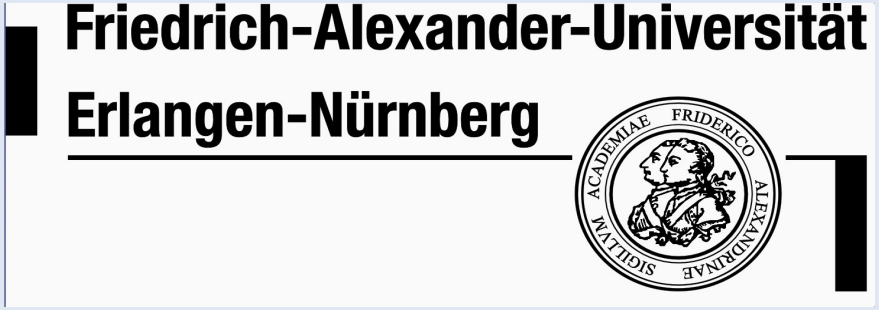
Update of lifetime measurement of Photonis XP85112



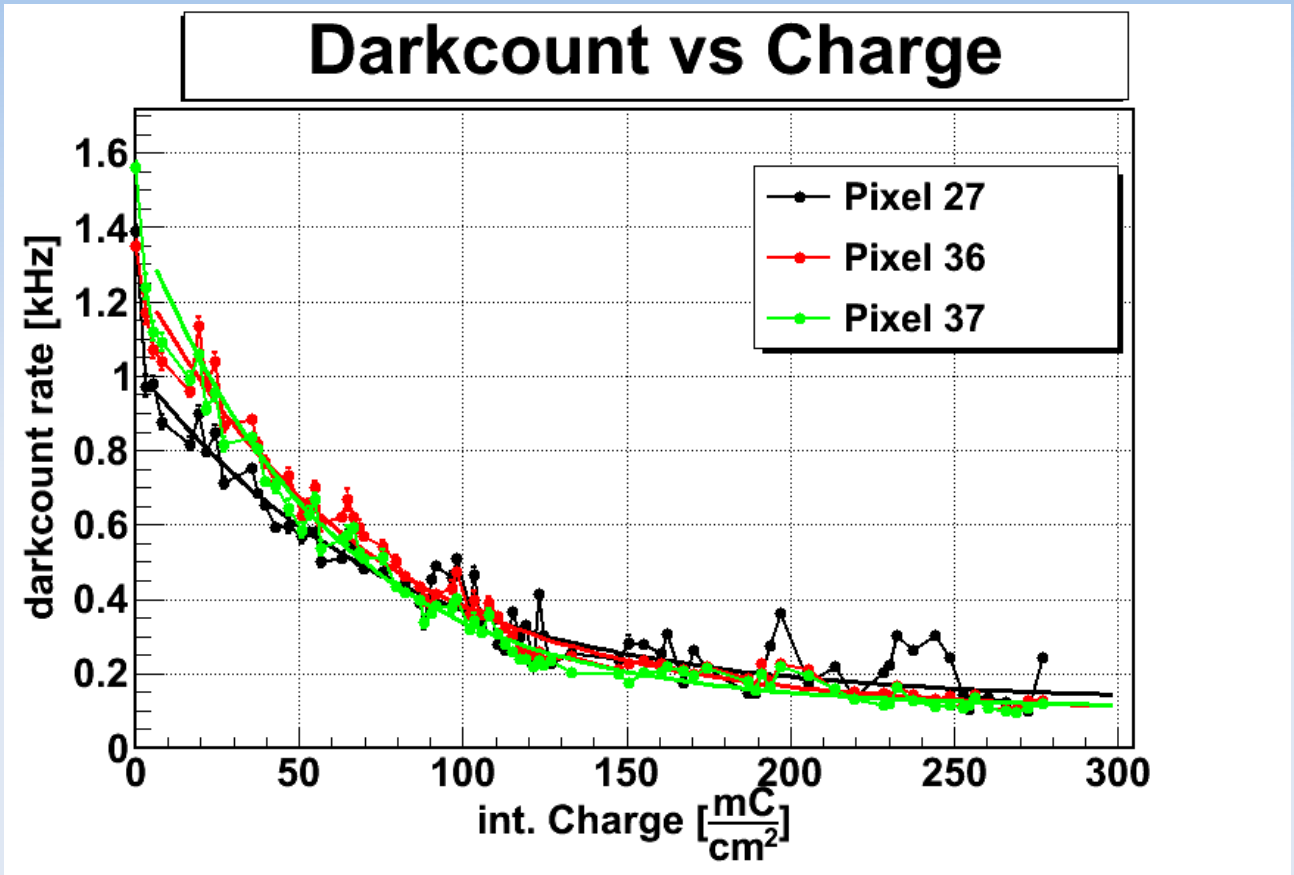
Alexander Britting, Wolfgang Eyrich, Albert Lehmann, Fred Uhlig

supported by BMBF and GSI

Overview

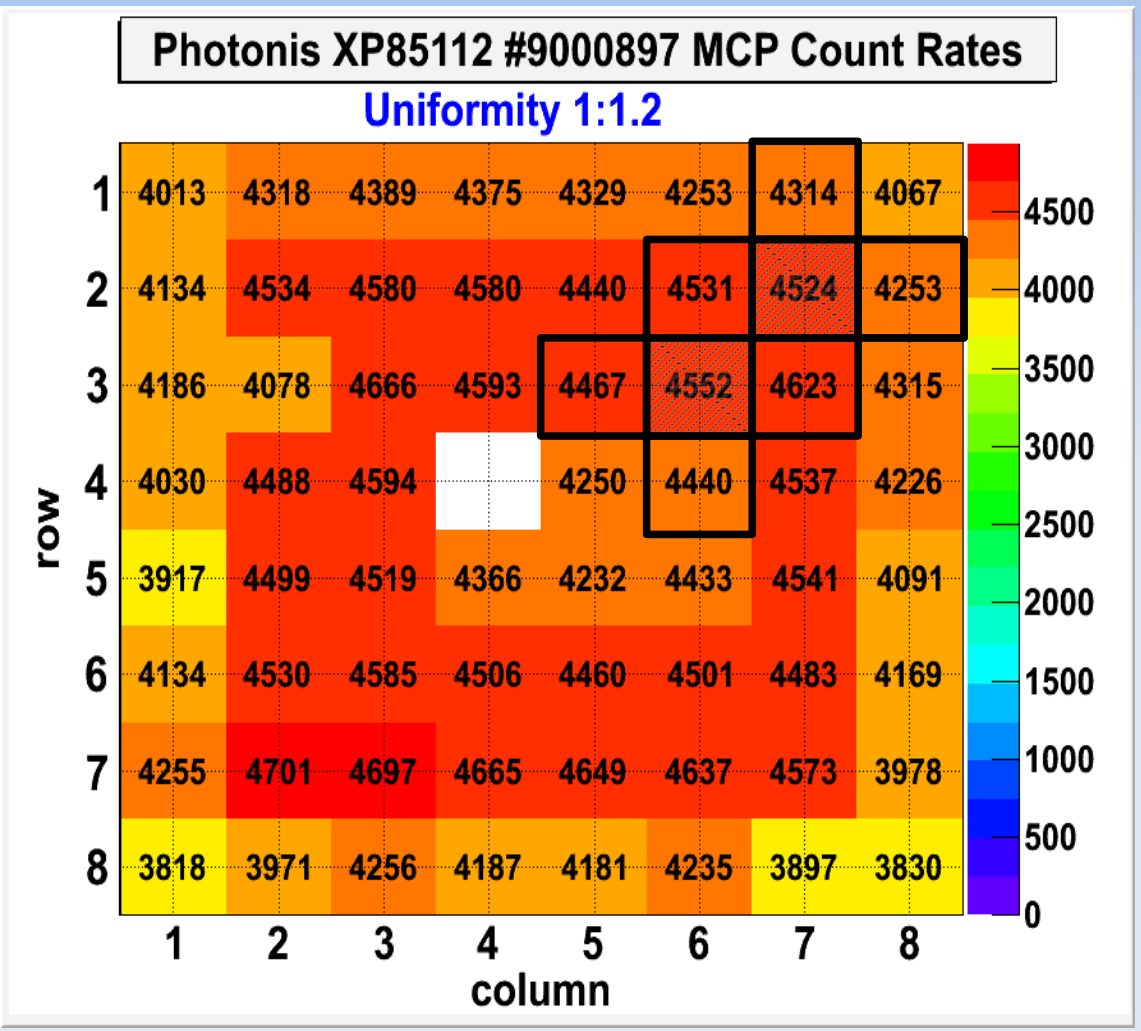
- Lifetime of XP 85112:
  - Dark count rate
  - Gain and relative photon detection efficiency
  - Results of QE-scans
  - Illumination impact on quantum efficiency as a function of wavelength and integrated charge
- Comparison with Quantum efficiency of previous measured MCPs

