Updates on HRPPD #25 activities
Amplitude vs. Rate for different ΔV_{MCPs} values

Ageing studies - Global Meet
30 April 2025

Jinky Agarwala[2], Chandradoy Chatterjee[2], Silvia Dalla Torre[2],
Mauro Gregori[2], Saverio Minutoli[1], Mikhail Osipenko[1], Fulvio Tessarotto[2]

[1]INFN Genova
[2]INFN Trieste

INFN
Istituto Nazionale di Fisica Nucleare

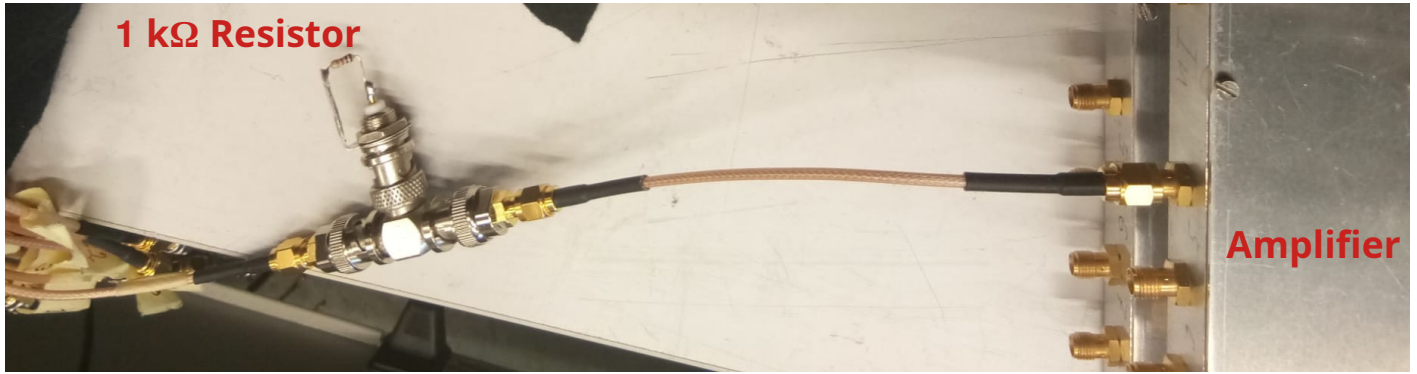
ePIC

Outline

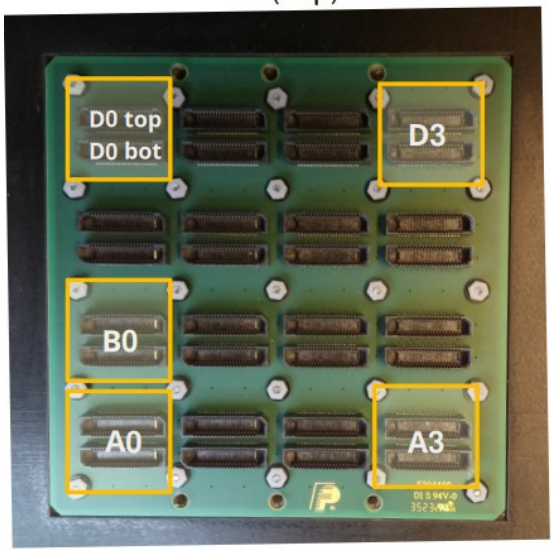
- SPE amplitude vs pulse rate for different values of ΔV MCPs

Amplifier

- Amplifier with a factor 10 gain is in the circuit
- Resistor of 1 kΩ to ground
- At present, single channel (Pin #12 A0 Top)



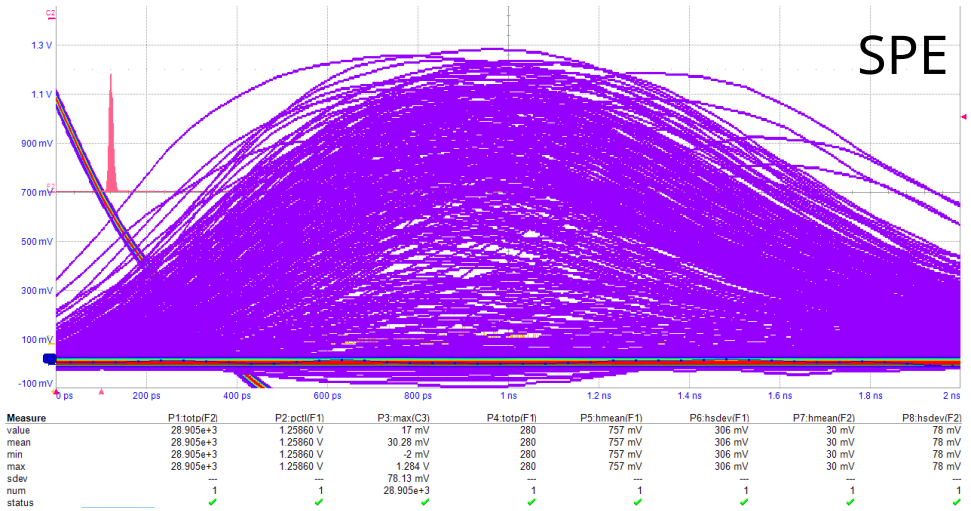
PC (Top)



