Progress of MPPC dev.

Oide, Otono, Sudo, Gomi
Sep. 2007 at Prague CALICE meeting

T. Takeshita (Shinshu)

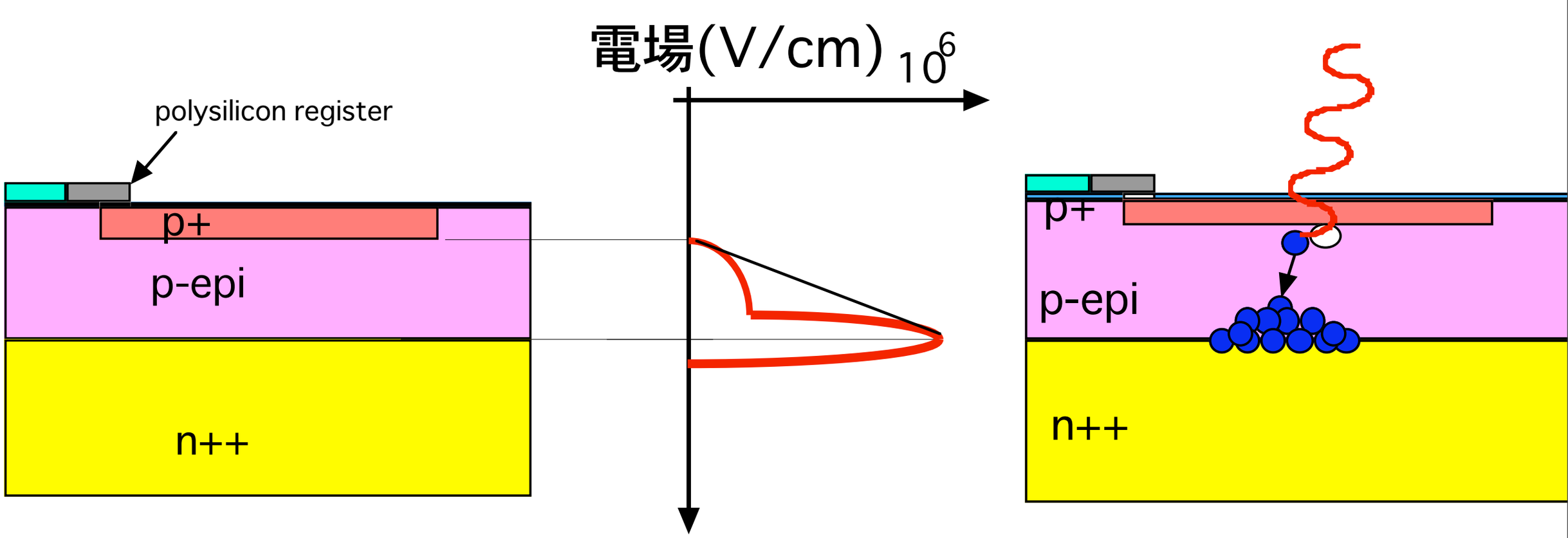
test with 1600 pix. MPPC
signal studies (After pulse and Cross talk)
linearity

test with small number of pix. MPPC

MPPC structure by Yamamoto of HPK

PD07
Kobe

- thin p+ layer to be sensitive blue light



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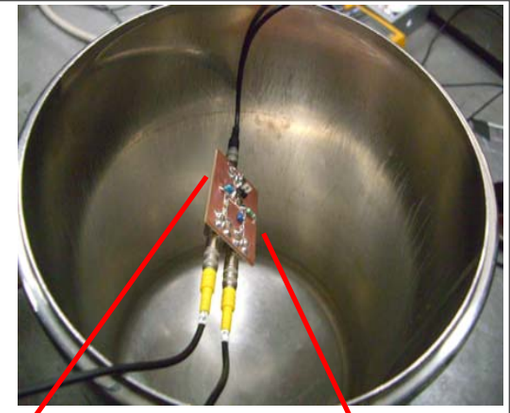
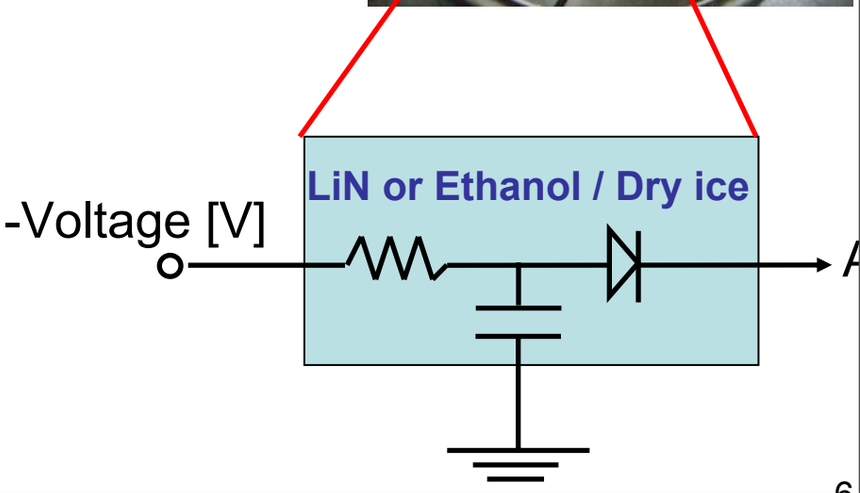
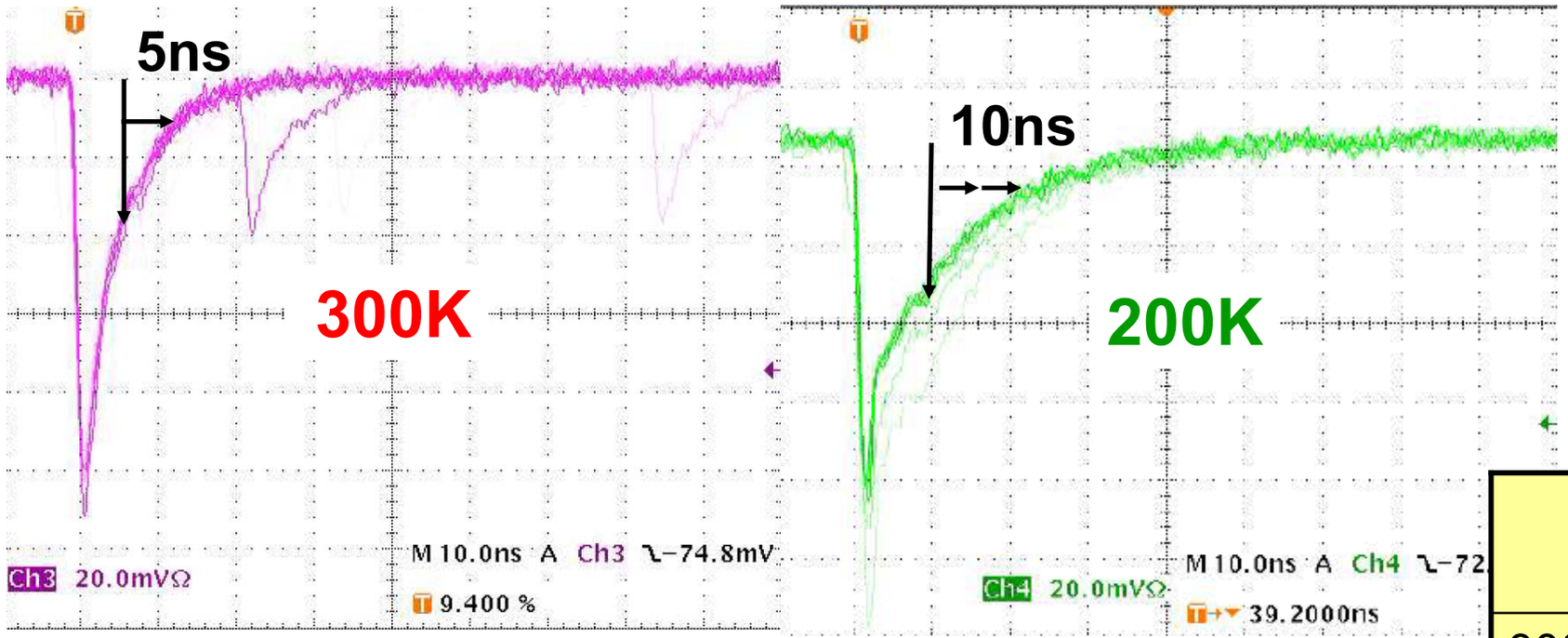
Out pulse analysis

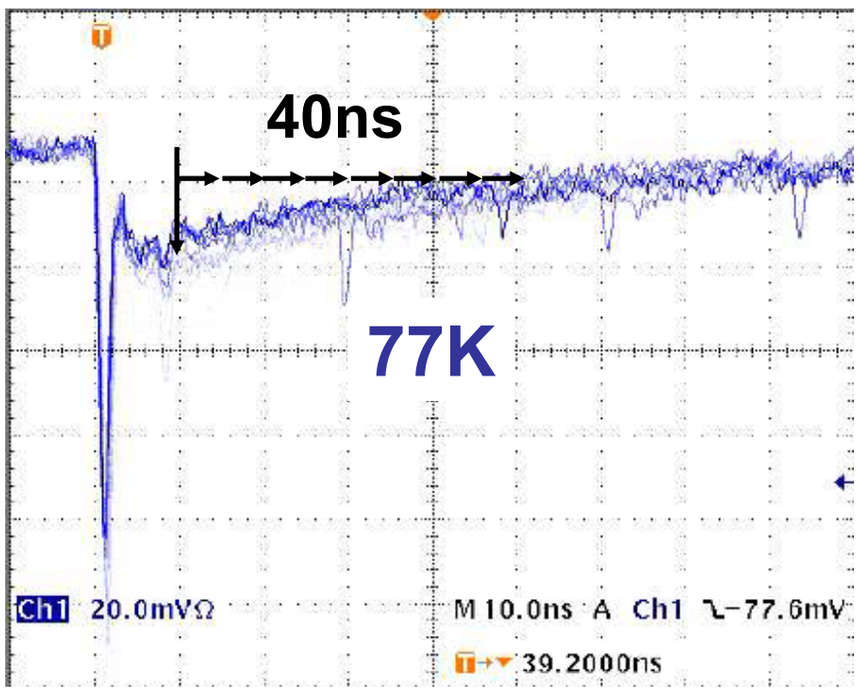
- temperature dependence

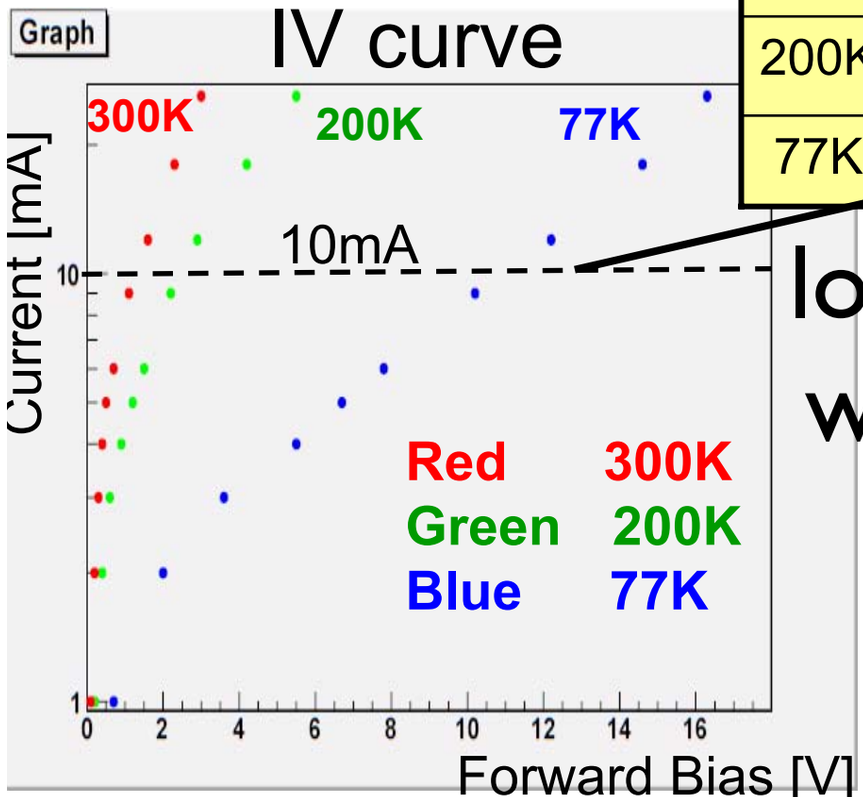






	Resistance (R)	Capacitance (C)	R x C
300K	0.21MΩ	22.1fF	4.6ns
200K	0.40MΩ	22.0fF	8.8ns
77K	1.68MΩ	21.3fF	35.8ns

