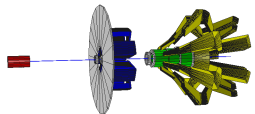


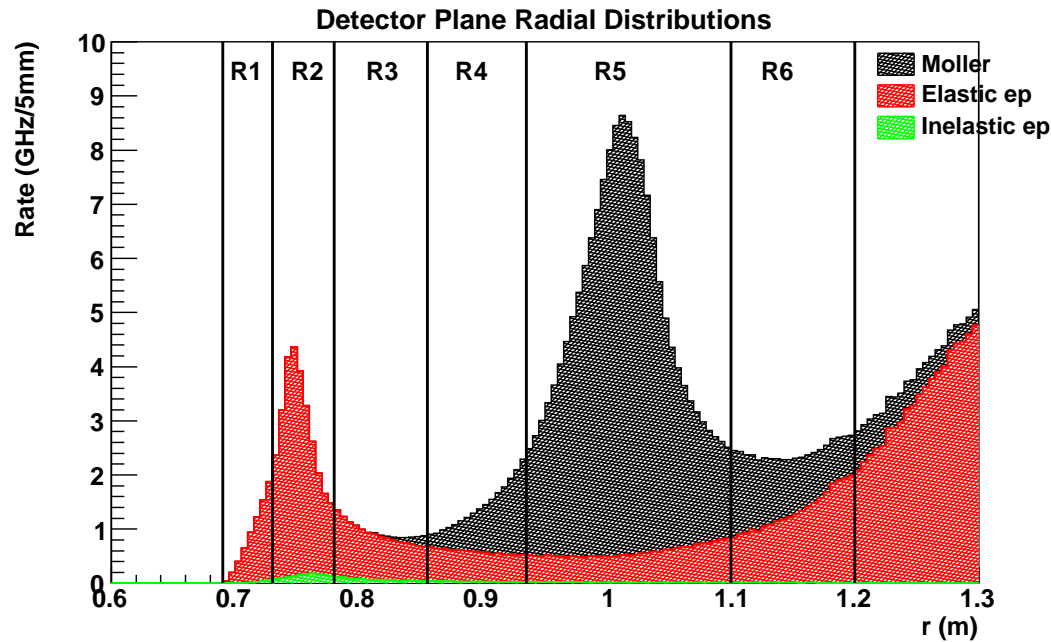
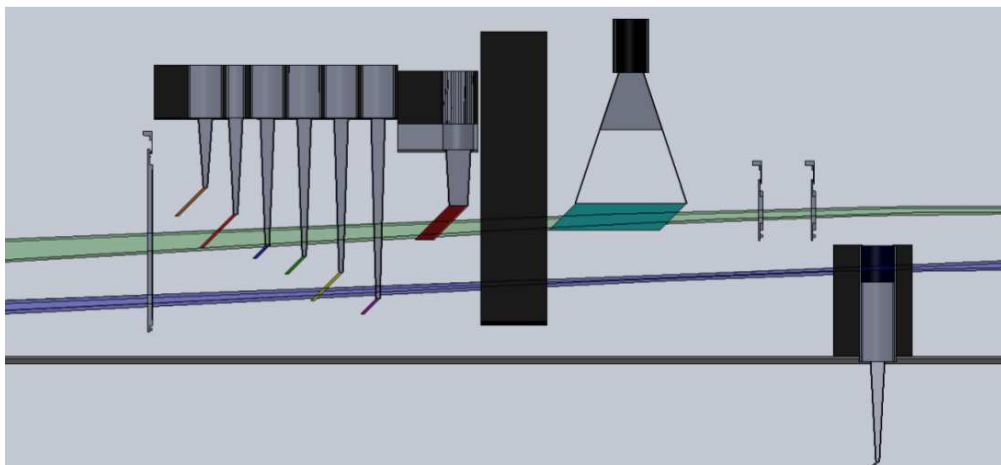
Light Guide Tests at Mainz

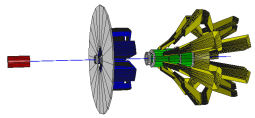
Dustin McNulty
Idaho State University
mcnulty@jlab.org

October 22, 2013



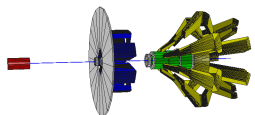
Why Light Guide Beamtests are Important





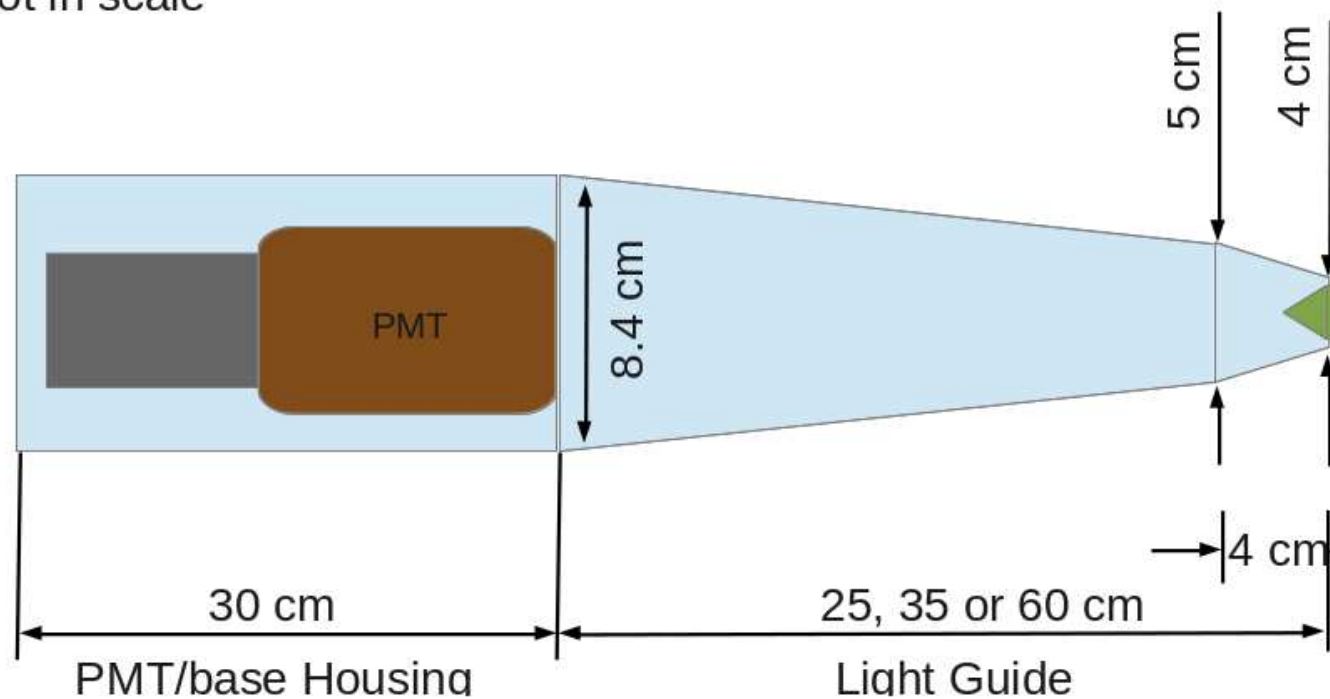
Light Guide Tests: Strategy

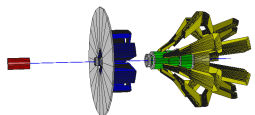
- Used Manitoba 60cm Miro-Silver light guide with 3inch “Electron Tubes 9305KFL” pmt SN:509 – Quartz window, standard bi-alkali Cathode, high QE
- Establish pmt HV which allows single PE peak to emerge from pedestal (for unamplified spectra with 0.2pf ADC sensitivity)
- Scan light guide through beam at three different orientations: 45° , 90° , and 135°
- Determine rate of light guide events per incident electron for each configuration



