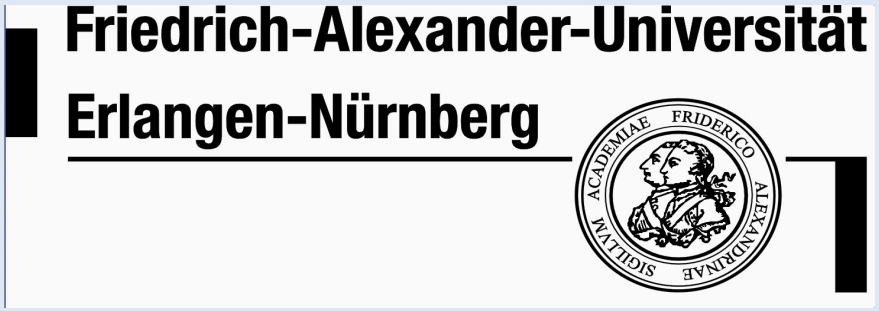
Lifetime measurement of MCP-PMT BINP #73



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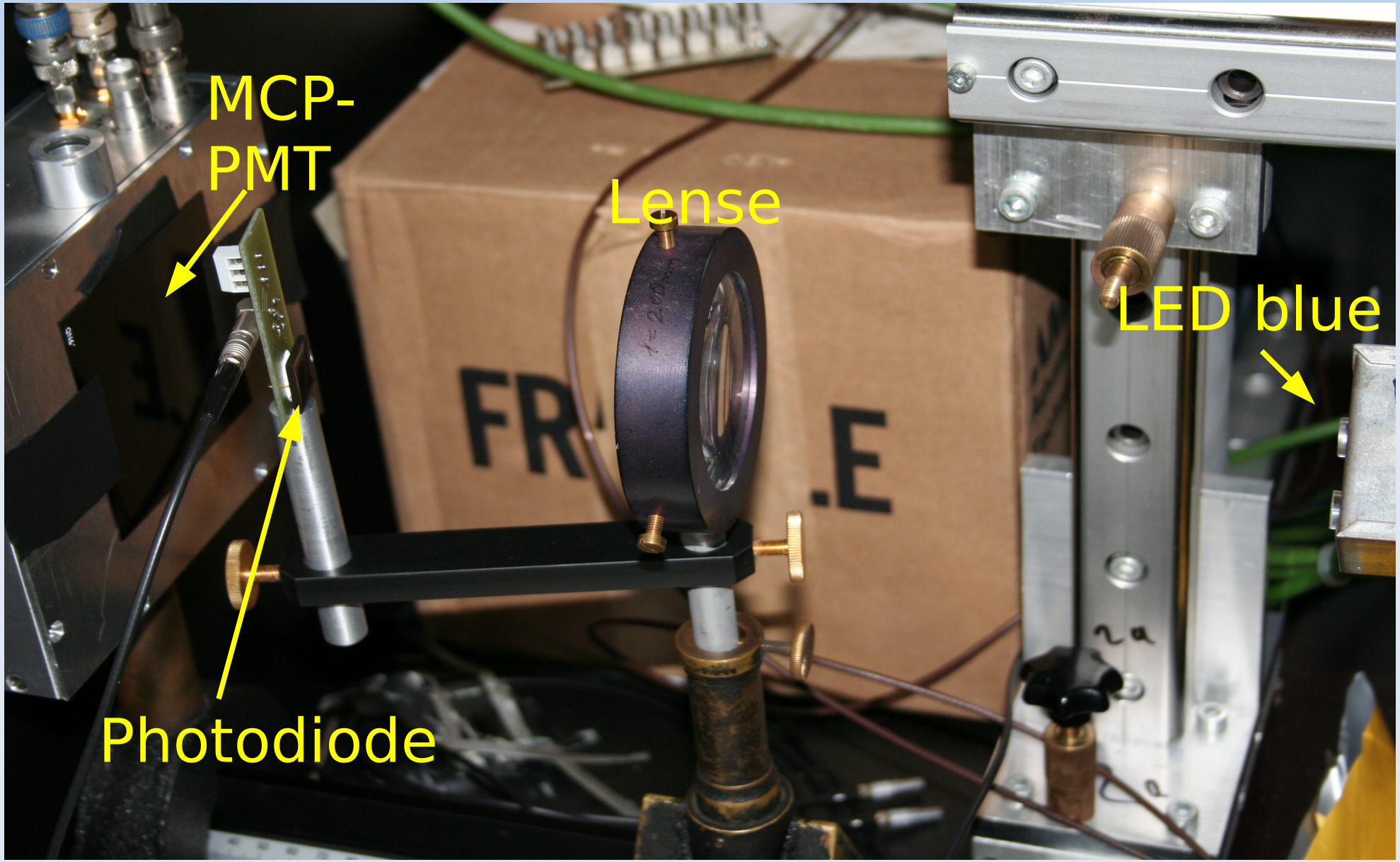
sponsored by BmBF und GSI