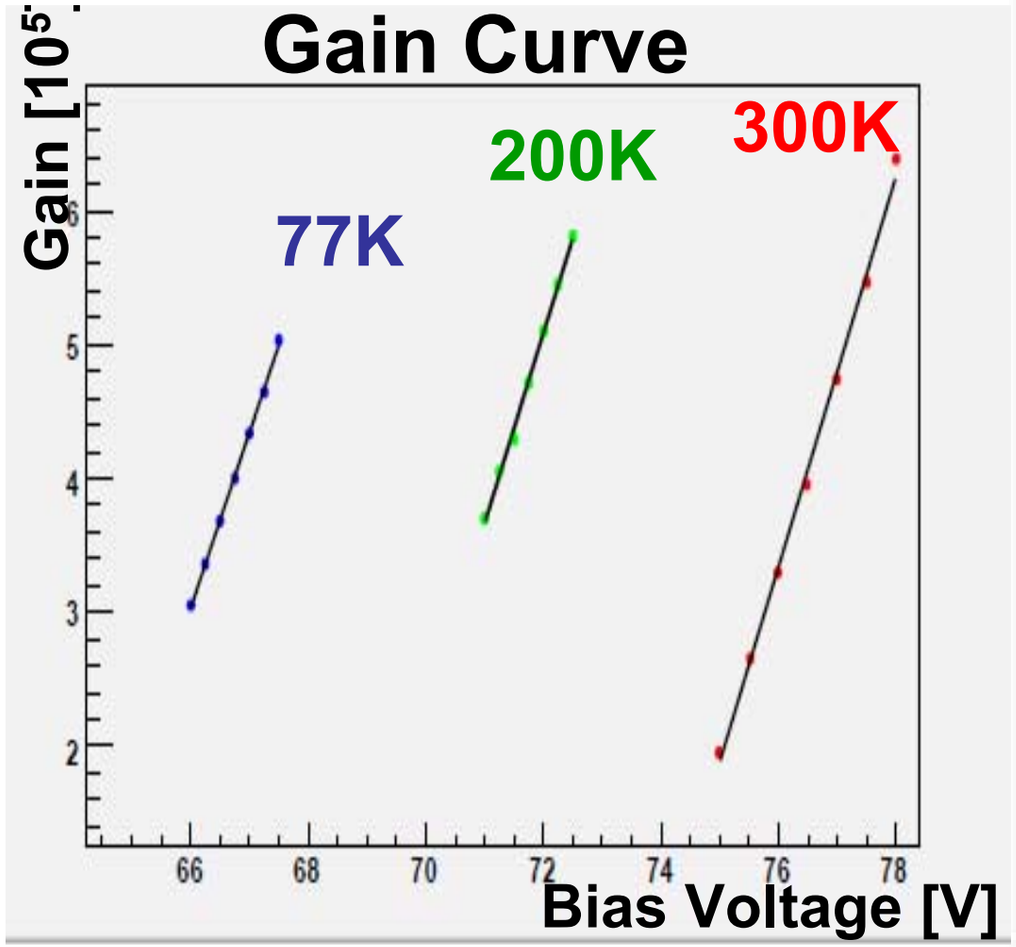


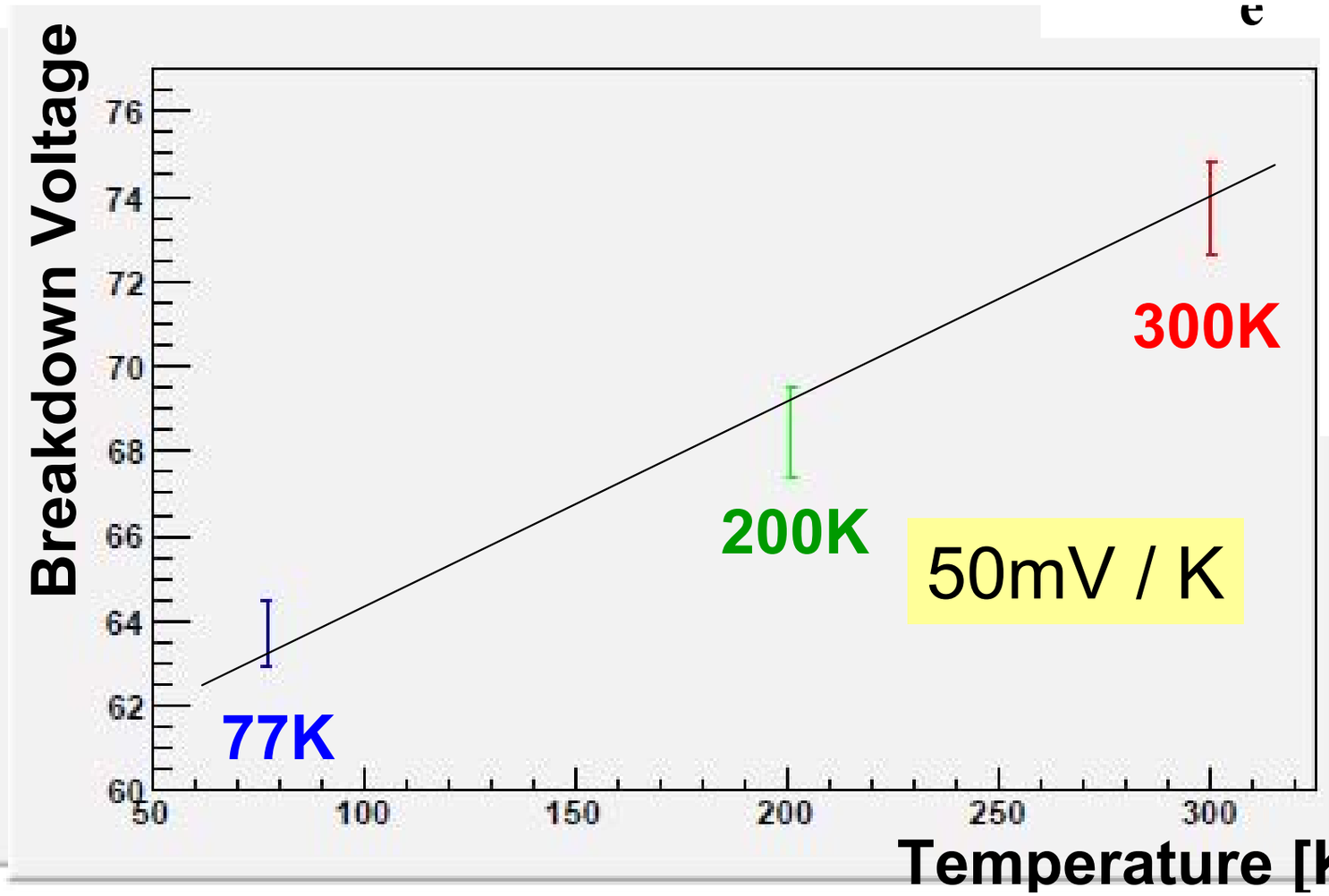


long tail is consistent with the time const.
R~1/Temp

break down voltage and capacitance

- temperature dep.



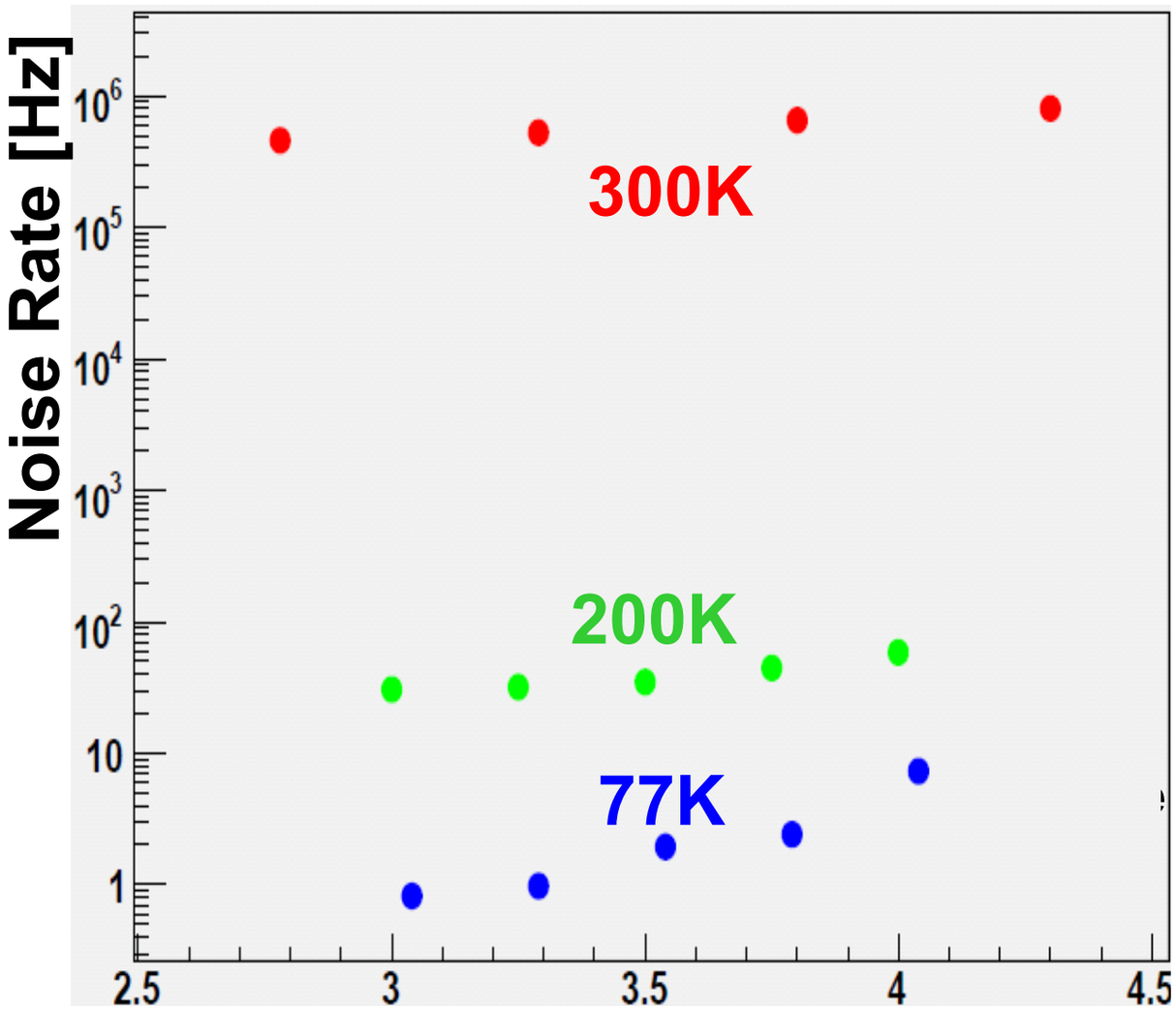


Linear behavior with const. capacitance

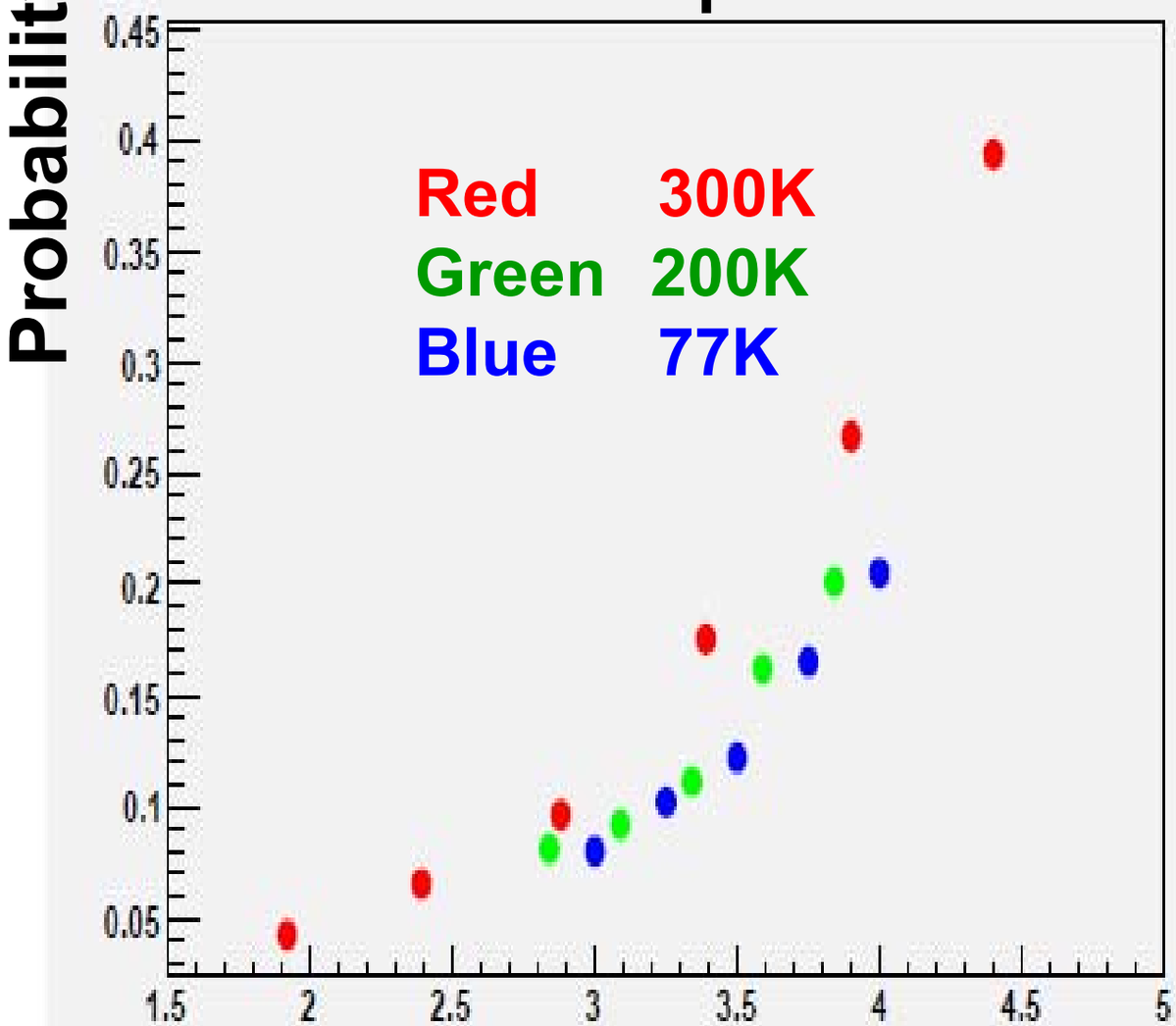
Dark Noise and X talk

- temperature dep.

Dark Noise rate



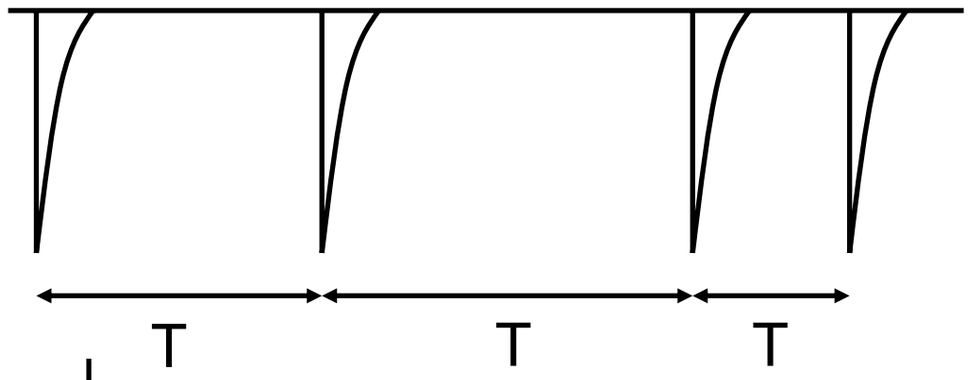
X talk prob.



