

Update on Lifetime Measurements and the strange behavior of the latest Photonis tubes

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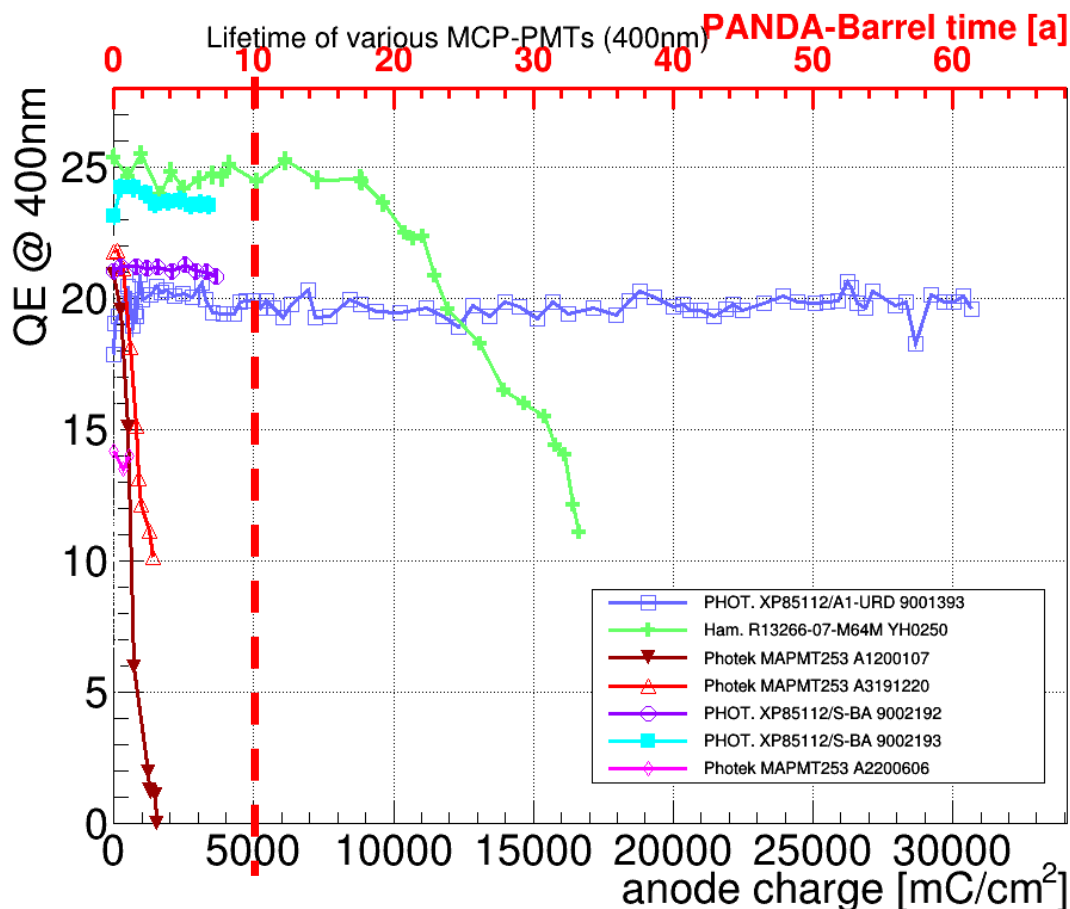
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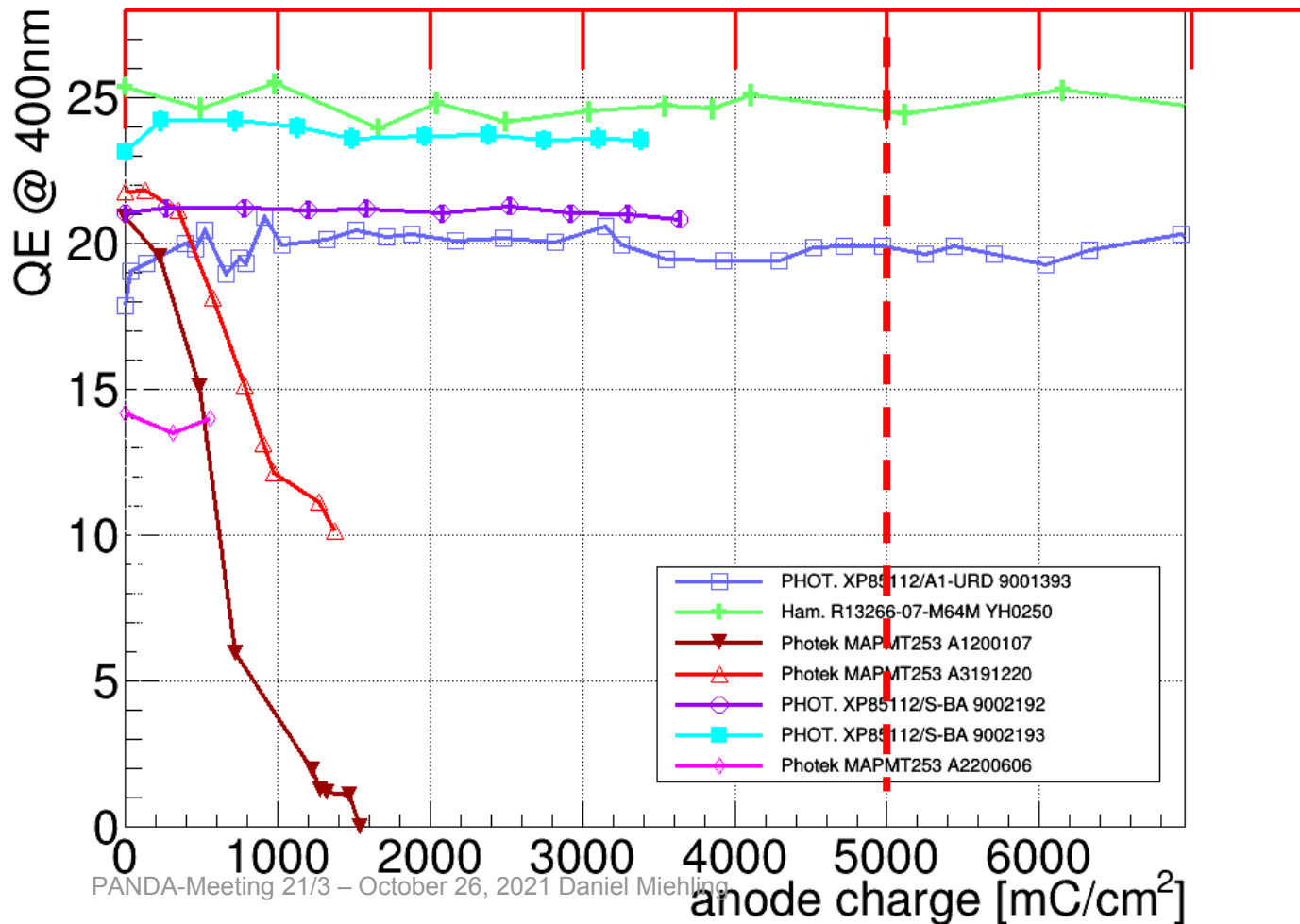
Lifetime data of latest sensors