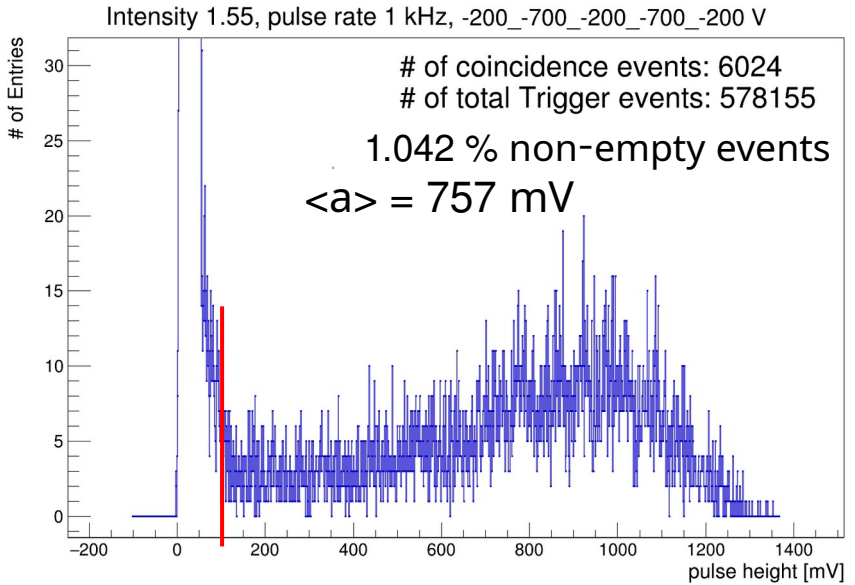
G (bottom)

Signals with amplifier

- HV bias: -200_-700_-200_-700_-200 V (ROP from Incom)
- Trigger on laser sync pulse
- Laser intensity 1.55 (**SPE**), λ=0.01, P(0)=99.005%, P(1)=0.990%, P(2)=0.005%
- Pulse rate 1 kHz