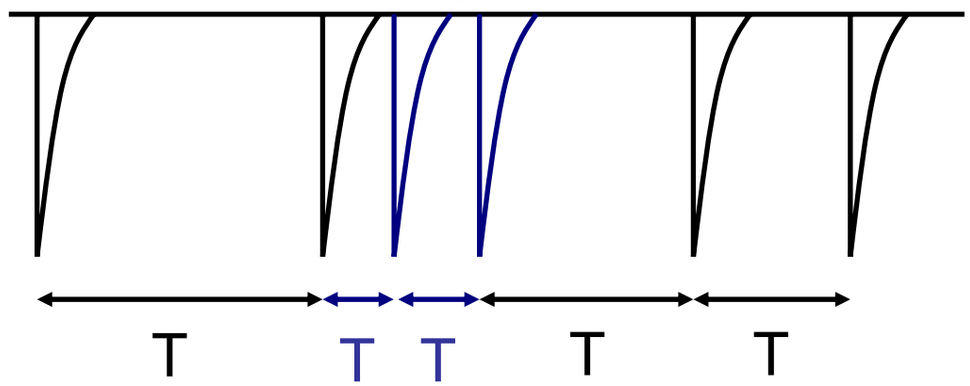
After Pulsing

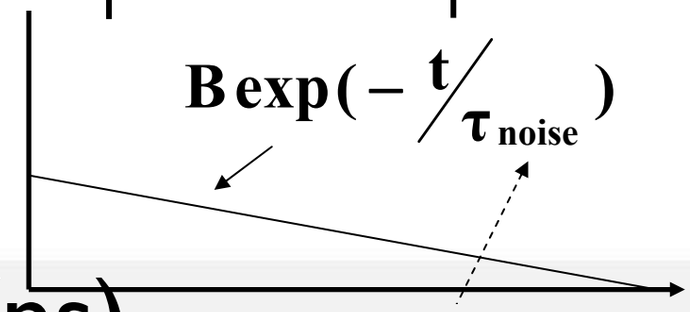
- temperature dep.

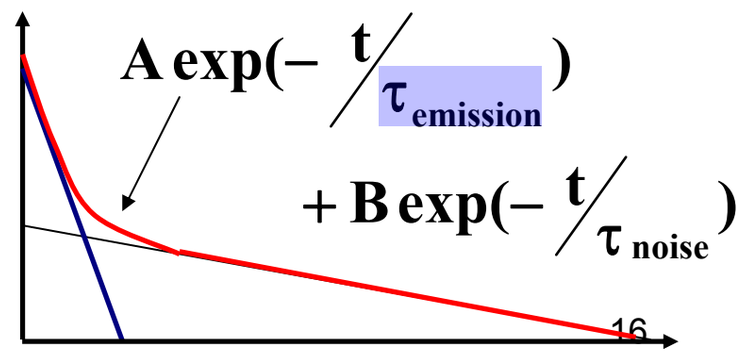
no After pulsing



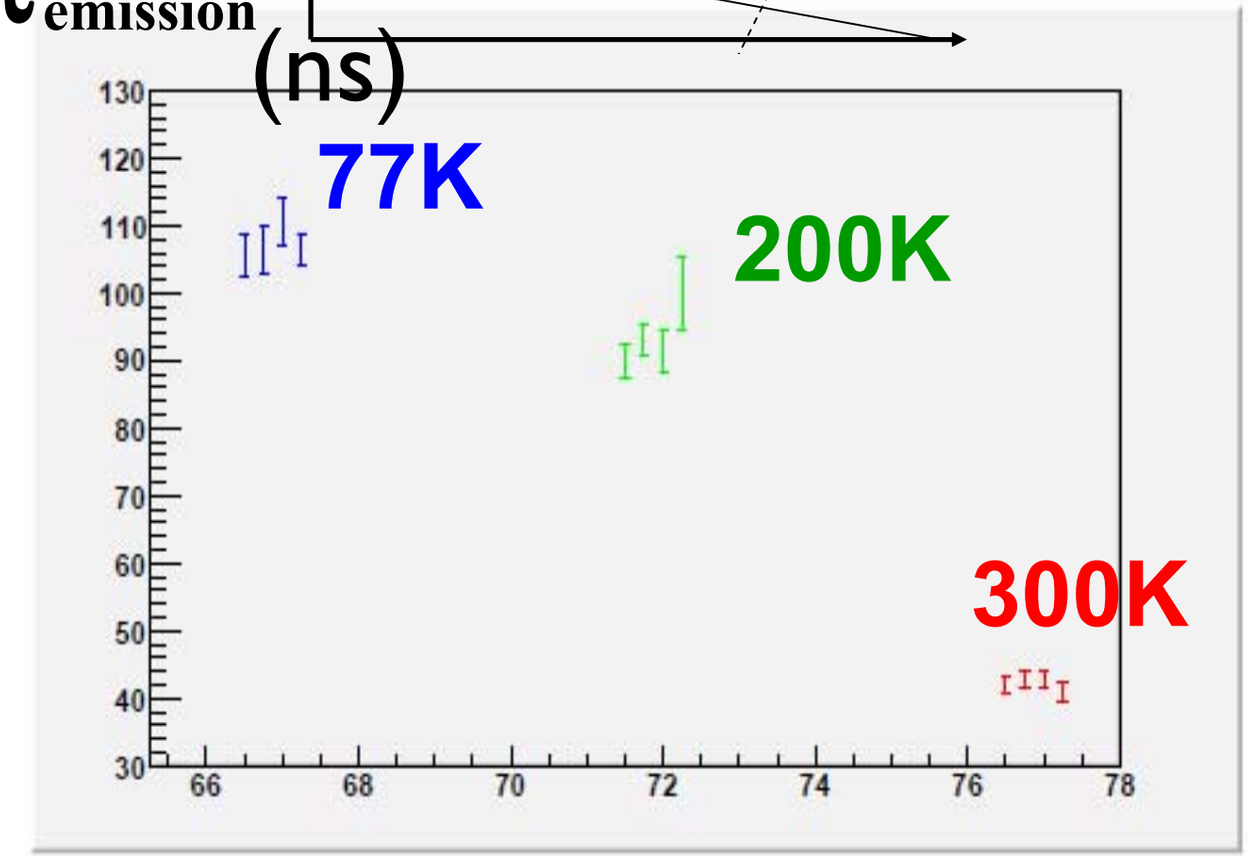
actual pulses

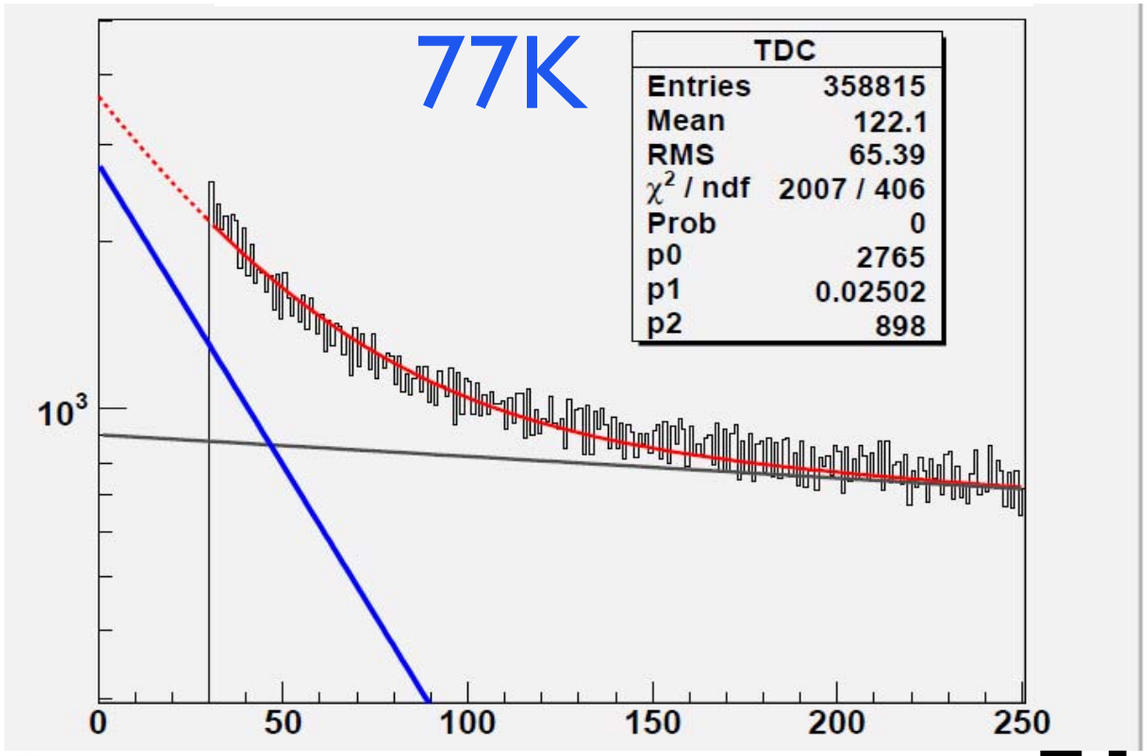






$\tau_{emission}$ (ns)





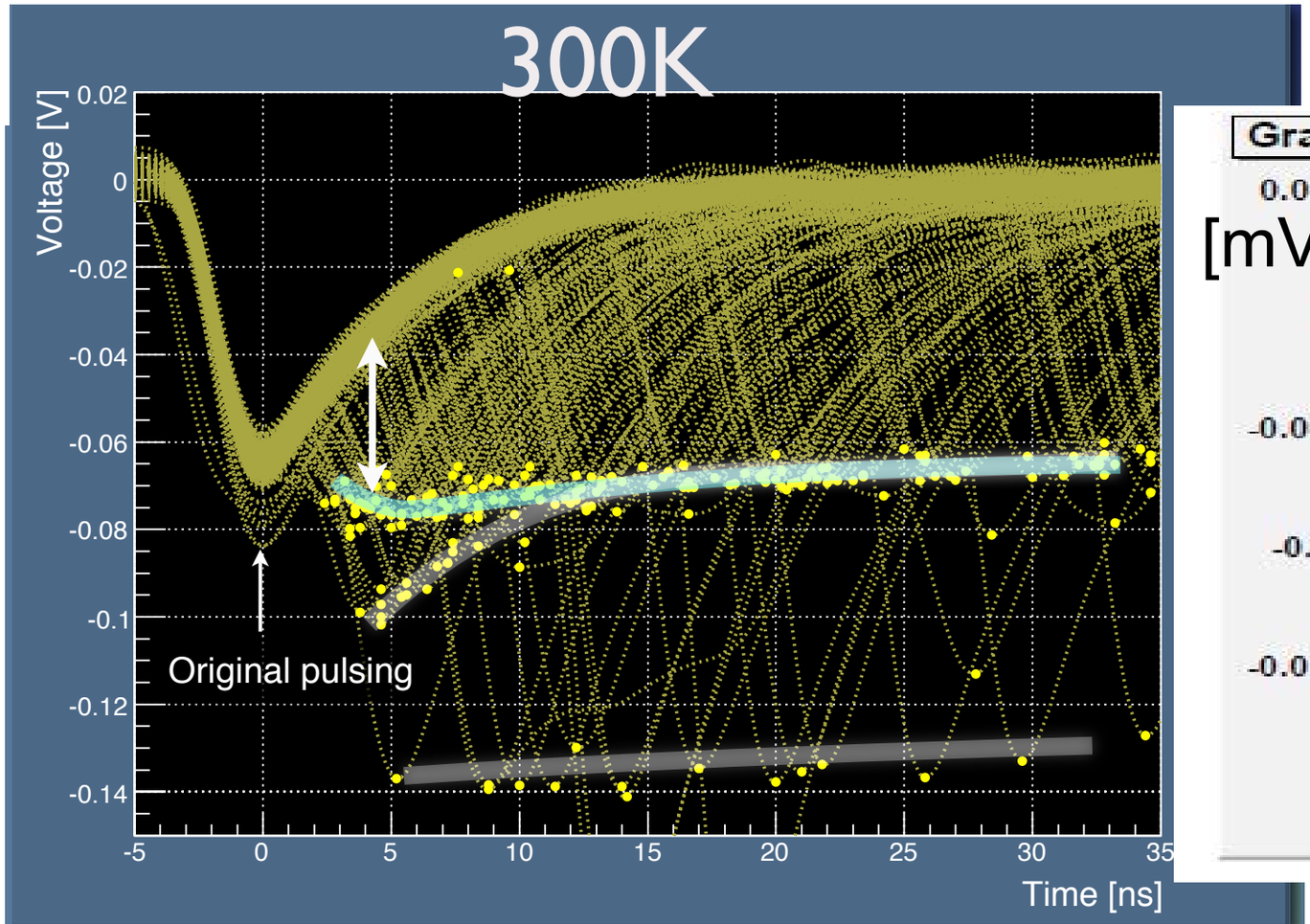
]