- Most sensors with **ALD** coated MCPs have lifetime $> 5 \text{ C/cm}^2$
- Photeks **A1200107** and **A3191220** have been removed and **A2200606** has been built in, Photonis **9002192**, **9002193** and **9001393** are not decreasing

Lifetime data of latest sensors

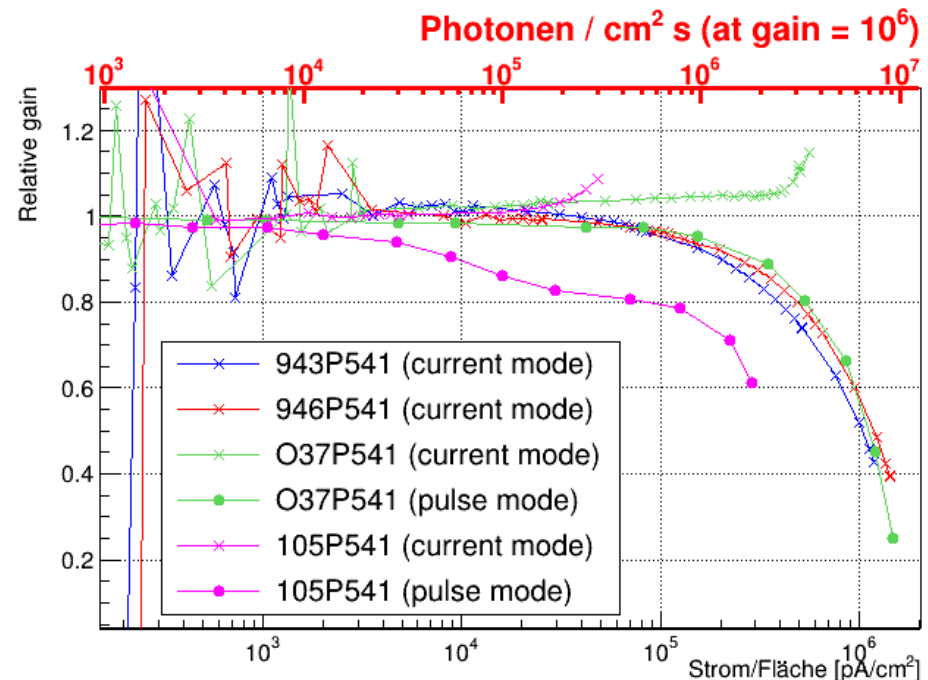
Lifetime of various MCP-PMTs (400nm)



