

# Update on Collection Efficiency (CE) and Lifetime Measurements

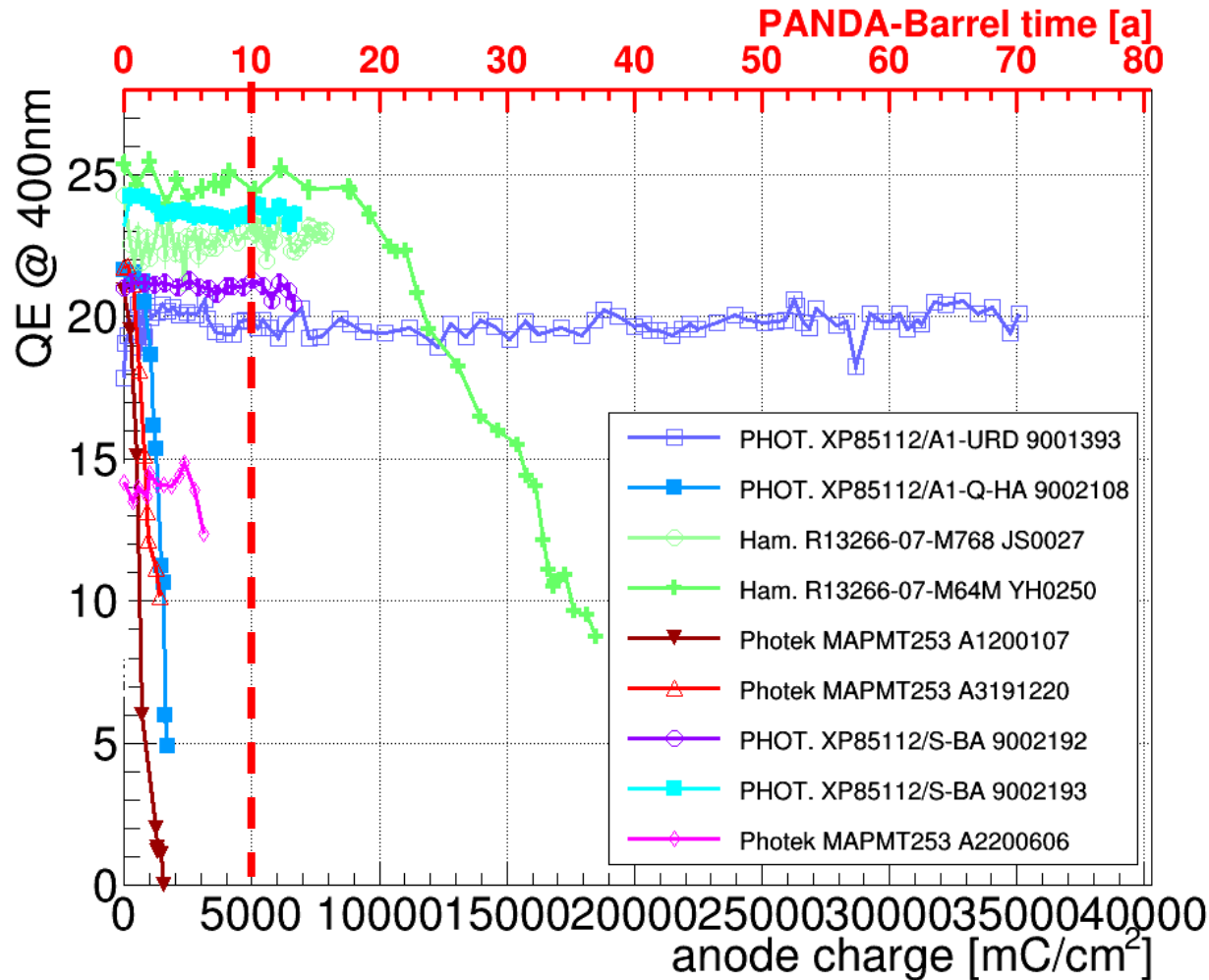
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PANDA-Meeting 23/1, Mar 9, 2023



