

Update on lifetime measurements and first results with new Photonis tube

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FOR ASTROPARTICLE
PHYSICS

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Photonis XP85112-Q-HA 9002018



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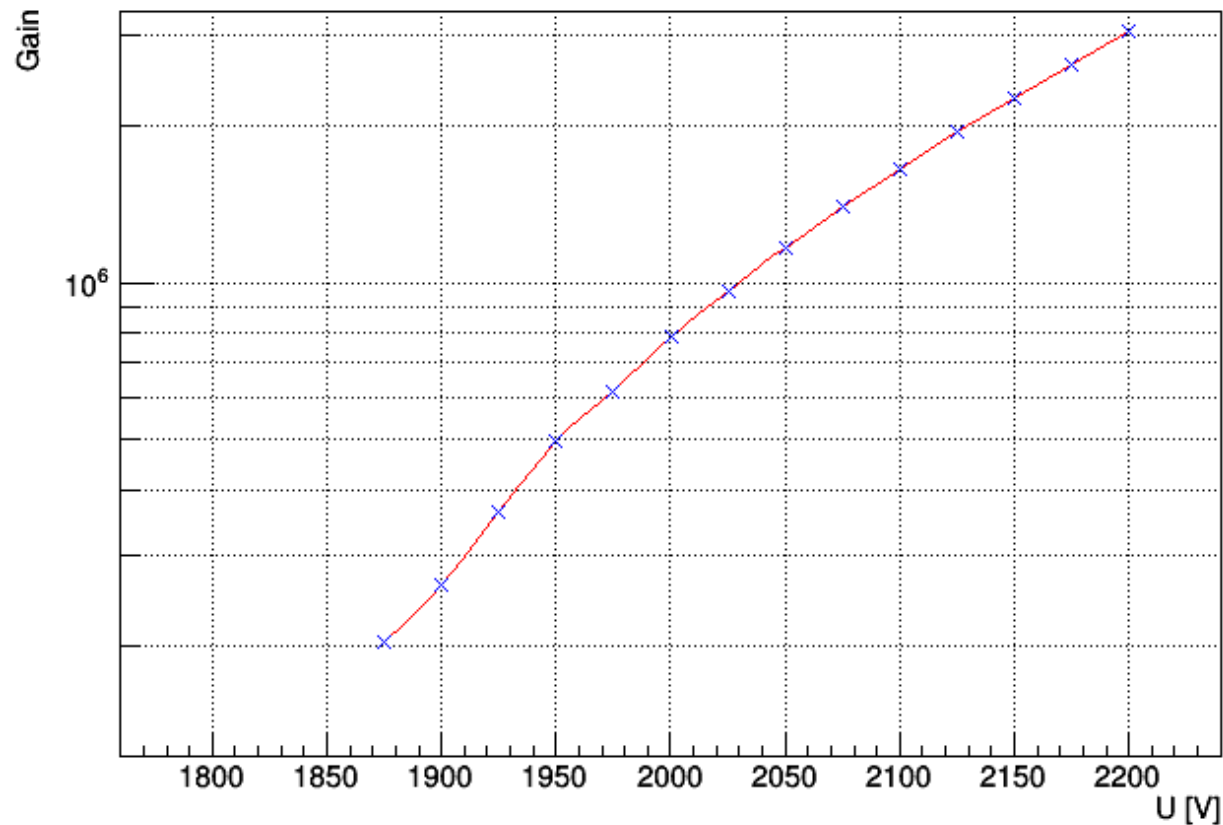
Photonis XP85112-Q-HA 9002018

- 8x8 pixelated Sensor
- ALD coated
- High collection efficiency MCPs
- 10^6 gain at 1803 V (datasheet)

Gain vs voltage

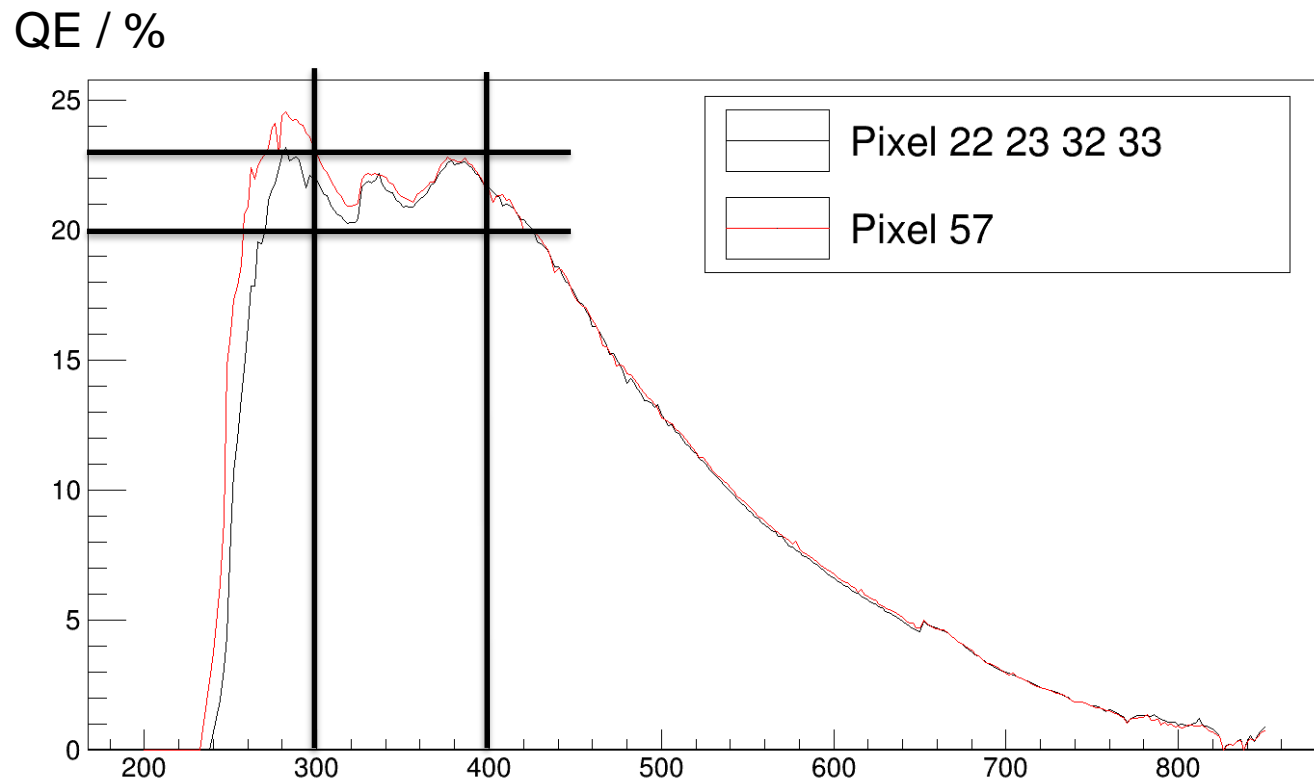
- Measured with scope
- Signal not amplified
- Gain calculated with double gauss fit in histogram data (pedestal and signal)
- 10^6 gain at 2030 V