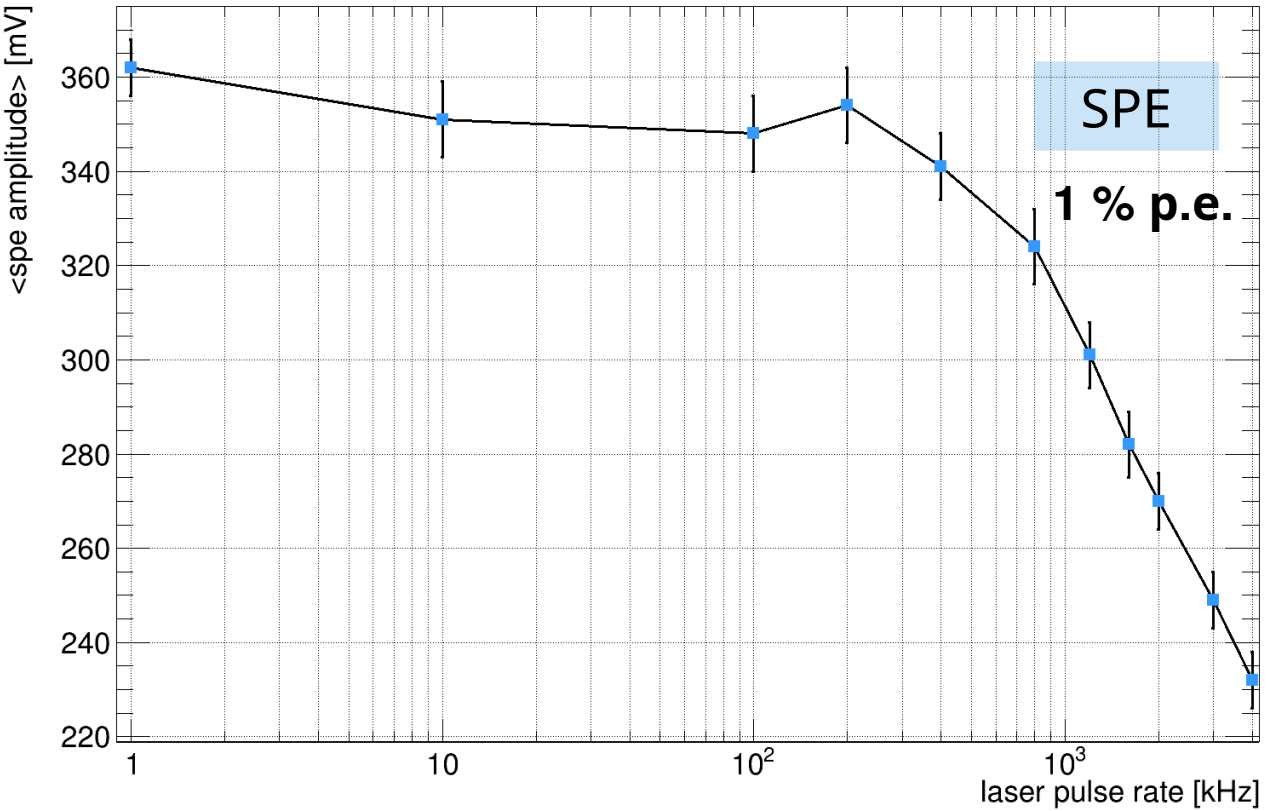
Measure	P1:totp(F2)	P2:pctl(F1)	P3:max(C3)	P4:totp(F1)	P5:hmean(F1)	P6:hsdev(F1)	P7:hmean(F2)	P8:hsdev(F2)
value	28.905e+3	1.25860 V	17 mV	280	757 mV	306 mV	30 mV	78 mV
mean	28.905e+3	1.25860 V	30.28 mV	280	757 mV	306 mV	30 mV	78 mV
min	28.905e+3	1.25860 V	-2 mV	280	757 mV	306 mV	30 mV	78 mV
max	28.905e+3	1.25860 V	1.284 V	280	757 mV	306 mV	30 mV	78 mV
sdev	---	---	78.13 mV	---	---	---	---	---
num	1	1	28.905e+3	1	1	1	1	1
status	✓	✓	✓	✓	✓	✓	✓	✓



<amplitude> is the mean of the distribution after the threshold cut

Amplitude vs. rate

- HV bias: -200_-675_-200_-675_-200 V
- Laser intensity 1.55



Threshold at 50 mV

- Clear saturation effects from 800 kHz
- ~ 20% drop at 1.5 MHz

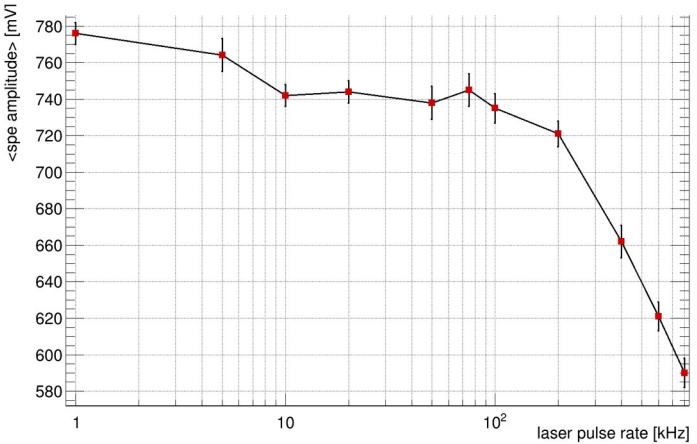
Amplitude vs. rate

- HV bias: -200_-ΔV_-200_-ΔV_-200 V
- Laser intensity 1.55

SPE

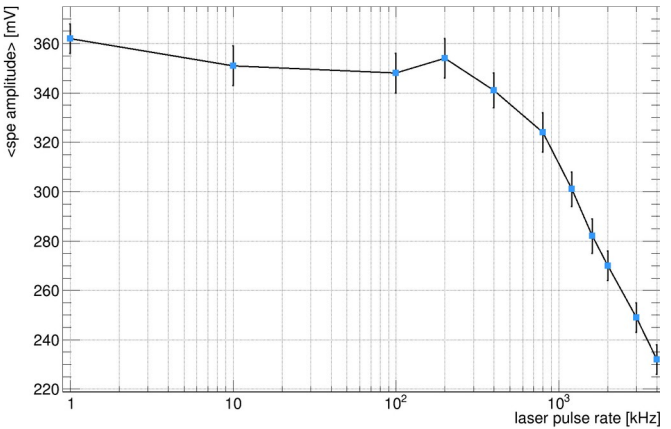
1 % p.e.