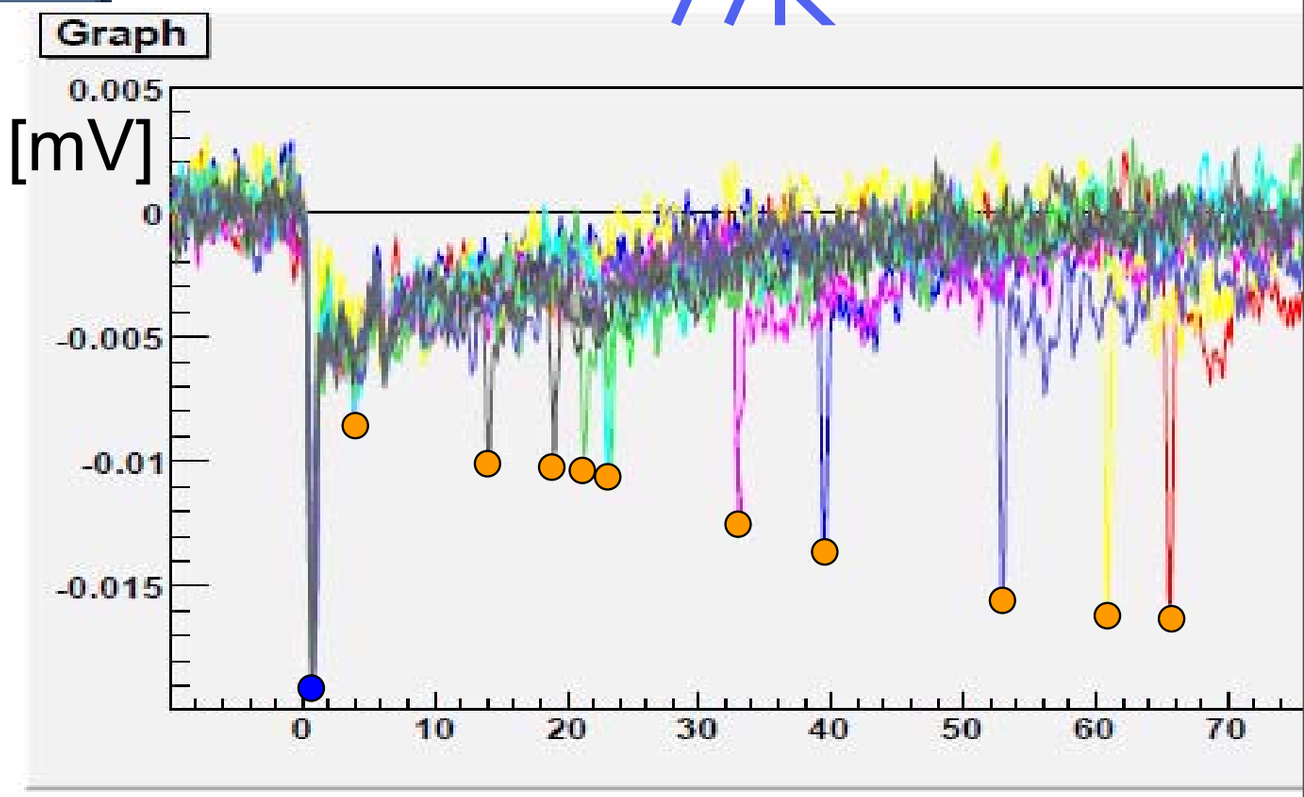
Bias Voltage [V]

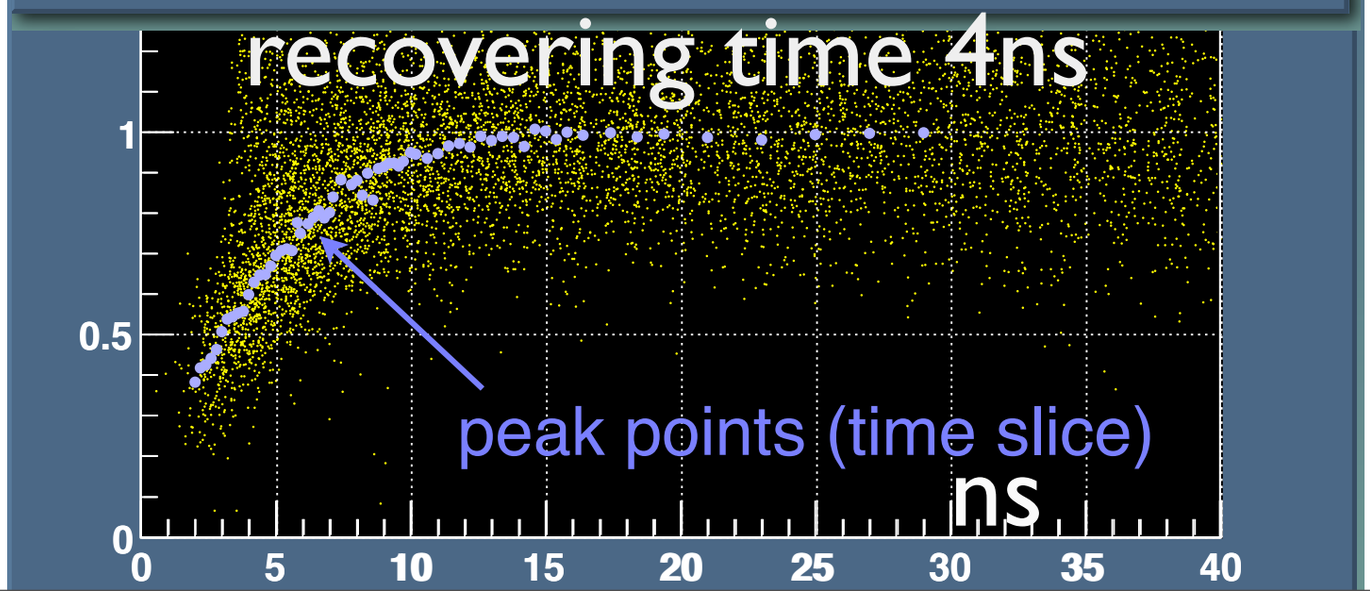
T [ns]

Recovery from quench

- a pixel operating at Geiger Mode 1600pix







~ 40 ns by low temp.
(R increased : 36ns)

so rapid!

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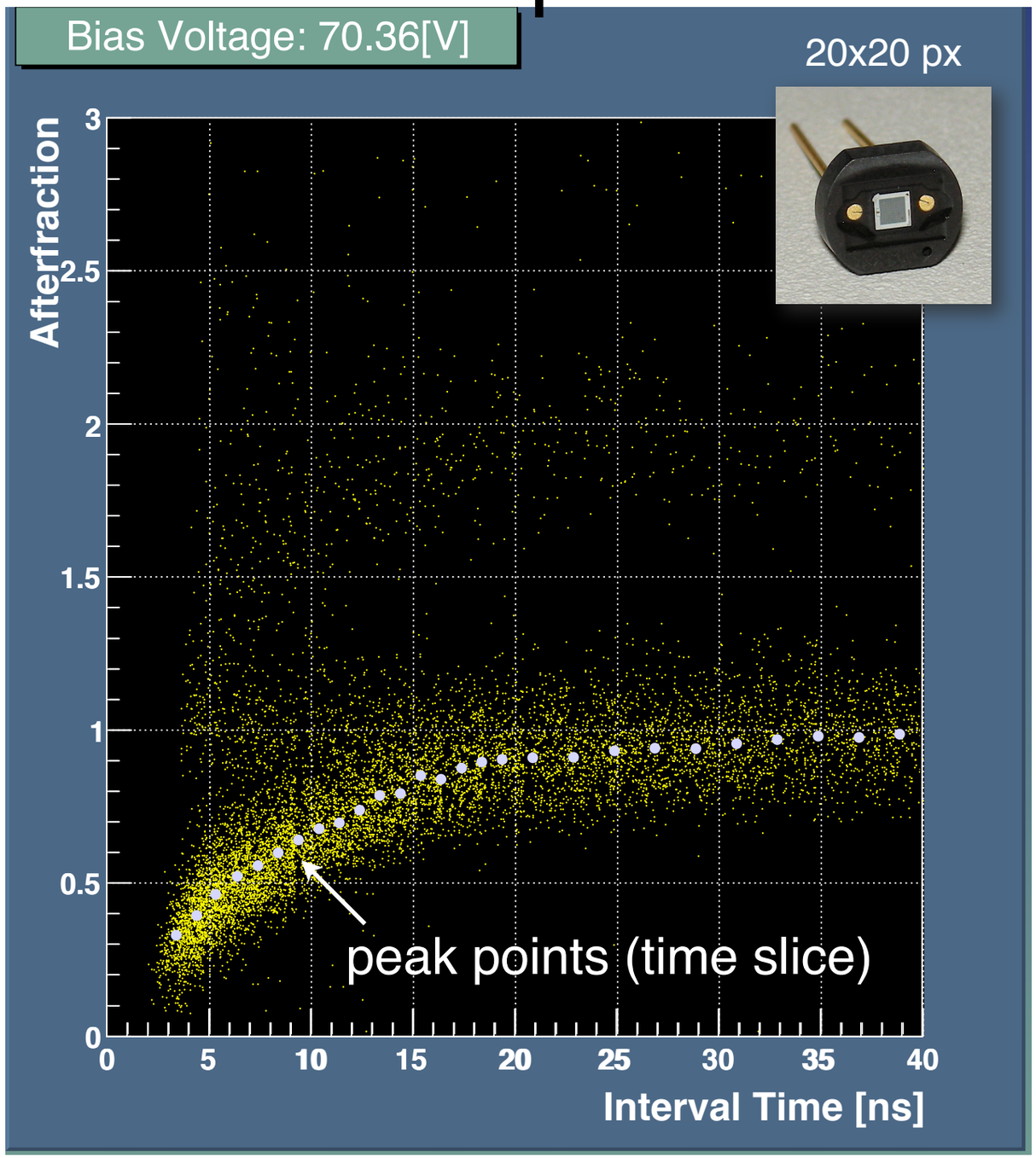
Recovery from quench II

- different MPPC type ; 100,400 and 1600 pix

400pix



at room temp.

