

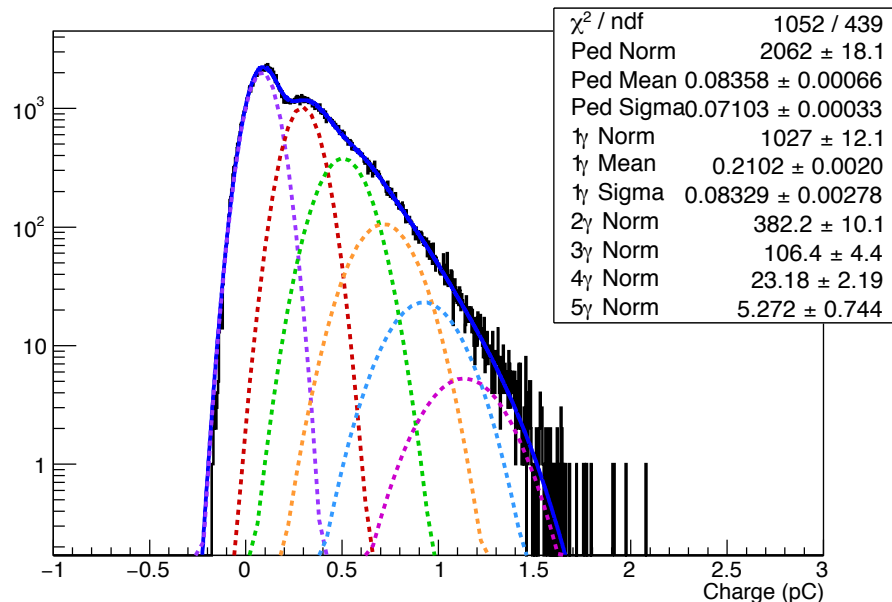
Light Output Measurement

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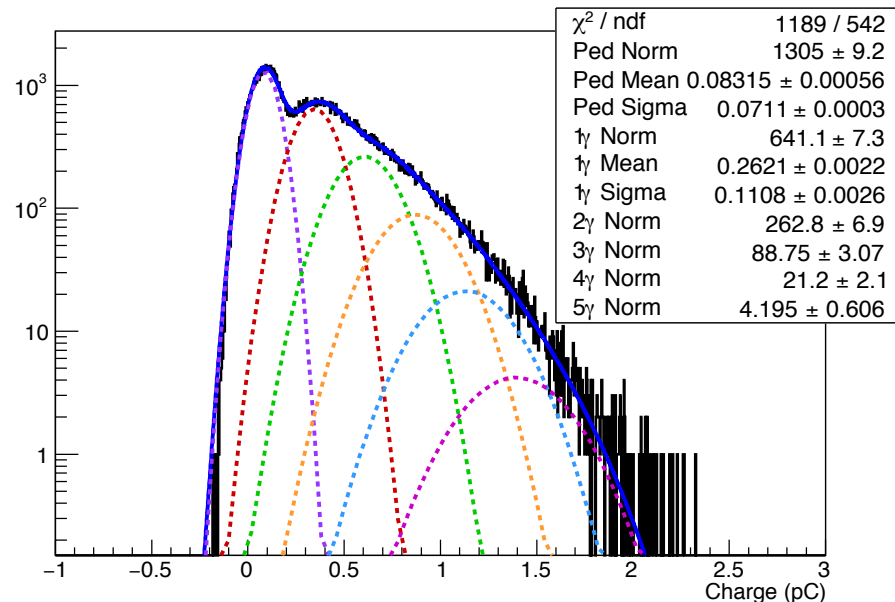
PMT Calibration

- PMT calibrated with pulsed LED (470nm)
- fit to extract Pedestal Mean and Sigma and Single photon Mean and Sigma
- Fit up to 5 photons
 - Mean and Sigma of multiple photon related to Single photon parameter
 - $N_{ph} \text{ mean} = N_{ph} \times \text{Single ph Mean}$
 - $N_{ph} \text{ Sigma} = \text{Single ph Sigma} \times \sqrt{N_{ph}}$

