MPPC R&D status

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CALICE collaboration meeting

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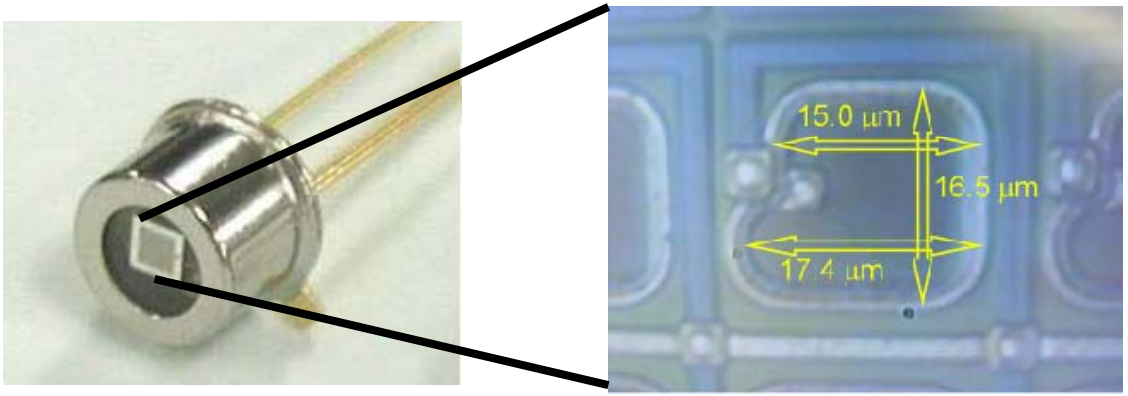
~ contents ~

Multi Pixel Photon Counter (MPPC)