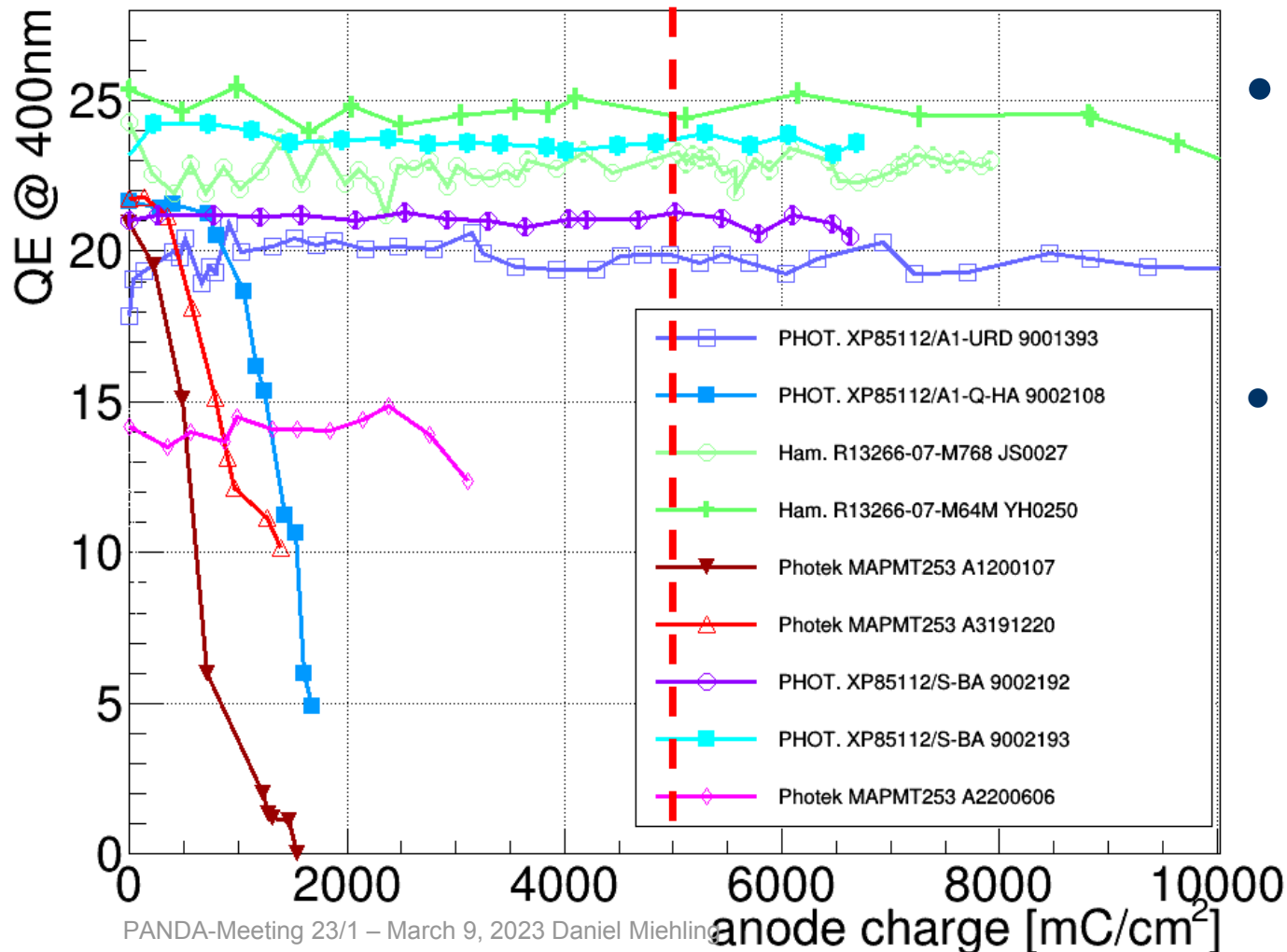
## Lifetime data of latest sensors



- Most sensors with ALD coated MCPs have lifetime > 5 C/cm<sup>2</sup>
- 9001393 (2 ALD-layers) at ~ 70 years of PANDA

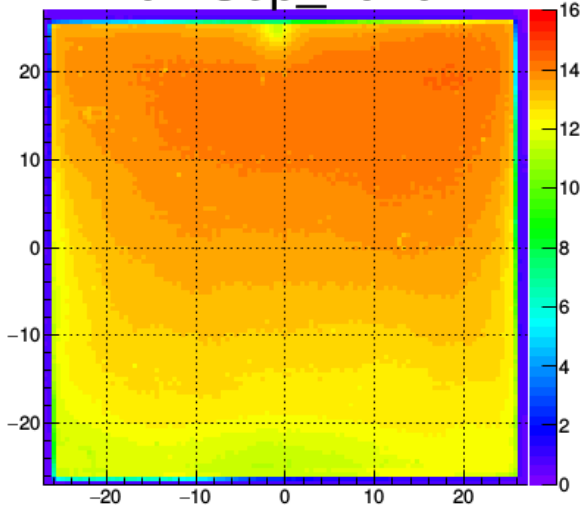
# Lifetime data of latest sensors

Lifetime of various MCP-PMTs (400nm)