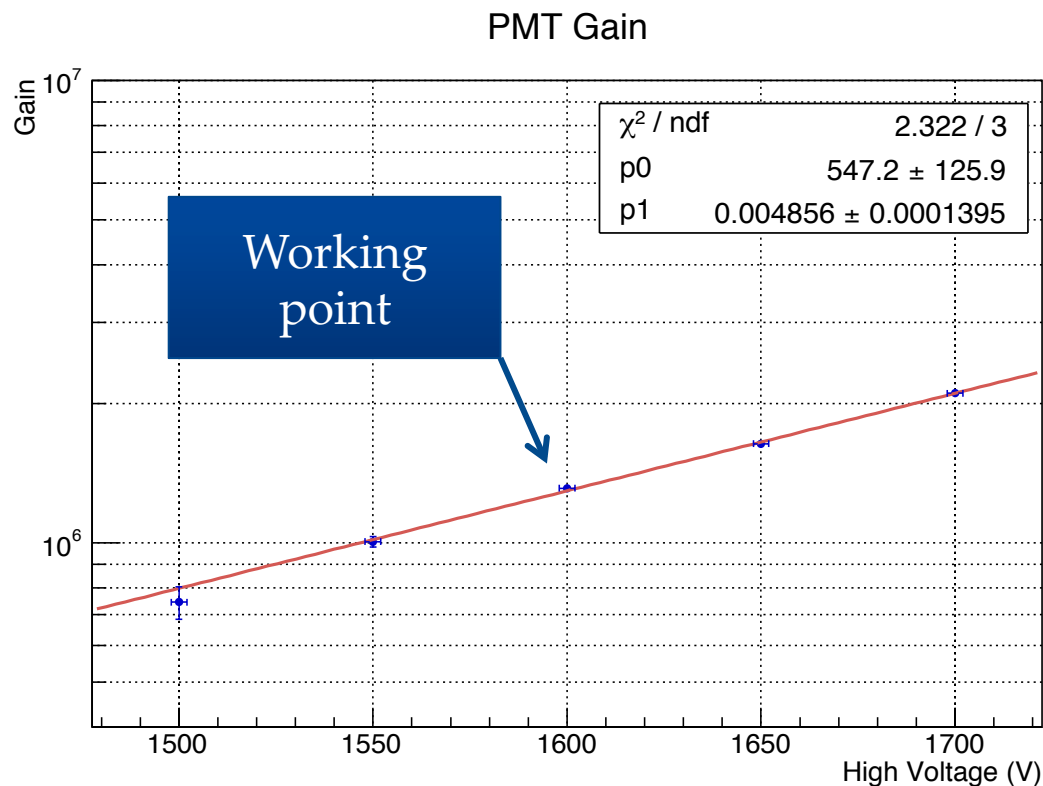
PMT Calib. - HV 1600V



PMT Calib. - HV 1650V



PMT Calibration

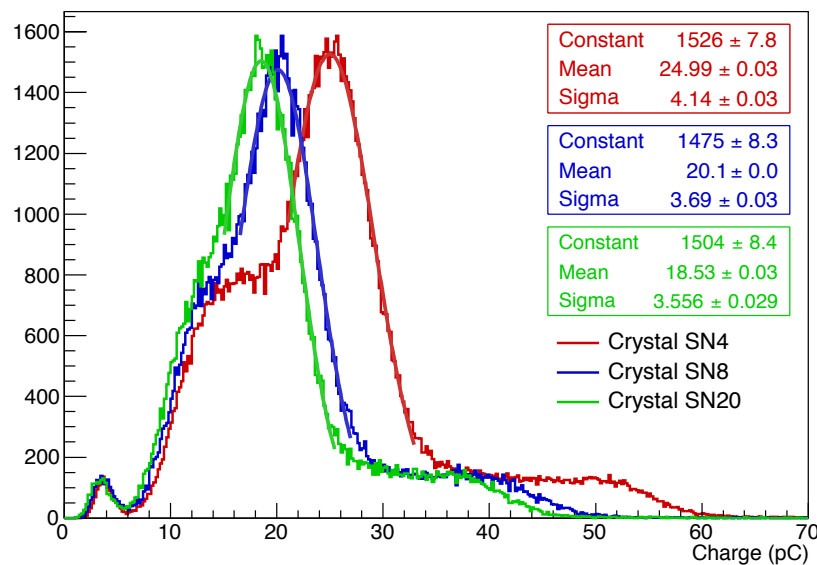


- PMT Gain Curve (Exponential Fit)
- 1.31×10^6 @ 1600V used for light output measurement