recovery time < RC time

100 pix : 33ns < 35ns

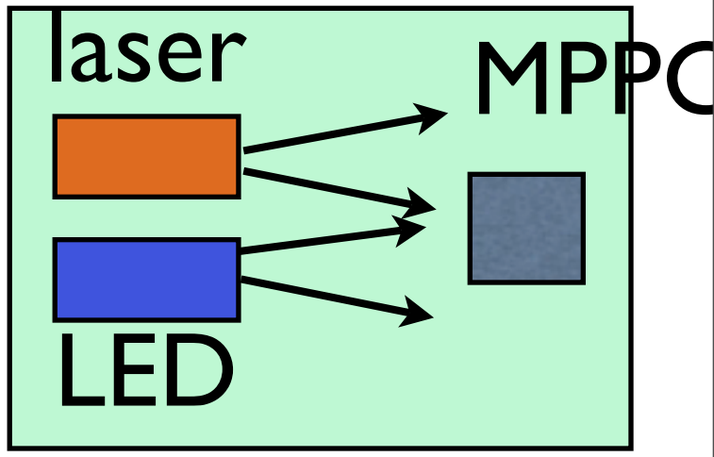
400 pix : 9ns < 11ns

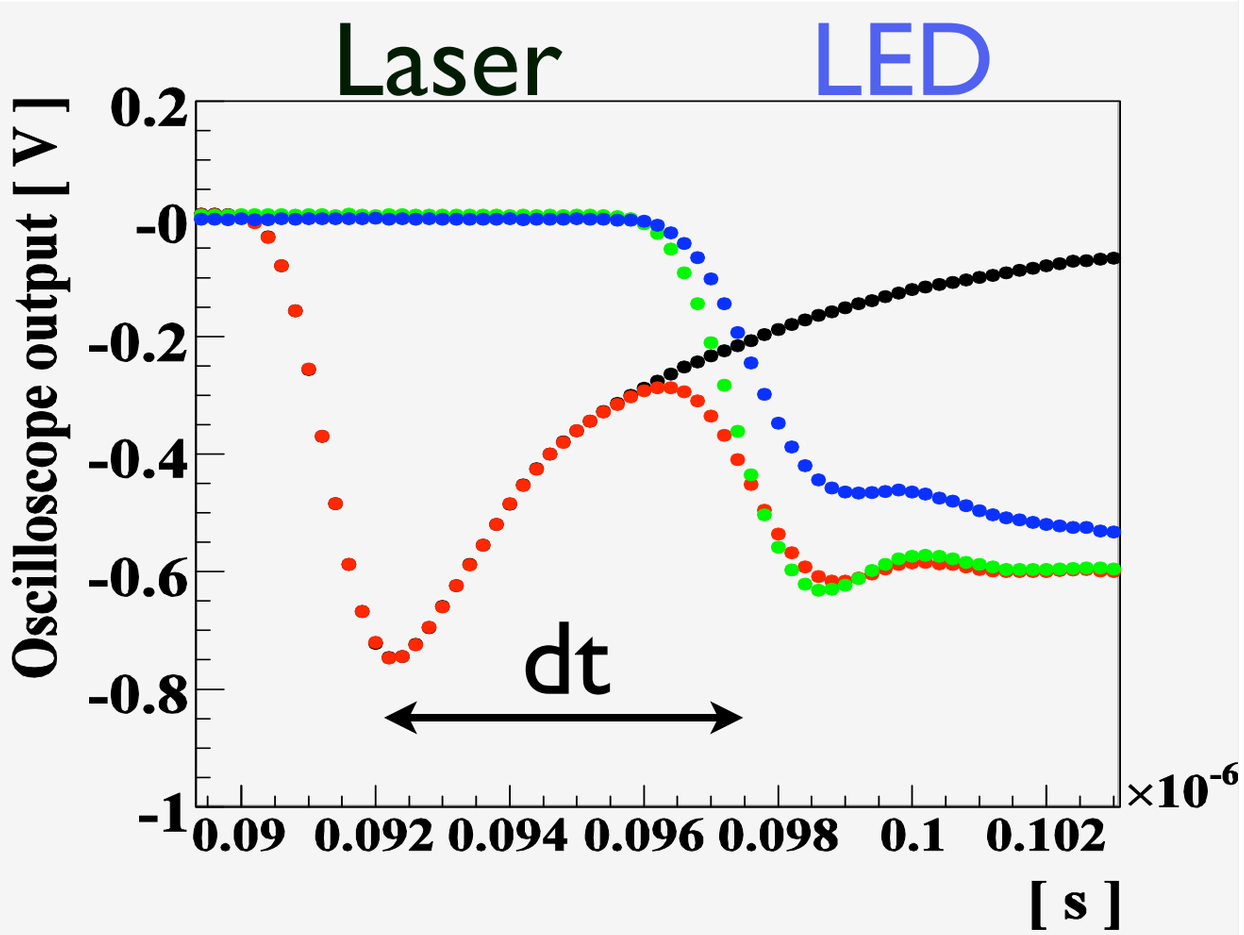
1600 pix : 4ns < 5ns

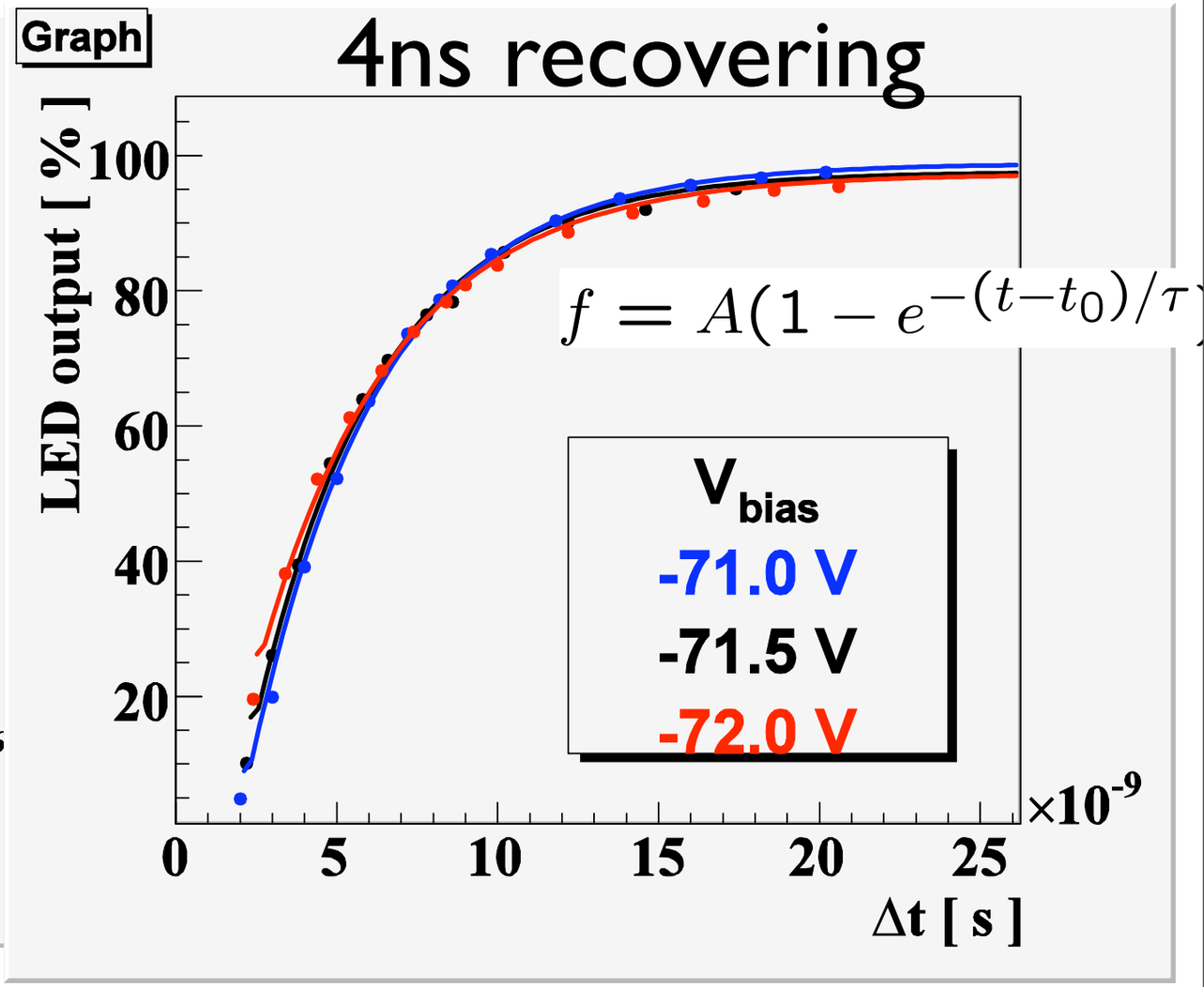
recovery time indep.
with bias Voltage

rapid recovery

- we have very linear scECAL at DESY
- with two light sources (Laser and LED)
  408, 470nm
- huge amount of light (all pix are firing)



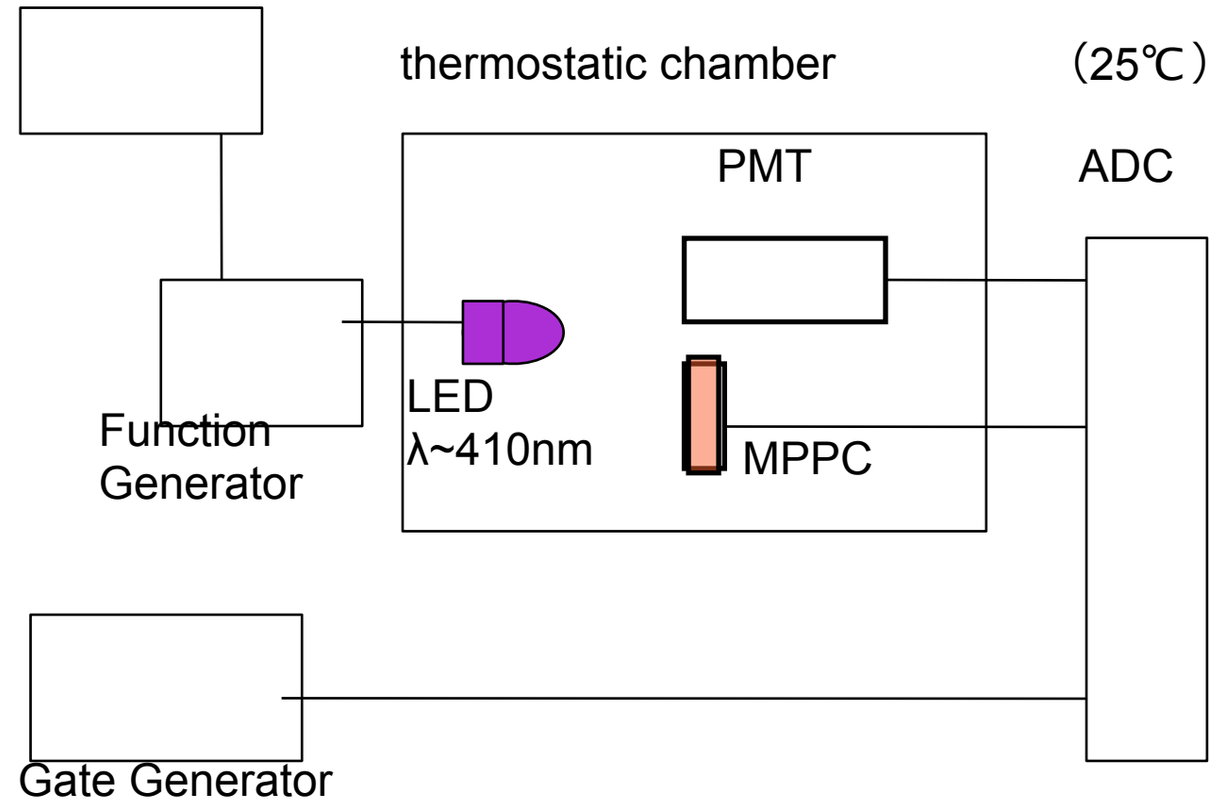




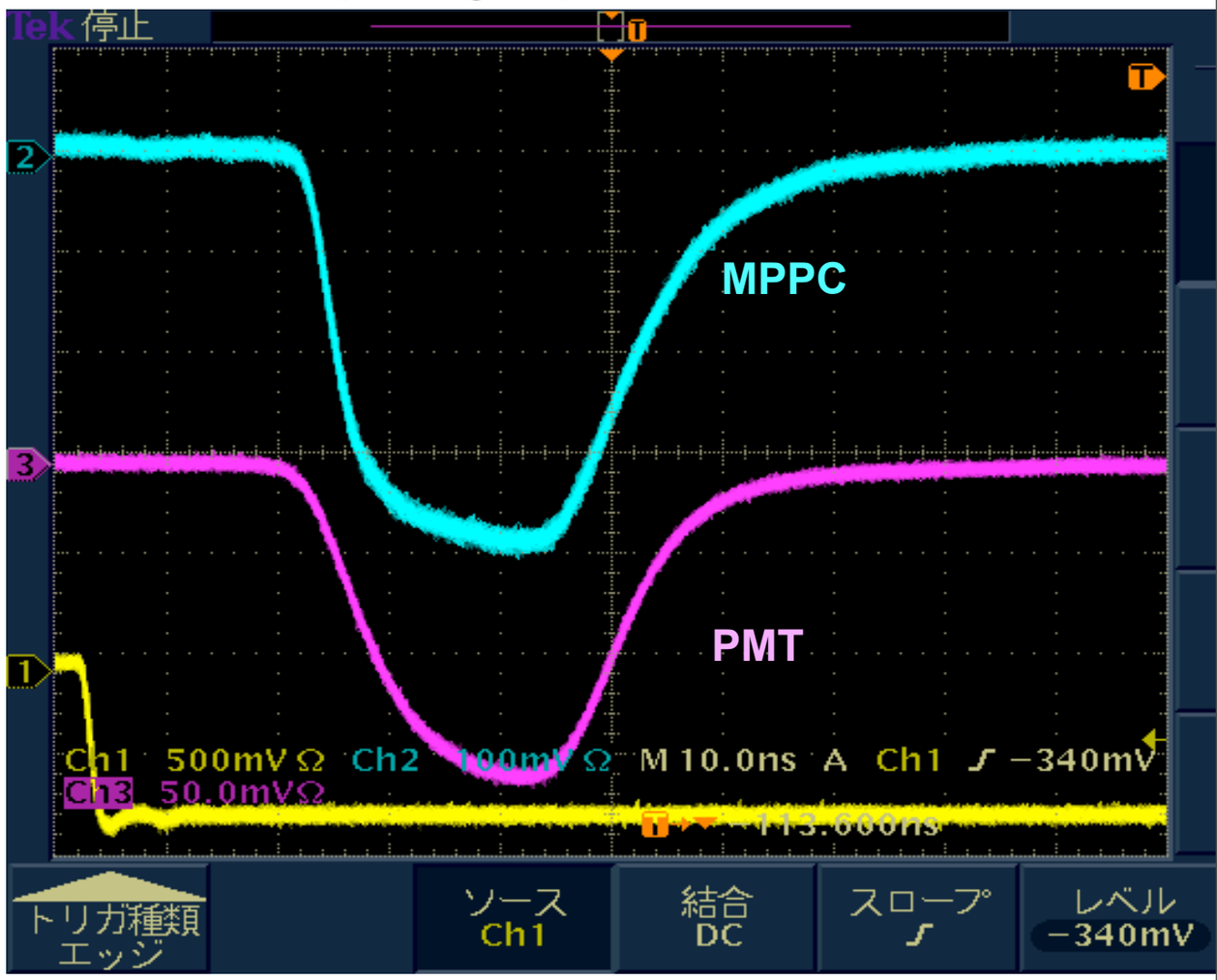
response curve of MPPC

- with respect to a PMT

set up



Input light pulse width 24ns



response curve of MPPC II

- responding up to 6000 pix equivalent

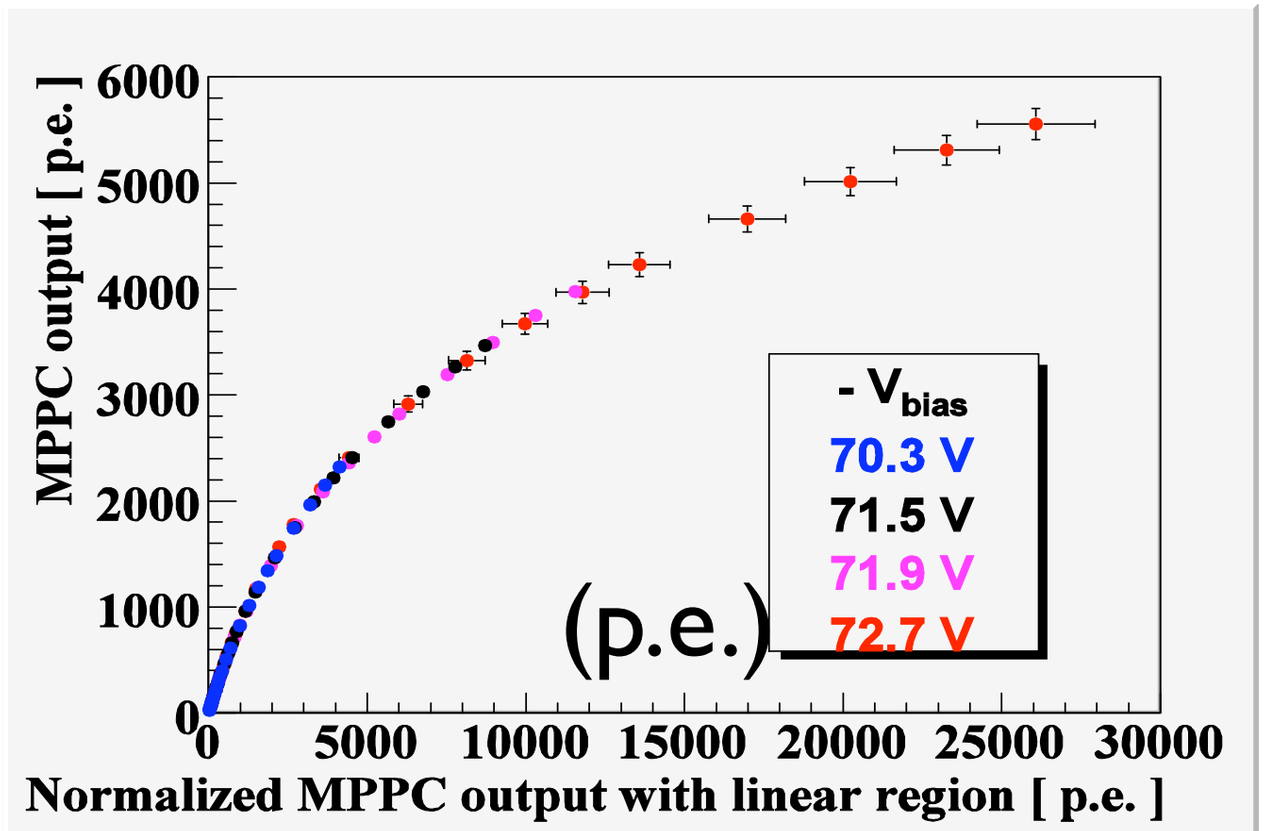
(p.e.)

(p.e.)