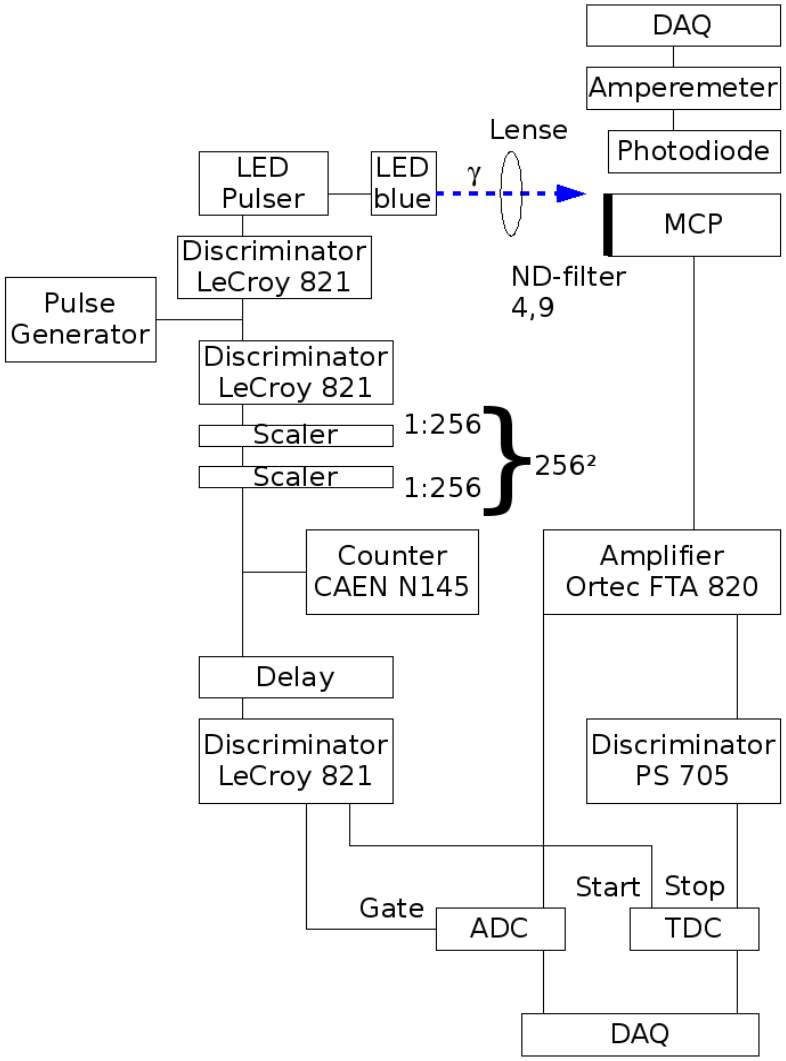
Overview

- Setup of Illumination, Gain- and QE-Measurements
- How do we measure?
- results