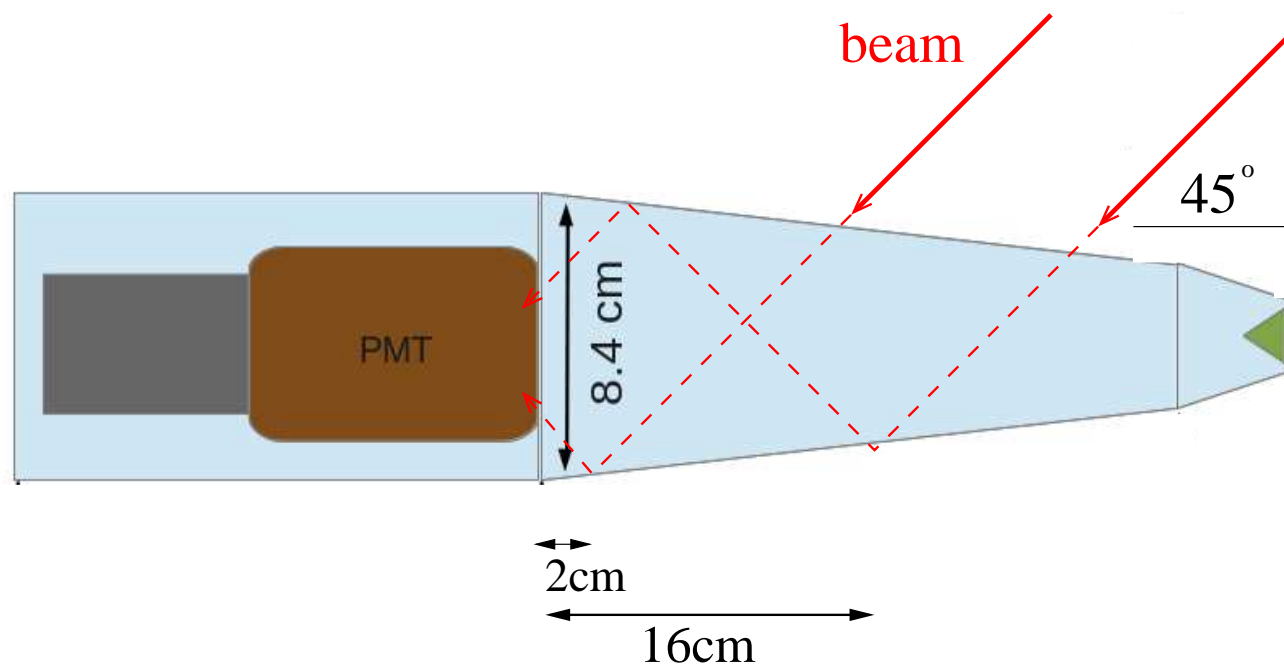
Manitoba Light Guide Geometry (60 cm) Tested (from Peiqing)

Not in scale

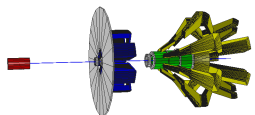




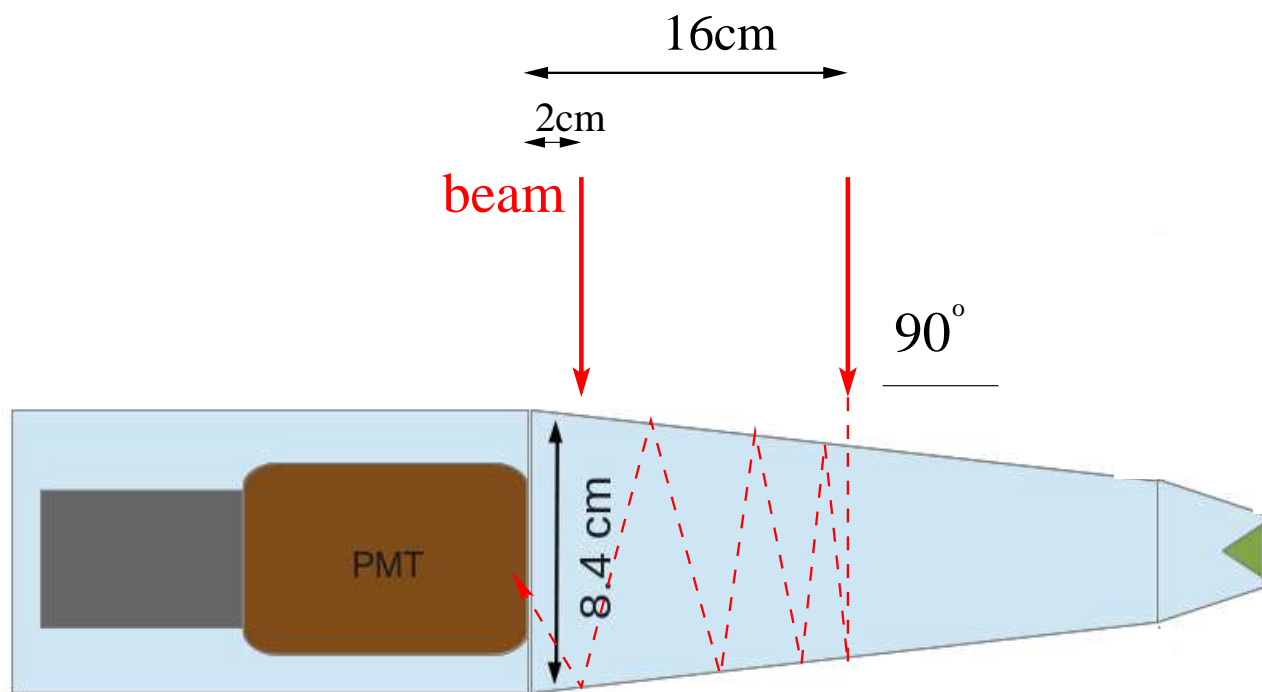
45 Degree Scan Configuration



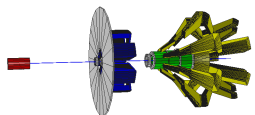
- This configuration gives most direct path for Cerenkov light in air (at 1 atm, $n = 1.0003$)



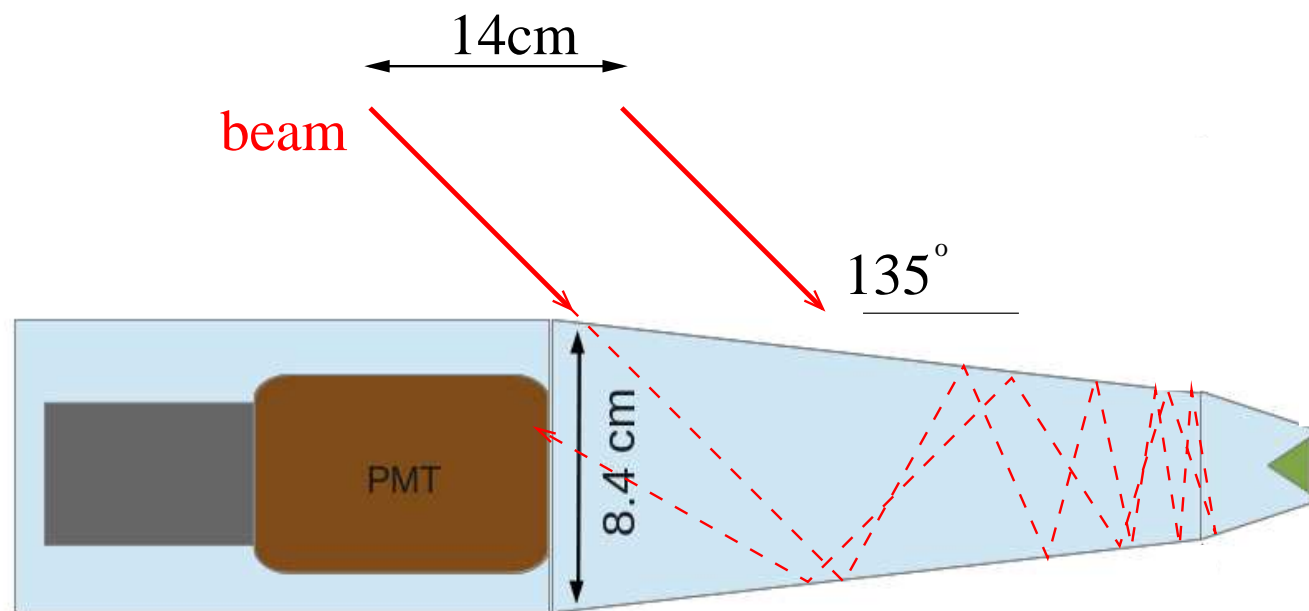
90 Degree Scan Configuration



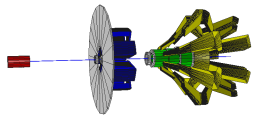
- Configuration closely matches experimental conditions shown in page 1 schematic where electrons traverse light guides from $\sim 87.6^\circ - 88.6^\circ$



