Latest lifetime data & update on strange behavior of the latest Photonis tubes

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ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

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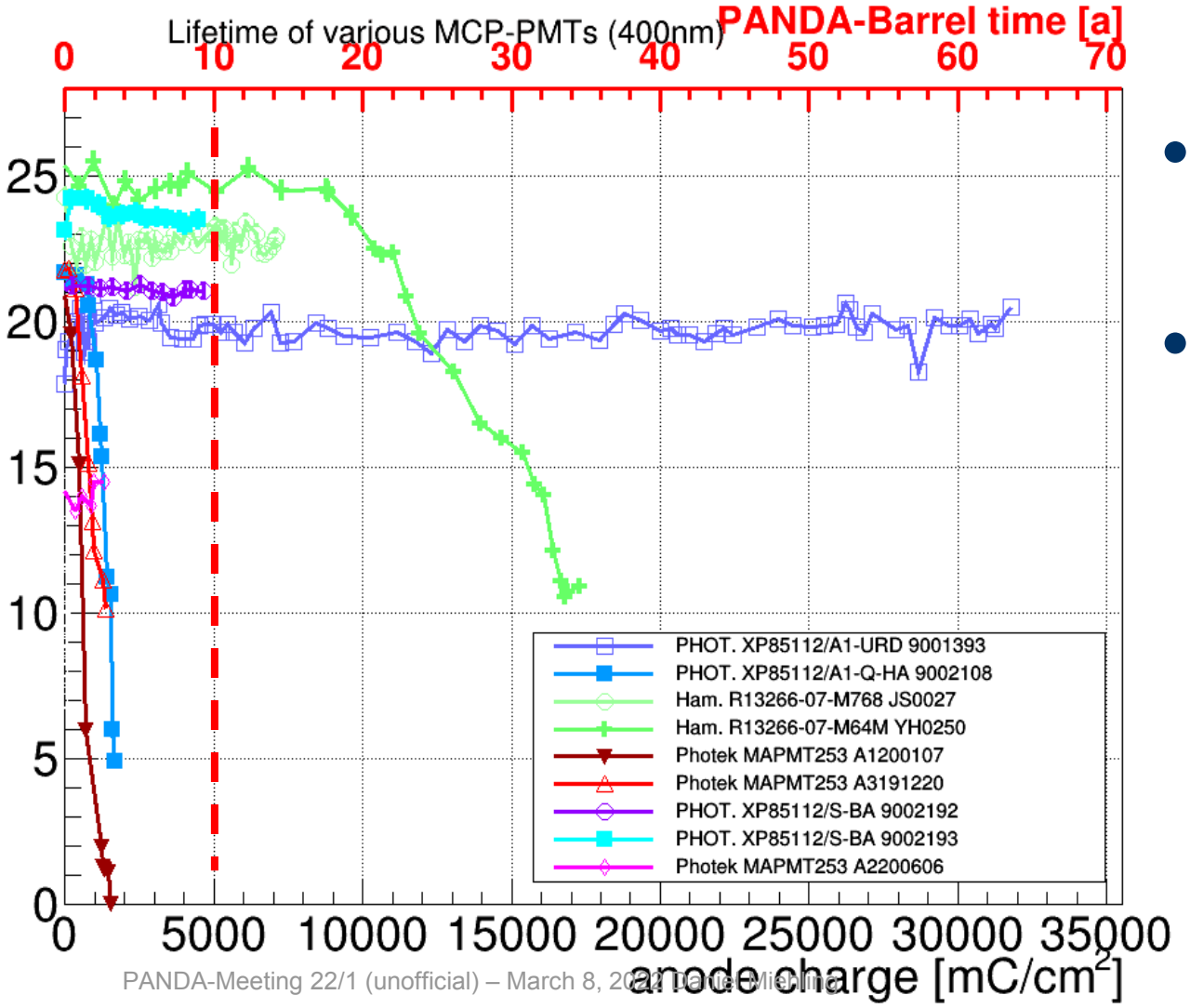
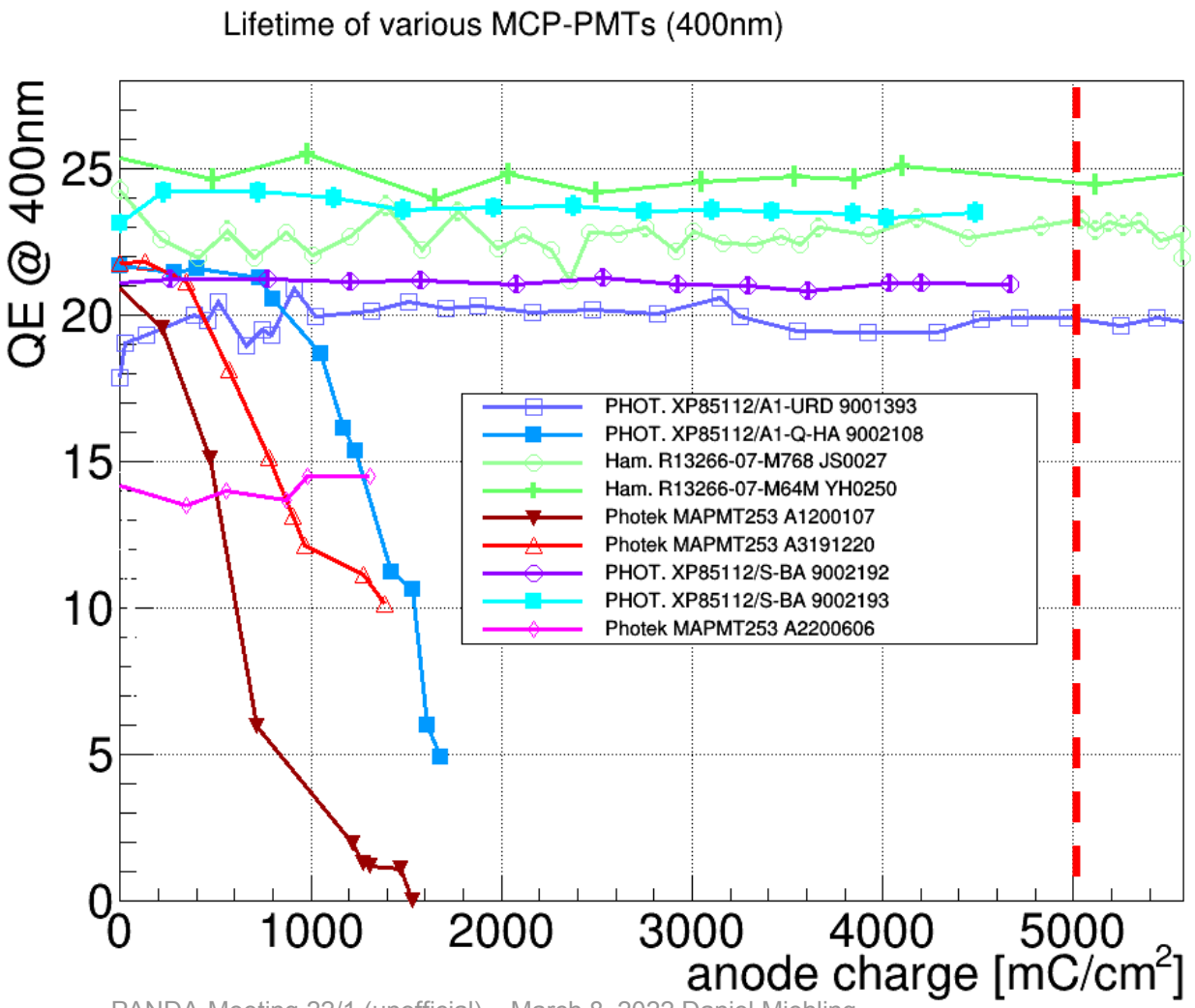
NATURWISSENSCHAFTLICHE FAKULTÄT