Setup of the Illumination and Gain measurement

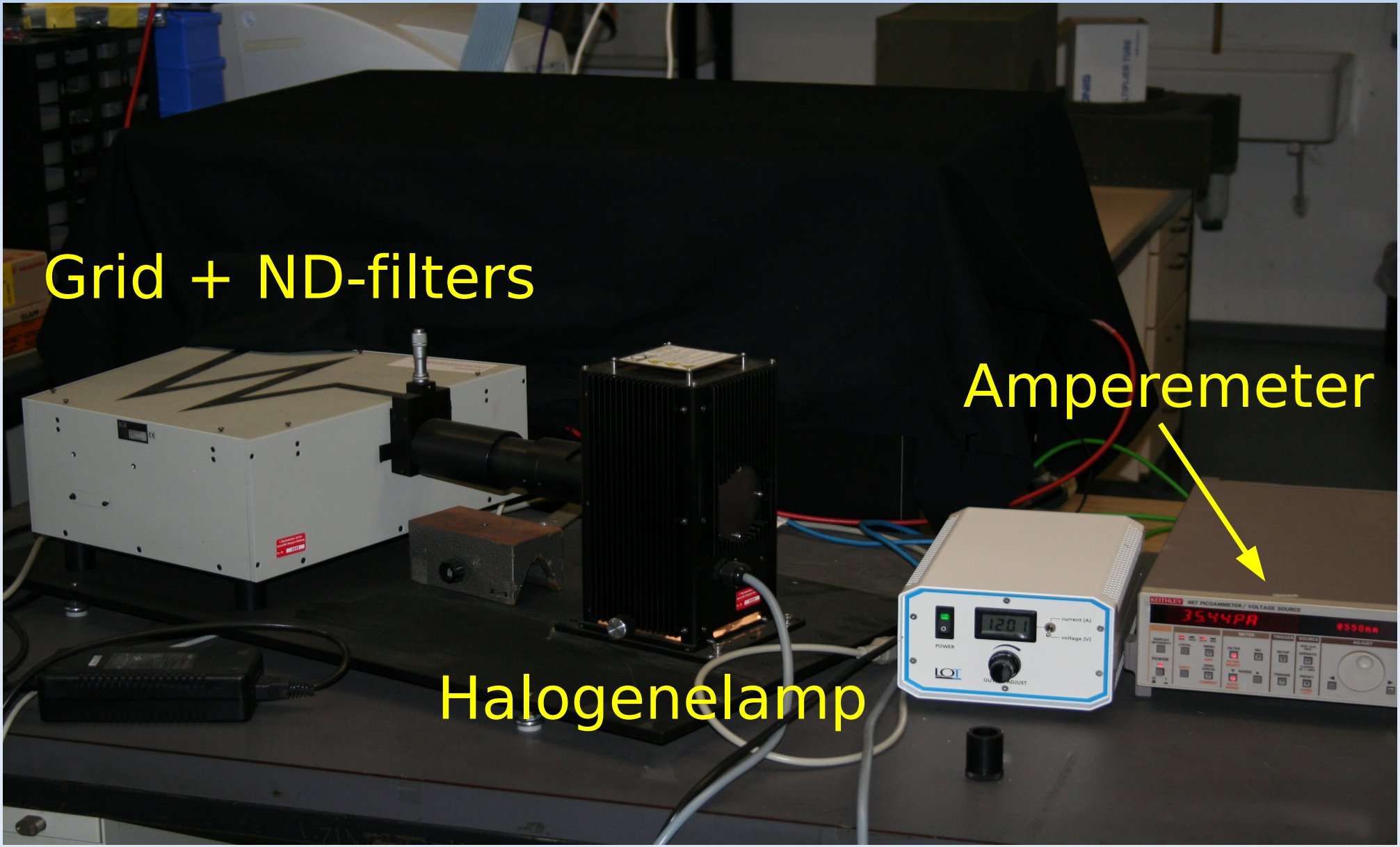


Setup of the Illumination and Gain measurement

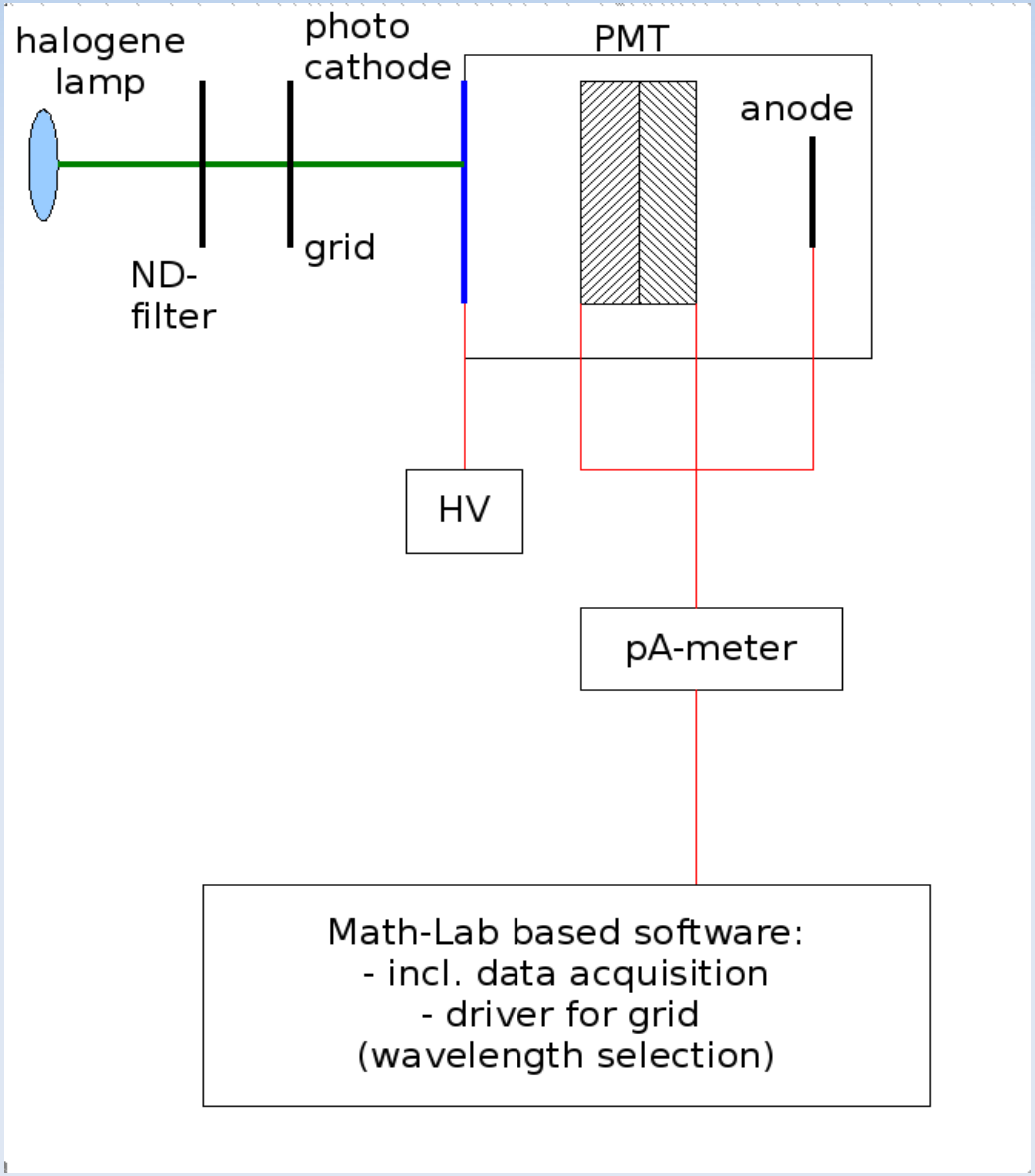


- Photodiode for monitoring of LED stability
- 2. Scaler for reduction to 'monitoring mode'