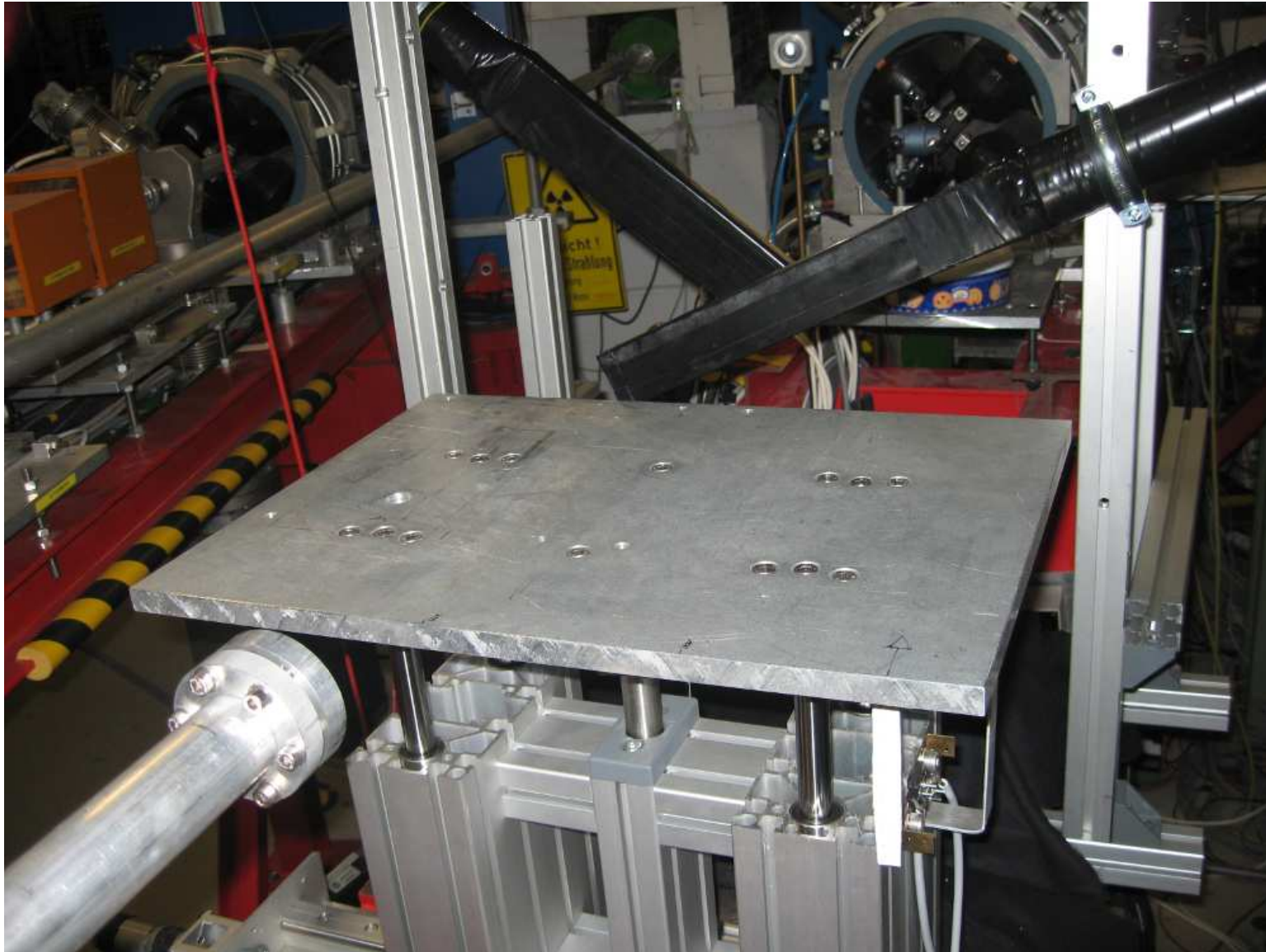
135 Degree Scan Configuration

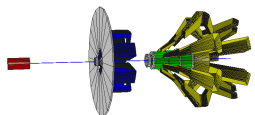


- This configuration expected to have least sensitivity to Cerenkov light and relatively more sensitivity to scintillation light; also would match alternate experimental setup ($133.6^\circ - 134.6^\circ$)

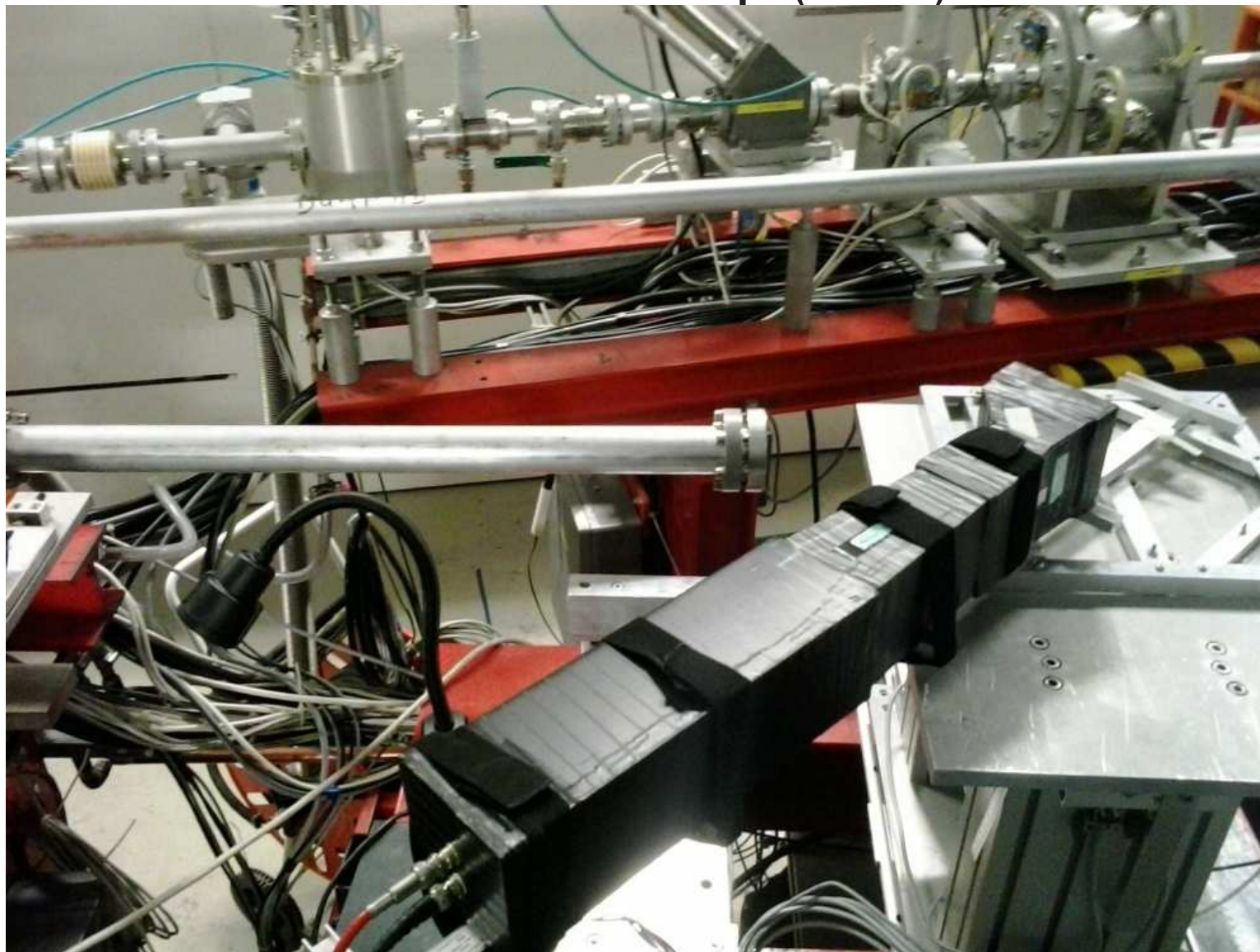


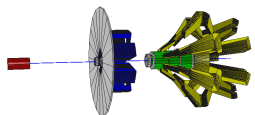
Test Beam Table





Manitoba Setup (135°)