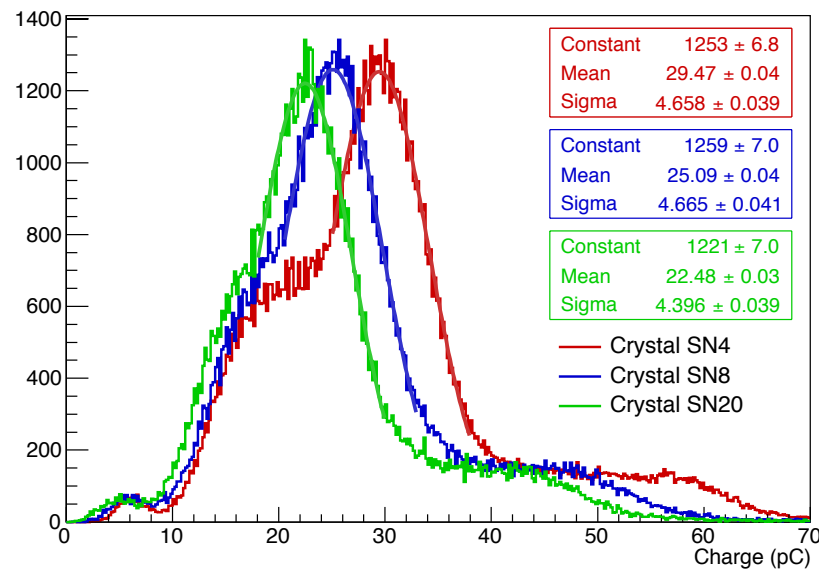
Light Output Measurement

- Use Co60 source and 3 different crystals (SN4,SN8,SN20) $\sim 1.25\text{MeV}$
- 2 different gate
 - Short 150ns
 - Long 600ns