GAIN Photonis XP85112/9002108



QE vs wavelength

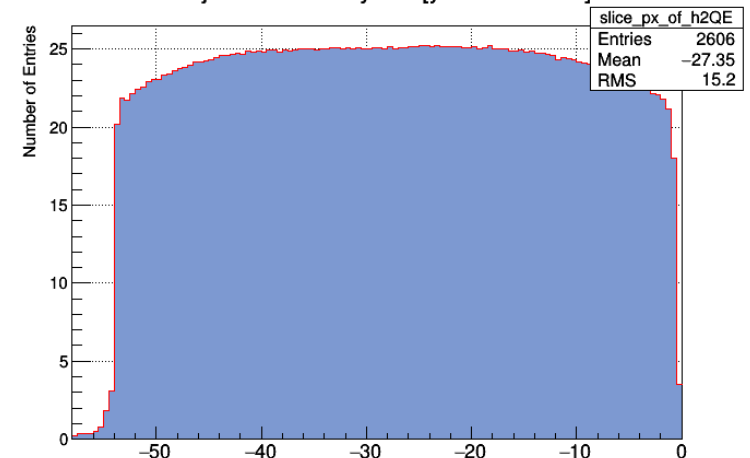
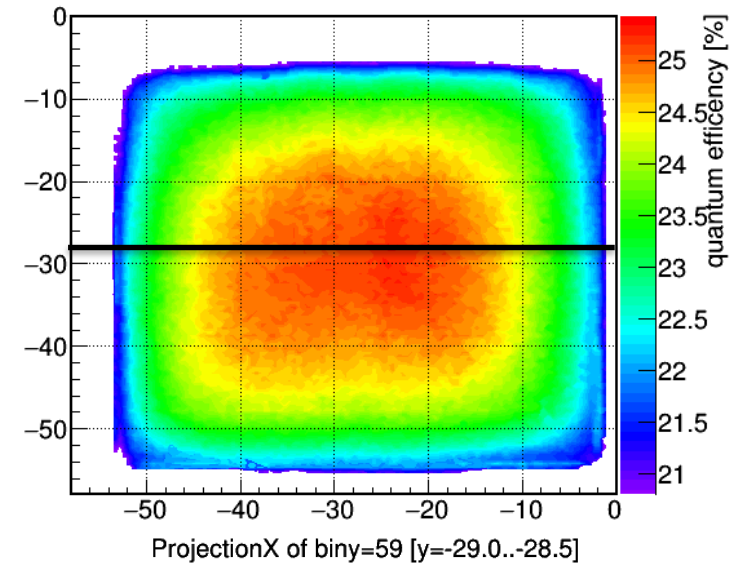
- -200 V at cathode
- Current measured at MCP IN
- Calculated with photo diode current (known QE for each wavelength)
- **~20-23 % QE at 300-400 nm**



Quantum Efficiency - Photonis XP85112/9002108

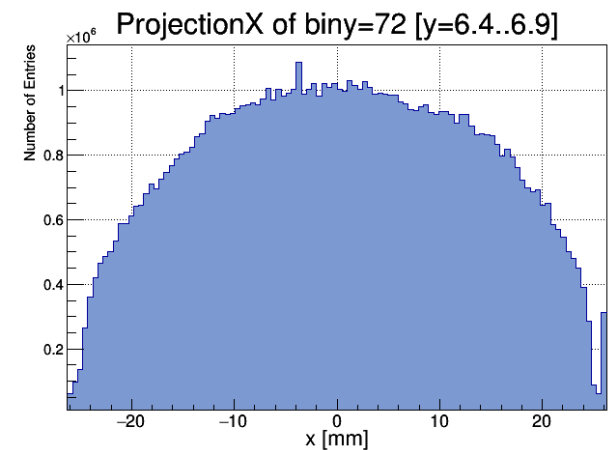
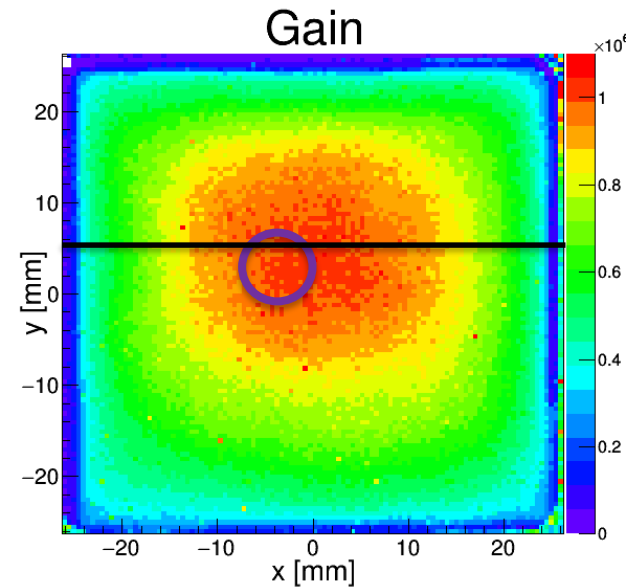
QE surface scan

- -200 V at cathode
- Current measured at MCP IN
- Calculated with photo diode current (known QE for wavelength)
- Scanned with 372 nm PiLas laser
- 0.5 mm steps across surface
- Projection is “worst” homogeneity measured
- 25 % QE in max. region 22 % at the rims