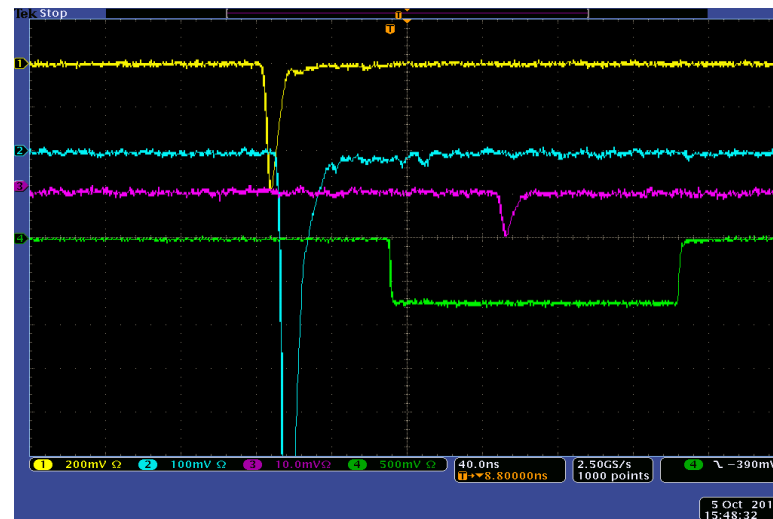
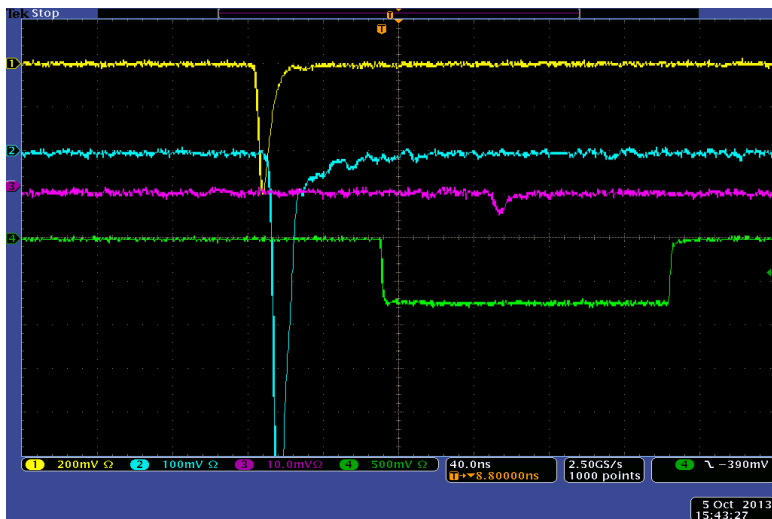