Dark count rate



Dark count rate decreases with higher int. Charge for all pixels and saturates (~100 Hz)

Crosstalk suppression for Gain measurement

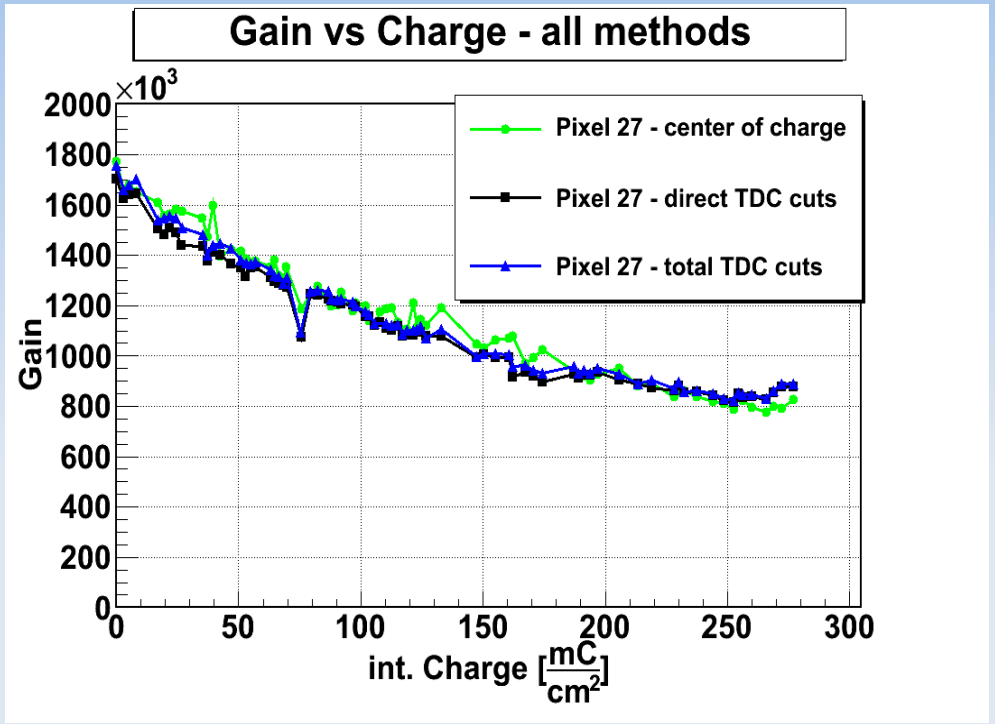


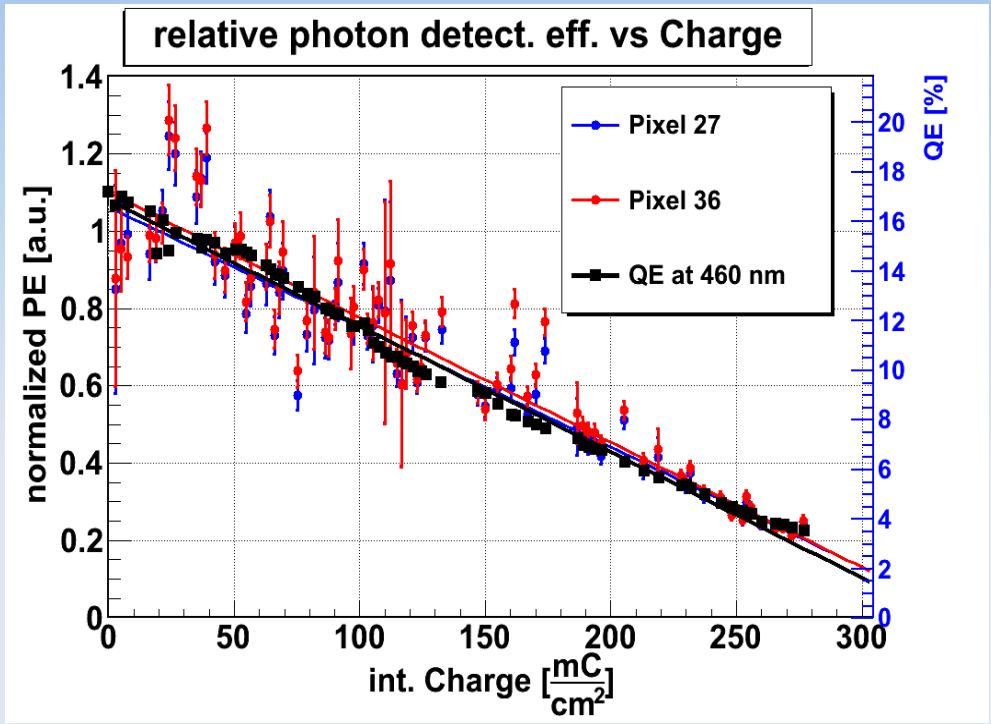
<= Read-out of 8 Channels

2 Possibilities:

- "**Direct cut**": Events with signals in surrounding pixels are neglected
- "**Total cut**": Coincident signals induced by charge sharing are neglected