Current gain scan

- 2030 V at voltage divider
- Measured shortened anode current
- Scan would be folded with QE of the sensor
 - Is divided by QE
- Gain then scaled to known value of Pixel 44
- Gain range from about 10^6 in the center down to $6 \cdot 10^5$ at the rims



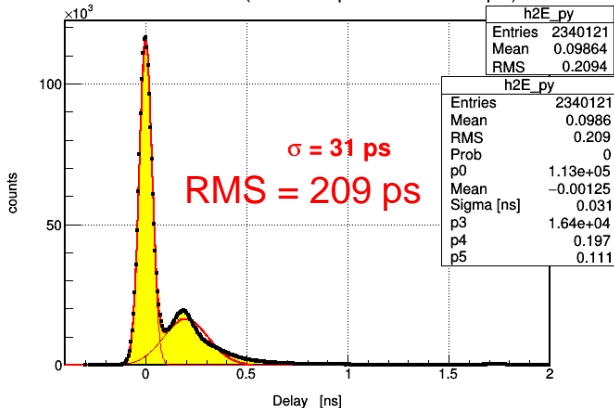
Time resolution

- High collection efficiency MCP causes worse time resolution
- Option to increase voltage between cathode and first MCP
- Tested up to 800 V between cathode and MCP by Photonis
- Measured with 3 voltage dividers:
 - 0.5:5:0.5 (M Ω) at 2030 V cathode-MCP voltage: 250 V
 - 1:5:0.5 (M Ω) at 2280 V cathode-MCP voltage: 500 V
 - 1.5:5:0.5 (M Ω) at 2530 V cathode-MCP voltage: 750 V
- Measured with scope at 10^6 gain
- Blue laser at 15 kHz and 45 % tune
- 200x amplified signal then impedance matched splitting and 100 mV discriminator threshold
- **Time walk corrected spectra**

Time resolution

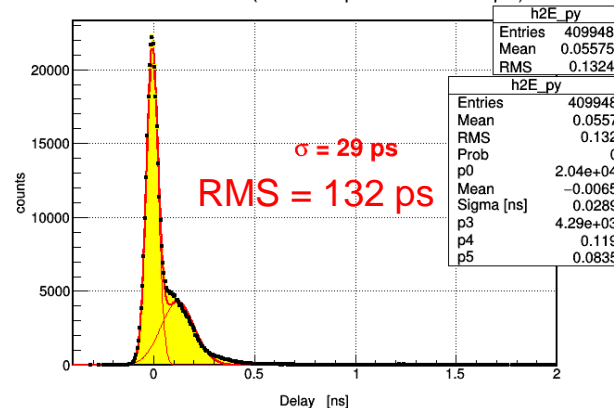
cathode-MCP 250 V

Time Resolution ($Q > -0.32$ pC & $Q < -0.08$ pC)



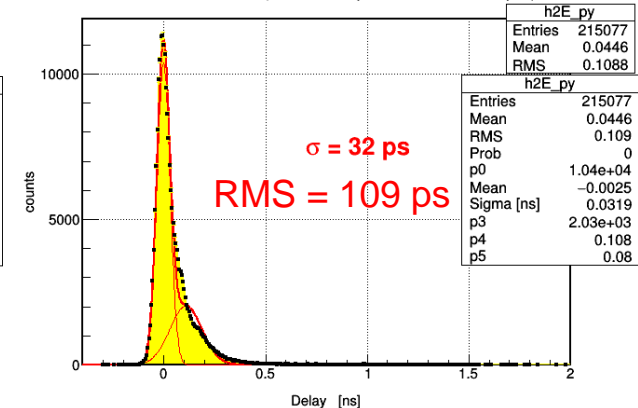
cathode-MCP 500 V

Time Resolution ($Q > -0.32$ pC & $Q < -0.08$ pC)



cathode-MCP 750 V

Time Resolution ($Q > -0.32$ pC & $Q < -0.08$ pC)



- Tail and RMS getting better with higher PC-MCP voltage
- Tail is a sensor artifact
- Possible to reduce RMS to 109 ps
- Same tests panned with TRBv3