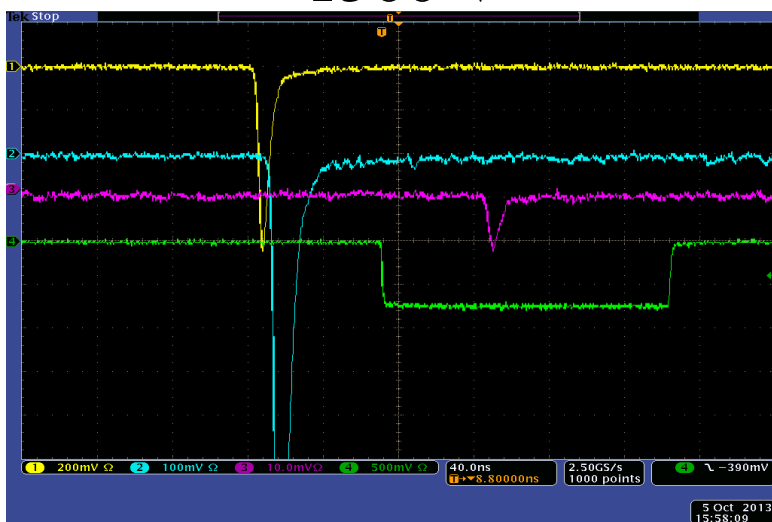
HV scans: Scope Traces

1290 V

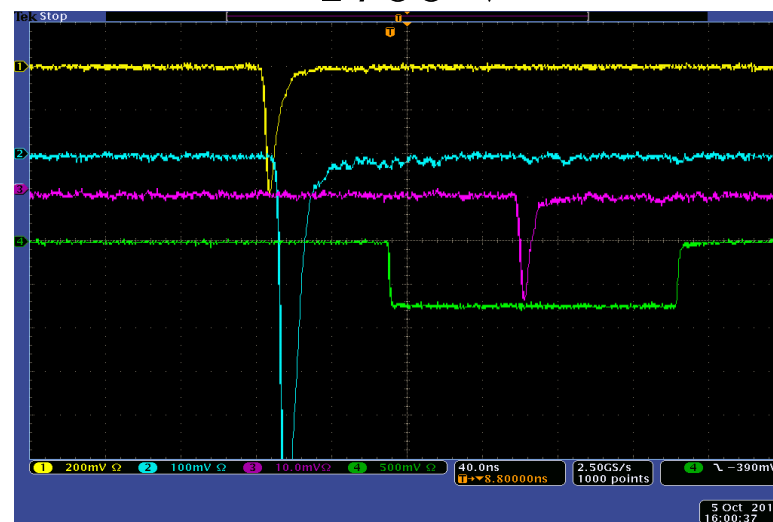
1400 V

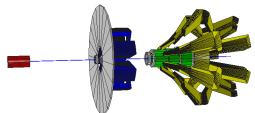


1500 V

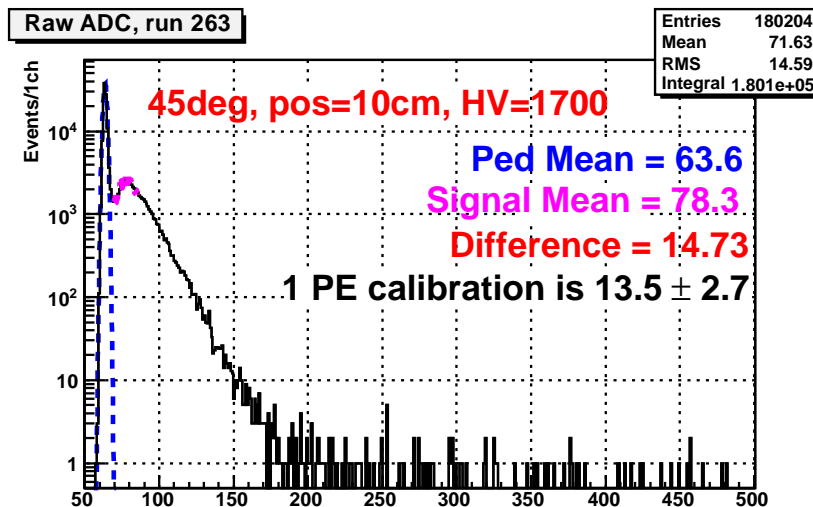
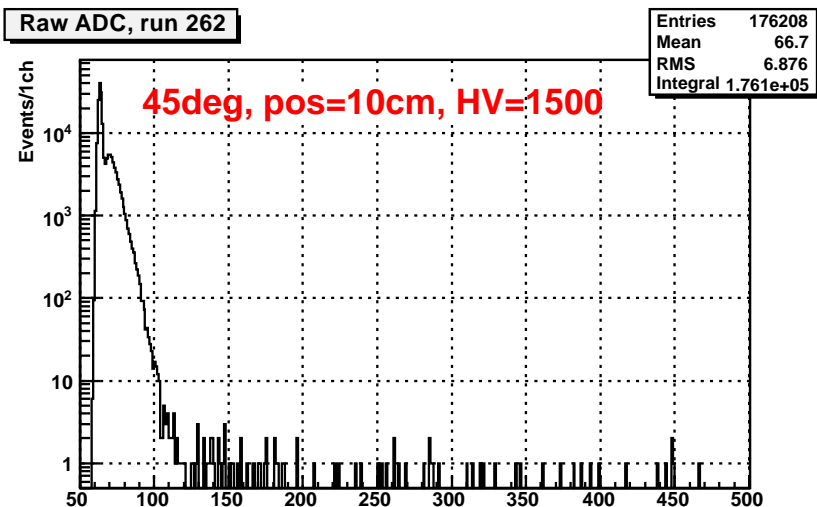
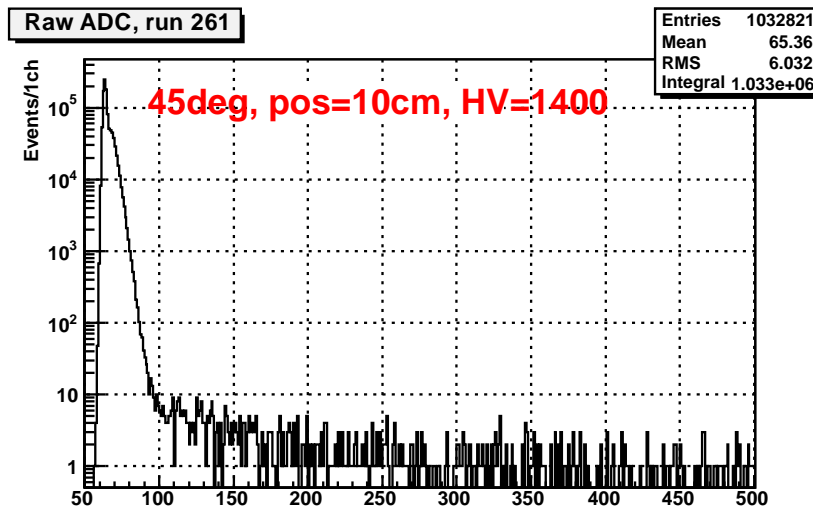
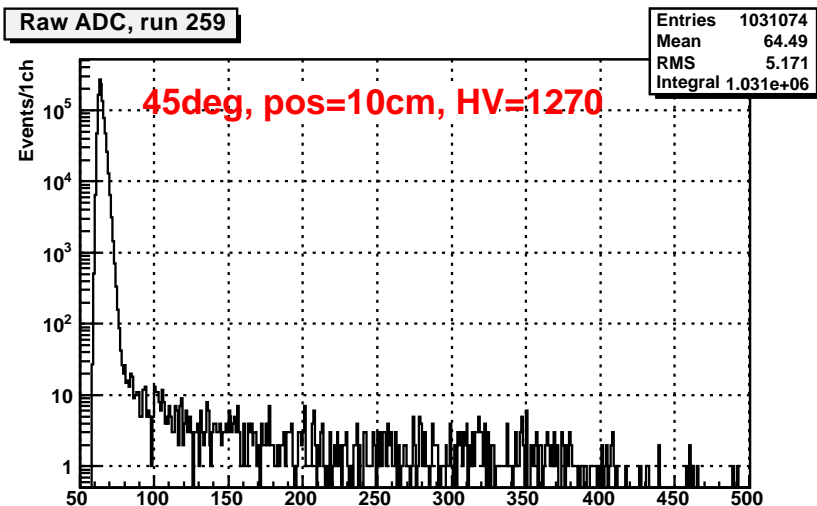


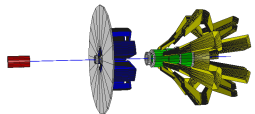
1700 V



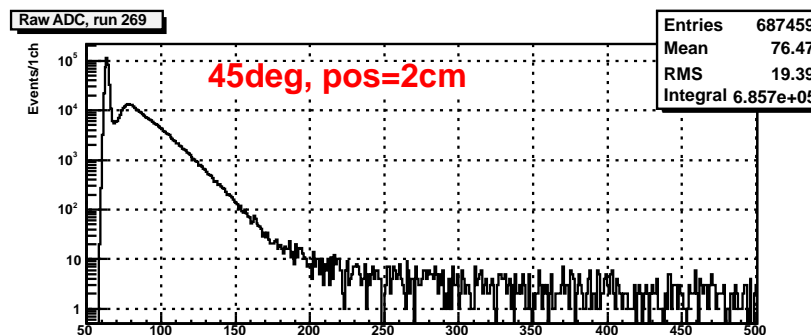
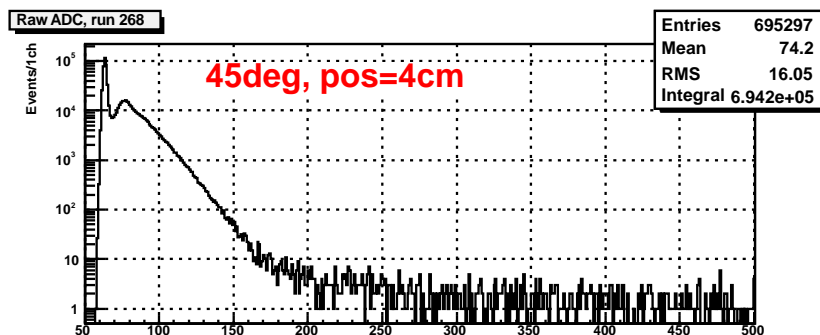
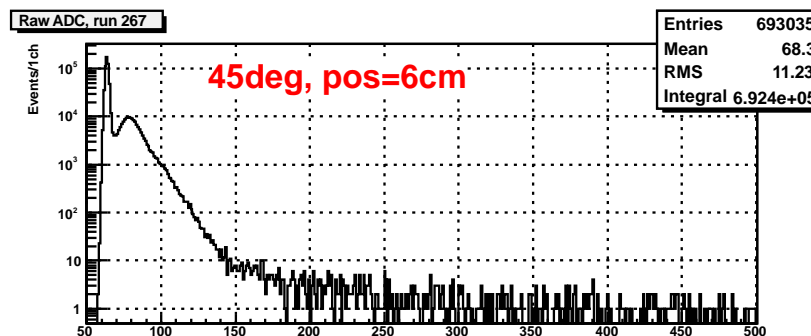
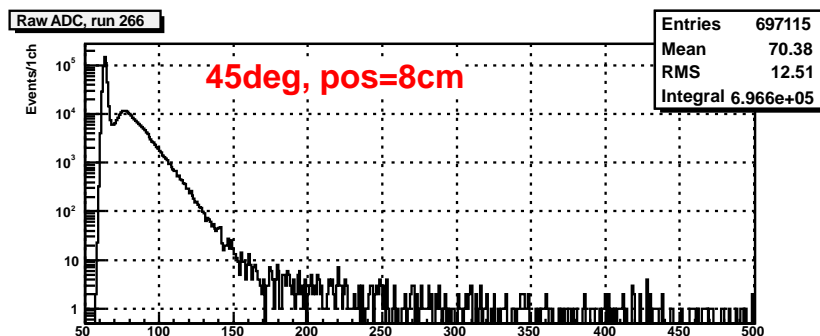
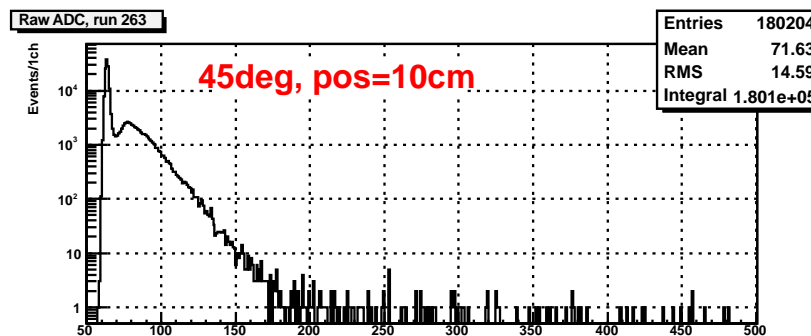
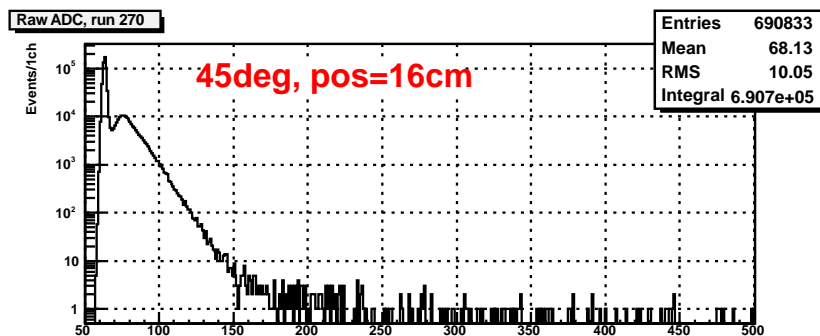