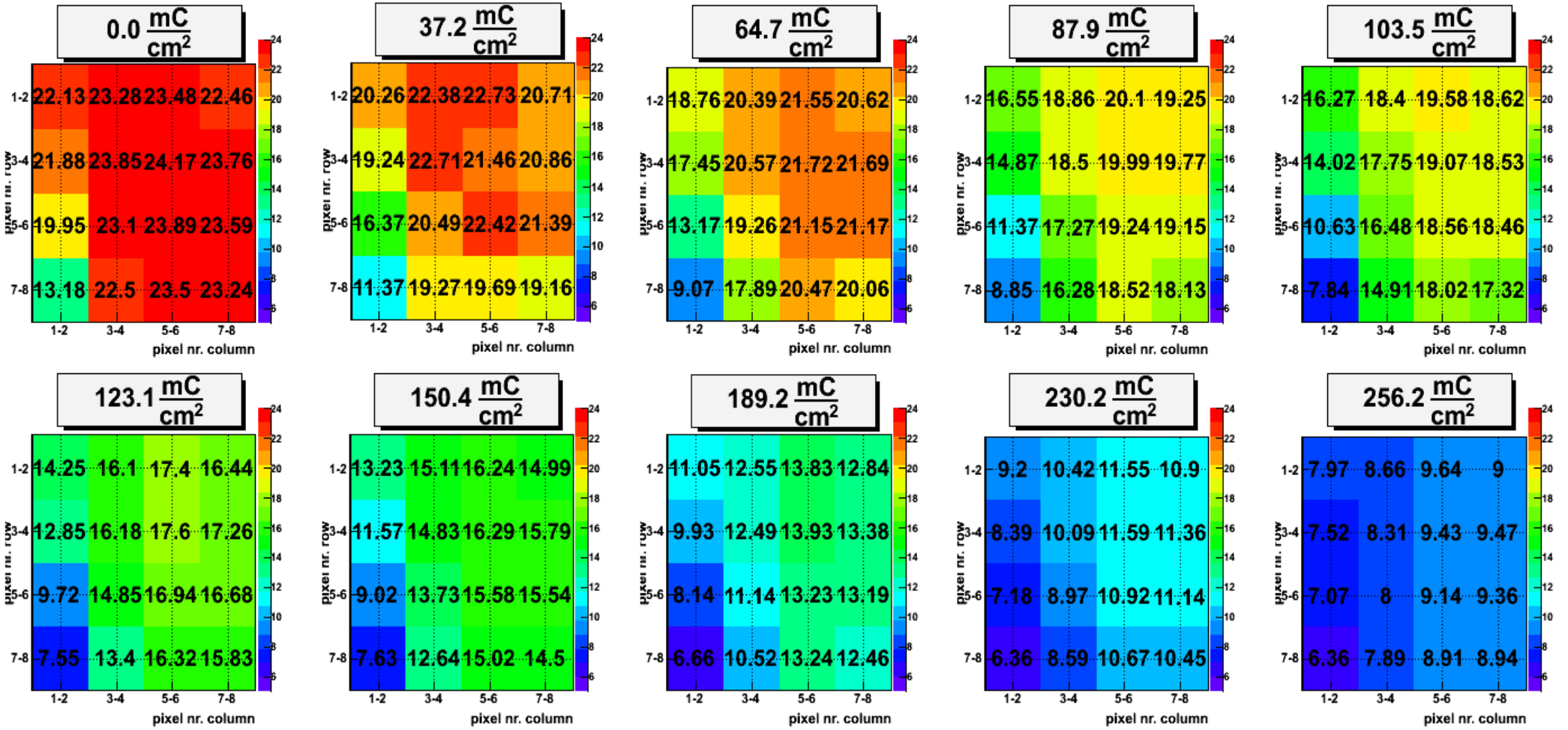
Gain and rel. Photon det. eff.





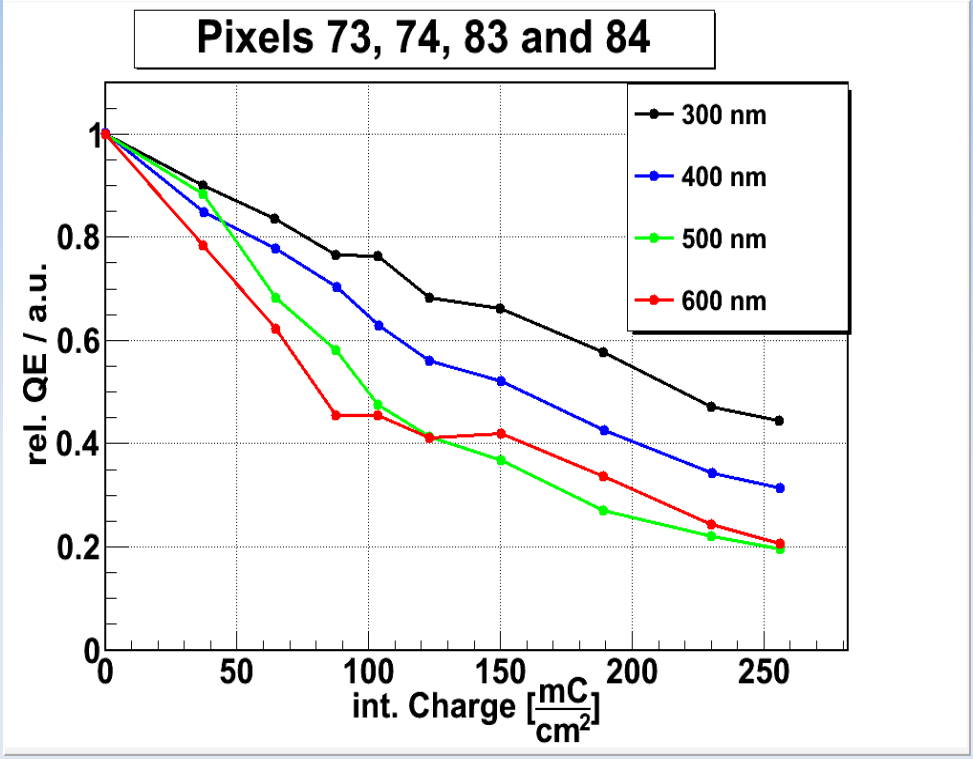
- Gain drops by ~50% at 277mC/cm²
- ”total-cut” and ”direct-cut” result in same Gain, center of charge is a bit higher
- Linear extrapolations of rel. Photon det. eff. and QE are similar (10% at ~300mC/cm² for 460nm)