Qshort - Gate 150ns

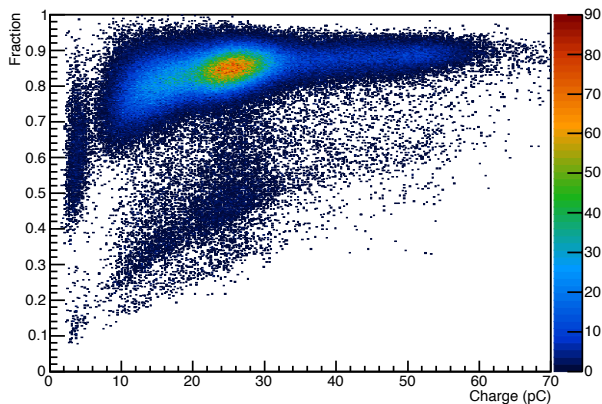


Qlong - Gate 600ns

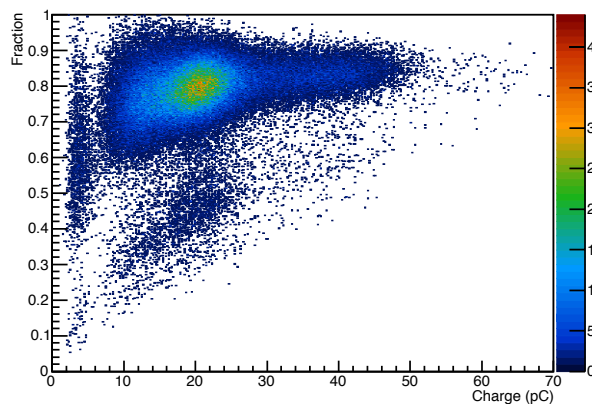


Light Output Measurement

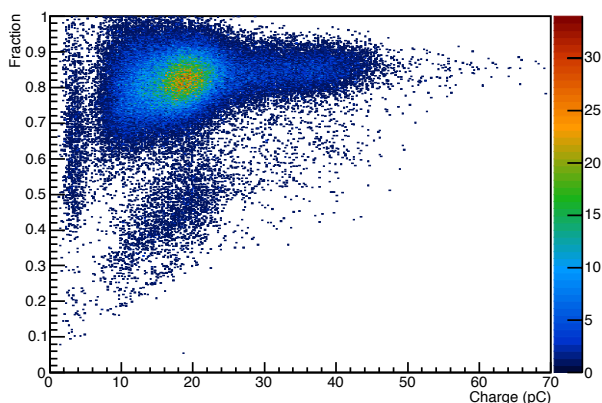
Fast/Total vs Fast - Crystal SN4



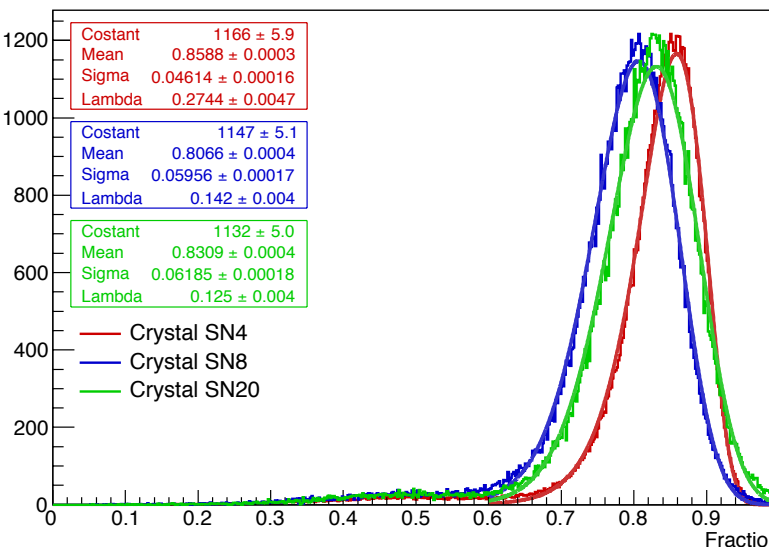
Fast/Total vs Fast - Crystal SN8



Fast/Total vs Fast - Crystal SN20



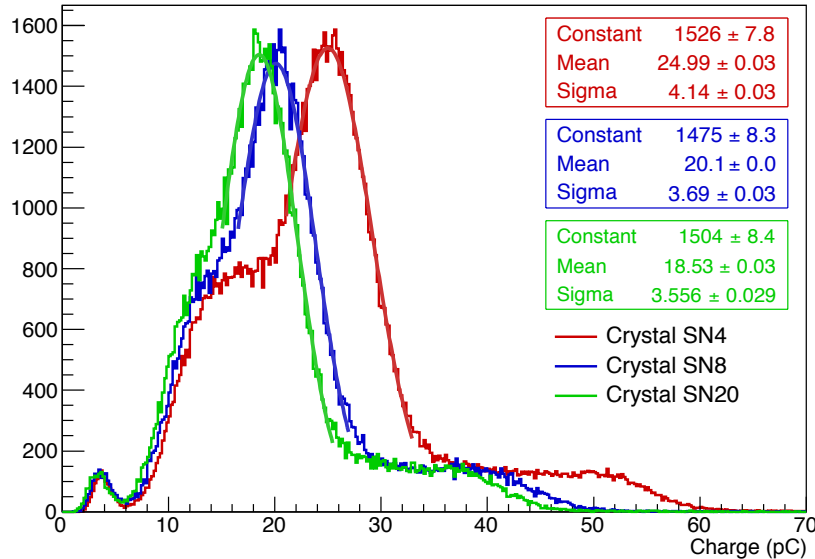
Fast/Total - Gate 150ns/Gate 600ns



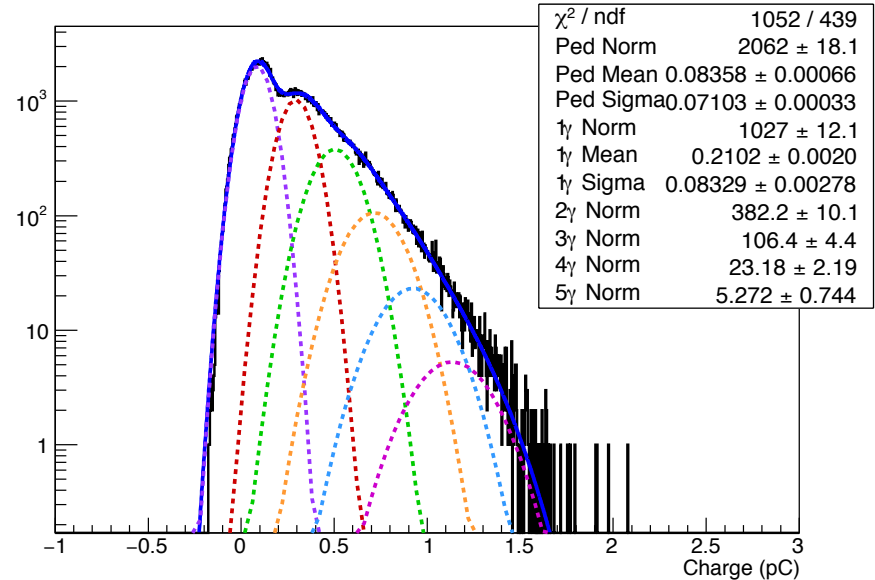
- Fast/Total light
 - total is 600ns integration gate
- Results between 85 and 80 %