… Geiger-mode avalanche photon sensor manufactured by Hamamatsu

- **Model number : S10362-11-025U (1600-pixel 2006/12)**



V_{bias} -71.5 V, Temperature 25 ℃

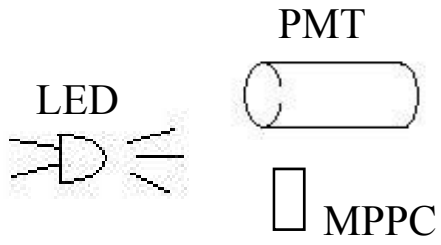
Gain $2.8 * 10^5$

Noise rate ~100 kHz

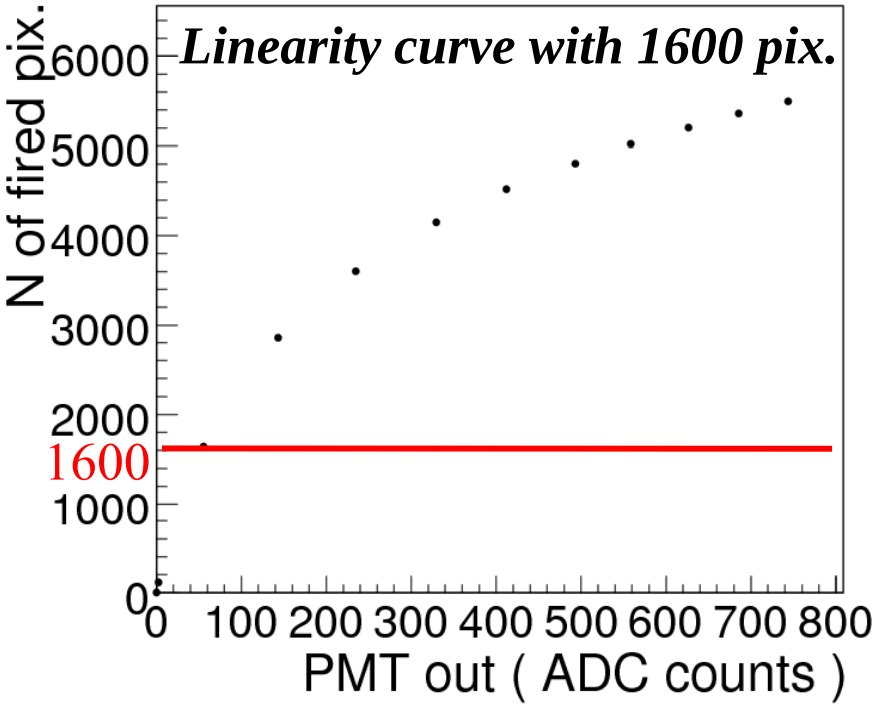
Cross talk probability ~ 5 %

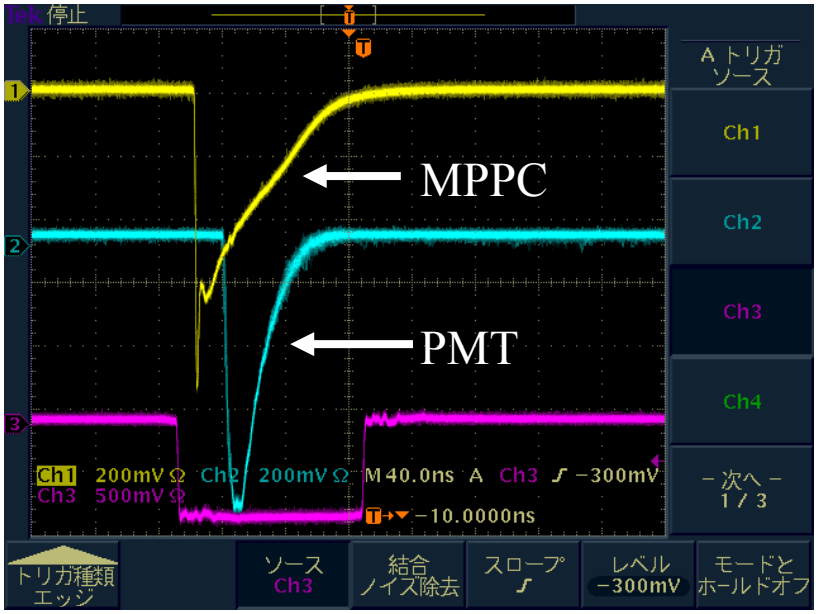
Linearity curve

Measurement of MPPC linearity is important for energy measurement



• Model number : ILC-11-025 (**1600-pixel** 2006/10)





• Observed outputs exceed total number of pixels (1600).

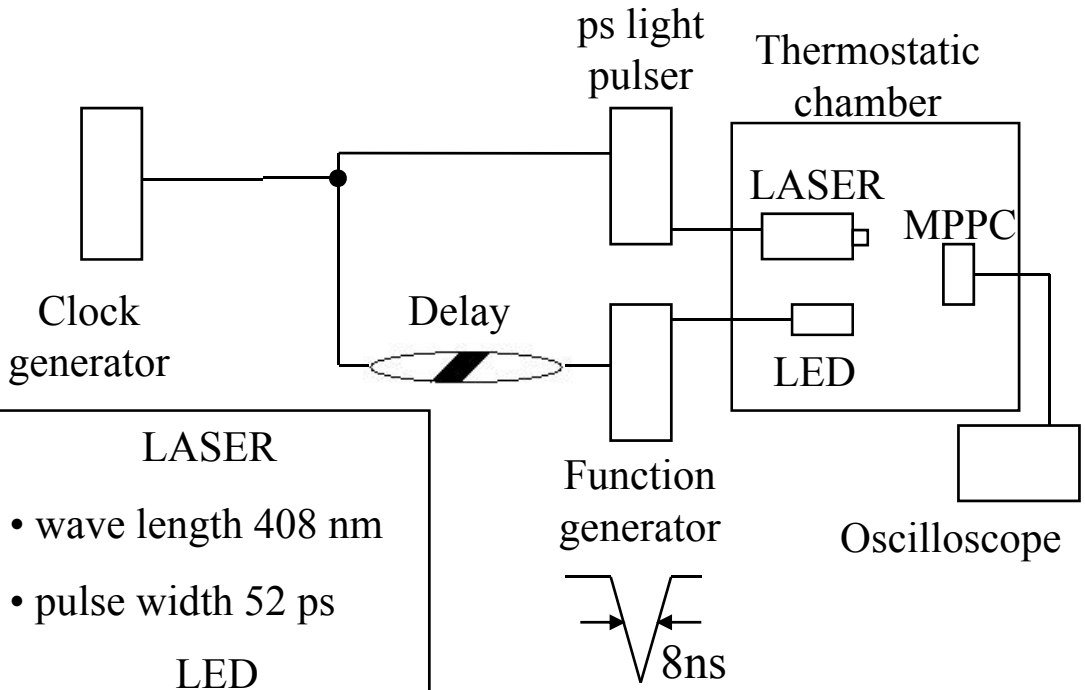
• Recovery time of MPPC may be very short and a same pixel fires several times?