Reminder: strange effects of 9002192, 9002193, 105P541 and O37P541

- 9002192 & 9002193: sometimes extremely high count rates in TRB scans in Juelich in both 2020 & 2021
- 105P541 & O37P541: seeming increased rate stability in current mode, but way less in pulse mode, sometimes highly increased anode and supply current

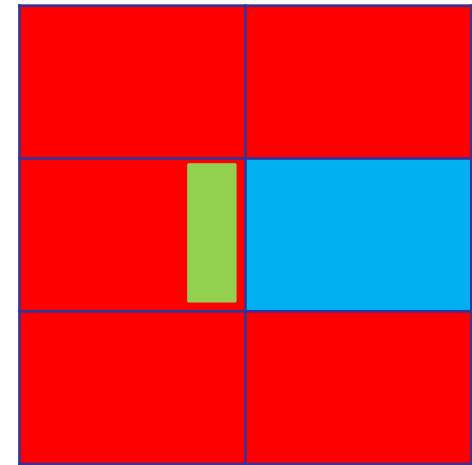
- systematic approach:
when does it occur and what happens then?



Example video for 105P541

- left side will show **Padiwa/TRB system** readout of non illuminated 50 channels
 - upper right corner will show **scope** with 1 illuminated pixel (~ 0.5 pe, 5kHz)
 - in the center there will be the HV control panel with the supply current
 - first voltage: 2280V ($\sim 1.0e06$), then 2330V ($\sim 1.7e06$), then 2380V ($\sim 2.5e06$)
- high count rates, low signal height, high currents

105P541
(3x100 pixels)



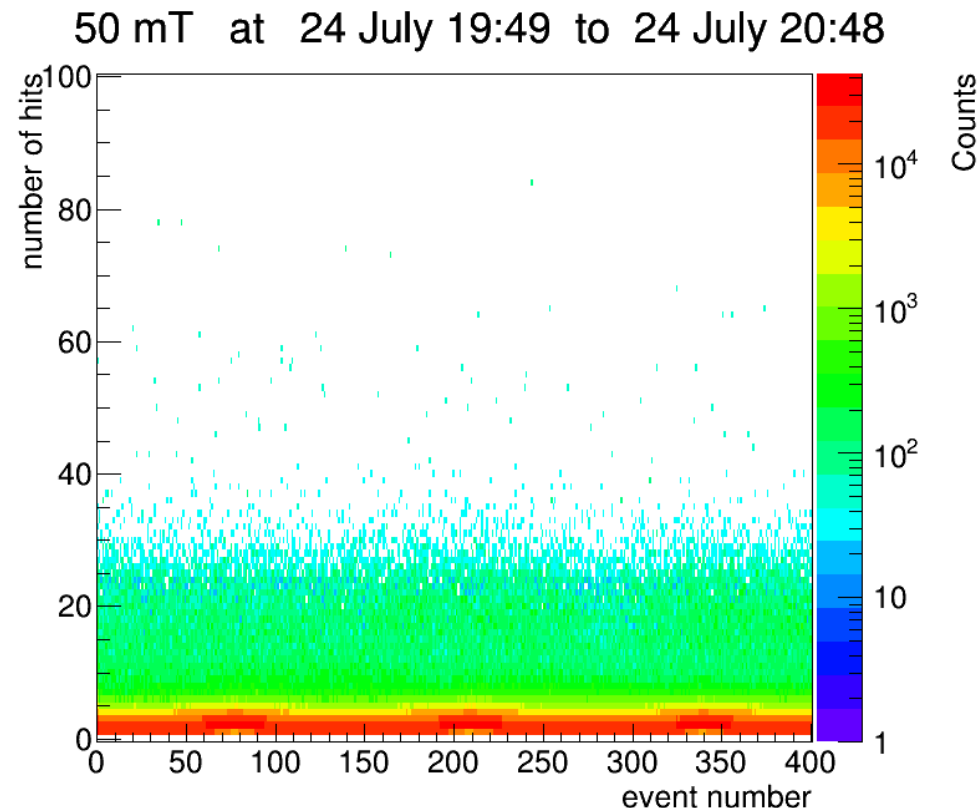
- **Scope readout, illuminated pixel**
- **Blue: TRB readout, not illuminated**
- **Red: shorted to ground**

