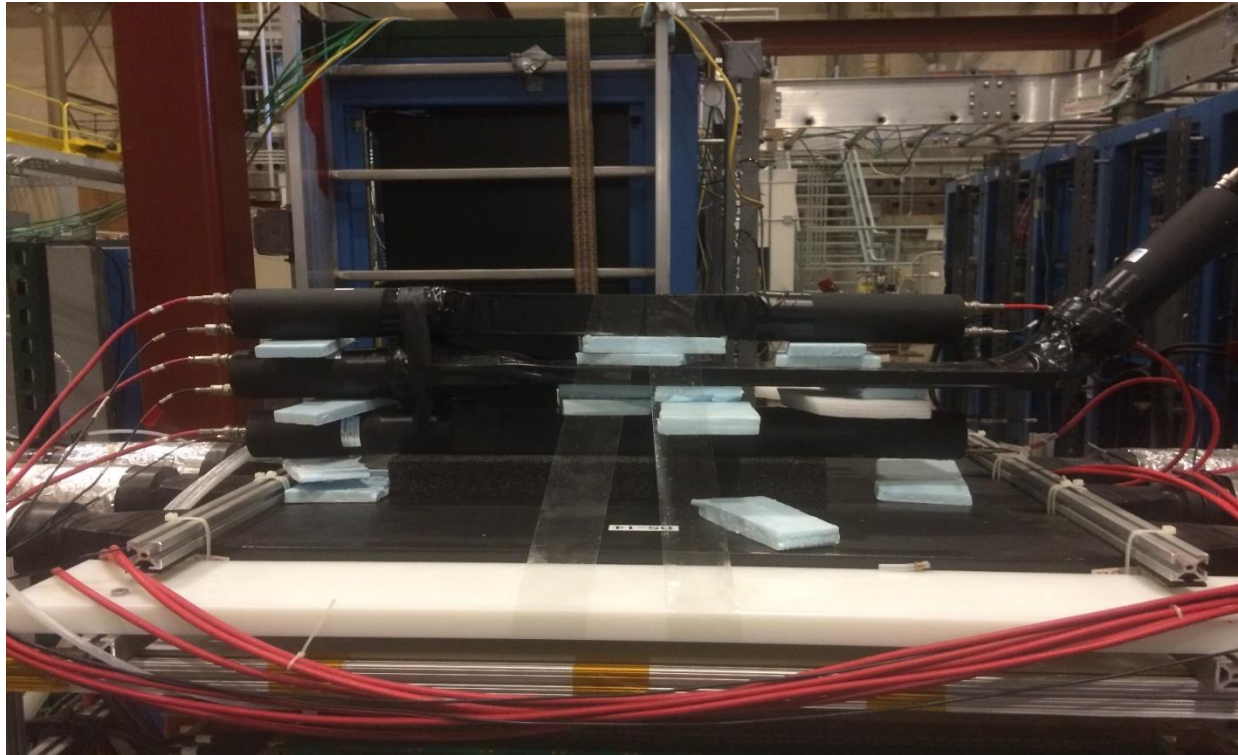
From above we get: ***NPE=476(not enough)***

If width is 40ns: NPE=634

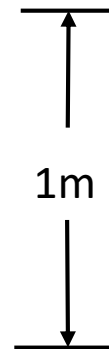
For future test, to get better linearity:

- *Use lower HV*
- *Use other type divider: better linearity for same gain*

Shashlik detector cosmic test in JLab



Shashlik detector

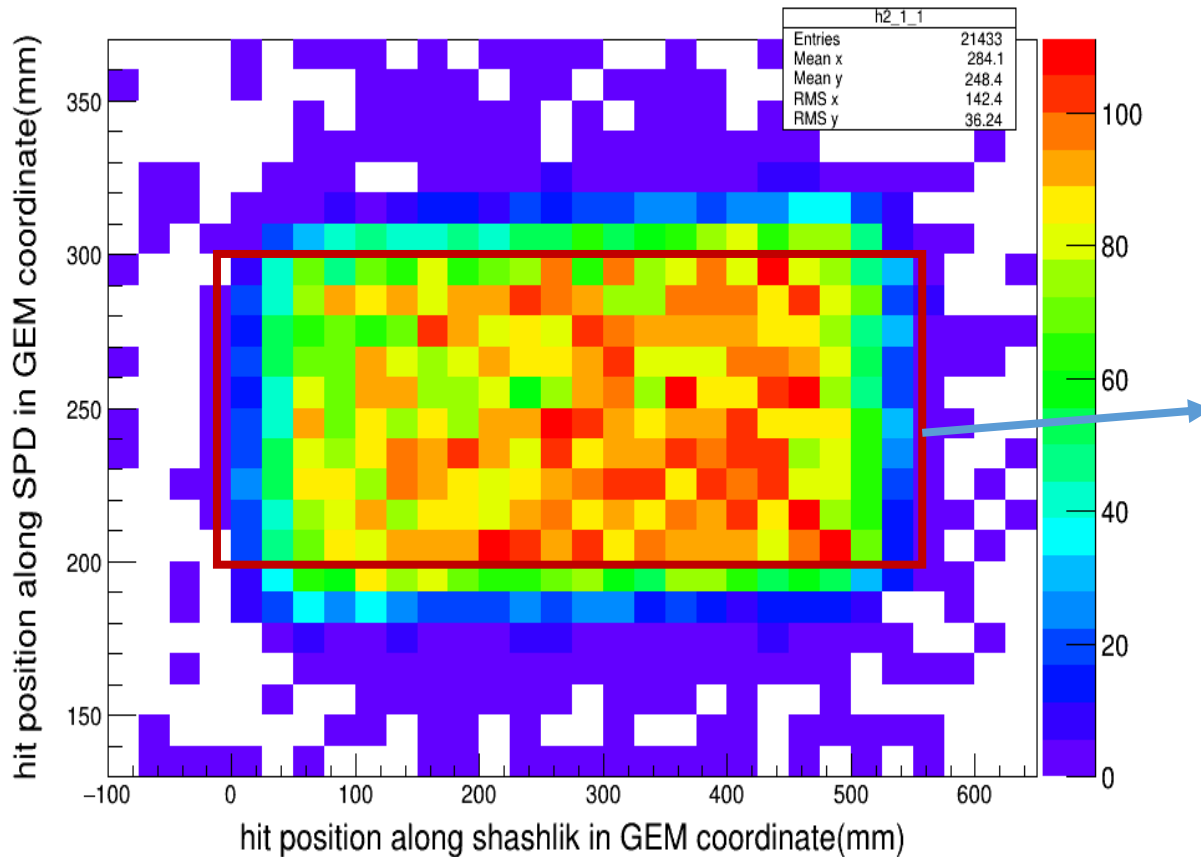


- 3 shashlik detectors are tested at same time with SPD.
- Have cosmic tracking and FADC data, no TDC data
- Low efficiency, but have enough data
- Since we also have the trigger of GEM large scintillator paddle, which triggered most shashlik events

SDU#2 (gain $5 \cdot 10^6$)

which is put at the middle of three detectors

Events distribution



FADC signal distribution related to x(along shashlik detector)