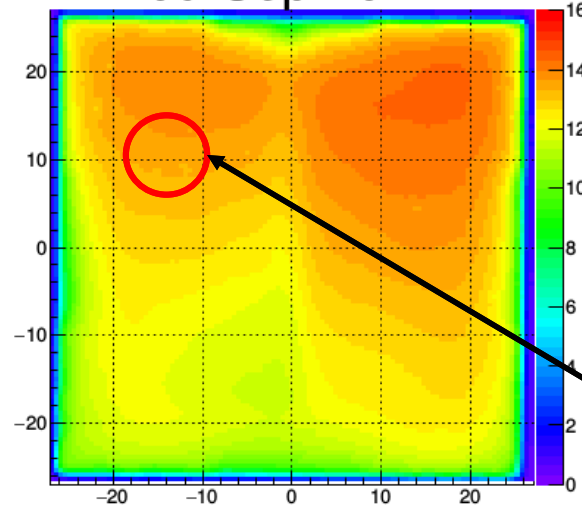


- Photonis 9002192, 9002193 are at over **6 C/cm<sup>2</sup>** without loss unlike 9002108
- Photek A2200606 is at **~3 C/cm<sup>2</sup>** and started to drop but later than A1200107 and A3191220

07-Sep\_2020

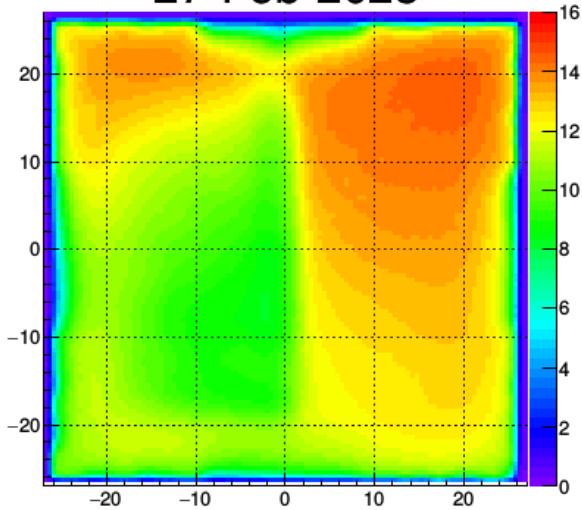


09-Sep-2022

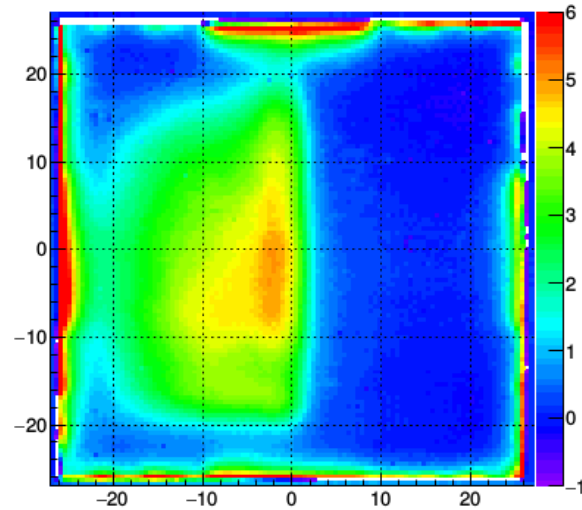


area of QE for lifetime plot

27-Feb-2023



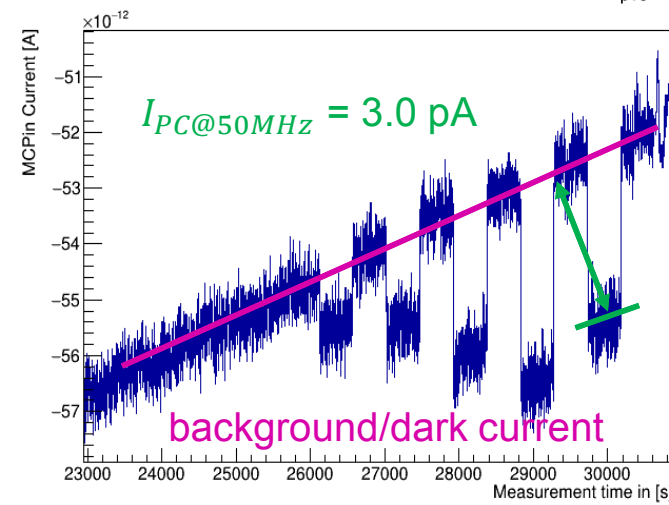
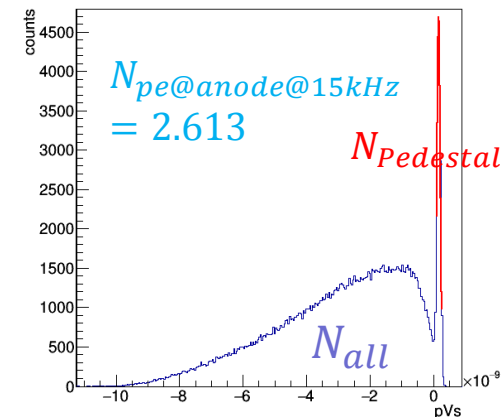
A2200606: oldest histo minus newest histo