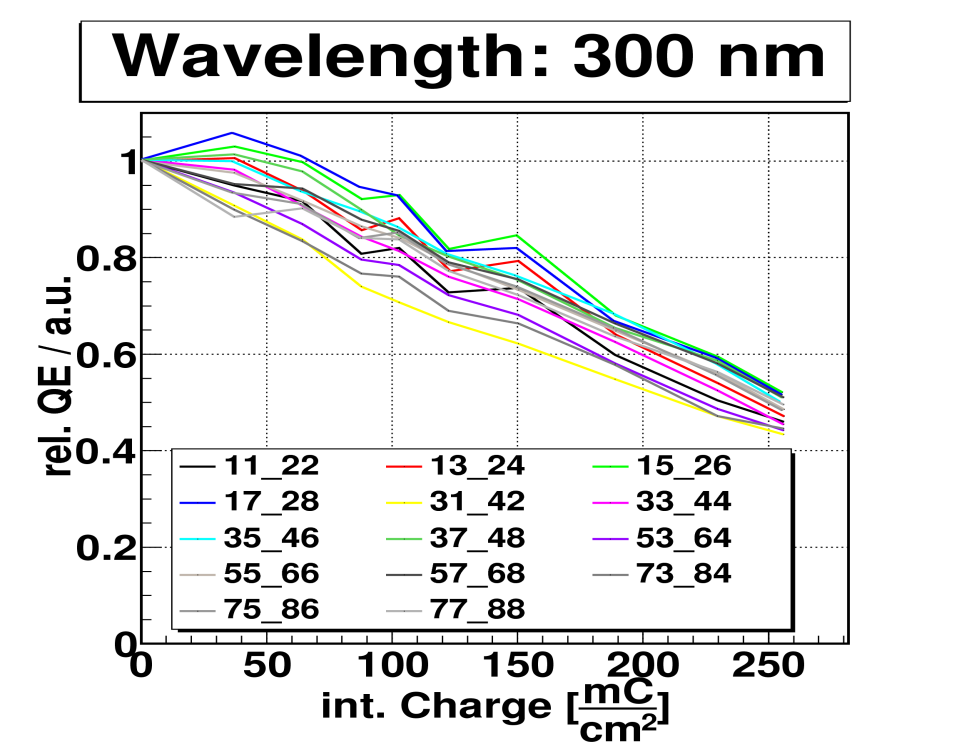
QE Scans



Lower left corner had a few ”bad pixels” resulting in a high darkcount rate and low QE at the beginning

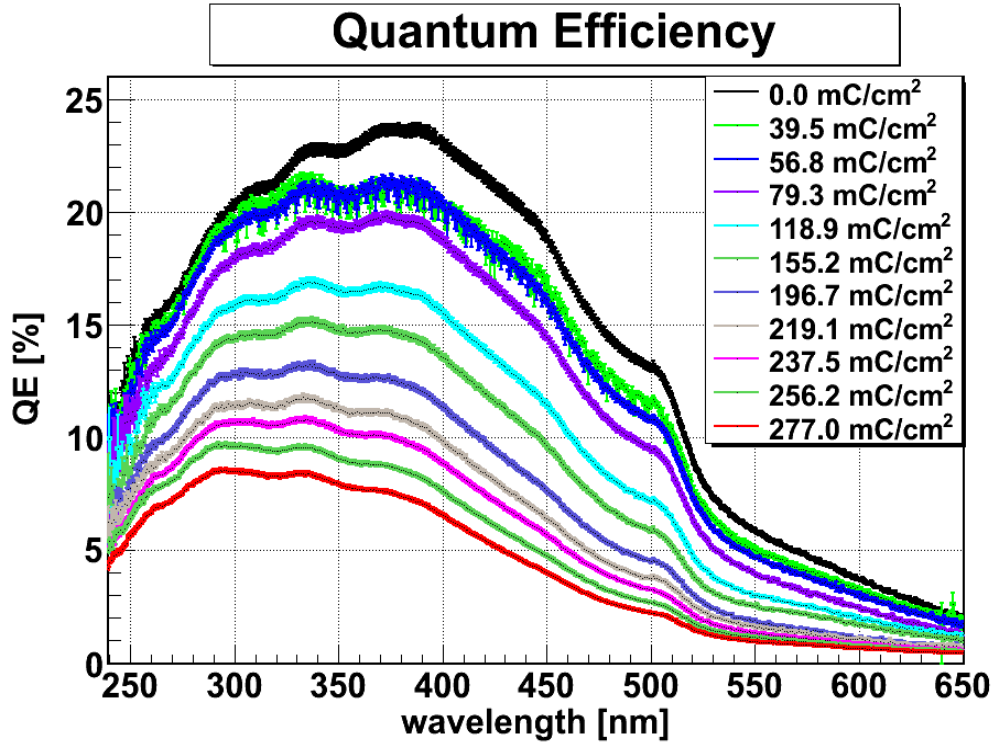
QE Scans (2)

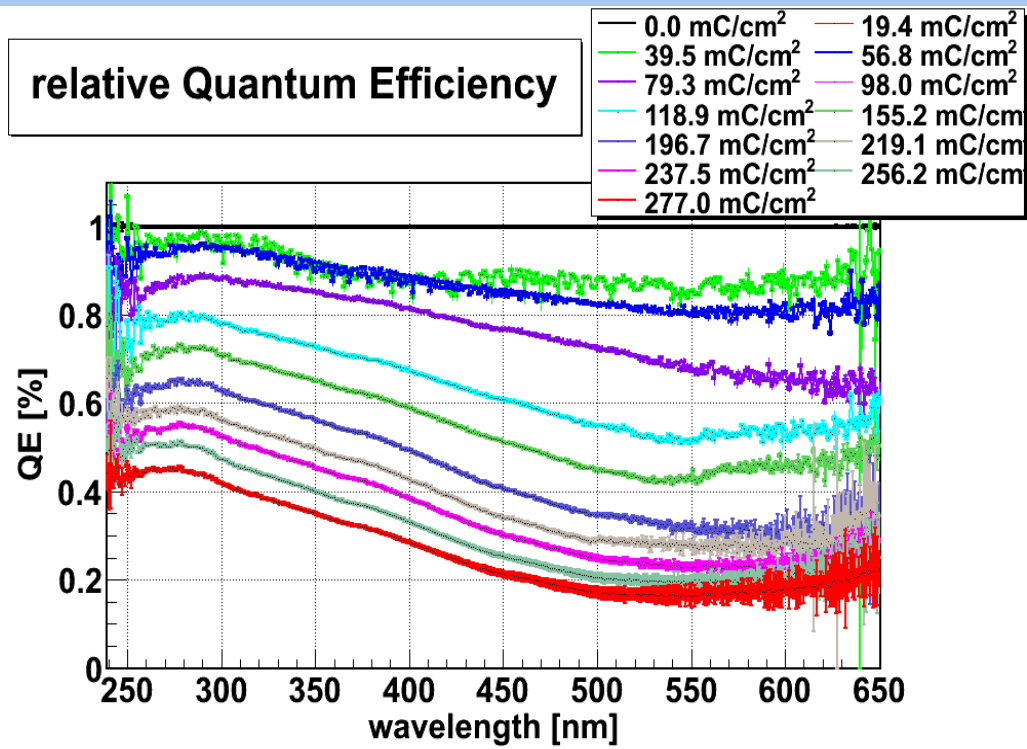




- Faster decrease of higher wavelengths can be measured for all pixels
- The relative loss for a given wavelength is quite similiar for all pixels