- linear response up to 200 p.e.
- independent to boas Voltage

response curve of MPPC II

- responding up to 6000 pix equivalent

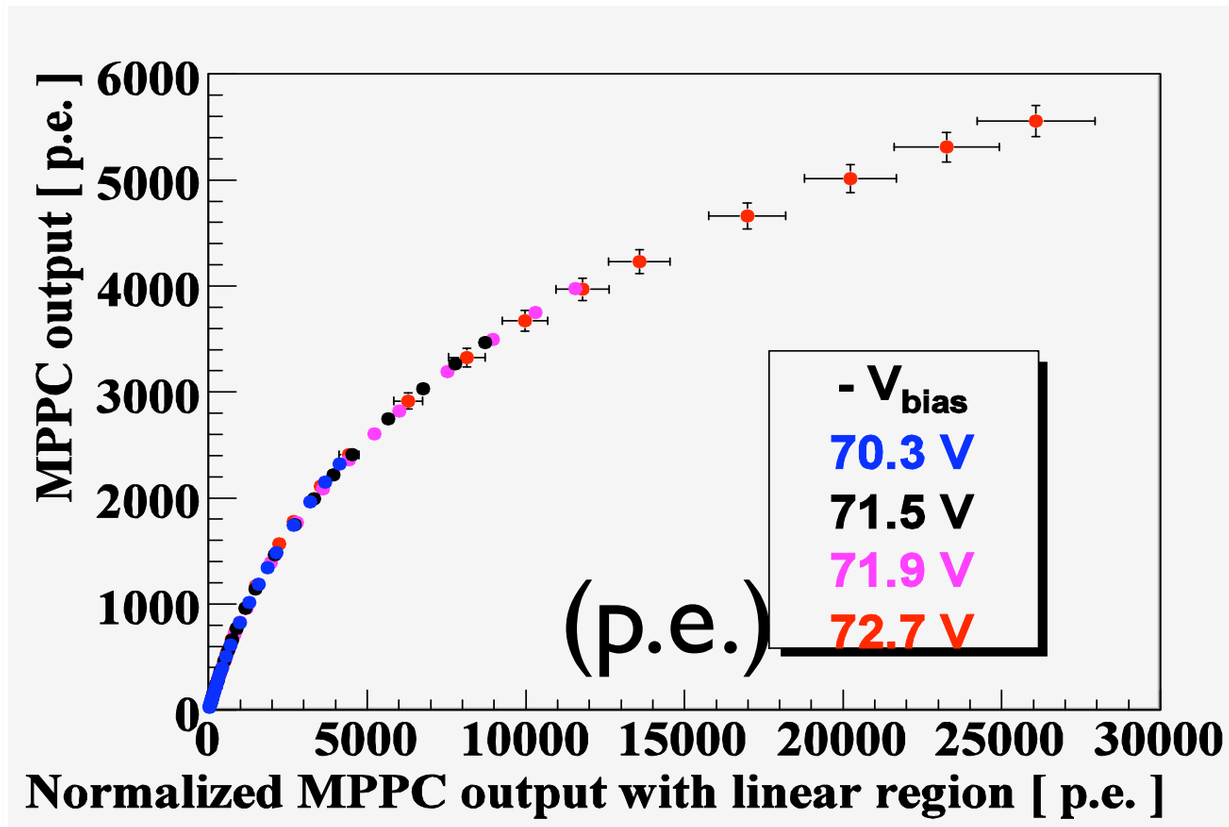


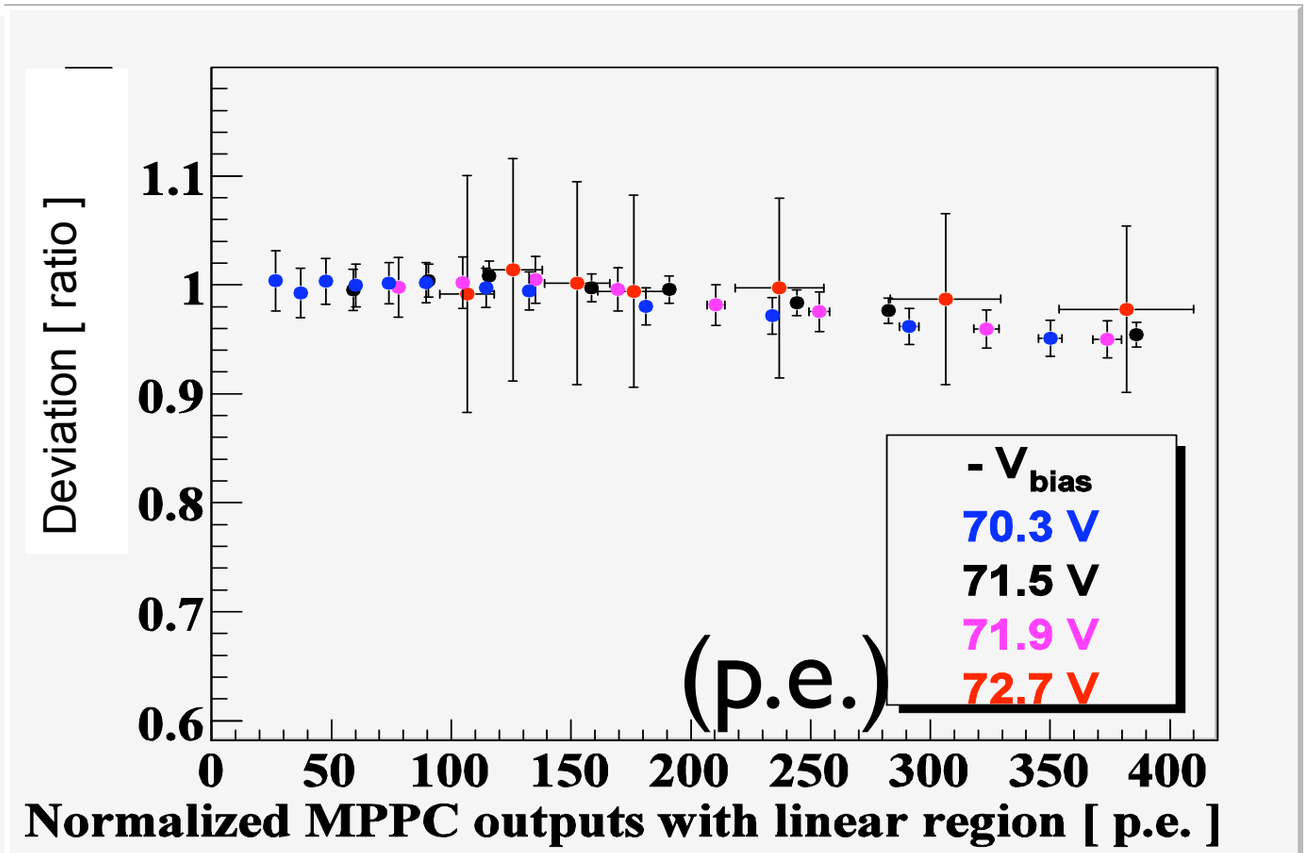
(p.e.)