ΔV_{MCPs} = 700 V, Th at 100 mV



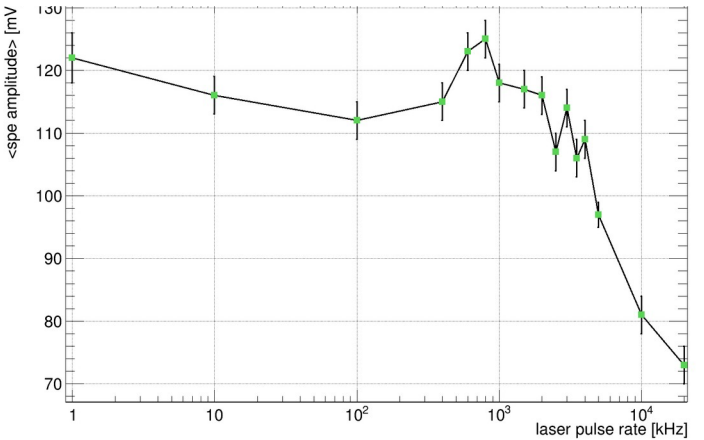
- Clear saturation effect at 200 kHz
- ~ 20% drop at 400 kHz

ΔV_{MCPs} = 675 V, Th at 50 mV



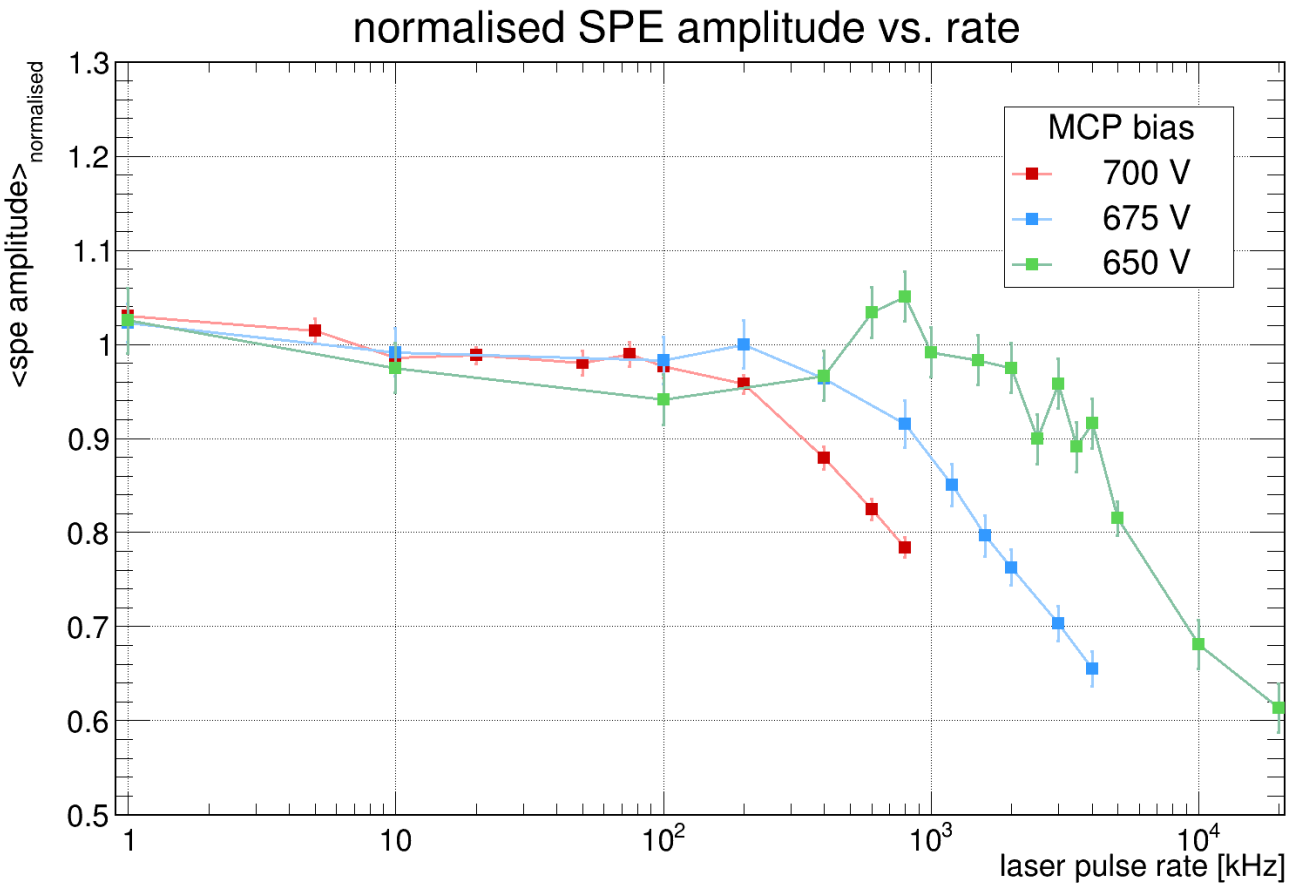
- Clear saturation effects from 800 kHz
- ~ 20% drop at 1.2 MHz