Influence of the voltage divider (PC-MCP_in voltage)

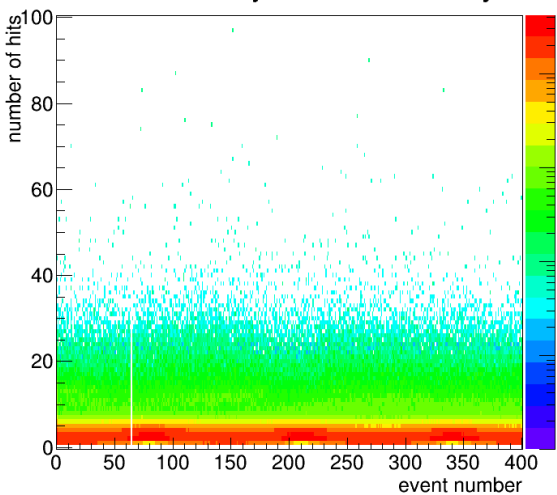
- definition of „escalation“:
 - high count rate
 - smaller signals
 - high anode current
 - high supply current
- different voltage divider configurations for 9002192 & 9002193 from 1:10:1 to 4:10:1
- → the higher the PC-MCP_in voltage the higher the probability for escalation (no effect to almost no effect with 1:10:1 and 2:10:1, high voltage needed for 3:10:1 and low voltage for 4:10:1)

Influence of the magnetic field

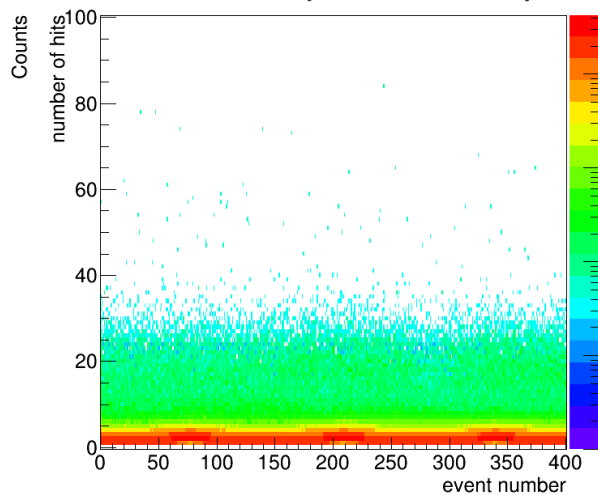
- TRB scans of Photonis 9002192 with modified PC-MCP voltage
- Strange count rates for some measurements (shown in next slide)
- Plot at right shows for each event number the number of hits per laser event
- Number of hits summed up for all 64 channels
- Following plots are chronologically ordered (see title)
- Top: X-row scans
- Bottom: XY scans