• To understand linearity curve, we have to consider the recovery time

Recovery Time Measurement

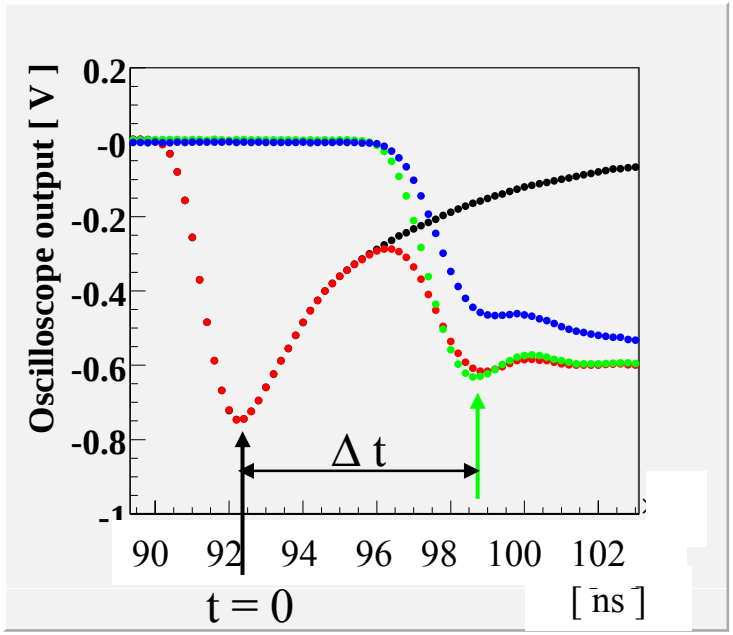
- Model number : S10362-11-025U (1600-pixel 2006/12)
- A LASER and sequential LED light pulses with high intensity enough to fire almost all pixels