ΔV_{MCPs} = 650 V, Th at 25 mV



- Clear saturation effects from 2 MHz
- ~ 20% drop at 5 MHz

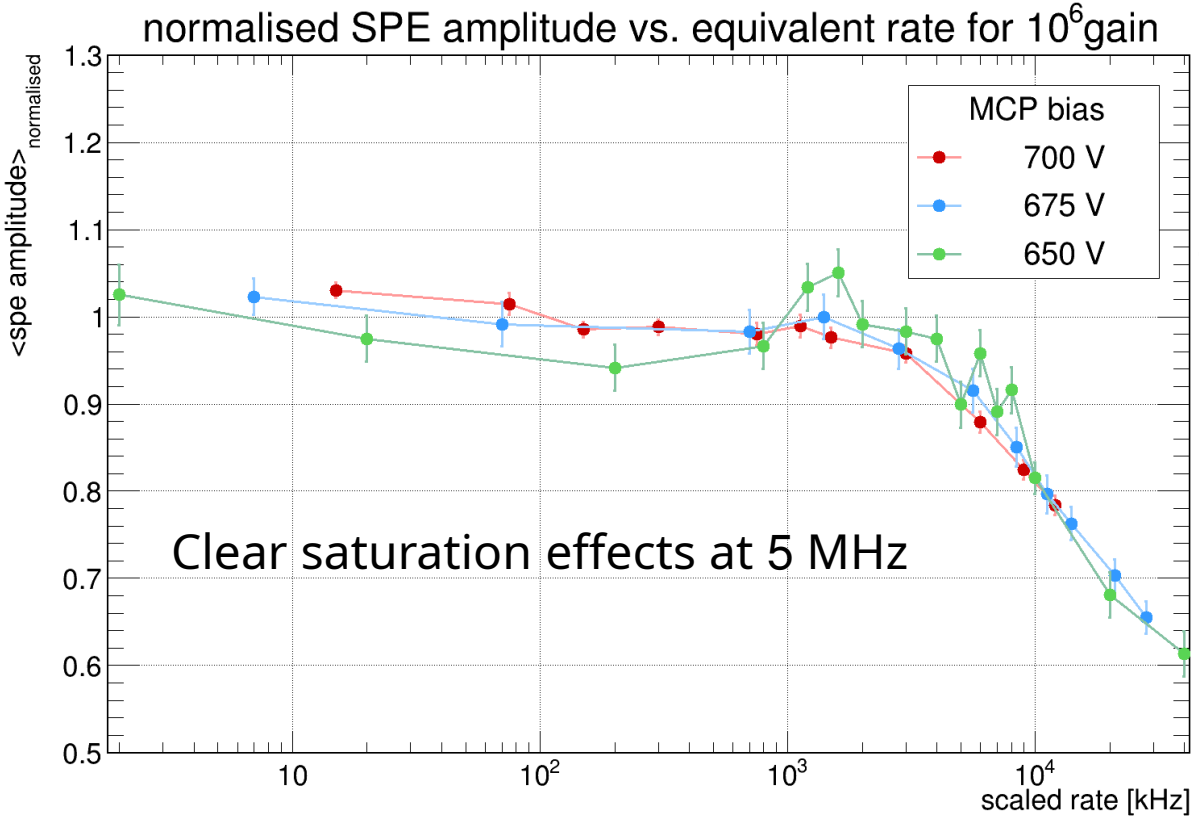
Normalised amplitude vs. rate



- Amplitudes normalised with respect to the average amplitude of first few points