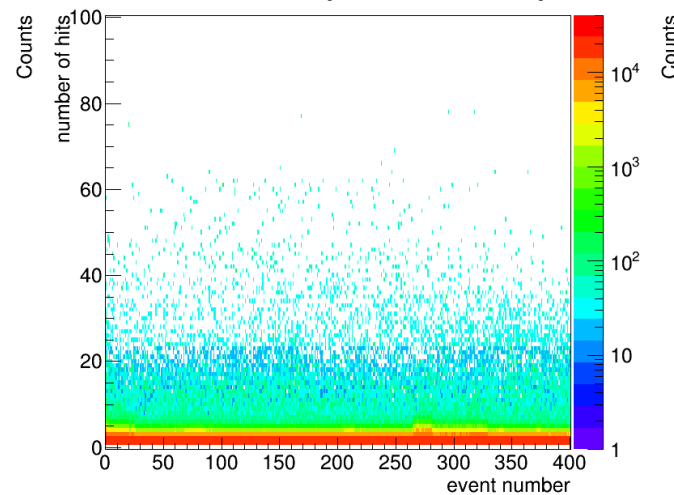
0 mT at 24 July 17:49 to 24 July 18:48



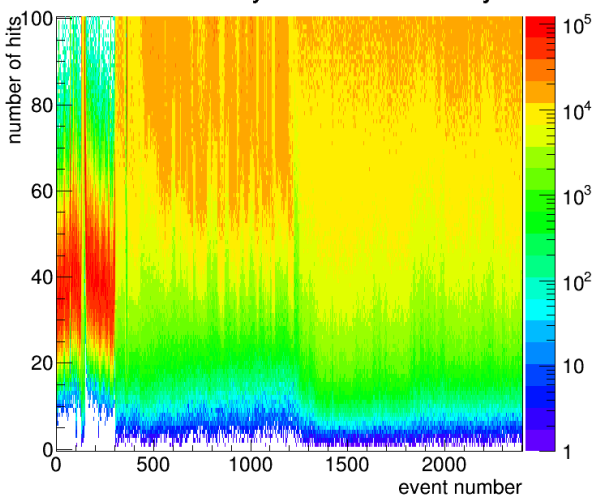
50 mT at 24 July 19:49 to 24 July 20:48



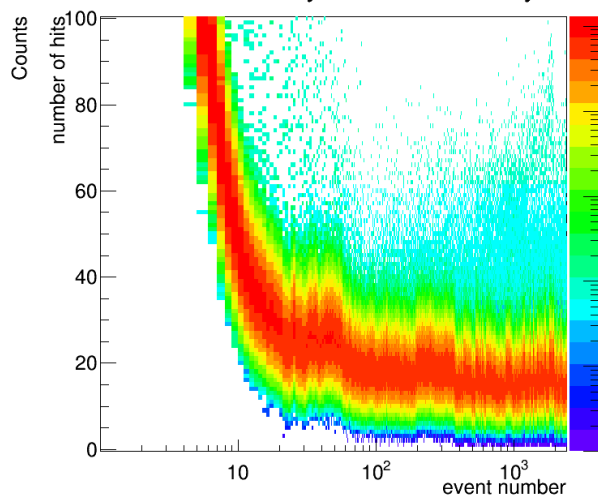
1000 mT at 25 July 01:49 to 25 July 02:48