Setup of the QE-measurement

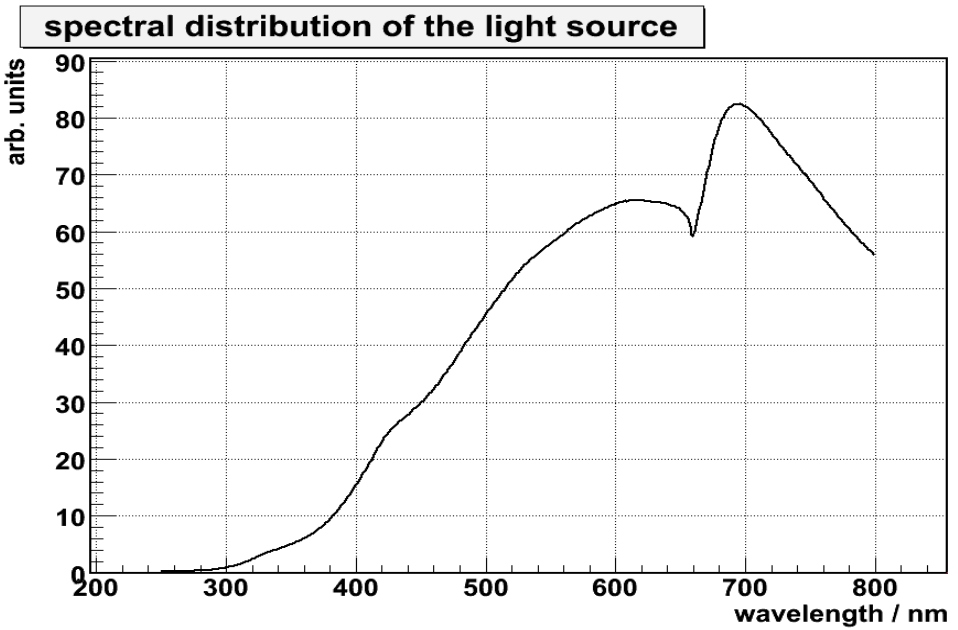


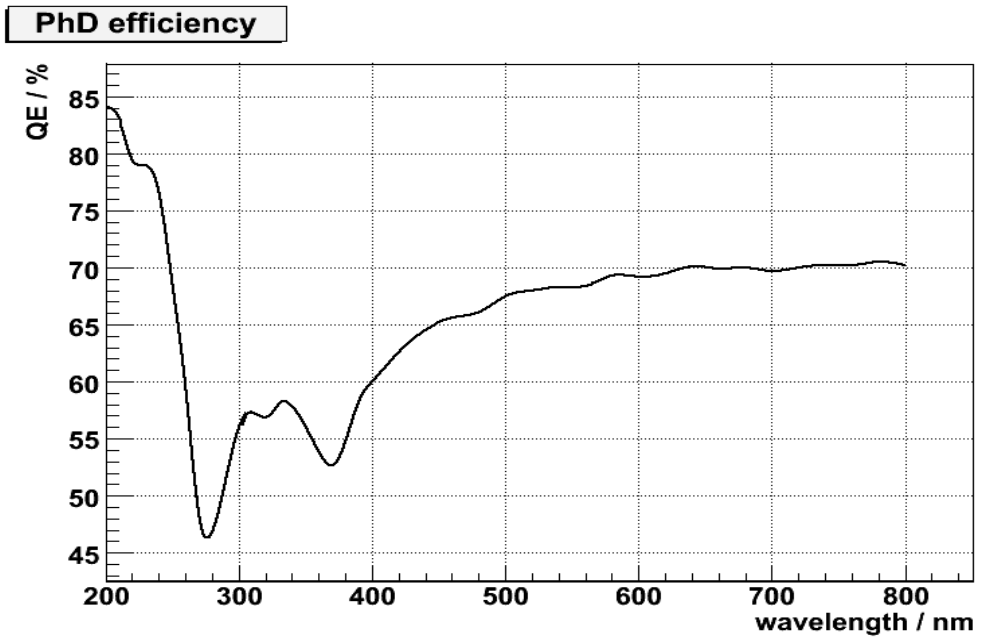
Quantum efficiency measurement



- wavelength selection by grid
- anode and PMT are shorted and current measured

halogene lamp





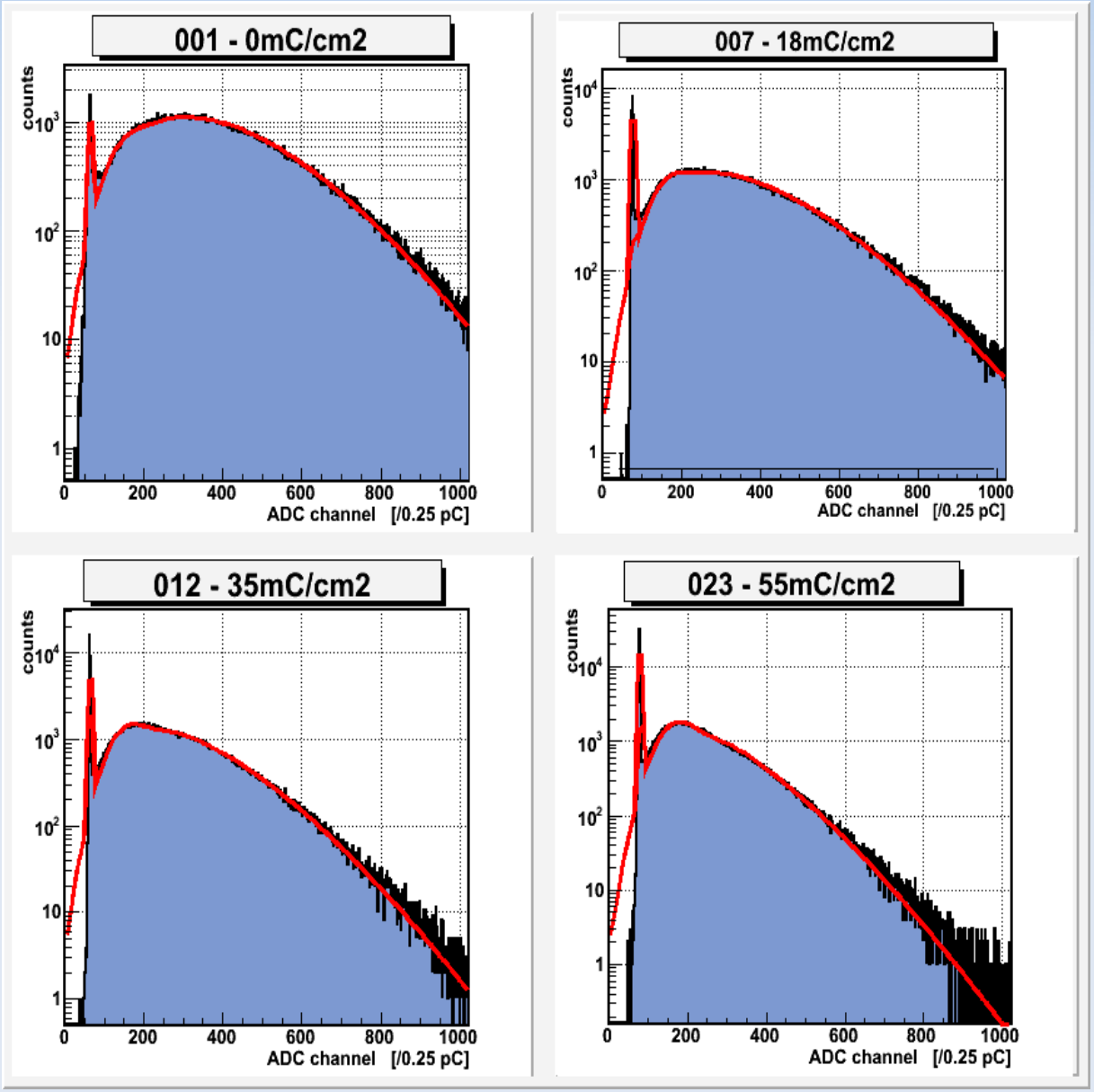
- apparently measurement limited for $\lambda > 300$nm (ND-filters)
- stable light source (halogene lamp, 100W)
- $\Delta\lambda = 1$nm
- calibrated PhD: Hamamatsu S6337-01