Results of latest measurements



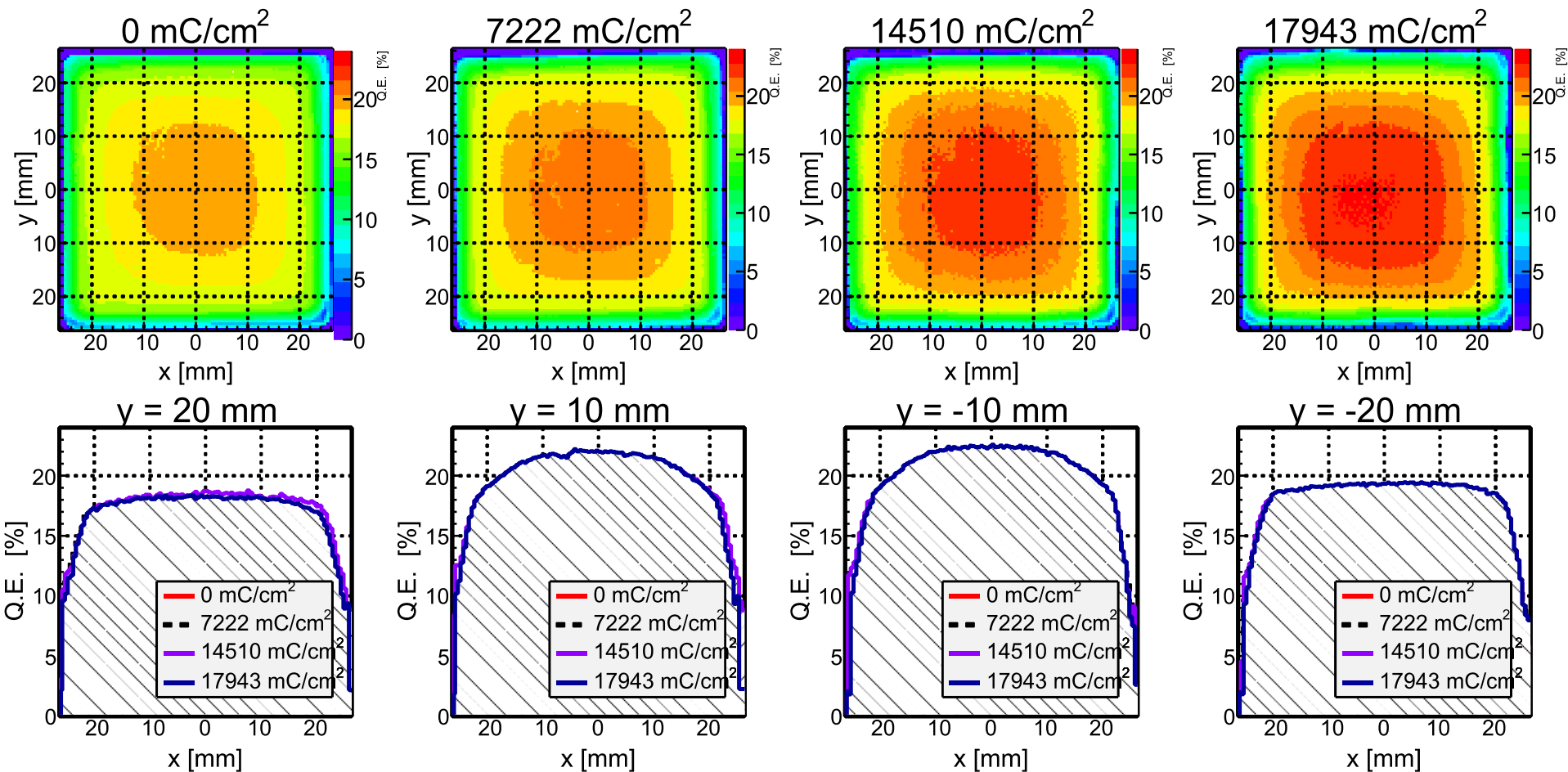
Data from February 21, 2018

Illumination Overview QE (all sensors with ALD)

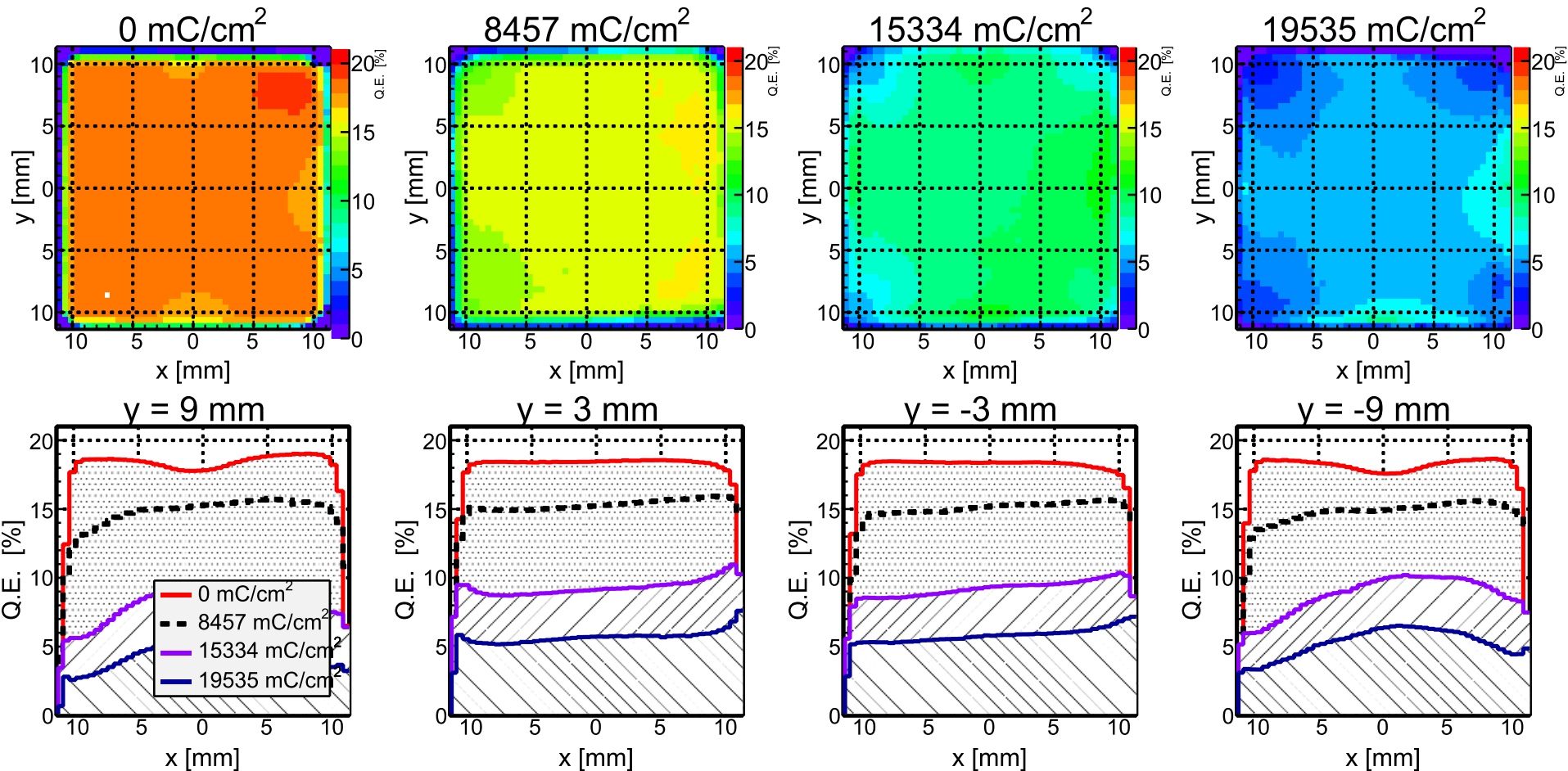
Film between MCP
Two ALD layers
Film in front of first MCP