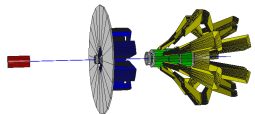
HV Scans: Spectra



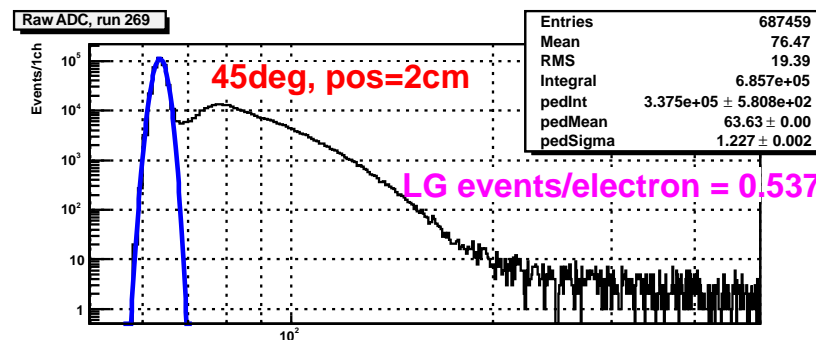
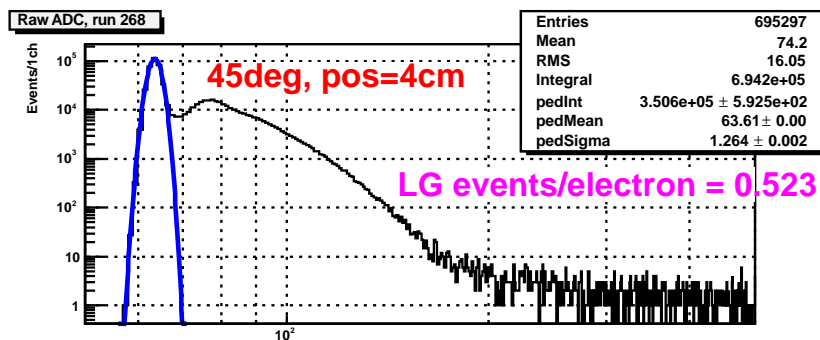
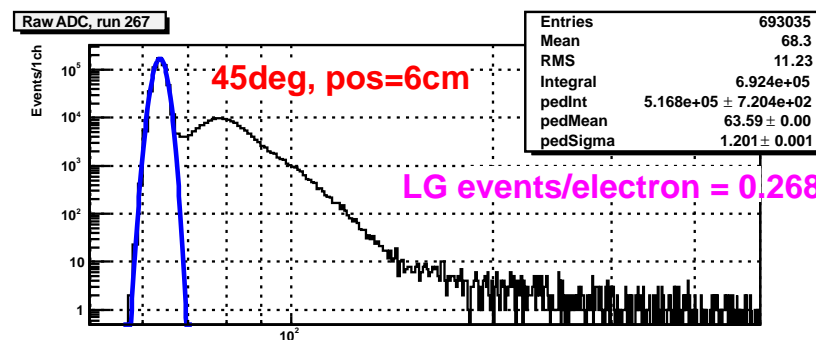
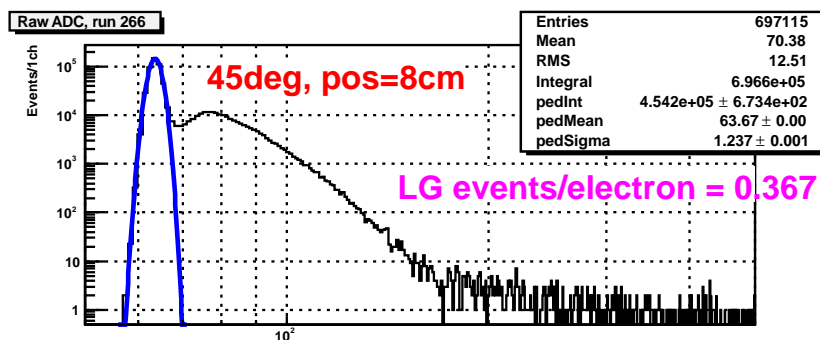
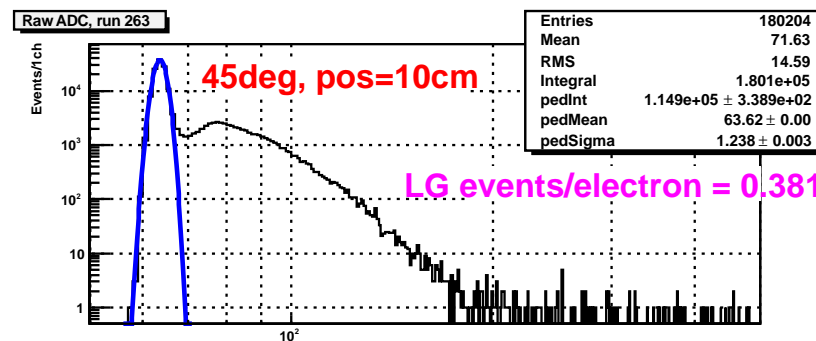
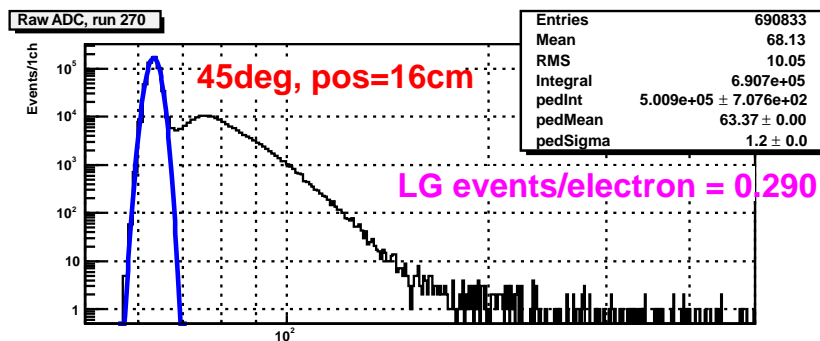