How do we measure?

- Measurement of the ADC-spectra (1 Scaler active)
- Illumination, Measurement of the ADC-spectra in 'monitoring mode' = reduced event rate (few Hz) with both Scalers active
- 2. Measurement of the ADC-spectra (1 Scaler active)
- QE-Measurement

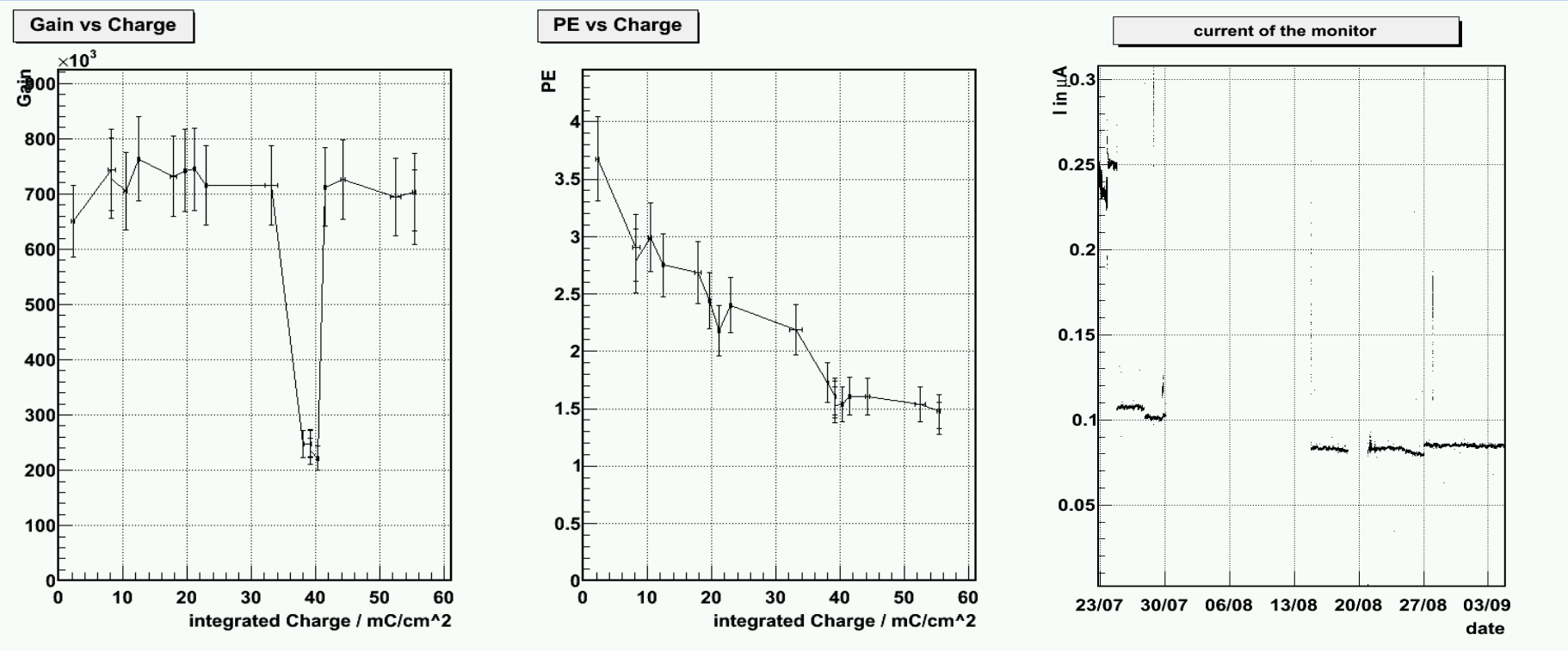
Results

ADC-spectra