Manufacturer		Sensor ID	IAC [mC/cm ²]	QE start [%]	QE latest [%]	QE latest/QE start [%]
2 Inch	Photonis XP85112	9001223	9234	22.1	5.3	24
		9001332	15909	23.0	8.2	36
		9001393	17942	19.1	19.3	101
1 Inch	Hamamatsu R10754X	KT0001 (M16M)	19534	21.7	5.6	26
		KT0002 (M16M)	18175	21.1	6.2	29
2 Inch	Hamamatsu R13266-07-M768 / M64	JS0022 (64 pix.)	608	17.4	4.9	28
		JS0035 (64 pix.)	5294	25.5	24.8	97
		JS0018 (768 pix.)	1133	18.0	3.22	18
		JS0027 (768 pix.)	2261	24.3	22.2	91

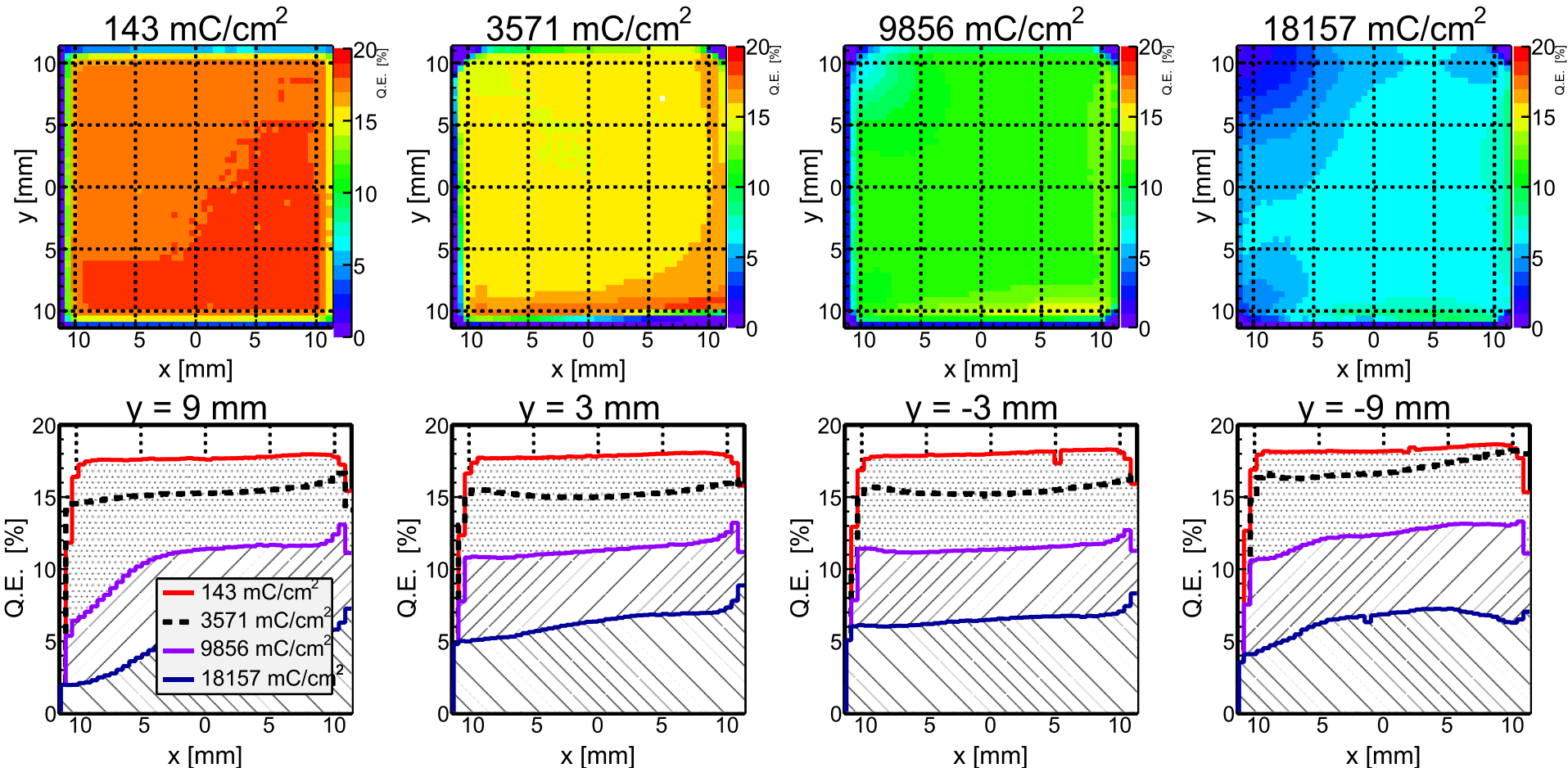
QE scan of Photonis 9001393-URD (double ALD)