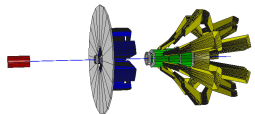
45° Scan Results: Spectra





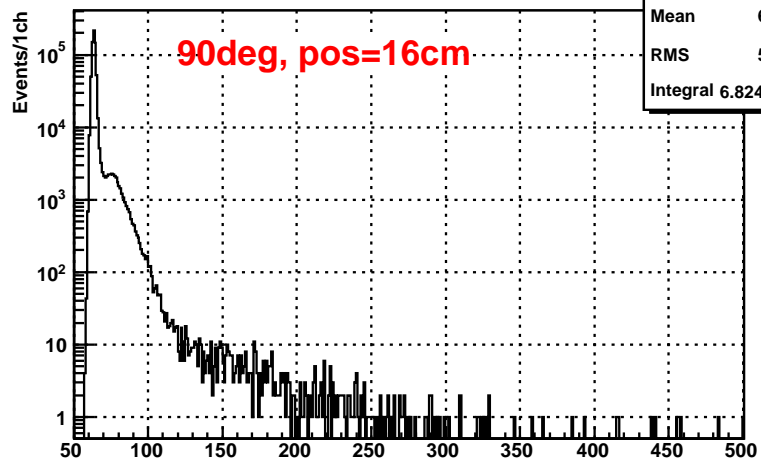
45° Scan Results: Rates



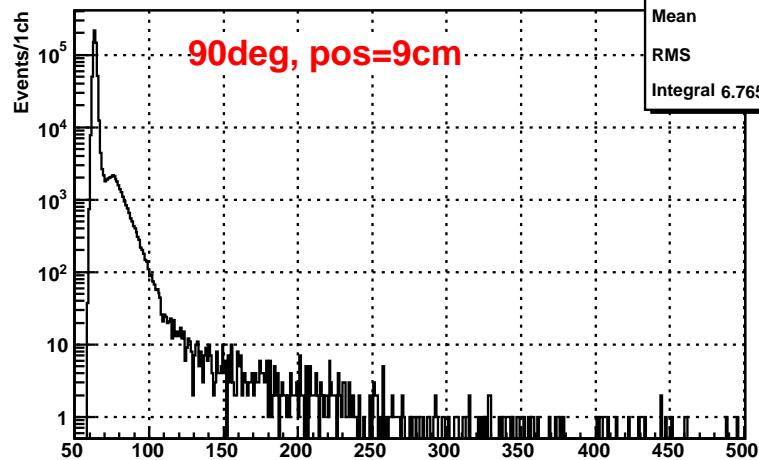


90° Scan Results: Spectra

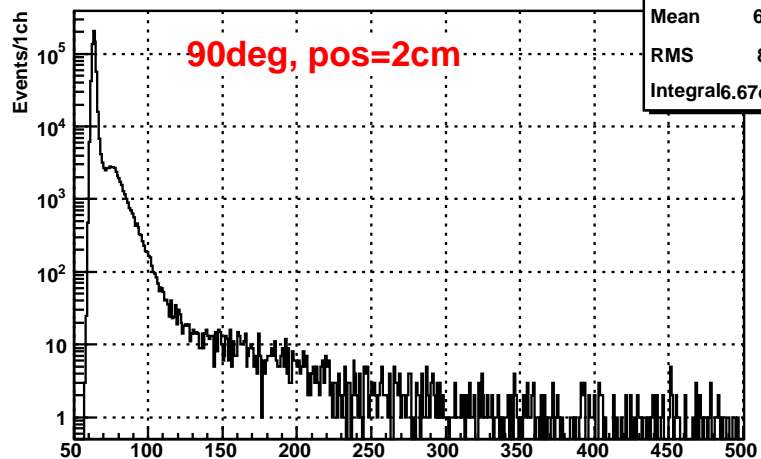
Raw ADC, run 271

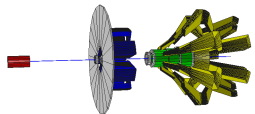


Raw ADC, run 272



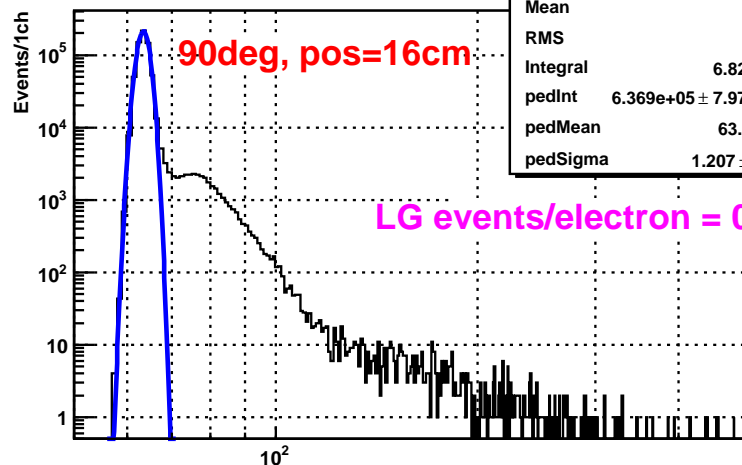
Raw ADC, run 273





90° Scan Results: Rates

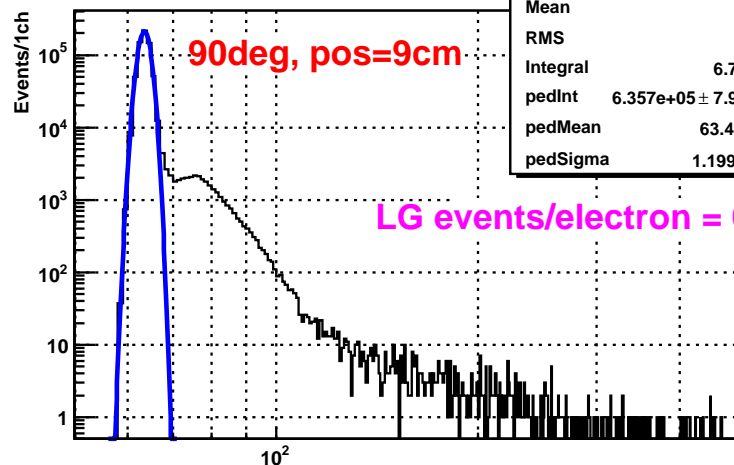
Raw ADC, run 271



Entries	682393
Mean	64.47
RMS	5.557
Integral	6.824e+05
pedInt	6.369e+05 ± 7.977e+02
pedMean	63.5 ± 0.0
pedSigma	1.207 ± 0.001

LG events/electron = 0.070

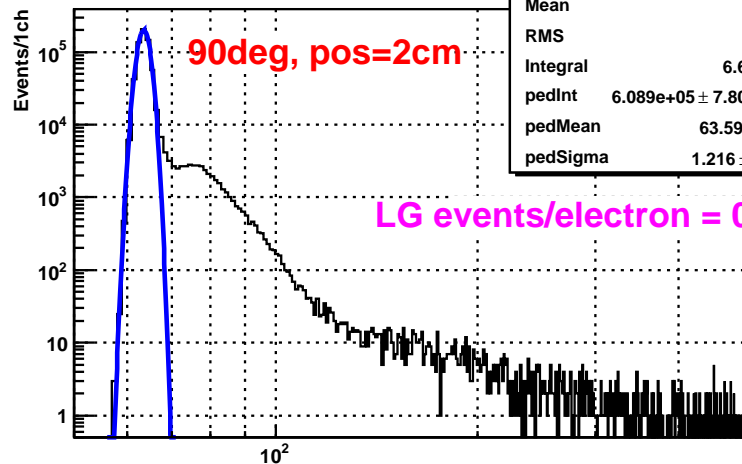
Raw ADC, run 272



Entries	676607
Mean	64.39
RMS	5.725
Integral	6.765e+05
pedInt	6.357e+05 ± 7.971e+02
pedMean	63.49 ± 0.00
pedSigma	1.199 ± 0.001

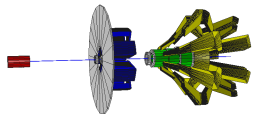
LG events/electron = 0.064

Raw ADC, run 273



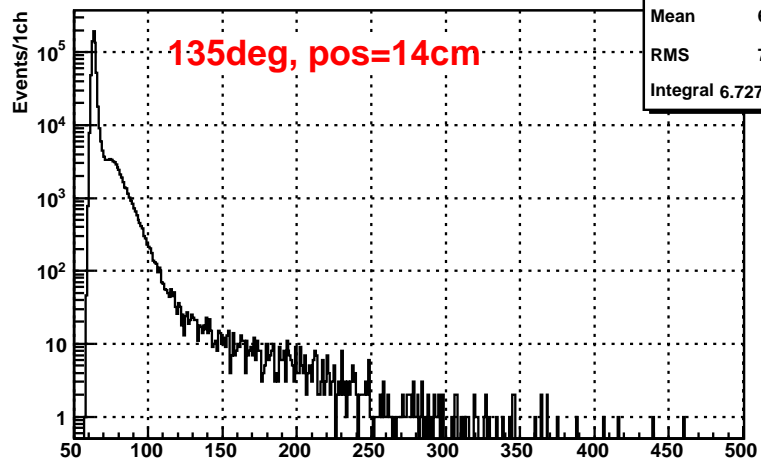
Entries	667224
Mean	64.99
RMS	8.651
Integral	6.67e+05
pedInt	6.089e+05 ± 7.801e+02
pedMean	63.59 ± 0.00
pedSigma	1.216 ± 0.001