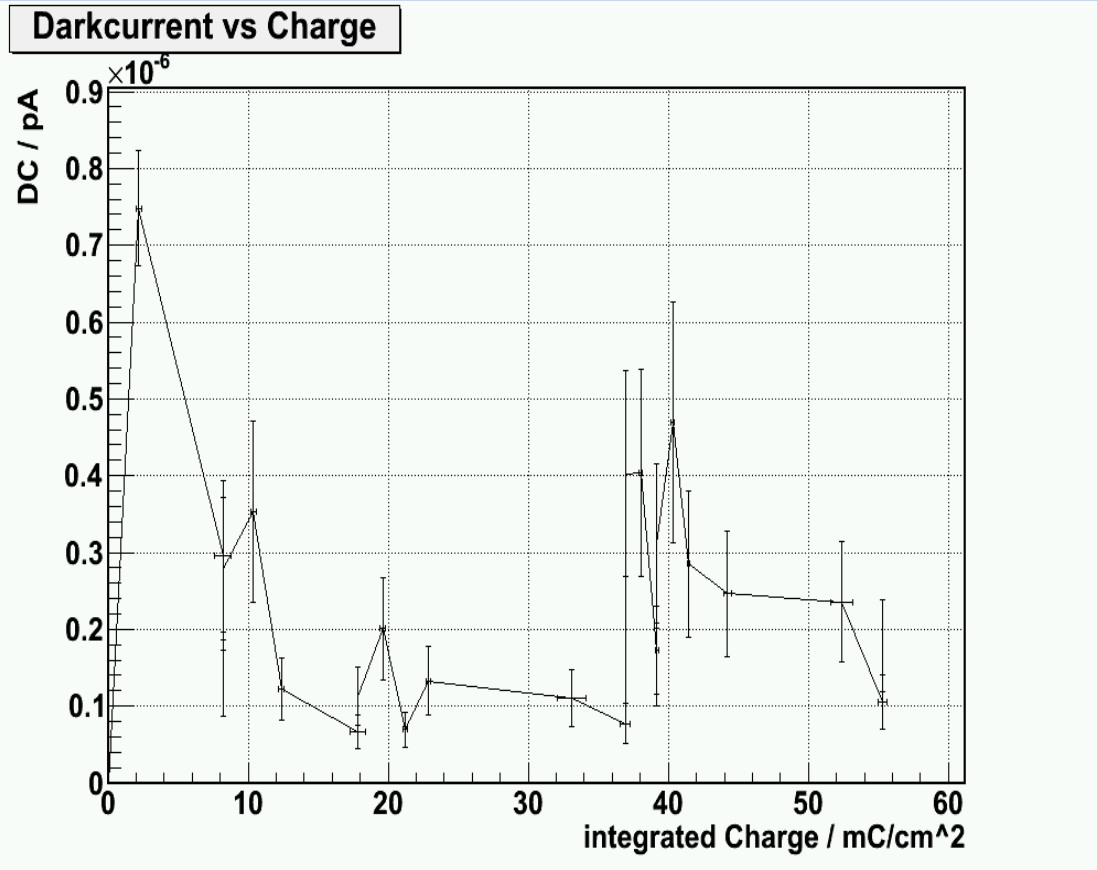
- increase of pedestal events
- signals are decreasing

Gain and Number of PE



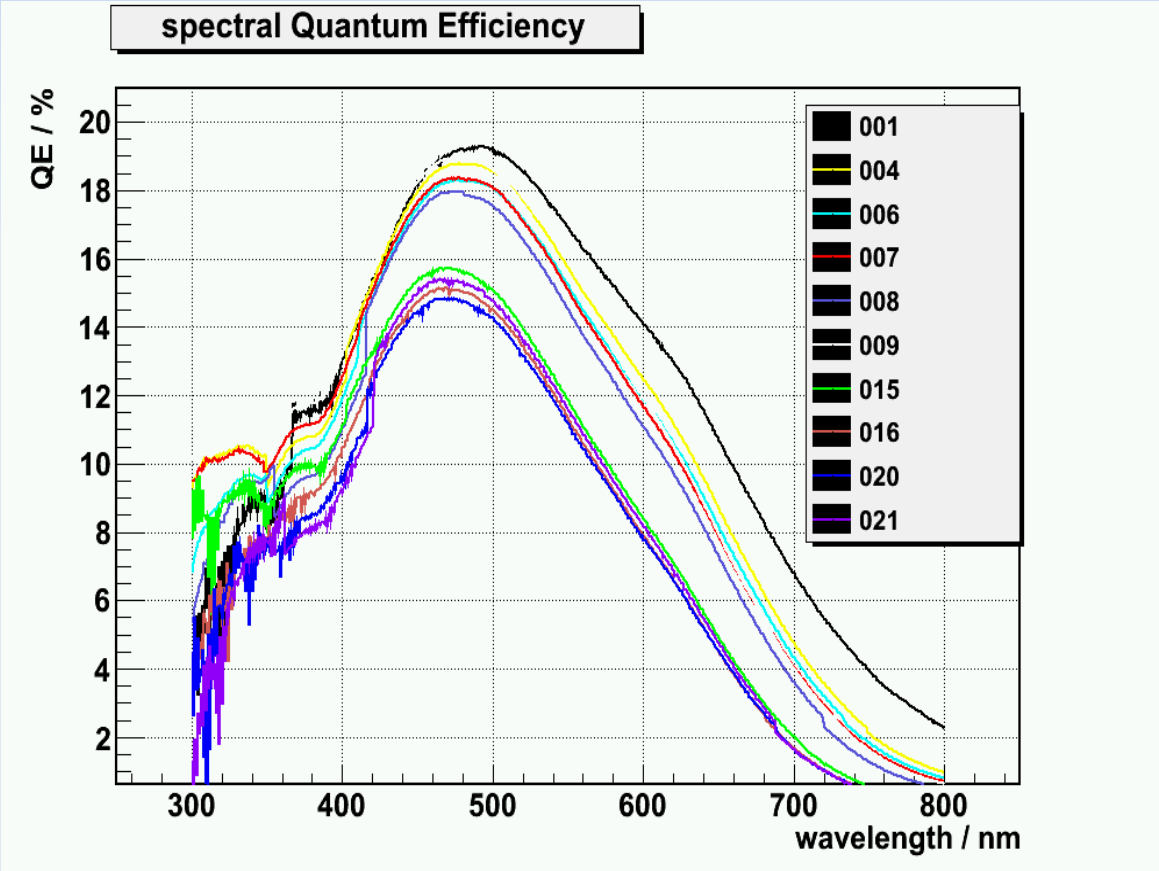
- Gain remains constant, PE decreases by factor ~2.4
- Blackout destroyed +60V channel of HV, resulting in Gain 'gap'
- with monitor: PE decreases by factor ~2