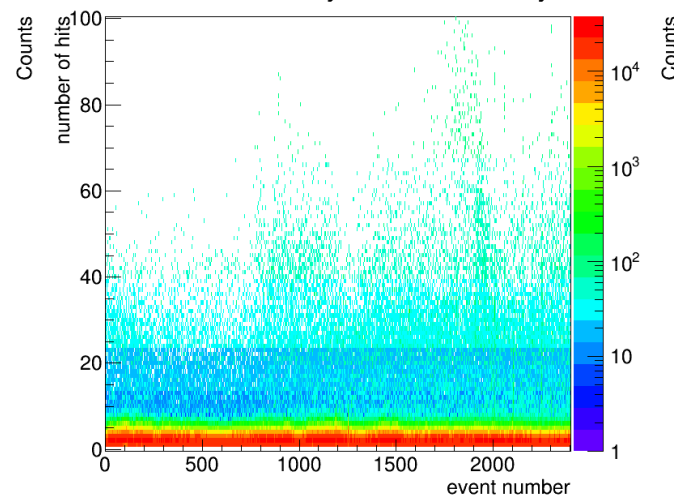
0 mT at 25 July 02:48 to 25 July 09:02



50 mT at 25 July 09:03 to 25 July 15:28



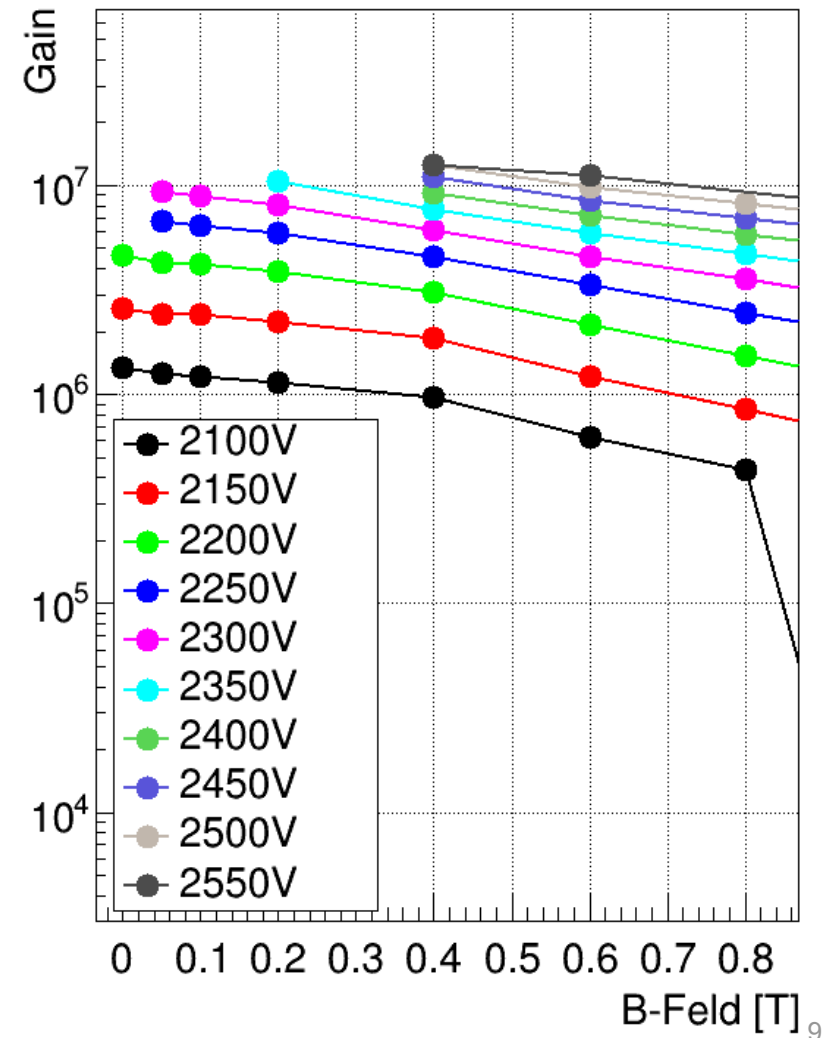
1000 mT at 26 July 10:34 to 26 July 16:52



Influence of the magnetic field

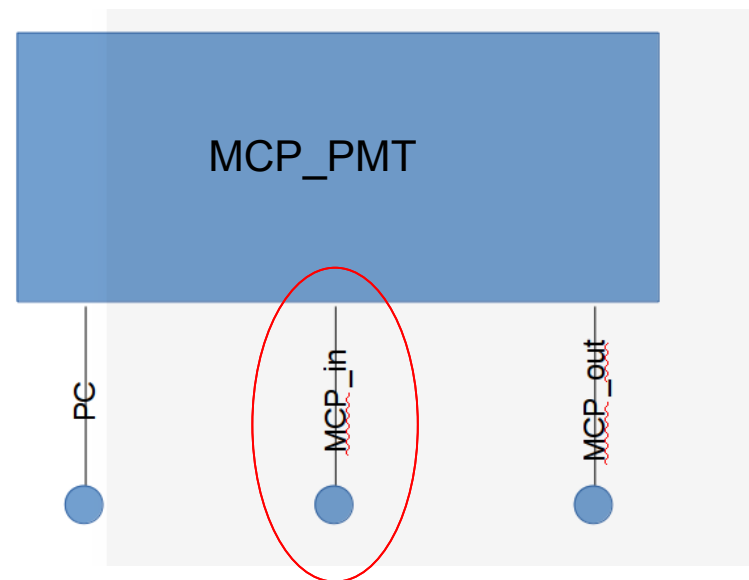
- gain vs B field for O37P541 for different voltages
- the higher the gain/voltage the latter the gaincurve „starts“
- somehow **positive effect** of the magnetic field on the escalation