LG events/electron = 0.092

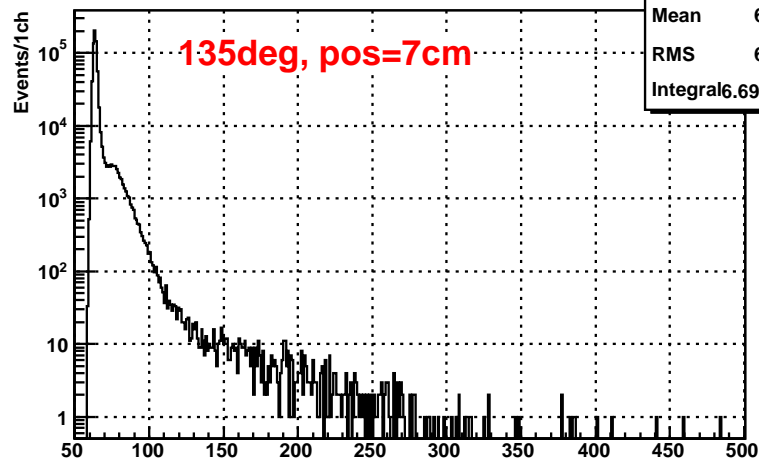


135° Scan Results: Spectra

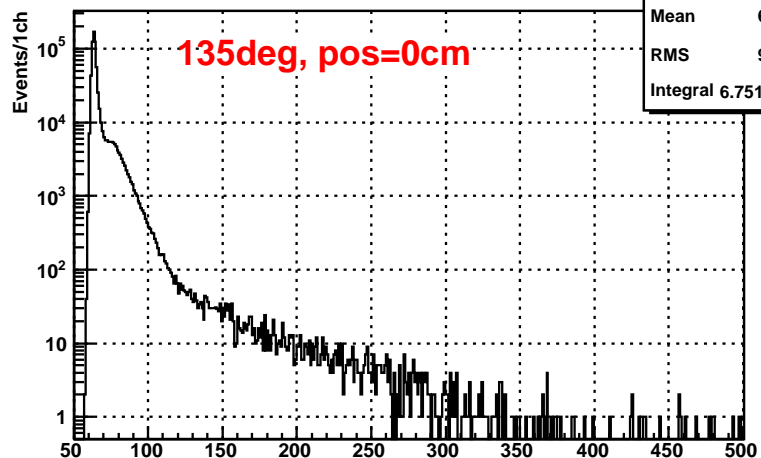
Raw ADC, run 276

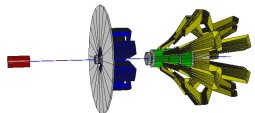


Raw ADC, run 275



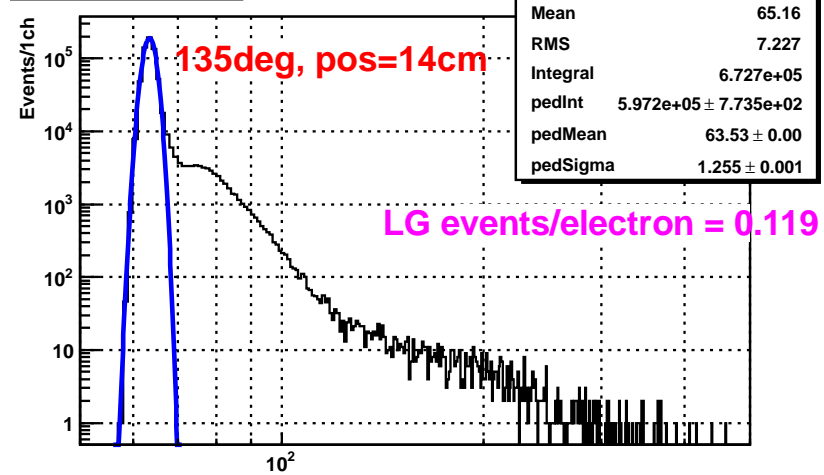
Raw ADC, run 274





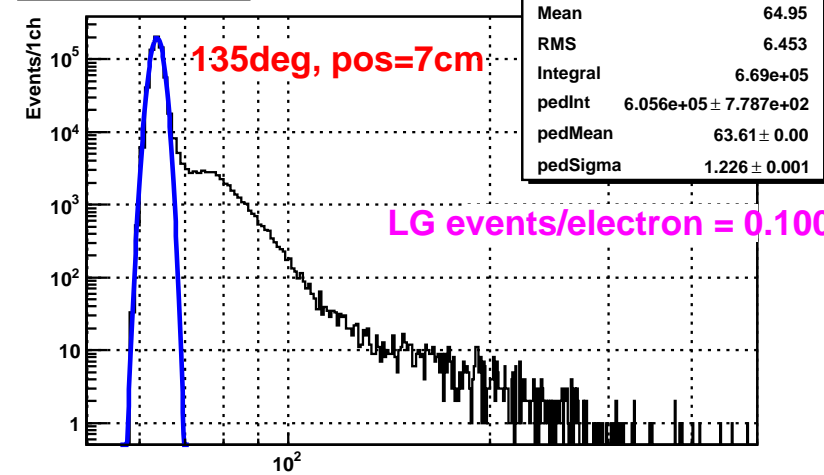
135° Scan Results: Rates

Raw ADC, run 276



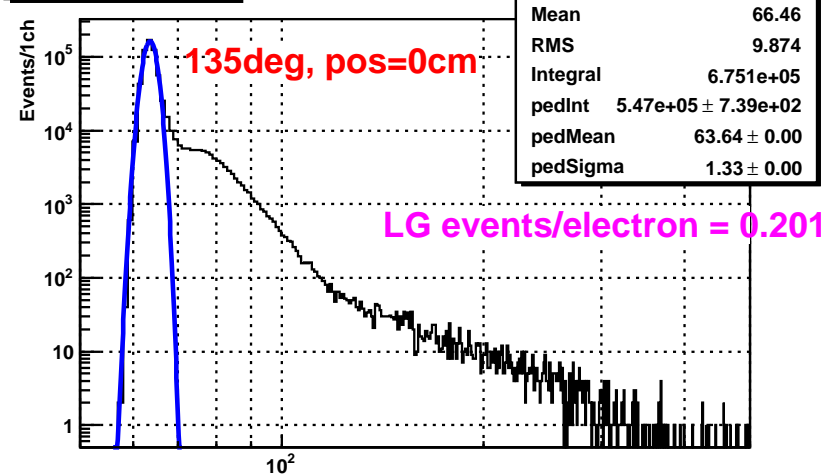
Entries	672749
Mean	65.16
RMS	7.227
Integral	6.727e+05
pedInt	5.972e+05 ± 7.735e+02
pedMean	63.53 ± 0.00
pedSigma	1.255 ± 0.001

Raw ADC, run 275

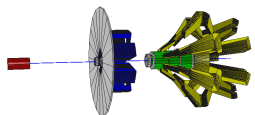


Entries	669066
Mean	64.95
RMS	6.453
Integral	6.69e+05
pedInt	6.056e+05 ± 7.787e+02
pedMean	63.61 ± 0.00
pedSigma	1.226 ± 0.001

Raw ADC, run 274

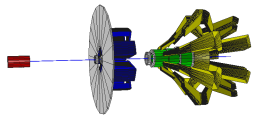


Entries	675195
Mean	66.46
RMS	9.874
Integral	6.751e+05
pedInt	5.47e+05 ± 7.39e+02
pedMean	63.64 ± 0.00
pedSigma	1.33 ± 0.00



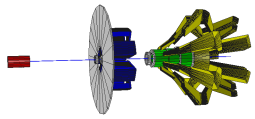
Rates Summary

Configuration	Distance from pmt	Rate
45°	16cm	0.290
45°	10cm	0.381
45°	8cm	0.367
45°	6cm	0.268
45°	4cm	0.523
45°	2cm	0.537
90°	16cm	0.070
90°	9cm	0.064
90°	2cm	0.092
135°	14cm	0.119
135°	7cm	0.100
135°	0cm	0.201



Comments and Disclaimers

- Since Moller ring is at larger radius, it is less susceptible to light guide event backgrounds—but worrying is healthy
- However, if we are serious about clean measurements in the inner rings, we must study this effect and learn how to optimize
- Results agree with simulation claims that air light guide events are at \sim single PE level
- Further analysis needed to better understand spectra—how much double PE events, etc. Also, consider the possibility that Mainz testbeam has instabilities at 10^{-4} level
- Also try to answer question about how much scintillation versus Cerenkov light is contributing
- Rate calculation used here = $(\text{Total Events} - \text{PedInt}) / (\text{Total Events} - \text{PedCorrection})$, where $\text{PedCorrection} = 300 * \text{RunTime}$ in seconds (from 300Hz Random ped trigger)



Summary and Conclusions

- In general, relative rate trends in the data roughly agree with expectations although there are some curiosities
- LG events per incident electron increase as beam passes closer to pmt and 45° rates $>$ 135° rates $>$ 90° rates
- For 90° and 135° , $\sim 1/10$ of incident electrons produce PE(s)
- Question: Is non-monotonic nature of rate dependence on position real?
- Results seem promising. Future test runs needed for further study