- linear response up to 200 p.e.
- independent to boas Voltage

response curve of MPPC II

- responding up to 6000 pix equivalent

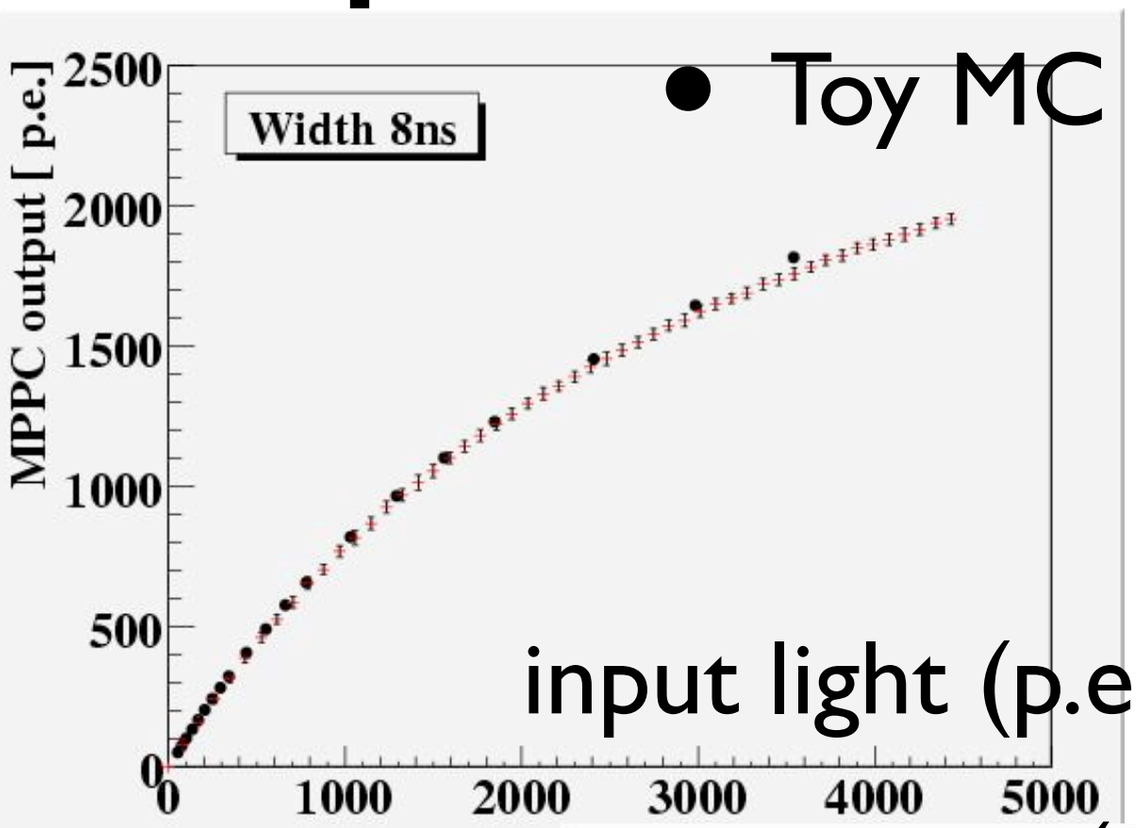


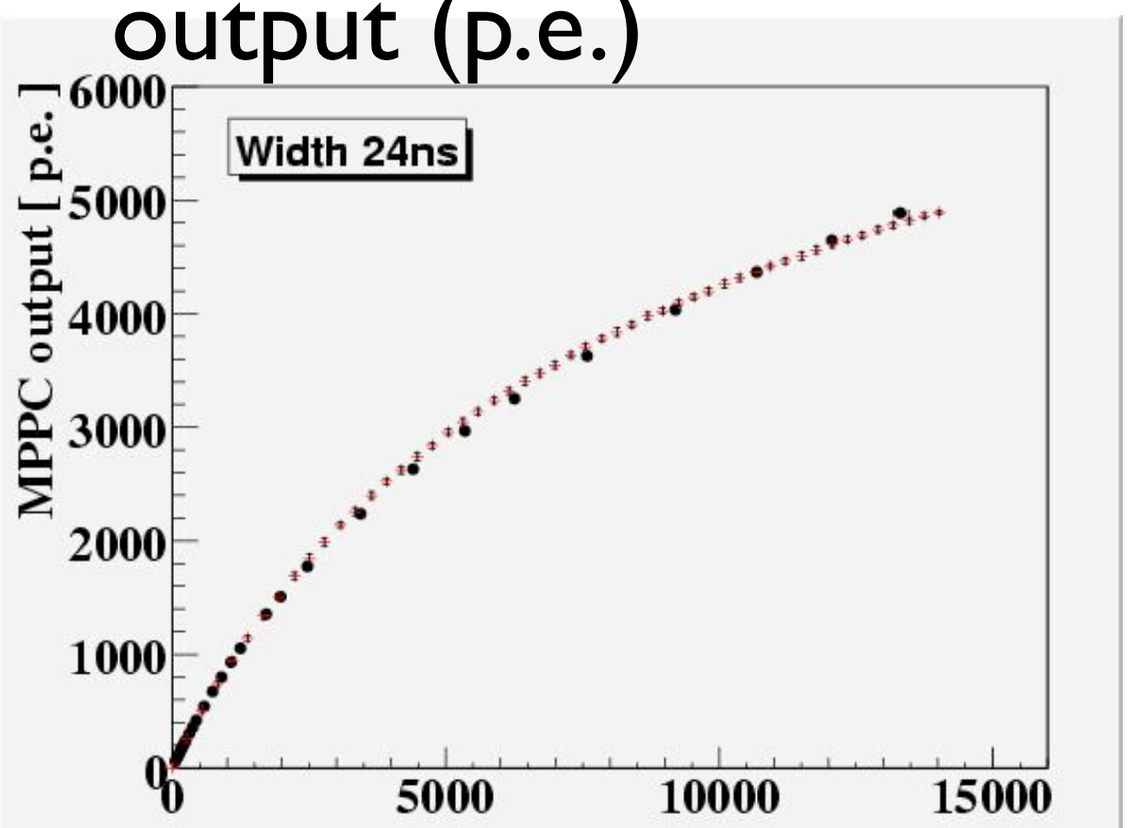


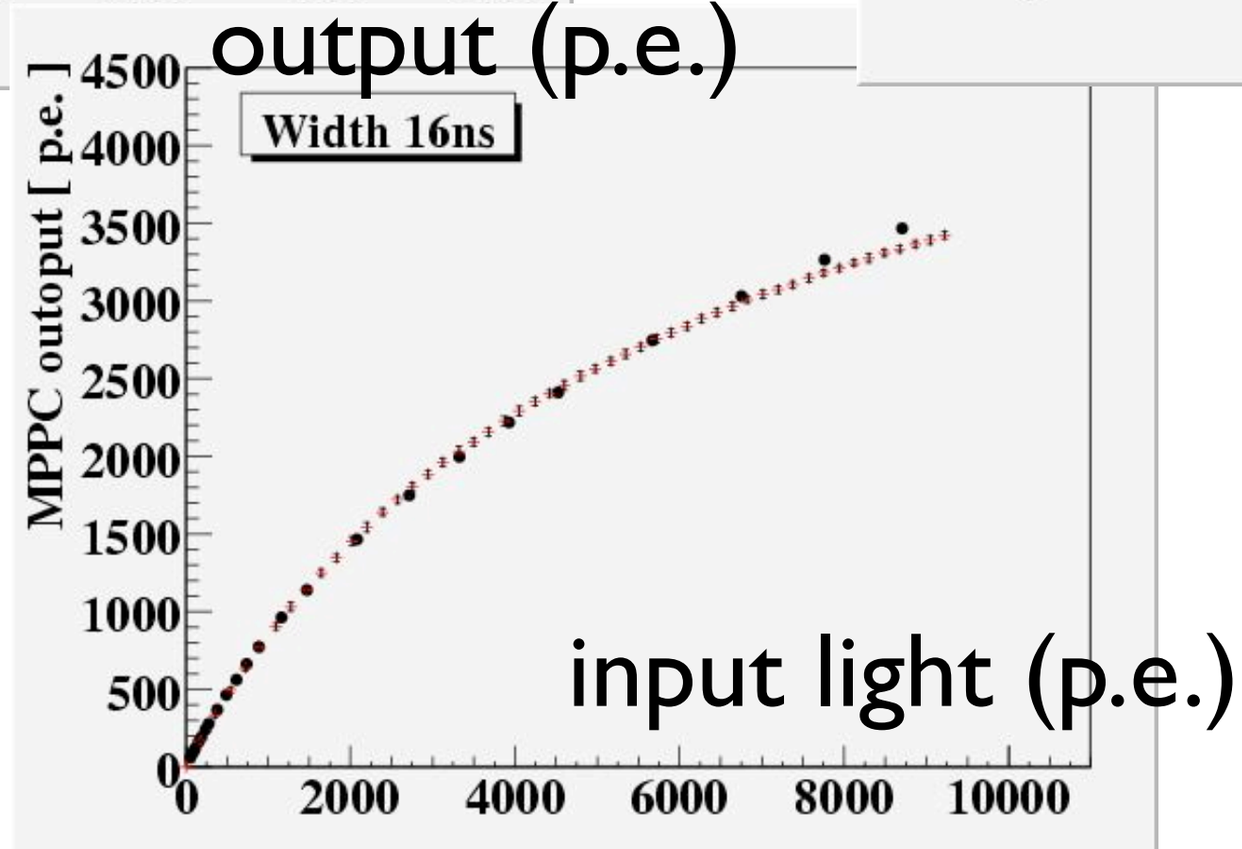
- linear response up to 200 p.e.
- independent to boas Voltage

response curve of MPPC II

- Toy MC



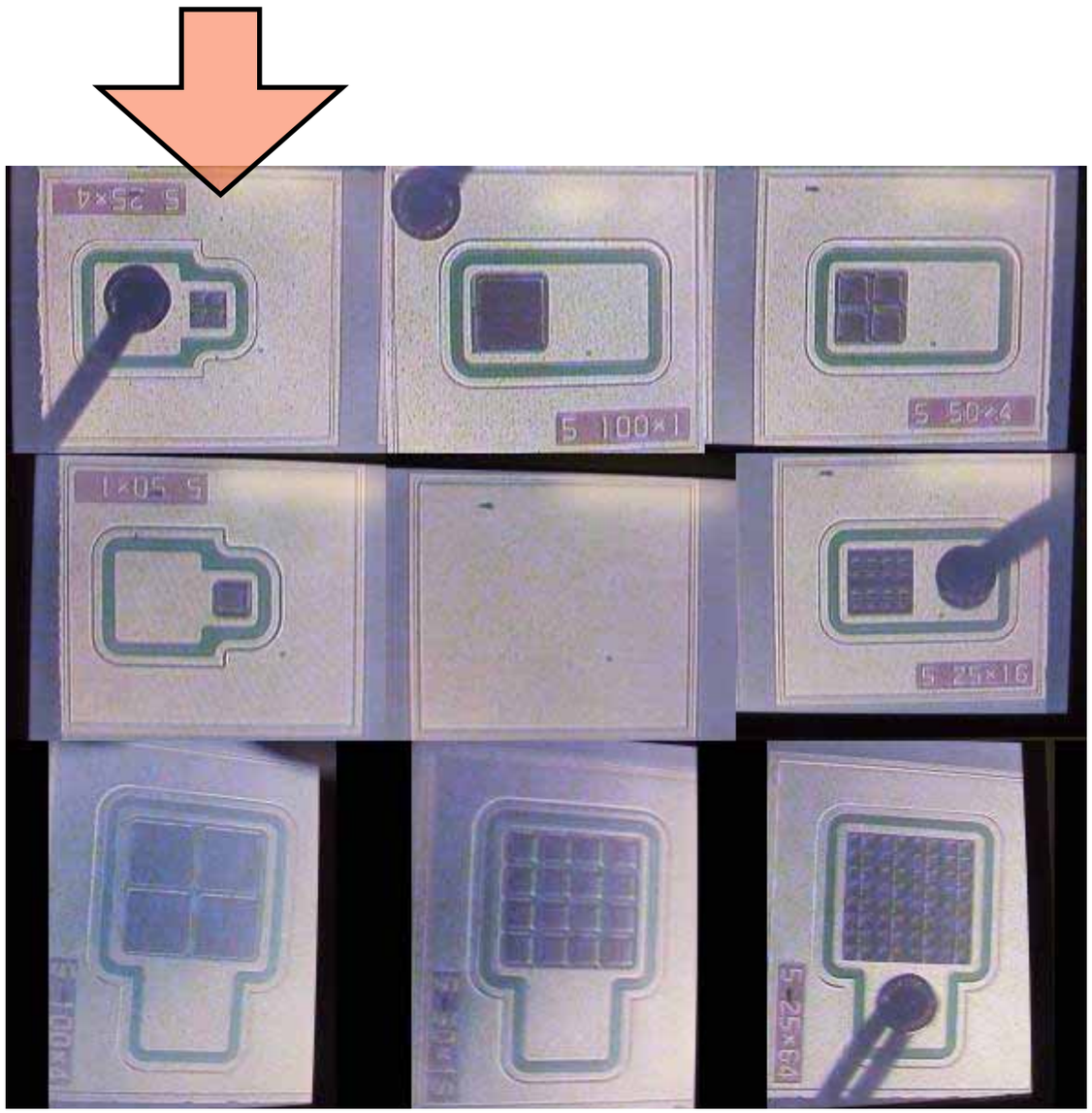




4 pix MPPC

- special version from HPK
- less noise (1kHz) and NO cross talk

after pulsing



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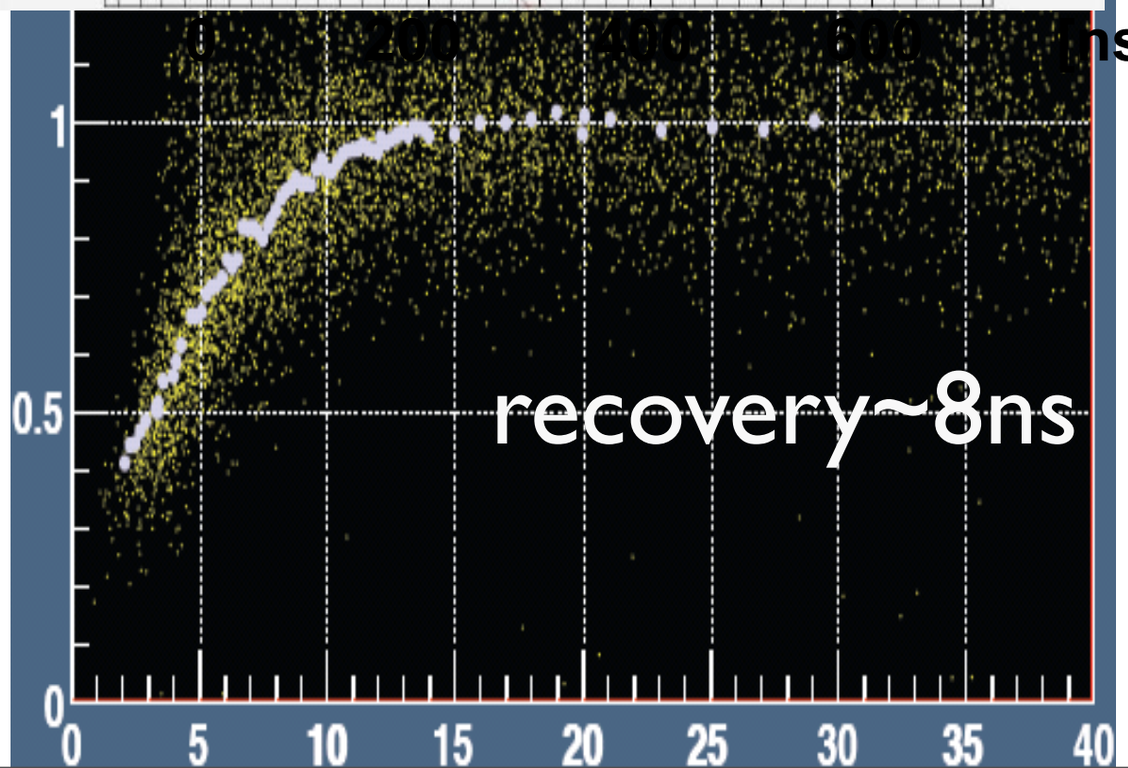
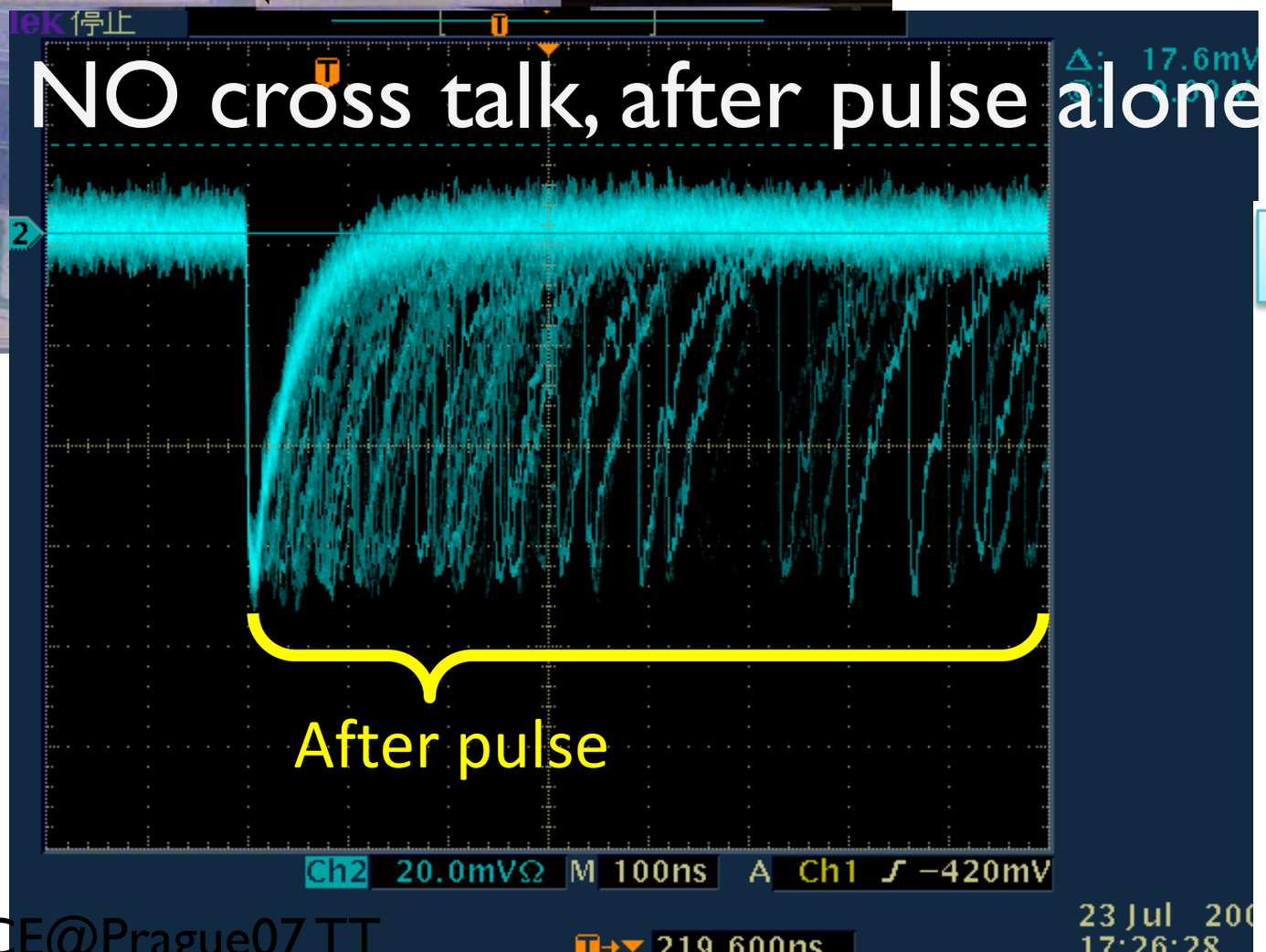