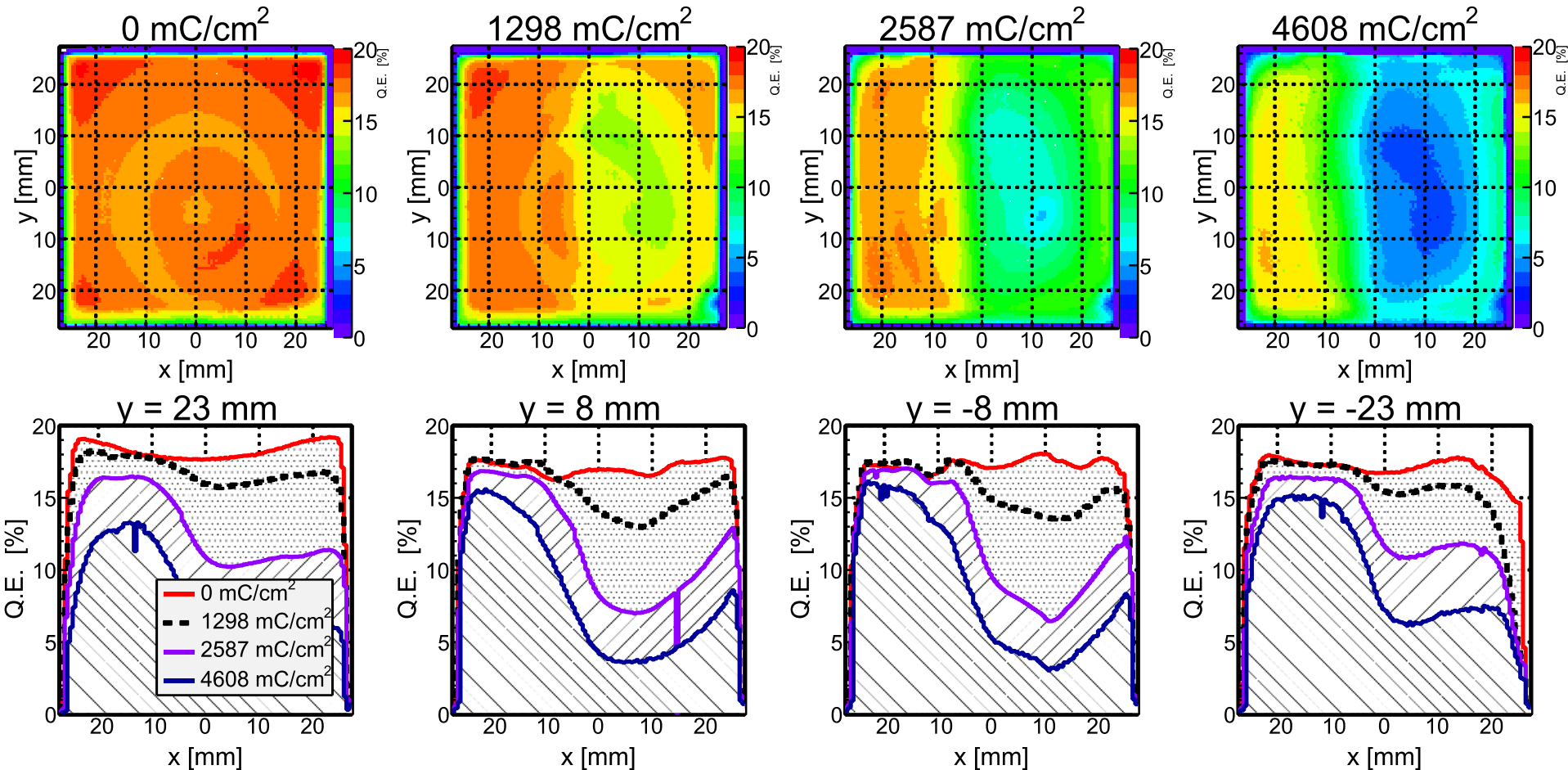
QE scan of Hamamatsu KT0001 (ALD)



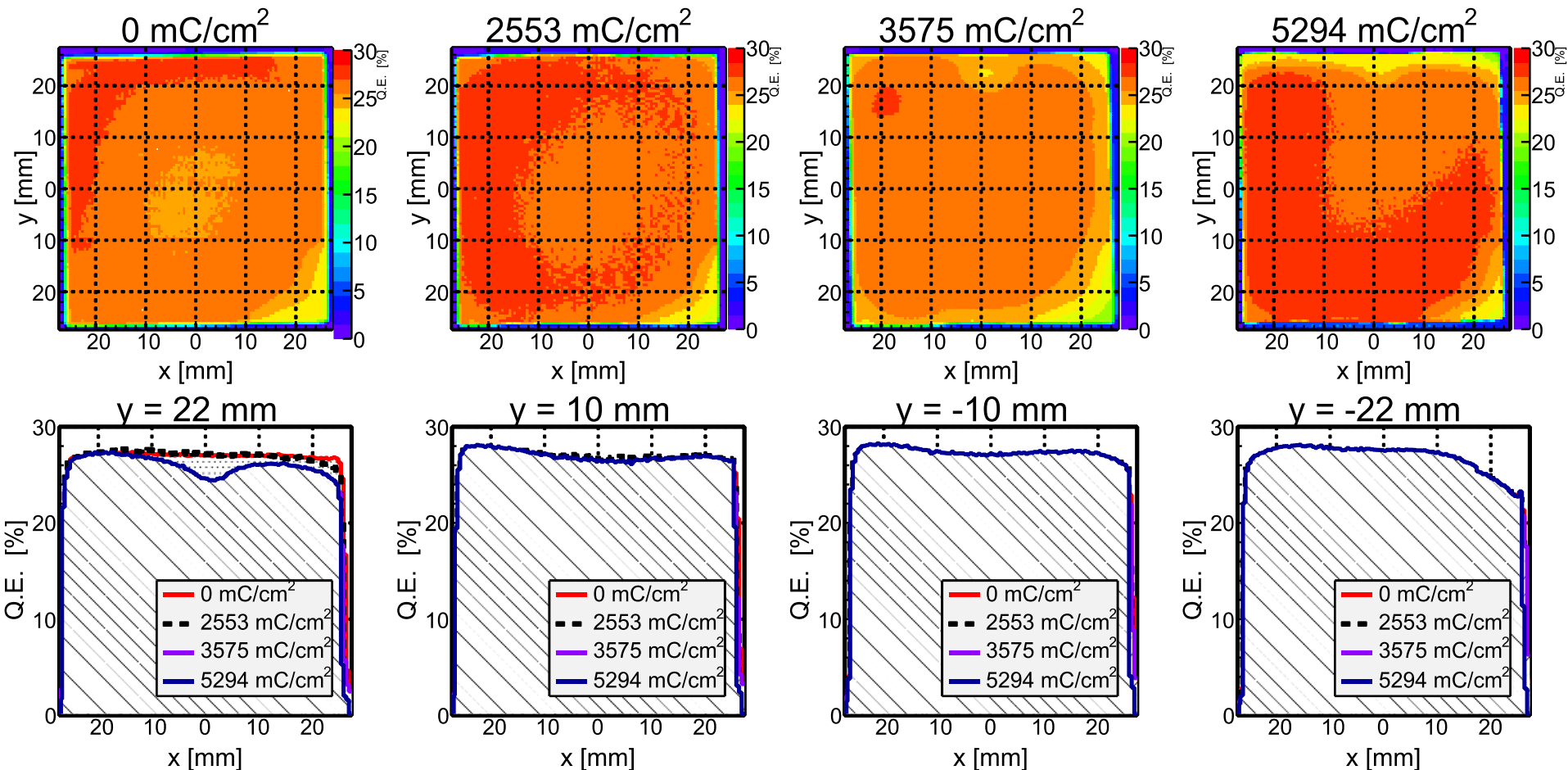
QE scan of Hamamatsu KT0002 (ALD)