Darkcurrent



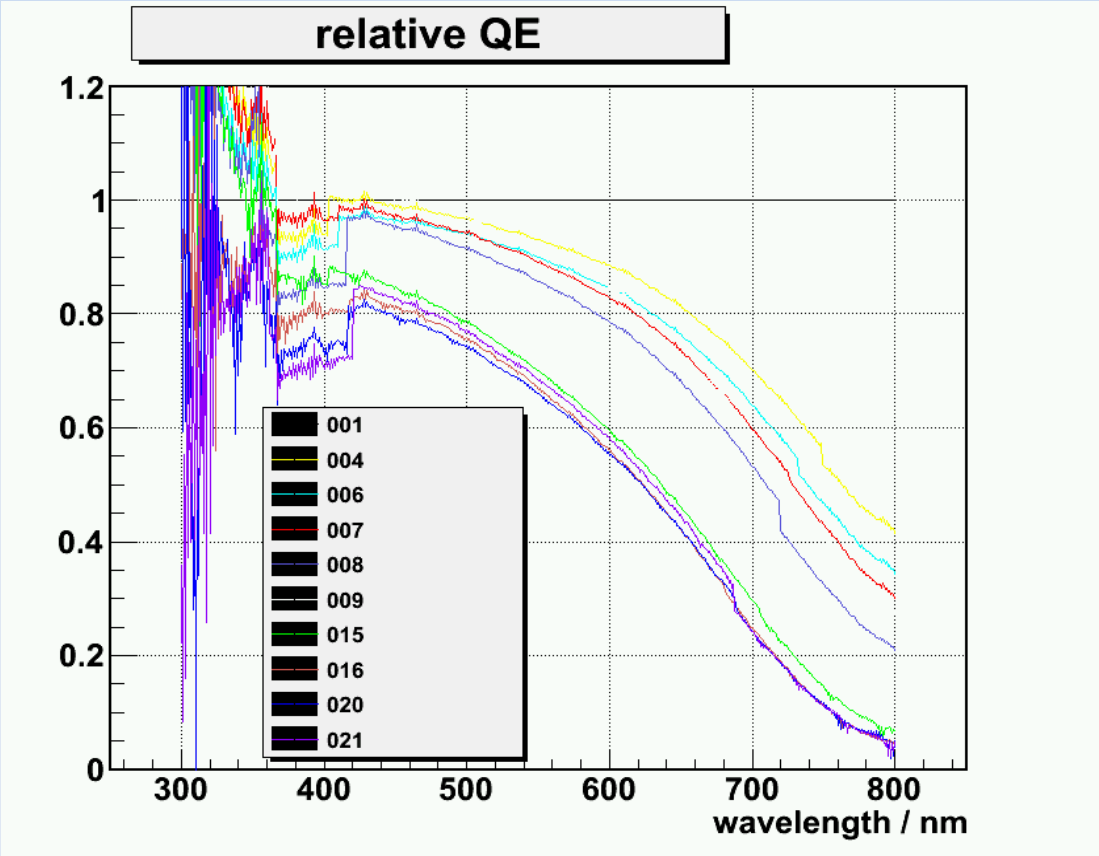
- Darkcurrent increases with increased charge
- Measurement error for 2mC/cm²
- strong darkcurrent while 'blackout-measurements'