Lifetime data of latest sensors



- Most sensors with ALD coated MCPs have lifetime > 5 C/cm²
- 9001393 (2 ALD-layers) at over 63 years of PANDA

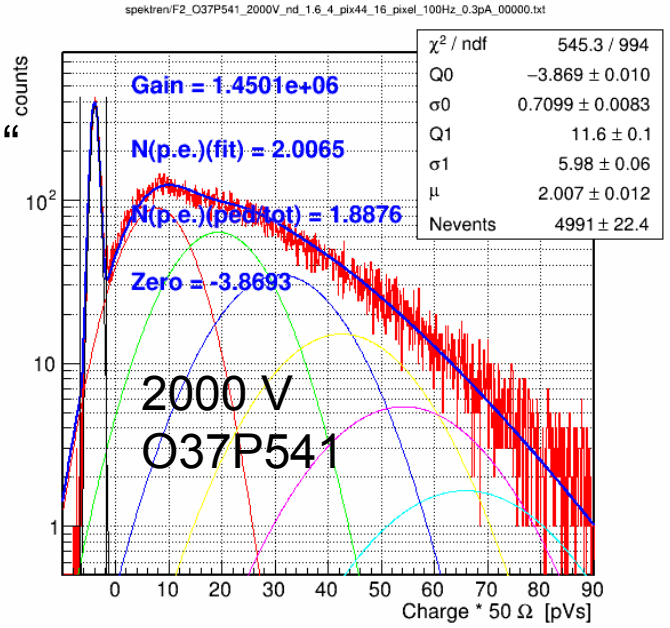
Lifetime data of latest sensors

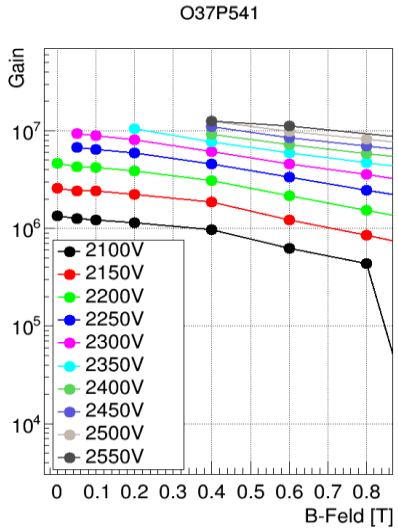


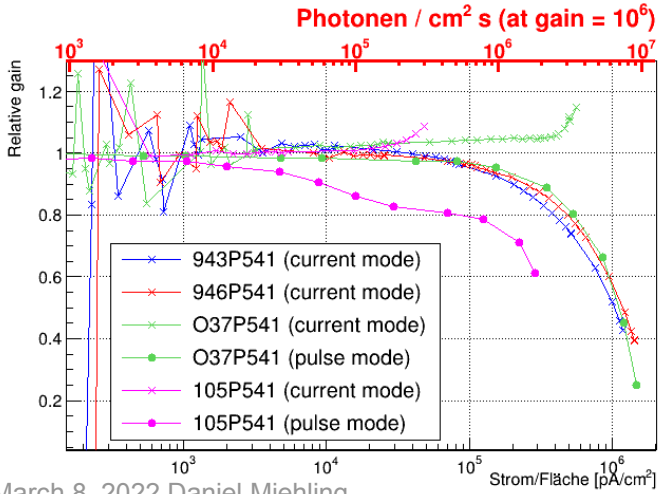
- Photonis 9002192, 9002193 are at almost 5 C/cm² without loss unlike 9002108
- Photek A2200606 is at ~1.4 C/cm² without loss yet unlike A1200107 and A3191220

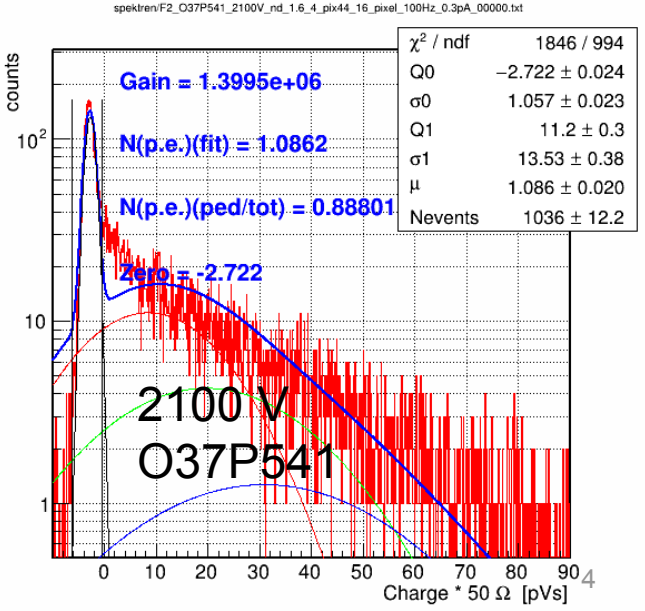
Reminder:

- known effects of newly discovered „escalation“ mode
  - high (dark) count rate
  - smaller signals → distorted charge spectrum
  - high anode current → seemingly high ratestability
  - high supply current
  - less effect in magnetic field



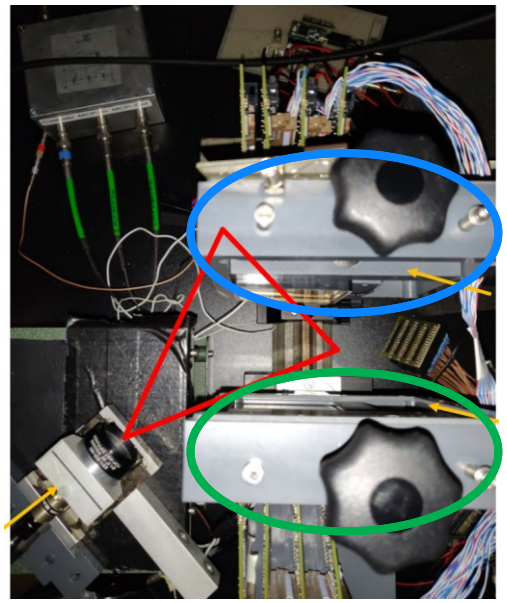


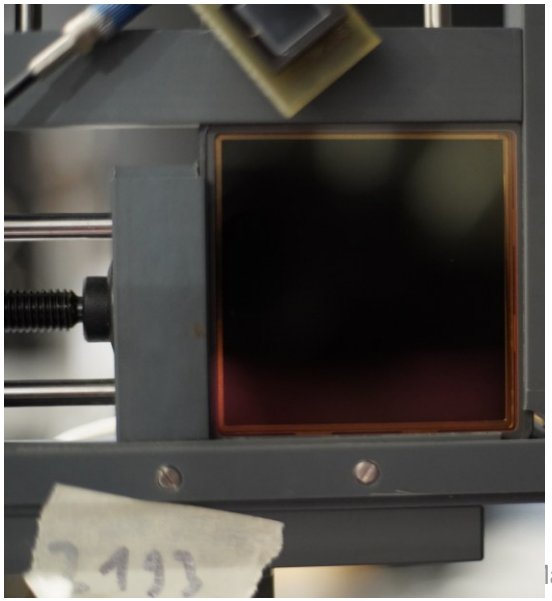


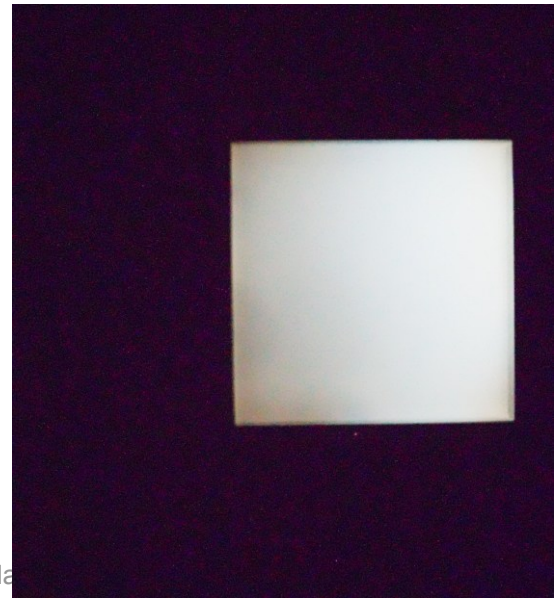


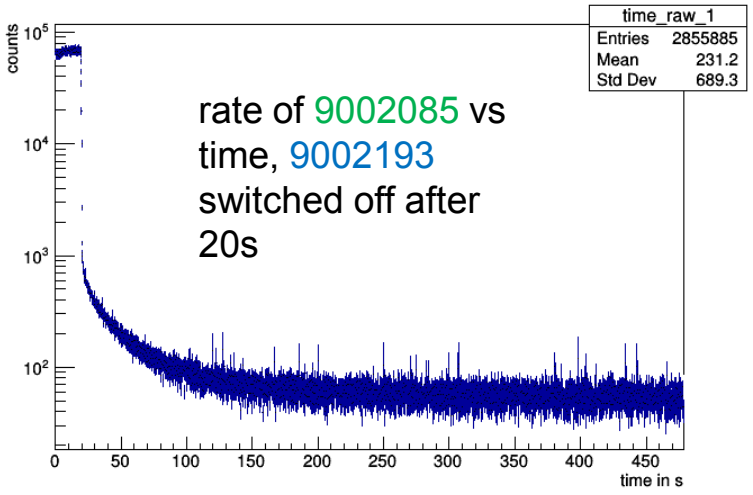
Photon creation during escalation

- 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
- these photons are white light and are visible with a photo camera (and even with bare eye)





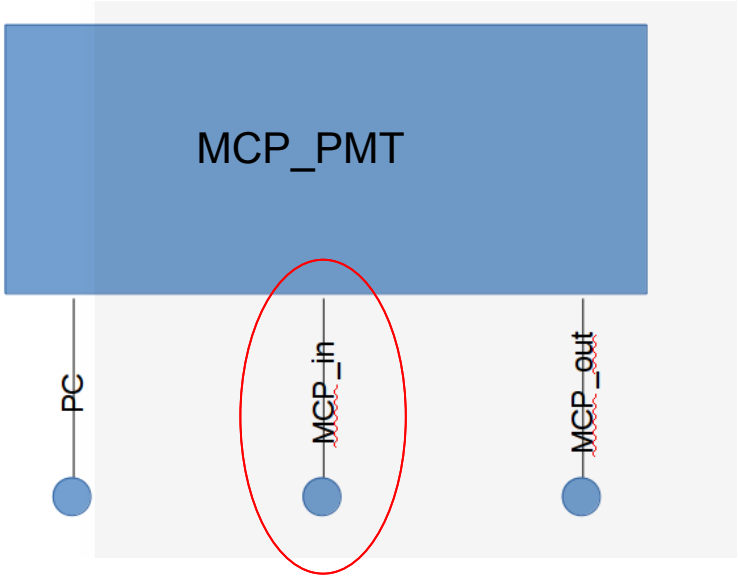




Supply current increase

- 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



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?

All this information is provided to Photonis, they are working on it

Voltage divider discussion

- Due to escalation behaviour of the tubes discussion of the operation mode of MCP-PMTs in Barrel-DIRC is required
- Time resolution for different voltage divider:

9002192

Divider [MΩ]	PC - MCP [V]	σ [ps]	RMS [ps]
0.5 : 5 : 0.5	182	41	269
1 : 5 : 0.5	364	30	168
1.5 : 5 : 0.5	547	27	140
2 : 5 : 0.5	729	26	109

9002193

Divider [MΩ]	PC - MCP [V]	σ [ps]	RMS [ps]
0.5 : 5 : 0.5	173	42	290
1 : 5 : 0.5	346	31	175
1.5 : 5 : 0.5	519	27	131
2 : 5 : 0.5	692	27	109

- 1.5 MΩ divider: escalation mode starts at very high gain (10^7)
- 2 MΩ divider: escalation mode is starting at lower gain $(3 - 5 \cdot 10^6)$, escalation voltage can differ significantly (~ 100 – 200 V)

➢ For newest tubes (3x100 pix) escalation mode starts at lower voltage (just above 10^6 gain)

➢ Which voltage divider should be used in the experiment?

➢ Roman simulates what time resolution is still tolerable

Summary

- issues with ratestability and behavior in Juelich of 9002192, 9002193, O37P541 and 105P541 can be linked to this “escalation” where a massive number of photons is produced in the MCPs (probably in the ALD-layers)
- 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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