Set-up



LASER
- wave length 408 nm
- pulse width 52 ps

LED
- wave length 470 nm



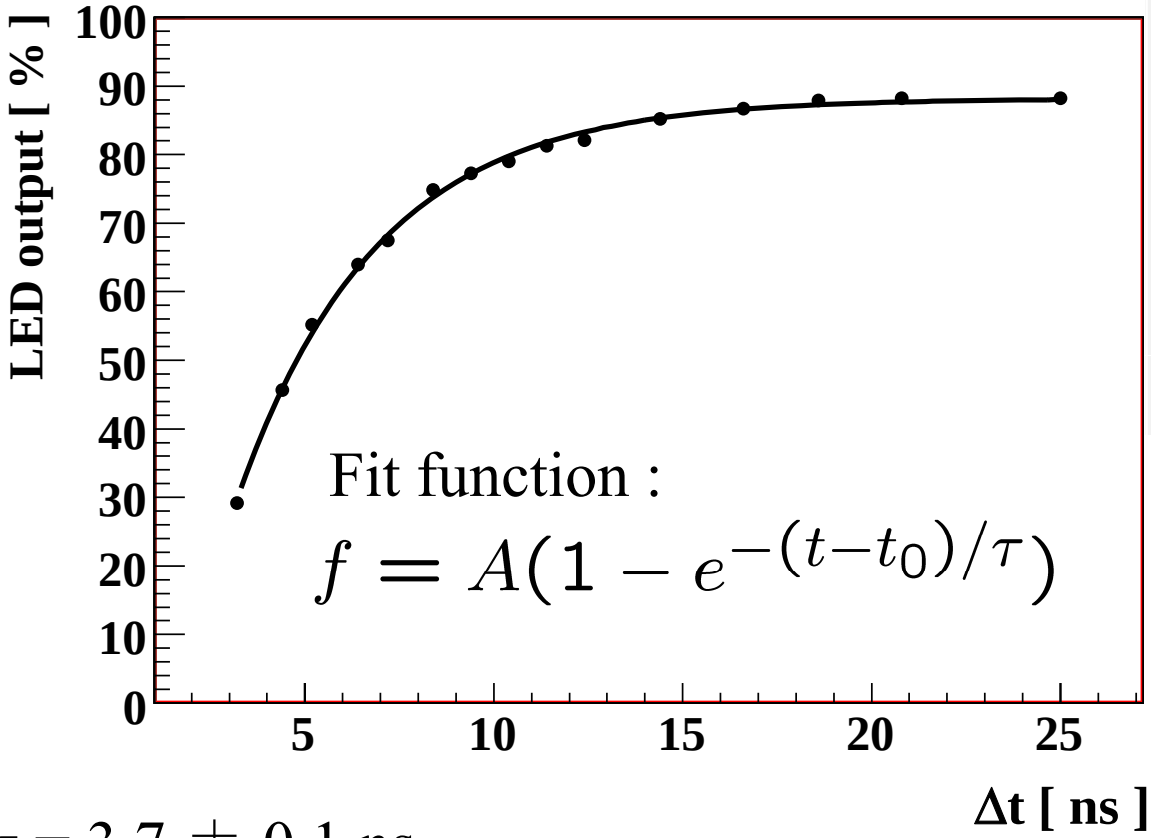
LASER ●

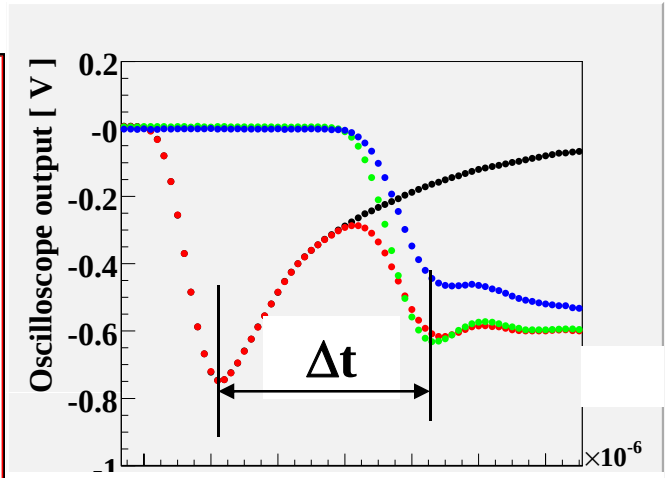
LED ●

LASER & LED ●

(LASER & LED) - LASER ●

Recovery time





LED output

$$= \frac{(\text{LASER \& LED}) - \text{LASER}}{\text{LED}}$$

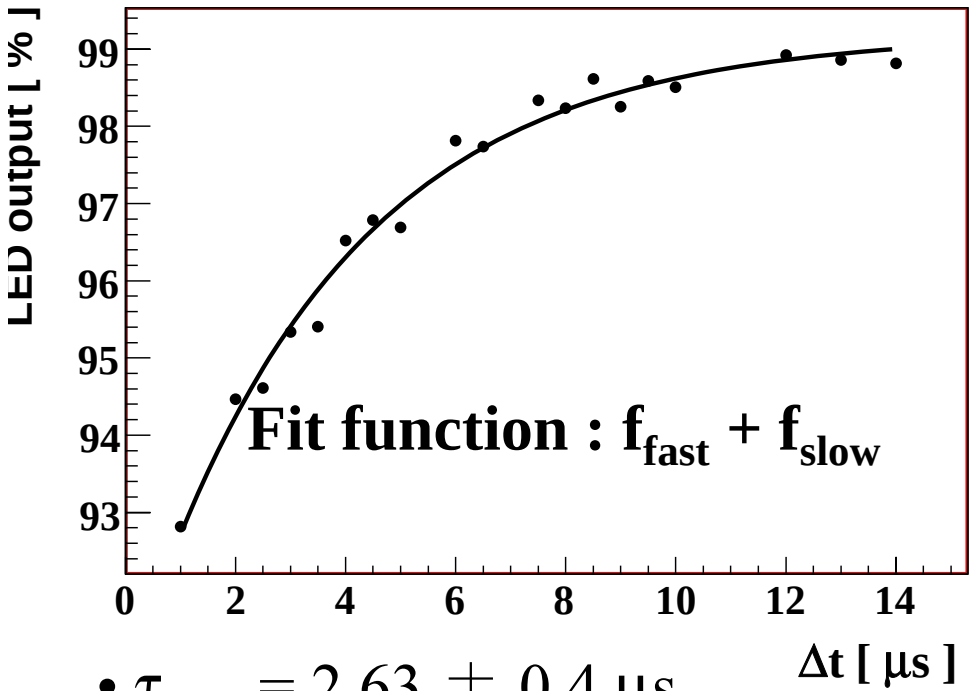
LED output without LASER ⇒ 100%

- $\tau = 3.7 \pm 0.1$ ns