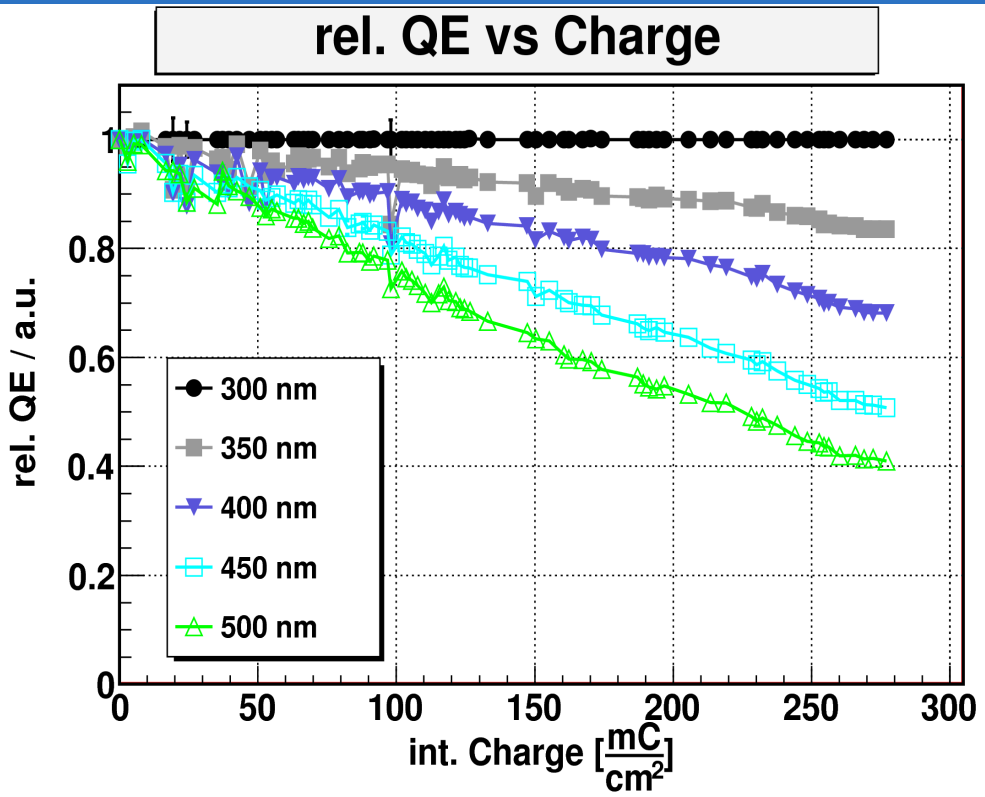
Quantum Efficiency

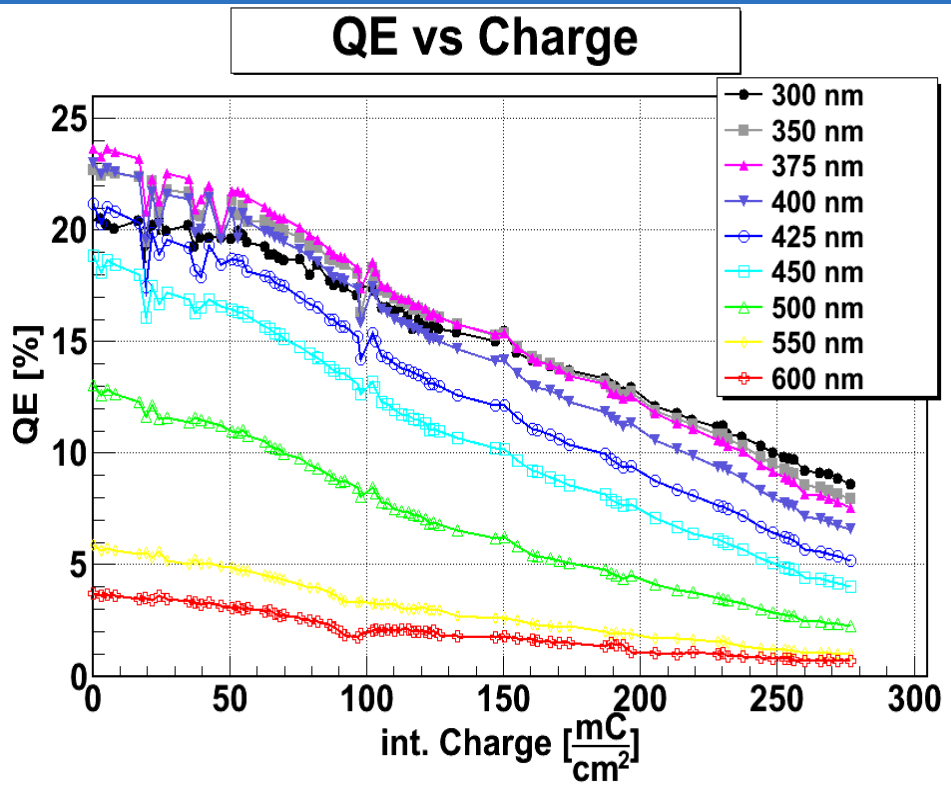




Rel. QE drops faster for higher wavelengths
=> absolute Maximum shifts to lower values

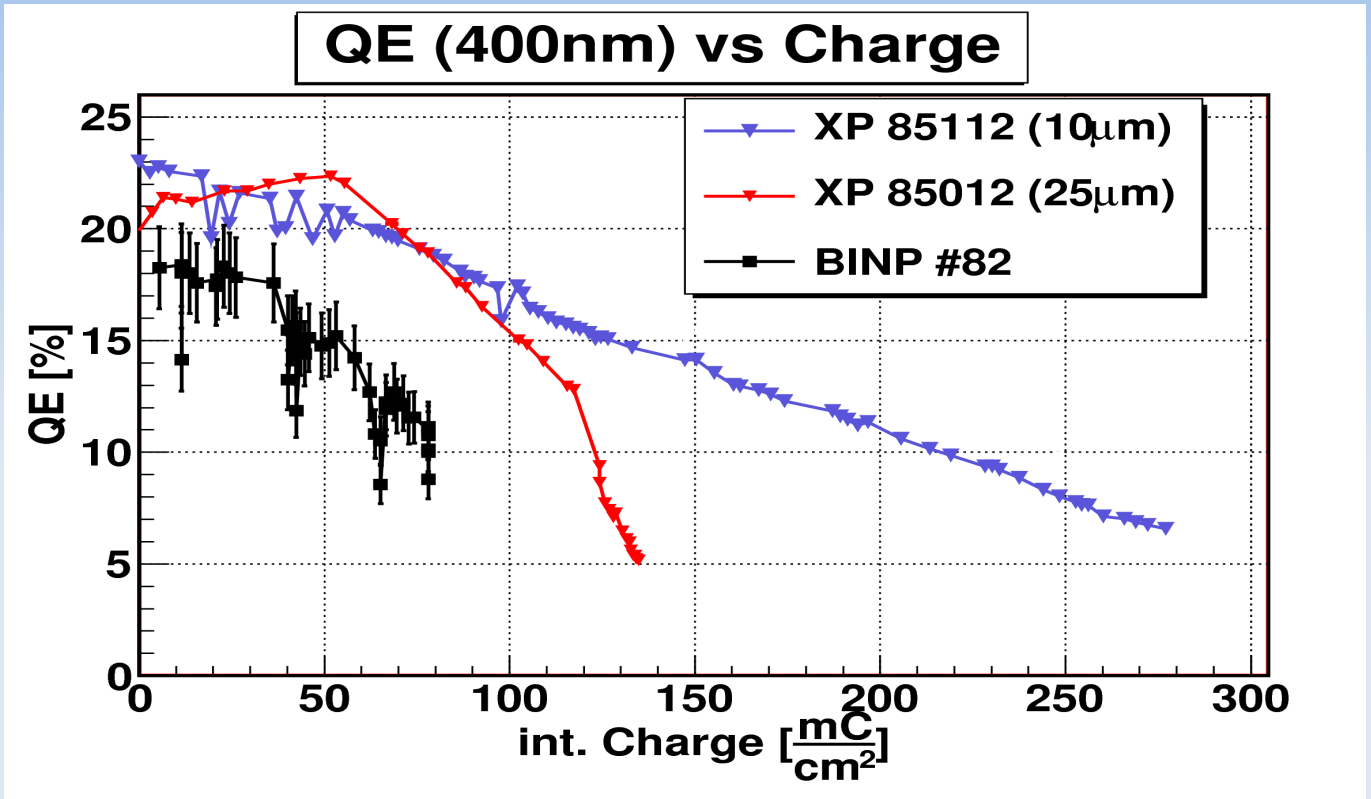
Quantum Efficiency (2)