spectral QE



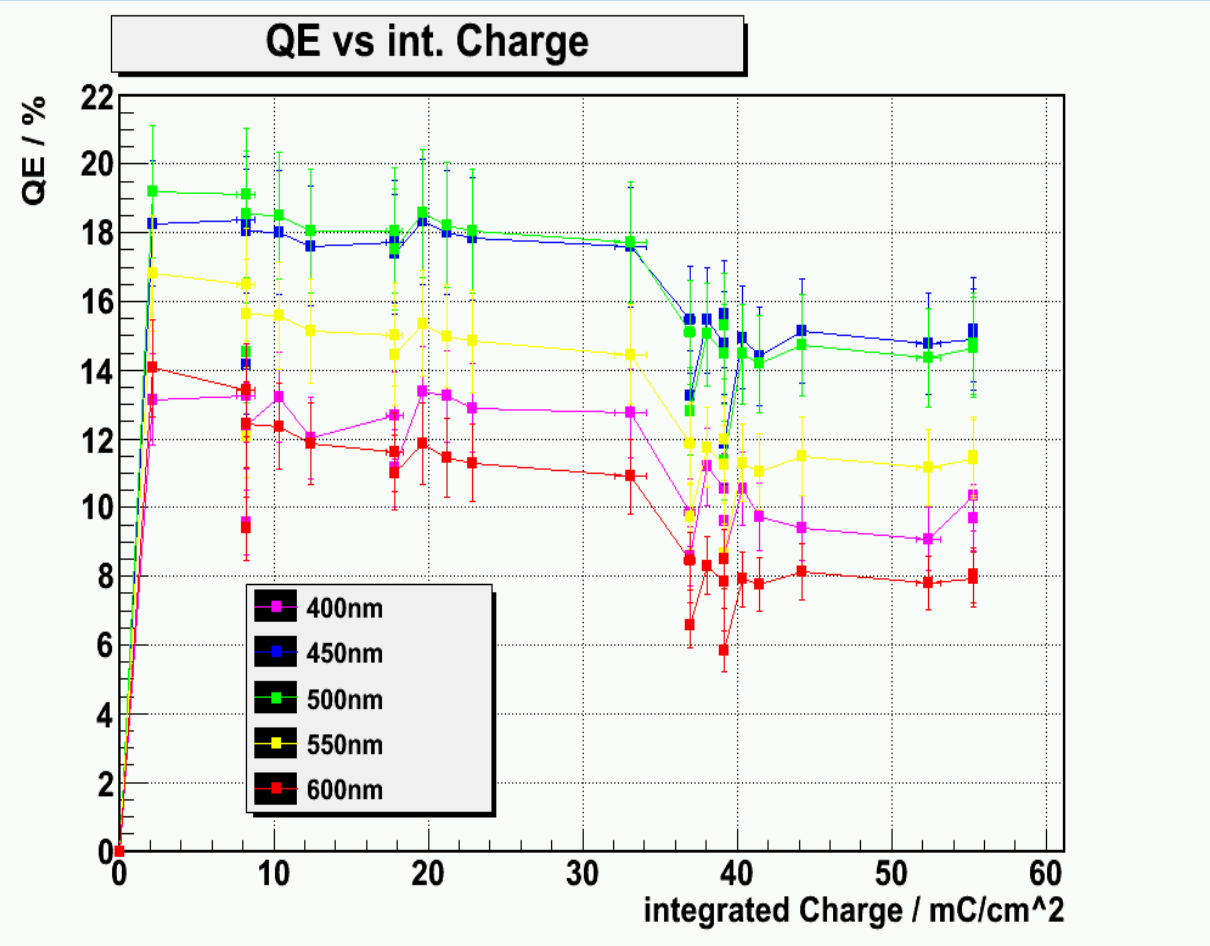
- decrease of QE with higher Illumination
- for low wavelengths: darkcurrents dominates because of spectral distribution of the light source
- origin of jumps unknown

relative QE



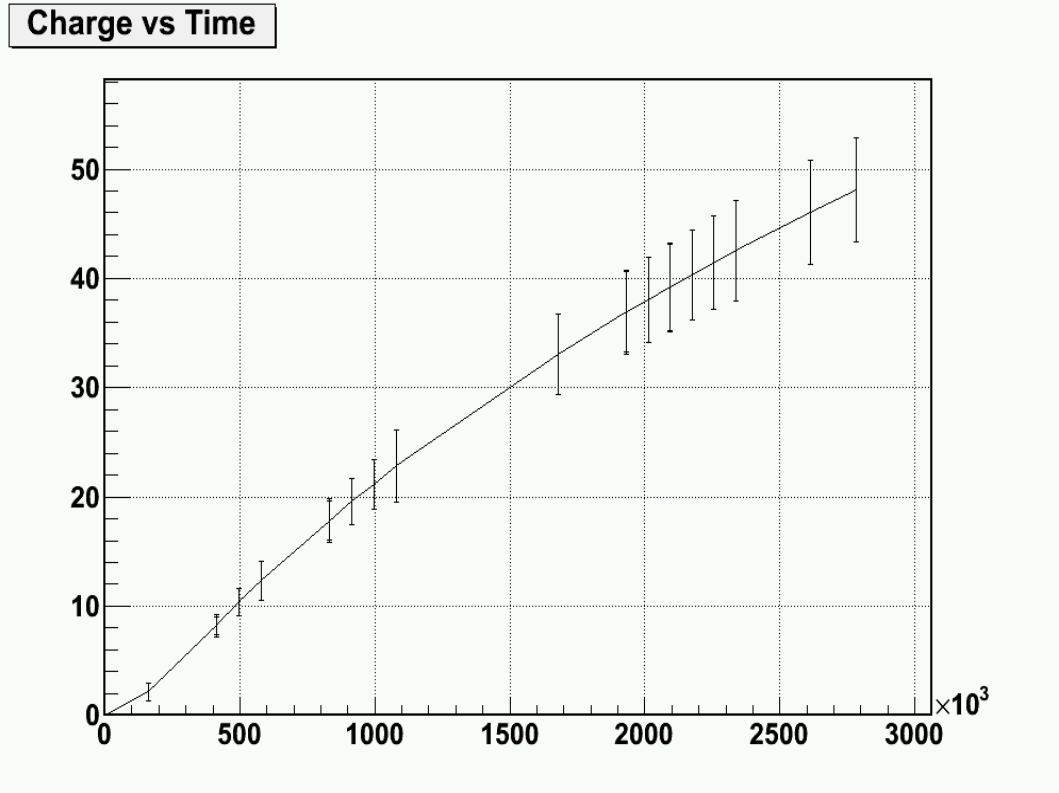
- QE drops significantly faster for higher wavelengths

QE(3)



- QE drops by 30%(400nm) to 70%(600nm)
- decrease slower than PE, possibility of aging LED needs to be investigated

Illuminationtime



- Chargeconsumption decreases with increasing time, because of decreasing PE
- jump at the beginning: artifact of higher rate (500kHz instead of 200kHz)

Outlook

- For further lifetime measurements a higher accuracy should be achievable by:
  - better stabilised positioning for QE-measurement
  - better stabilised lightsource for illumination
- Origin of faster PE drop compared to QE drop needs further investigation

But: Lifetime measurements are manageable!