## Collection efficiency (CE) measurement

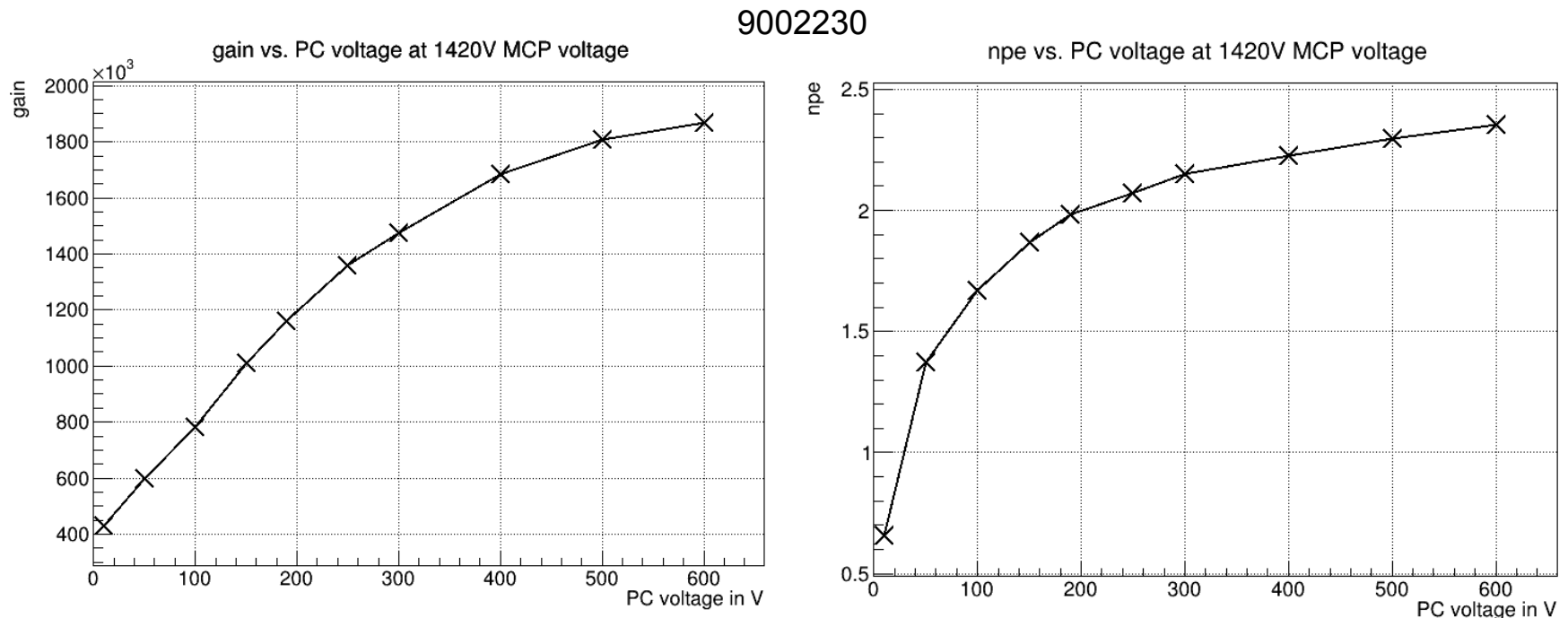
- Reminder:
- CE is probability that a photoelectron creates a signal at the anode (losses due to missing the MCP pore / absorption, ...)
- Measurement of CE =  $N_{pe@anode@15kHz} / N_{pe@PC@15kHz}$   
 $\rightarrow N_{pe@anode@15kHz} = -\ln(N_{Pedestal}/N_{all})$
- $N_{pe@PC@15kHz}$  can only be measured indirectly:
  - Measure MCPin **current** using the QE setup at several high laser frequencies
  - **Correct for non-linearities** in the intensity vs frequency relation of the laser by using a reference diode