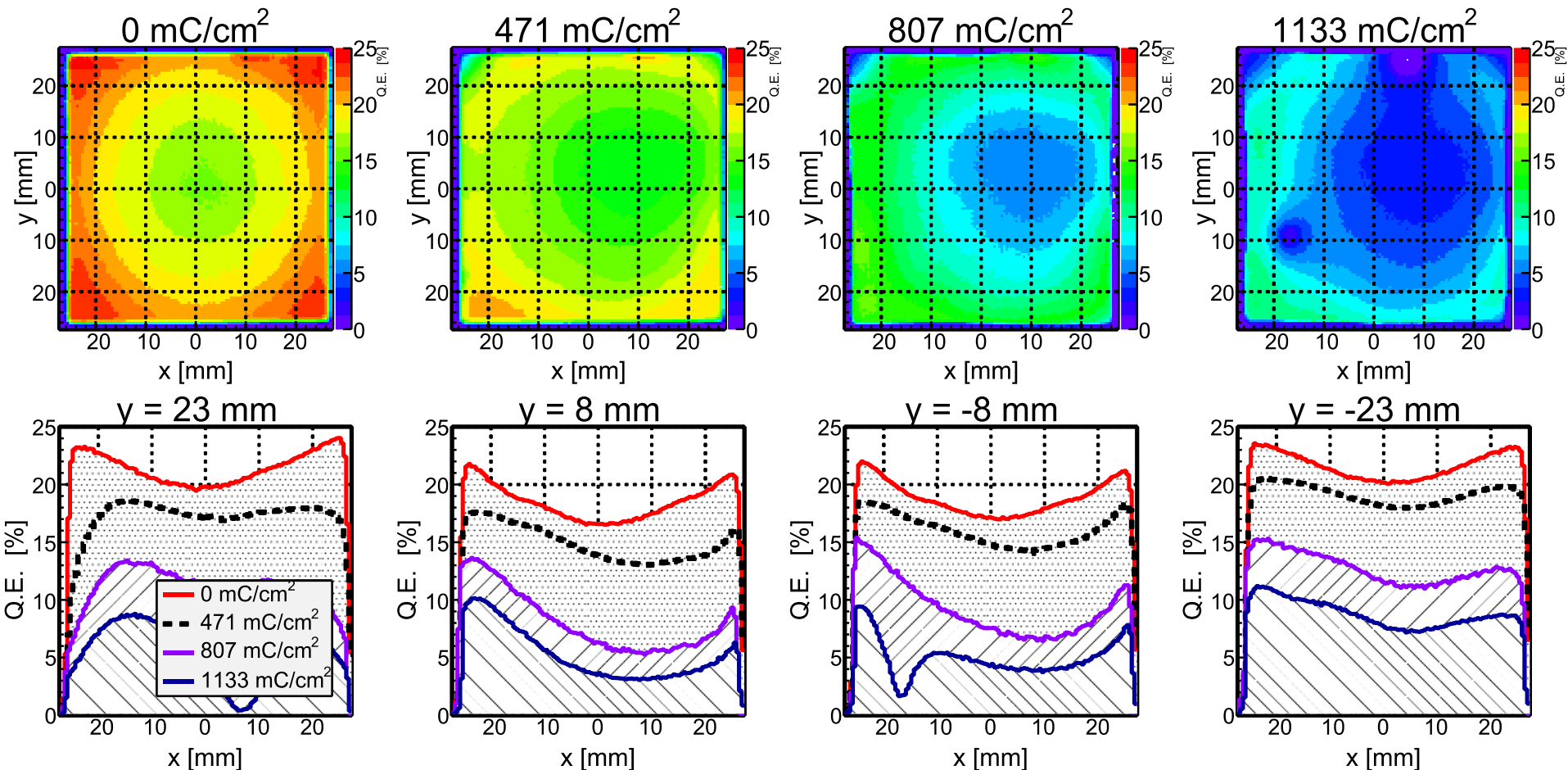
QE scan of Hamamatsu JS0022 (8x8, ALD)



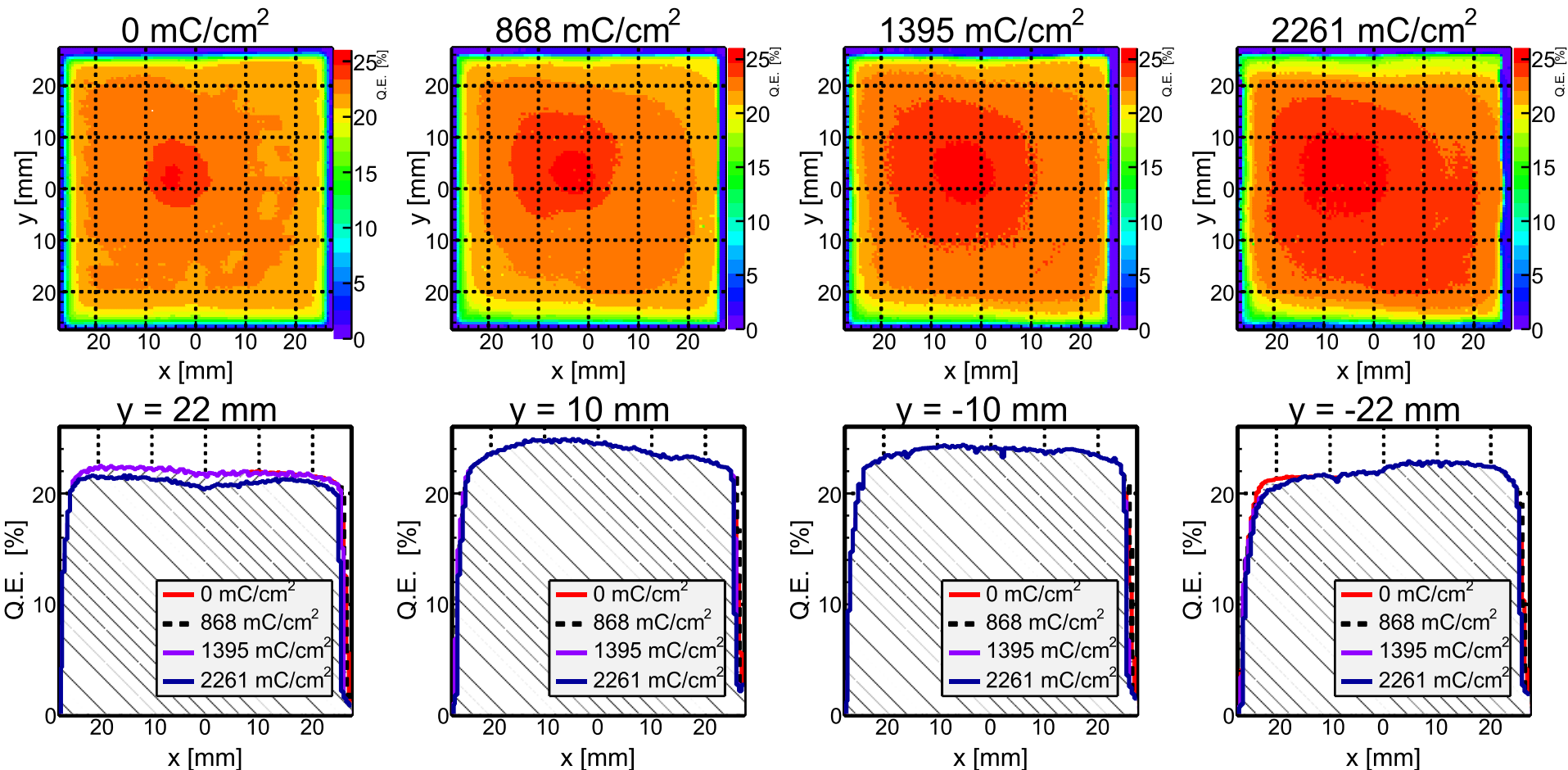
QE scan of Hamamatsu JS0035 (8x8, ALD)