Rel. QE is normalized to QE of 300nm of the corresponding charge, i.e. would be equal to one if behaviour is unchanged

Quantum efficiency of previous measured MCP-PMTs

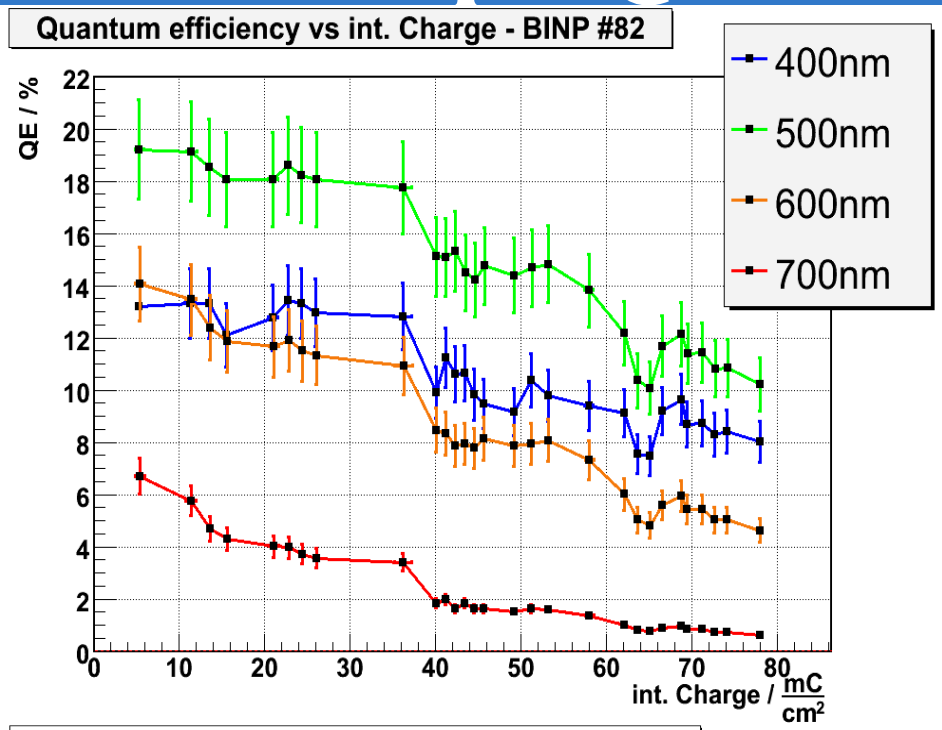


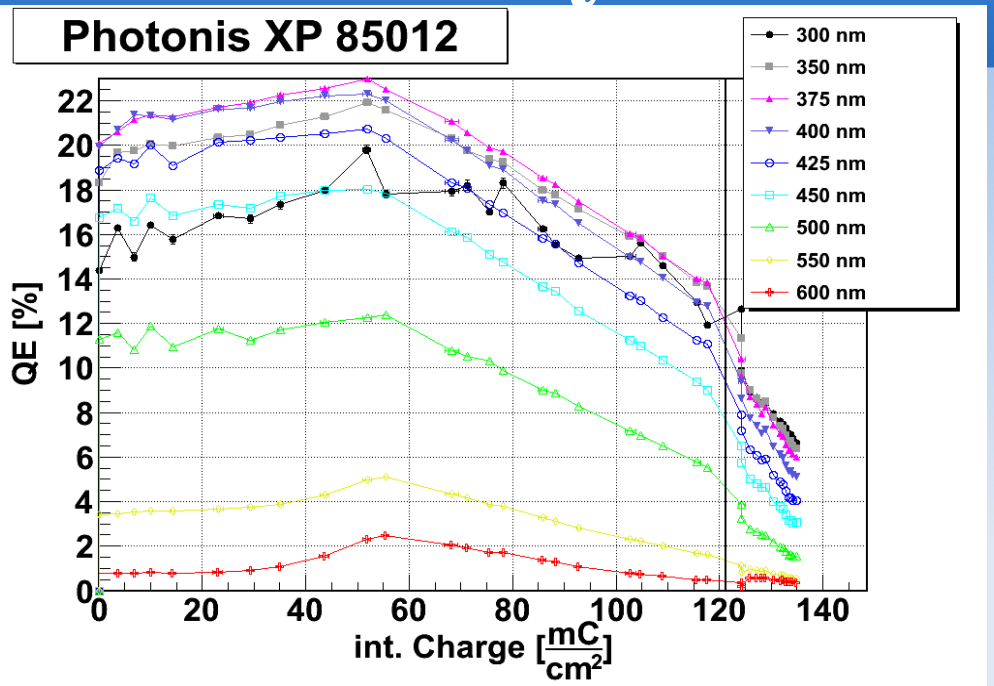
- Lifetime increased, since first measurement with BINP #82 and XP85012
- QE of XP85012 increased at the beginning, cannot be observed with any other MCP-PMT so far

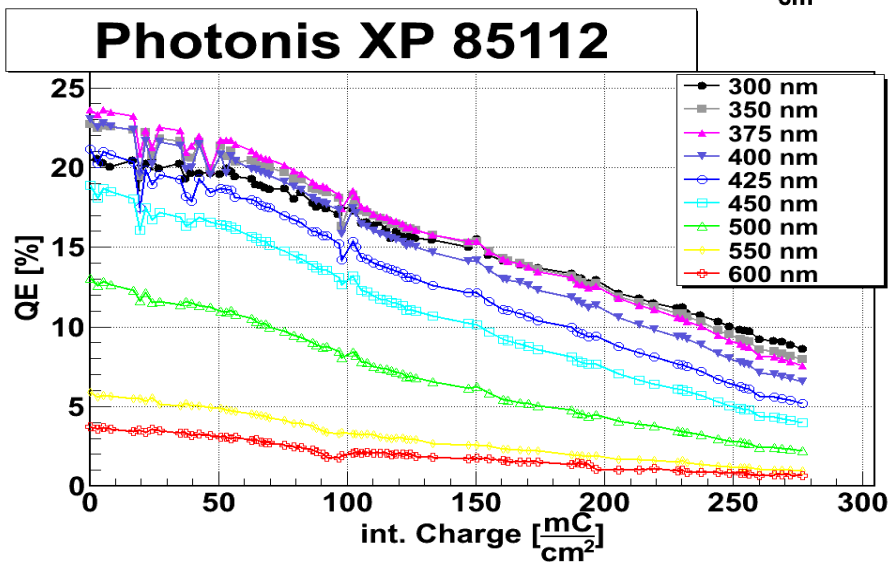
Summary and Outlook

- **Results of XP85112 after 277mC/cm²:**
  - Gain dropped by ~50%
  - QE (460nm) by ~80%
- Lifetime of XP85112 still not sufficient for PANDA requirements ($1\frac{C}{cm^2 * a}$, 100% duty cycle)
- **On the other hand:**
  - Lifetime upgrades of Photonis MCP-PMTs ongoing
  - Recent developments of Hamamatsu SL10 seems promissing ($2-3\frac{C}{cm^2}$!! T.Mori et al., Lifetime-extended MCP-PMT, NIMA 629, p. 111-117, 2011)
  - Measurement of new SL10 imminent