$$CE = \frac{N_{pe@anode@15kHz} \cdot e \cdot 50MHz}{I_{PC@50MHz}} \cdot \frac{I_{Diode@50MHz} \cdot 15kHz}{I_{Diode@15kHz} \cdot 50MHz}$$



# Dependence of CE value on voltage divider configuration

- both gain and number of photoelectrons depend on PC-MCP voltage (energy of initial electron)
- → CE is dependent on PC-MCP voltage

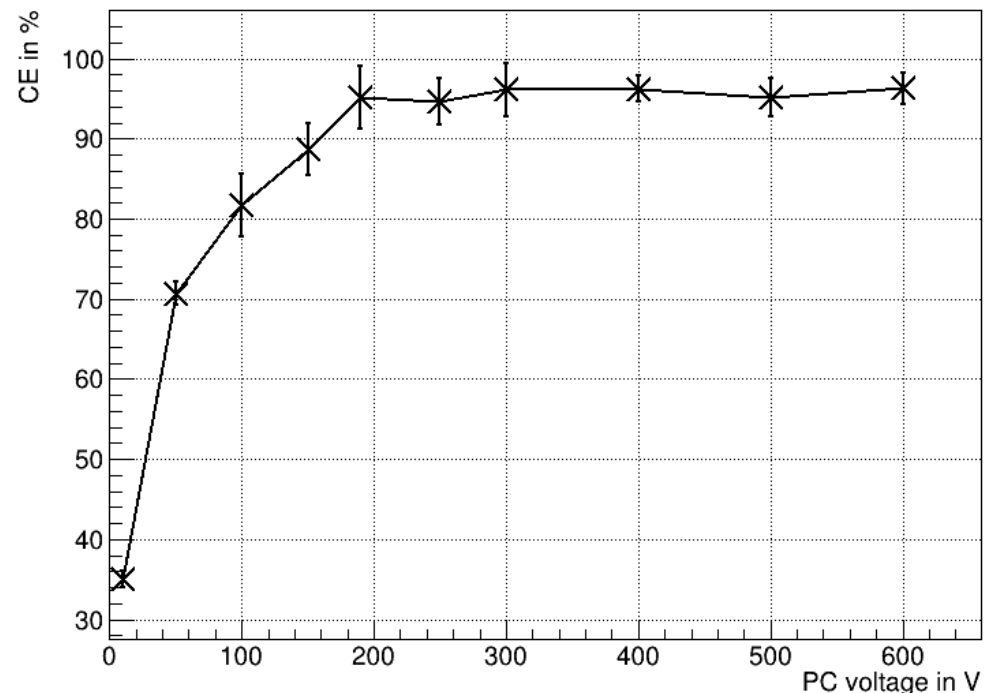


# Dependence of CE value on voltage divider configuration

- CE for different PC-MCP voltages (in both QE and full gain setup) for 9002230 shown below
- slight increase to higher voltages
- below 200V CE drops significantly

9002230

CE vs. PC voltage at 1420V MCP voltage



## Dependence of CE value on voltage divider configuration

- different CE at different combinations of PC-MCP voltage and voltage divider configuration:

<b>9002227</b>	<b>200V PC-MCP in QE-Setup</b>	<b>160V PC-MCP in QE-Setup</b>	<b>620V PC-MCP in QE-Setup</b>
1-10-1 in charge spectra setup (160V PC-MCP)	(87+/-2)%	<b>(90+/-1)%</b>	(75+/-1)%
4-10-1 in charge spectra setup (620V PC-MCP)	(113+/-2)%	(116+/-1)%	<b>(97+/-1)%</b>

- previously: always 200V in QE-Setup instead of corresponding PC-MCP voltage as applied in the full setup  
→ slightly different (mostly too low) CE (~2-3%)
- better: use of correct voltages
- 4-10-1 instead of 1-10-1 yields slightly higher CE as well (~5%)
- CE measurements now **between 95% and 100%** instead of ~90%



# Thank you for your attention!

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