Evaluate Light Output

Qshort - Gate 150ns



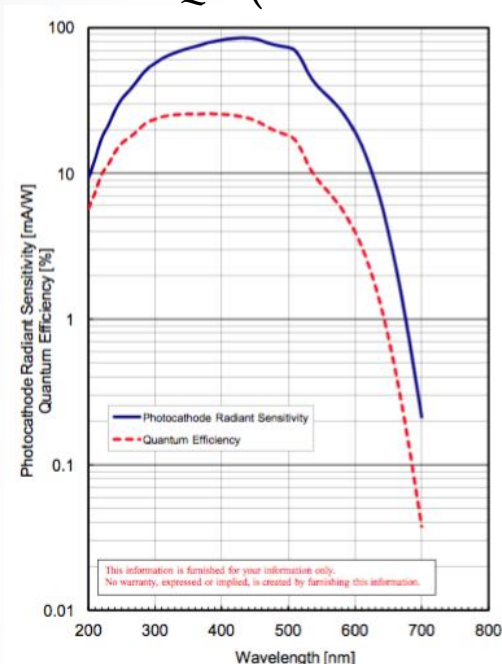
PMT Calib. - HV 1600V



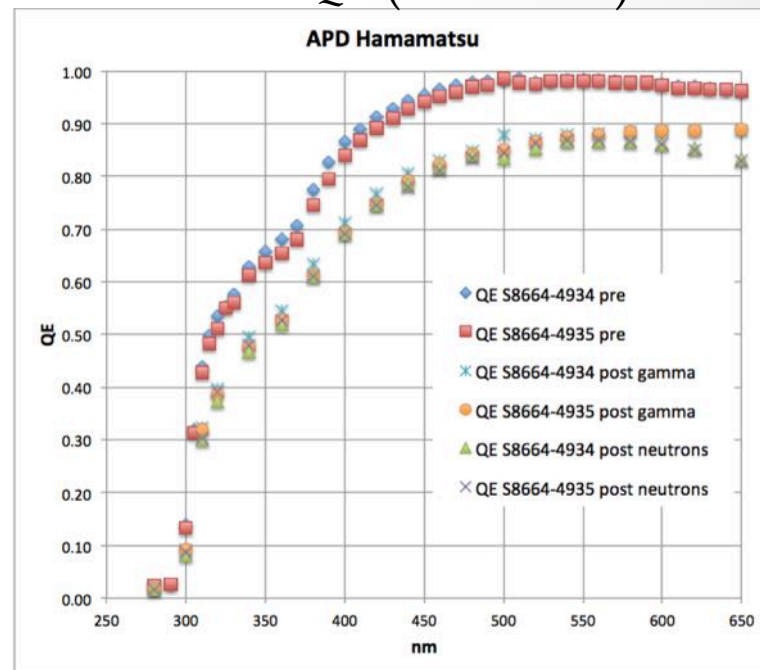
- Single Photon 0.210 ± 0.002 pC + 5% syst.
- Crystal SN4 : LO = $24.99 / 0.21 / 1.25 = \underline{\underline{95 \pm 5 \text{ pe/MeV}}}$
- Crystal SN8 : LO = $20.10 / 0.21 / 1.25 = \underline{\underline{77 \pm 4 \text{ pe/MeV}}}$
- Crystal SN20 : LO = $18.53 / 0.21 / 1.25 = \underline{\underline{71 \pm 4 \text{ pe/MeV}}}$

APD L.O. Evaluation

PMT QE (Hamamatsu)



APD QE (Measured)



- PMT QE @340nm ~20%
- APD QE @340nm ~60%
- PMT active surface $\varnothing 46\text{mm} = 16.6\text{cm}^2$
- 1 APD active surface 1cm^2

APD L.O. Evaluation

- $LO_{APD} = LO_{PMT} \times (QE_{APD}/QE_{PMT}) \times (S_{APD}/S_{PMT})$
 - QE ratio = 3
 - Surface ration = $1/16.6 = 0.06$
- Crystal SN4 : $LO_{APD} = \underline{17 \pm 1 \text{ pe/MeV}}$
- Crystal SN8 : $LO_{APD} = \underline{14 \pm 1 \text{ pe/MeV}}$
- Crystal SN20 : $LO_{APD} = \underline{13 \pm 1 \text{ pe/MeV}}$
- From TB evaluation :
 - Crystal SN4 (Ch9) : $1.7\%/\sqrt{E(\text{GeV})}$
 - $Nph/ENF = 3.5 \text{ pe/MeV}$
 - With hypothesis $ENF=4 \rightarrow LO_{TB}=14 \text{ pe/MeV}$