1 Pix MPPC

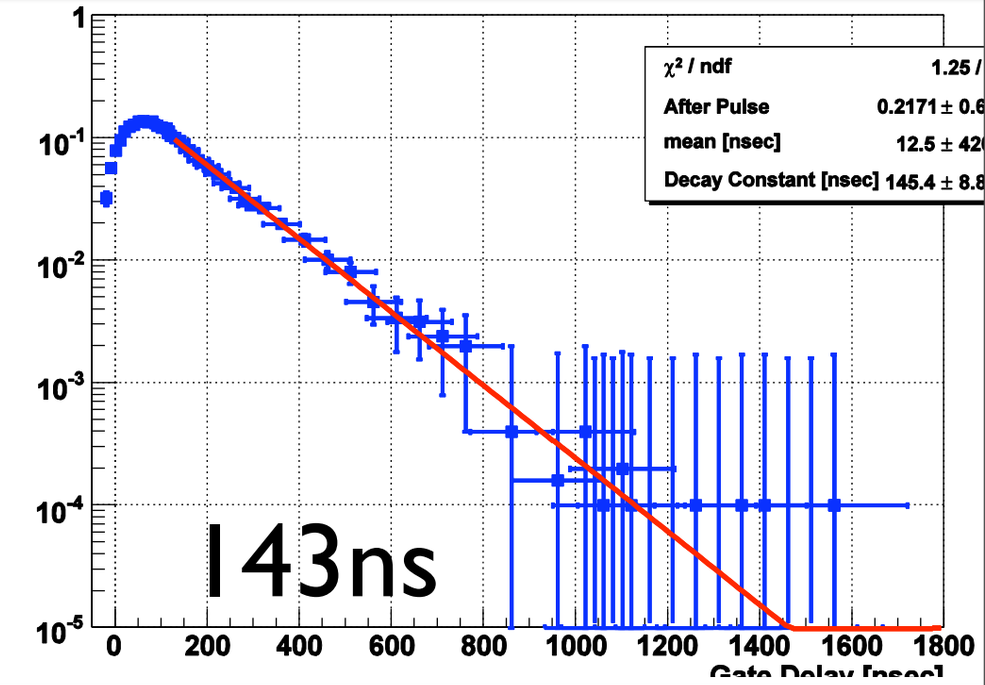
100 and 50 μm

Gomi/T2K

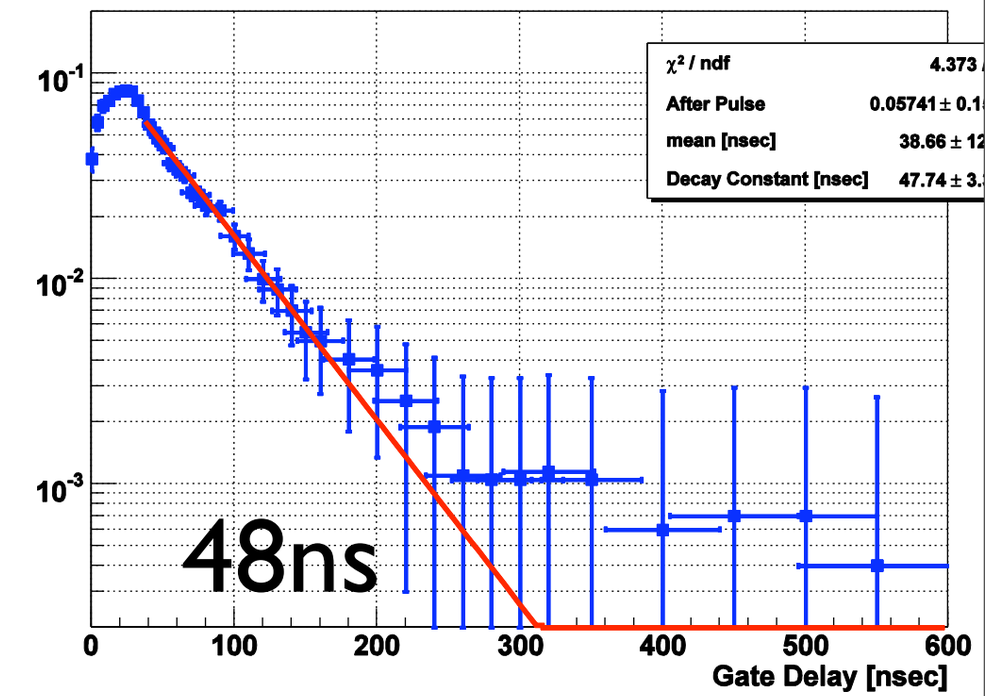
100 and 400pix



After pulse prob. vs. Gate delay : 100μm



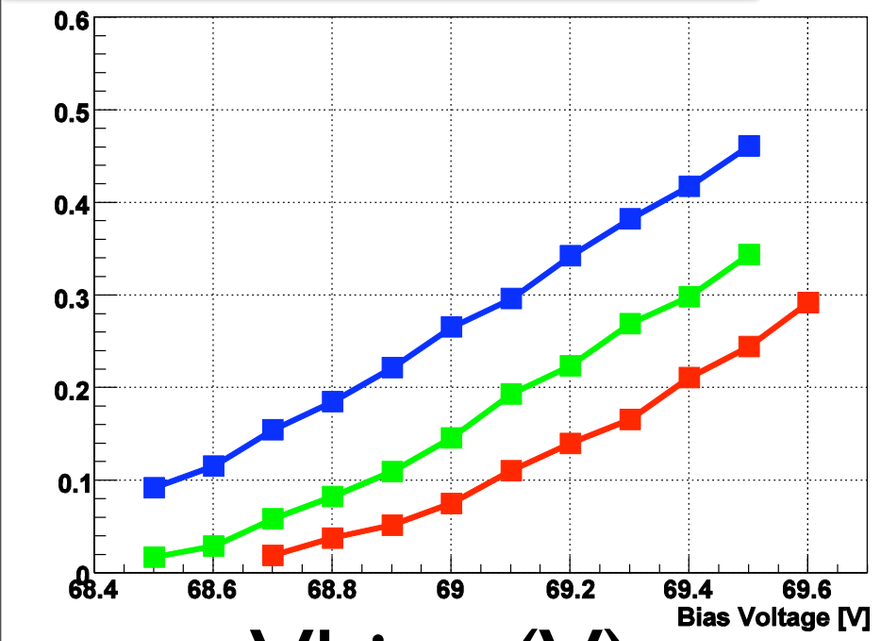
After pulse prob. vs. Gate delay : 50μm



1 Pix MPPC II

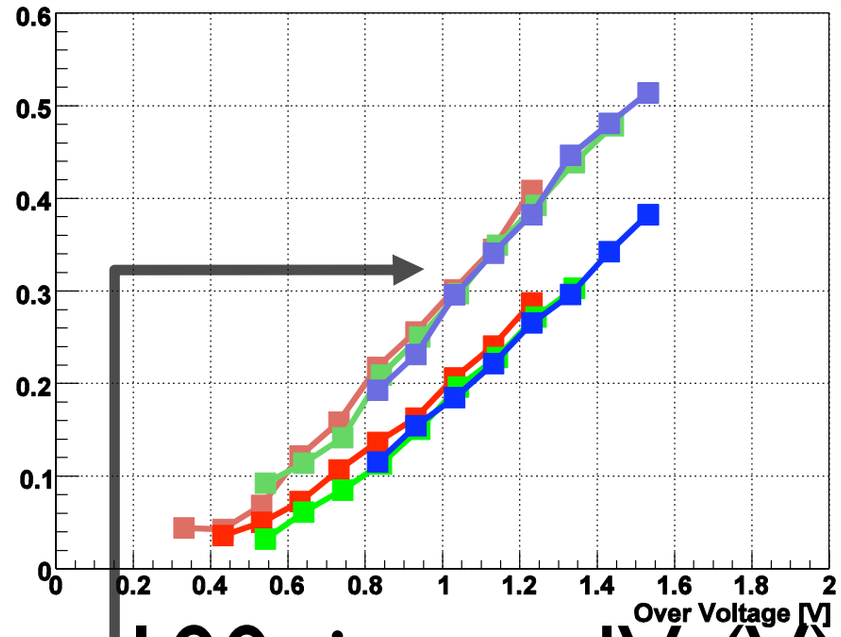
Gomi/T2K

After pulse rate : 100μm 1pixel



Vbias (V)

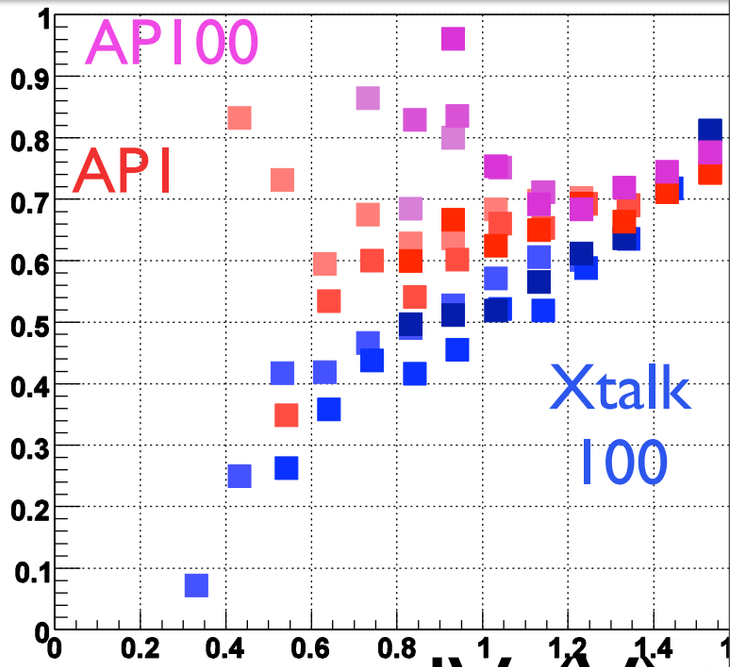
After pulse rate : 100μm 1pixel



100pix dV (V)

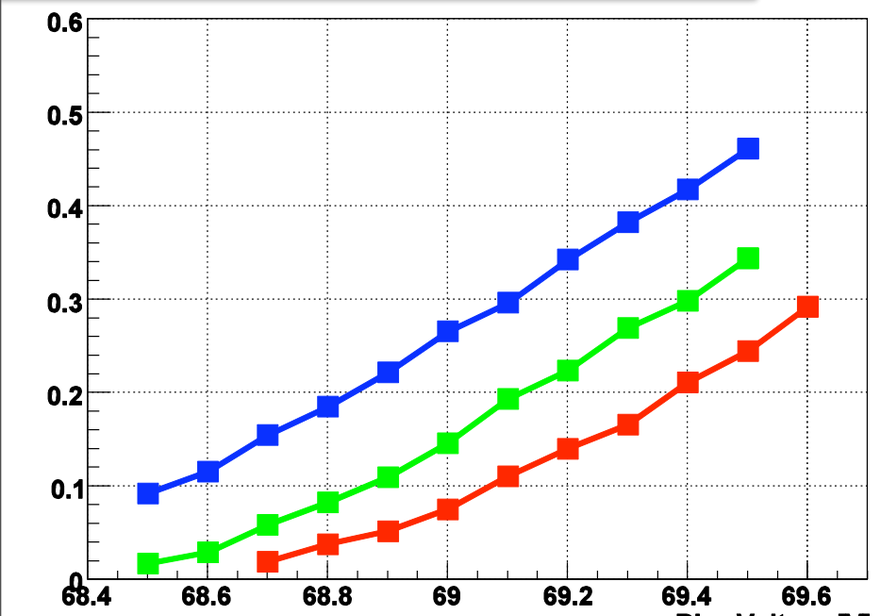
AP[Scalar-ADC], AP(1pix), X-talk(100p

÷ (Cross-talk + After pulse : 100μm 100p



dV (V)

After pulse rate : 100μm 1pixel



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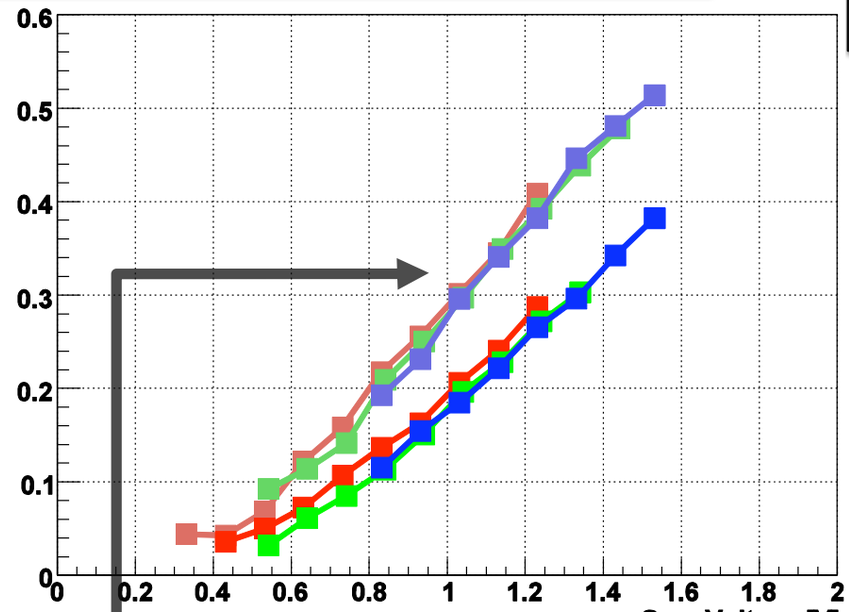
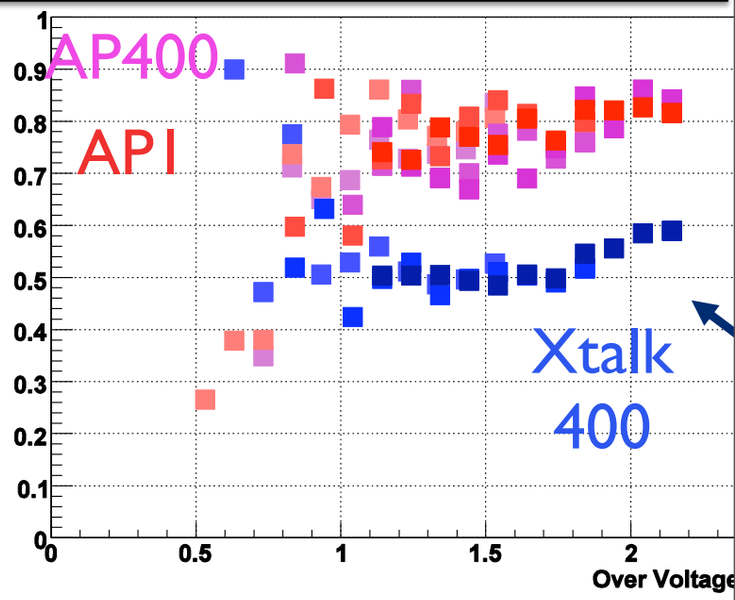
After pulse rate : 100μm 1pixel



400pix

AP[Scalar-ADC], AP(1pix), X-talk(400pix)

÷ (Cross-talk + After pulse : 50μm 400pixel)



summary

- understanding of MPPC in progress
- two components in the pulse shape (long tail : RC , sharp peak ?)
- MPPC works at 77K
- fast recovery time helps linearity
- cross talk is due to light
- after pulsing (lattice defect ?)
- need more study