Normalised amplitude vs. scaled rate

Universal amplitude vs. rate curve (at 10^6 gain)



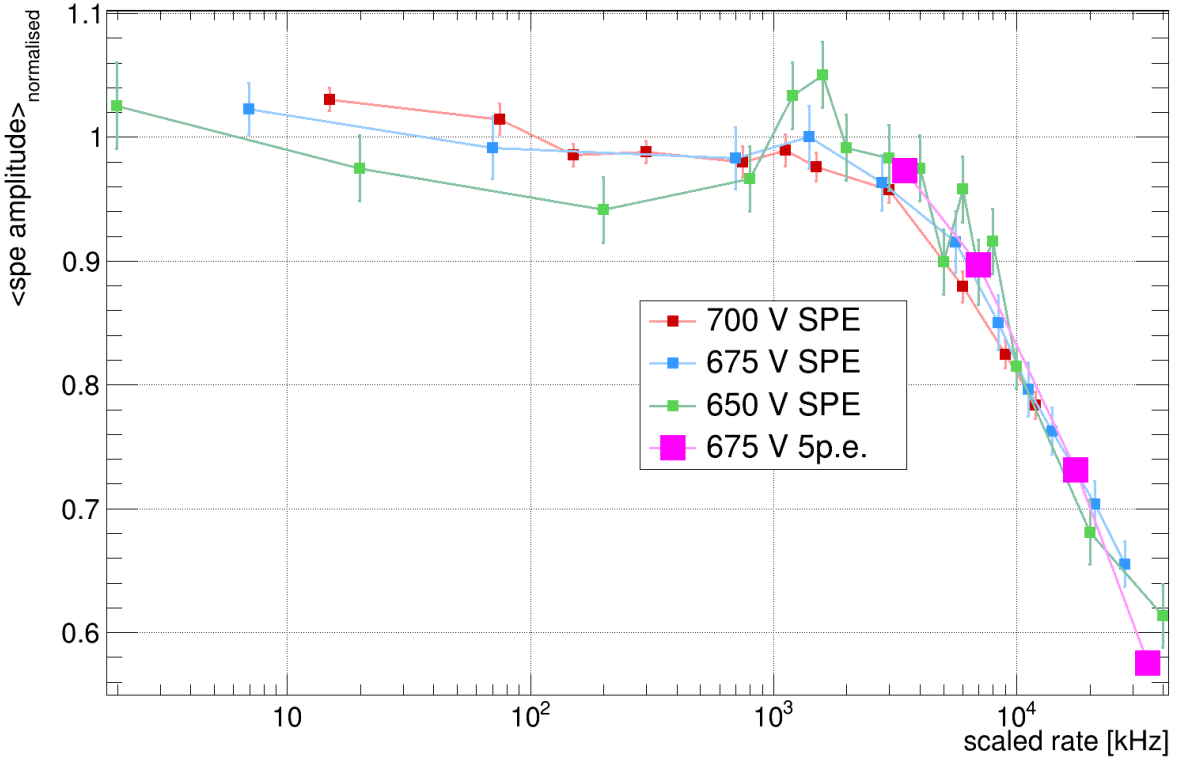
$$\text{Scaled rate} = \frac{\text{Rate x Gain } \mathbf{(datasheet)}}{10^6}$$

ΔV [V]	Scaling factor
700	15
675	7
650	2

Normalised amplitude vs. scaled rate

Universal amplitude vs. rate curve (at 10^6 gain)

→ 675 V, Int. 3.5 (5 p.e.), without amplifier



$$\text{rate} = \frac{\text{Rate x Gain } \mathbf{(datasheet)}}{10^6}$$

ΔV [V]	Scaling factor
700	15
675	7
650	2

Summary

- Gain saturation as a function of rates has been measured (SPE responses).
- The effects are clearly observed for various bias voltages across the MCPs.
- Saturation effects depend on the **product of Rate and Gain** (universal curve).

Summary

- Gain saturation as a function of rates has been measured (SPE responses).
- The effects are clearly observed for various bias voltages across the MCPs.
- Saturation effects depend on the **product of Rate and Gain** (universal curve).

Thank you!