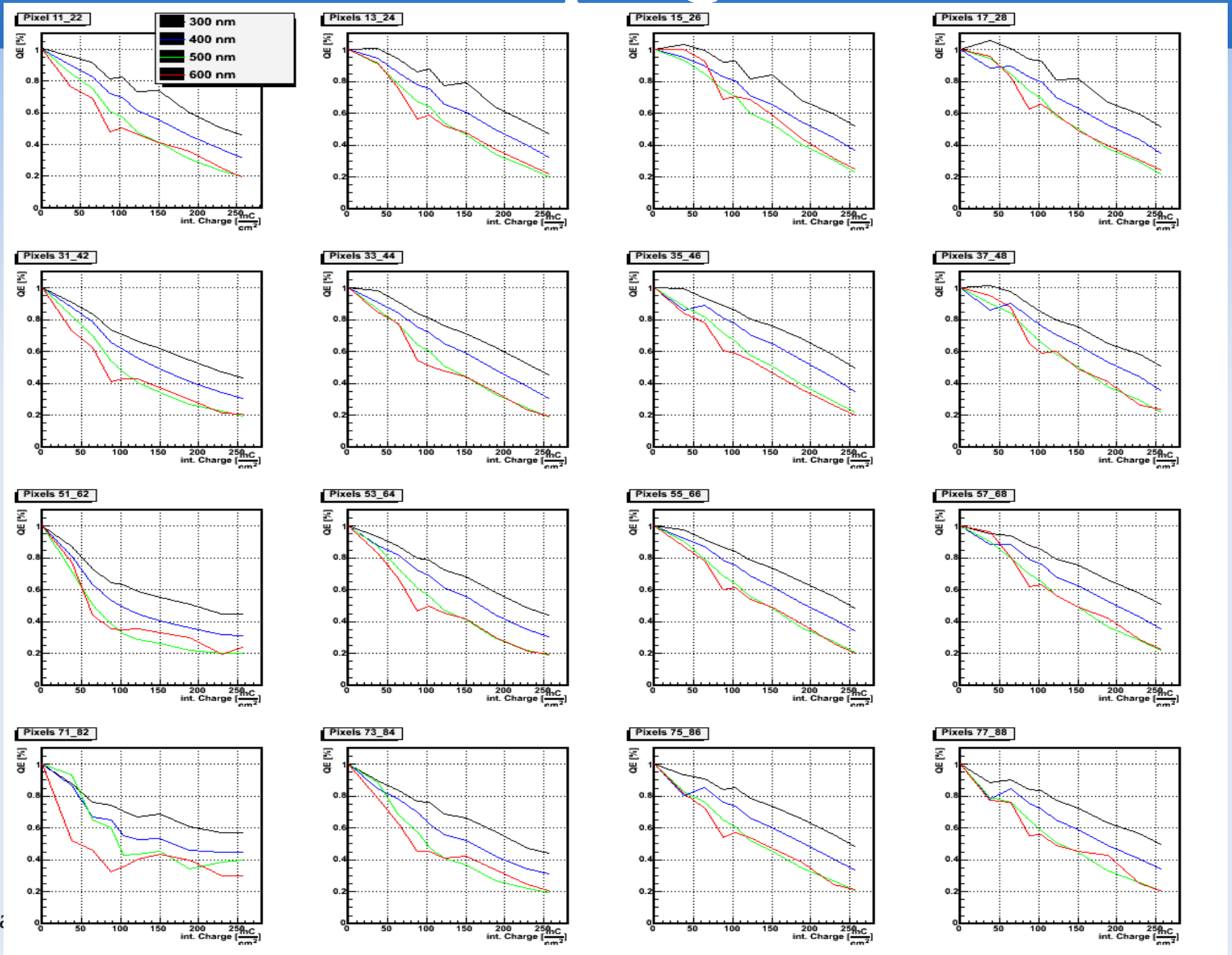
Backup: Quantum efficiency



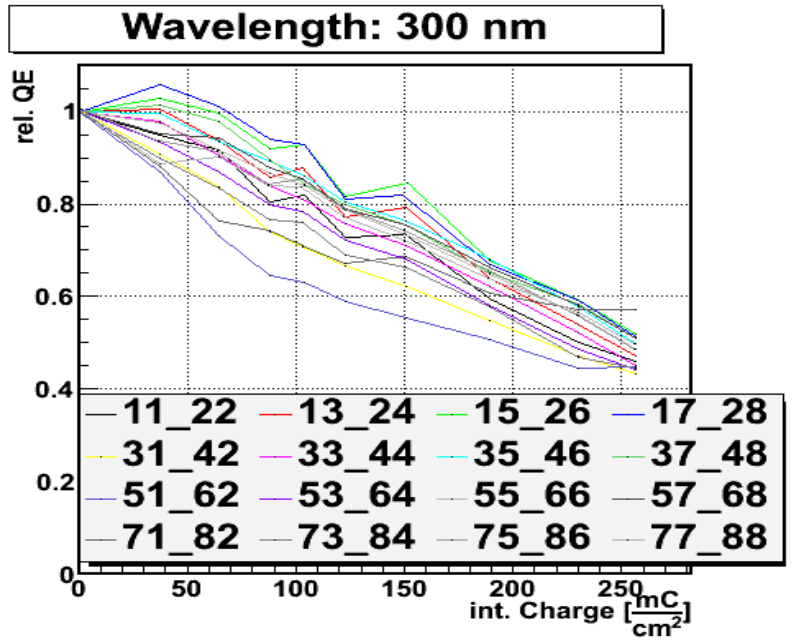


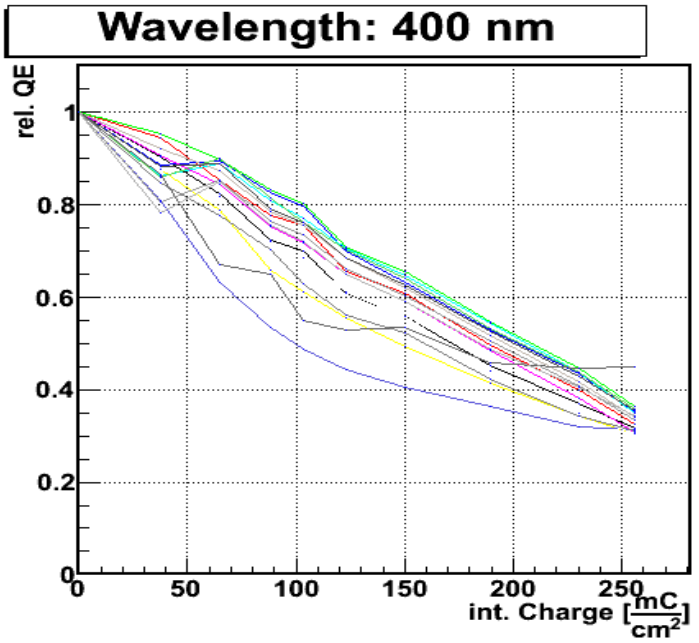


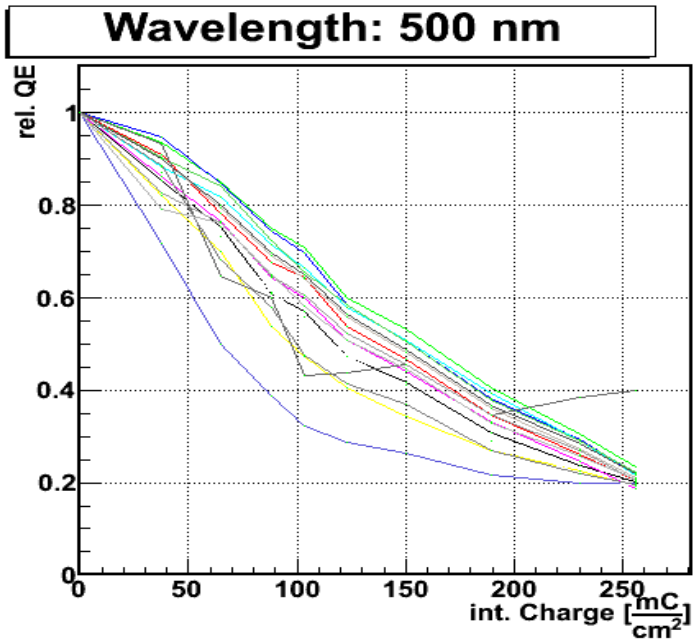
Backup: QE Scan

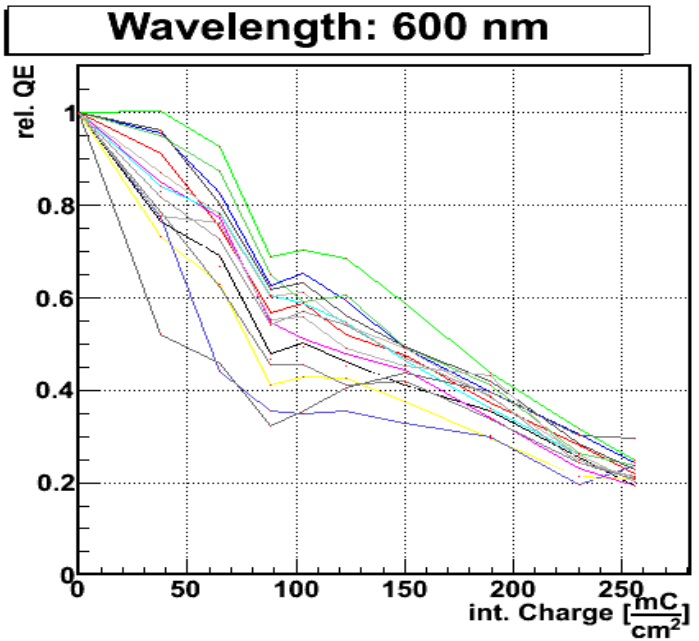


Backup: QE Scan (2)