O37P541



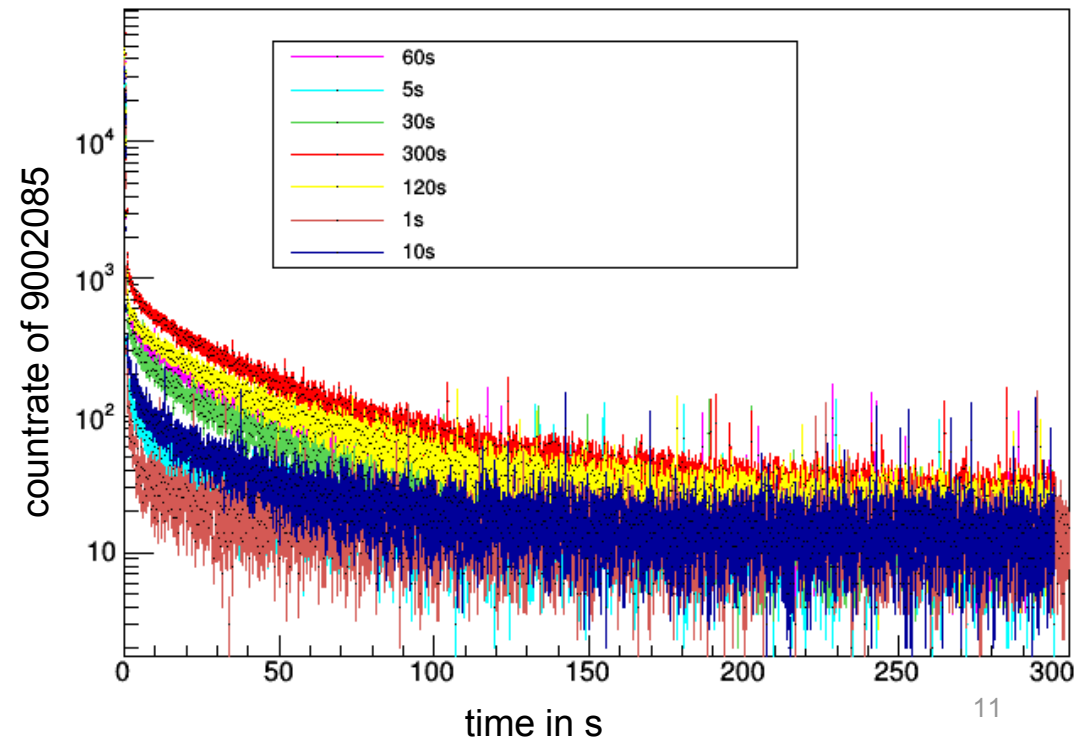
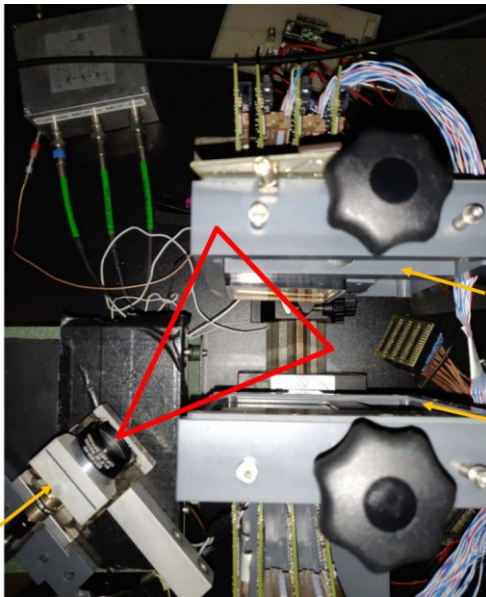
Supply current increase

- 3 different HV for PC, MCP_in and MCP_out to check where the additional current flows
- over MCPs and not between PC – MCP_in → corresponds to drop of MCP resistance of factor 2 – 3



Photon creation during escalation? (video 2)

- 2 MCP-PMTs face to face, 9002193 with 4:10:1 divider as escalating sensor and 9002085 as detecting one
- → 9002193 emits photons in escalation mode and slowly goes back to normal (not instant!) if switched off
- countrate of 9002085 in dependence of escalation time of 9002193



List of tubes

Escalation	No escalation (in or slightly above specs)
9002192 9002193 105P541 O37P541 } clearly in specs	9001165 9001332 9001340 9001341 9001394 9002108 9002150 946P541 Photek A1200107 Photek A1200116 Photek A3191220 Hamamatsu YH0250 (but massive afterglow)
9001393 (at max specs)	

→ Maybe connected to 2 layer-ALD coating?

Summary

- issues with rate stability and behavior in Juelich of 9002192, 9002193, O37P541 and 105P541 can be linked to the same effect
- Photonis is aware of this and we sent 105P541 back to them so they can do tests on their own
- in the B-field the effect **seems to be better** → so probably no problem for the experiment but maybe for the quality assurance measurements to be done in Erlangen

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Thank you for your attention!

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