To-do list PMT analysis

Analysis:

Fit optimisation:

- choose different **binnings**
- different **fit ranges** (vary first bin to fit and last bin to fit)
- maybe find better starting parameters/**limits** not only for Q1 and sigma1, but also for the others
- investigate **different cuts** for the baseline rms
- different limits for sigma1 upper limit (**finer steps** + automatical optimisation)
- fit different **number of max pe** peaks and take the one with best chi2

Modification of fit function:

- no cut with respect to baseline rms, but fit **2 pedestal distributions** (a broader one and a smaller one to compensate the strange distribution due to noise)
- pedestal is no gaussian distribution, but rather sum of Poisson (95%) and flat (5%) distributions (see DPG talk Oleg 2018)
- **fit original formula** with error function from paper
- or modified **formula from oleg**
- for crosscheck whether fit formula describes data well enough compare integral of of fit over entire fit range and integral of data, should be same, if not, fit formula is not good

Experimental:

Additional measurements:

- measure with **higher intensities**
  - integrate baseline before signal to obtain pedestal
  - fit only pedestal distribution (type I background process, only Q0 and sigma0, no exponential distribution here)
  - obtain „ideal“ parameters for Q0 and sigma0
  - fix them for fit of signal to these values
- measure gain/**Q1 dependency on intensity** (rising curve with saturation somewhere in ideal case) [measure e.g. $\mu = 0.2$ -2]
- measure at -100°C !!!!

Further considerations:

- use **diffuse flux on pmt**, gain/ results are dependent on incident angle of light, point of impingement onto photocathode is important for results, can differ (use diffusor or so)
- avoid **electronic crosstalk** of LED and PMT
  - for lower temperatures, strange oscillations at trigger visible
  - most probably electronic crosstalk between LED and PMT, resistances and capacities change with temperature, optimised for room temperature, for cold temperatures different
  - better to separate LED and PMT as good as possible
  - maybe place LED outside climate chamber or xenon cell and couple light inside with optical fiber
- avoid **ice formation**
  - when cooling down, humidity of air is not controlled in climate chamber
  - ice formation onto pmt is possible, maybe changing response of PMT
  - guarantee air circulation with e.g. ventilator
  - or use silica (kp whether they can be used for low temperatures) to absorb humidity