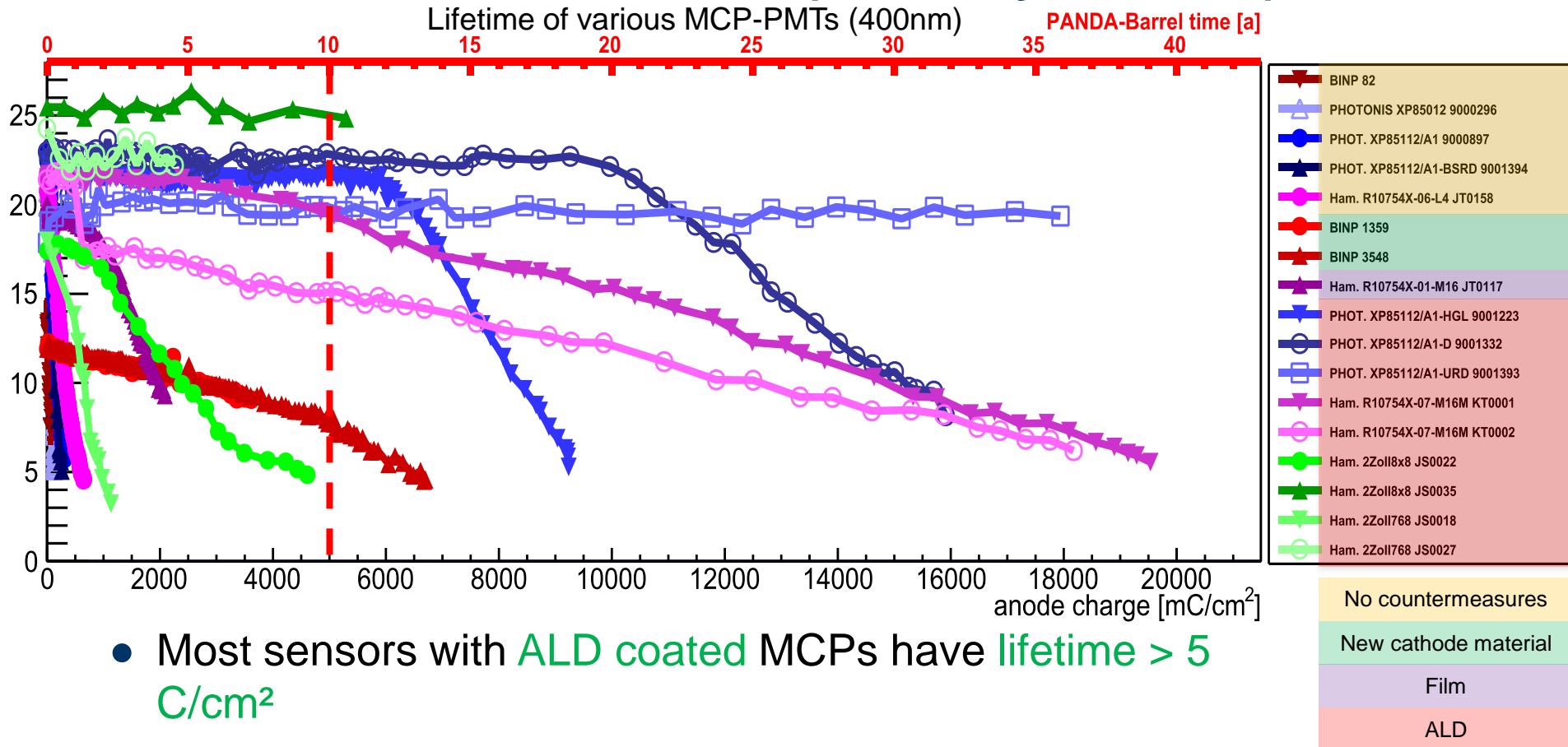
QE scan of Hamamatsu JS0018 (6x128, ALD)



QE scan of Hamamatsu JS0027 (6x128, ALD)



Lifetime data of all sensors (February 21, 2018)



- Most sensors with ALD coated MCPs have lifetime > 5 C/cm²
- All non ALD devices have a lifetime of < 200mC/cm²
- Measurements are taking a long time

Summary and outlook

- Double ALD Photonis tube (1393) at **18C/cm² without damage**
- First results with new Photonis tube obtained
 - QE homogeneity looking promising
 - Gain could be more homogeneous
- Further tests with TRBv3 and “new” dividers planned

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Thank you for your attention!

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