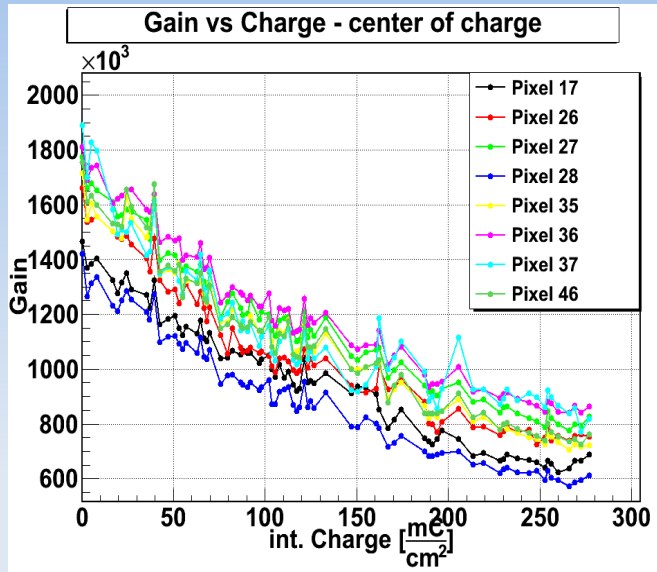


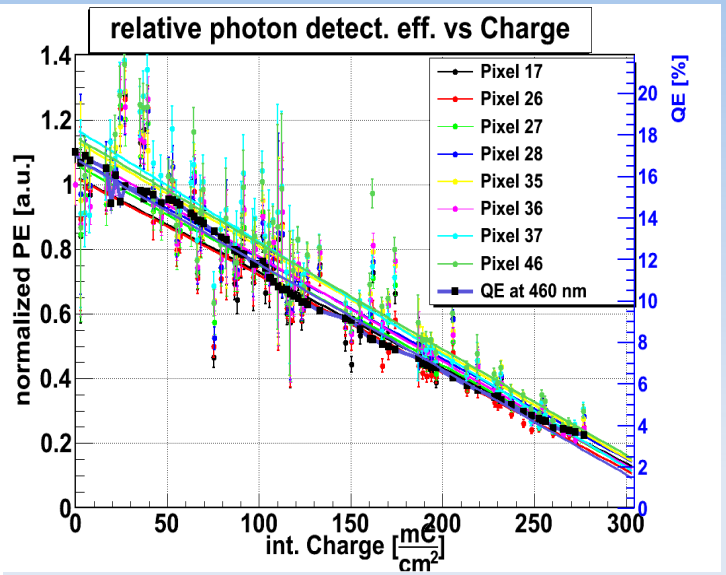


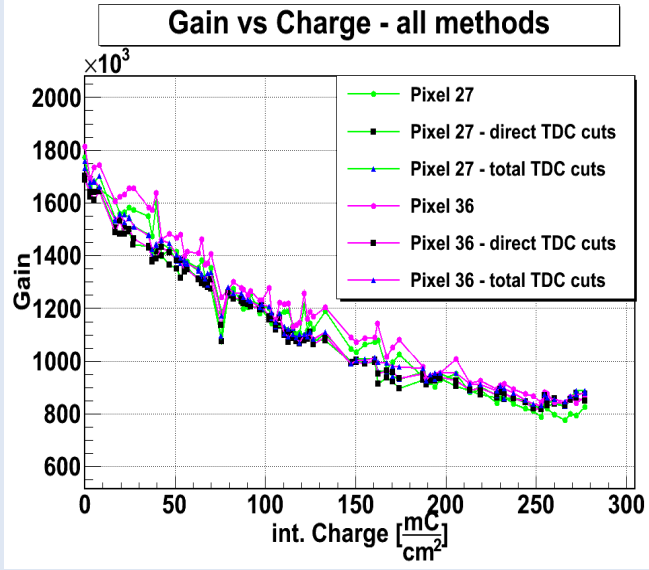


Lifetime XP85112:

Gain and rel. Photon det. eff.







- Gain drops by ~50% at 277mC/cm²
- ”total-cut” and ”direct-cut” result in same Gain, center of charge is a bit higher