- $A = 88.19 \pm 0.52$ % → **doesn't reach to 100% ?**
- $t_0 = 1.68 \pm 0.092$ ns

Recovery time

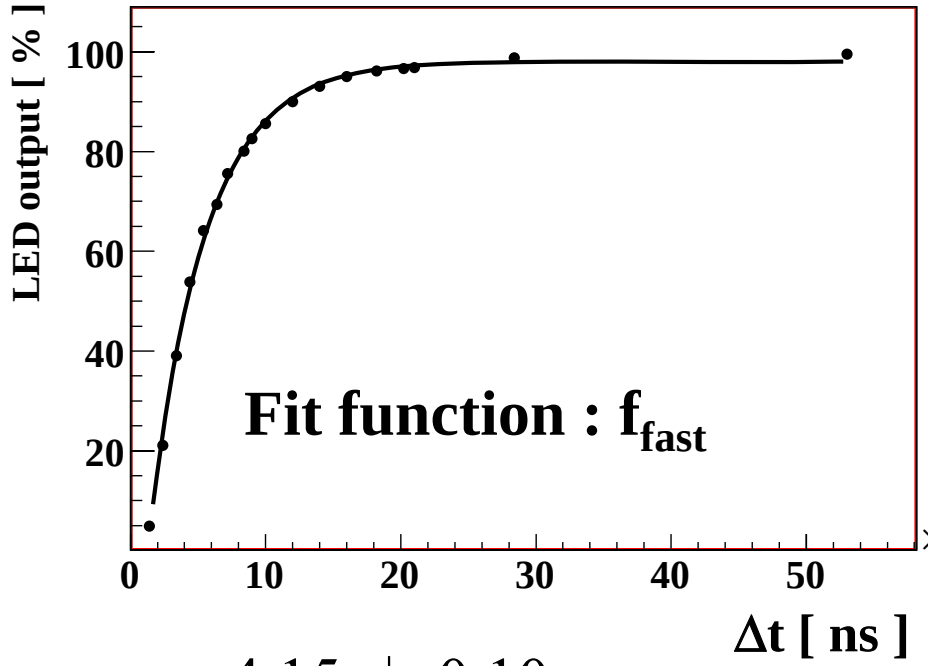
Check effect from a capacitor on circuit.

with C = 0.047 micro F



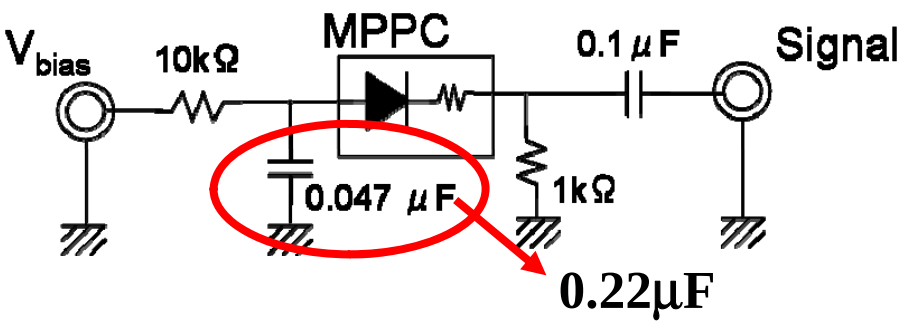
- $\tau_{slow} = 2.63 \pm 0.4$ μs

with C = 0.22 micro F



$\tau = 4.15 \pm 0.10$ ns

- $A = 98.05 \pm 0.43$ %
- $t_0 = 1.245 \pm 0.037$ ns



Cause of the slow component is the capacitor

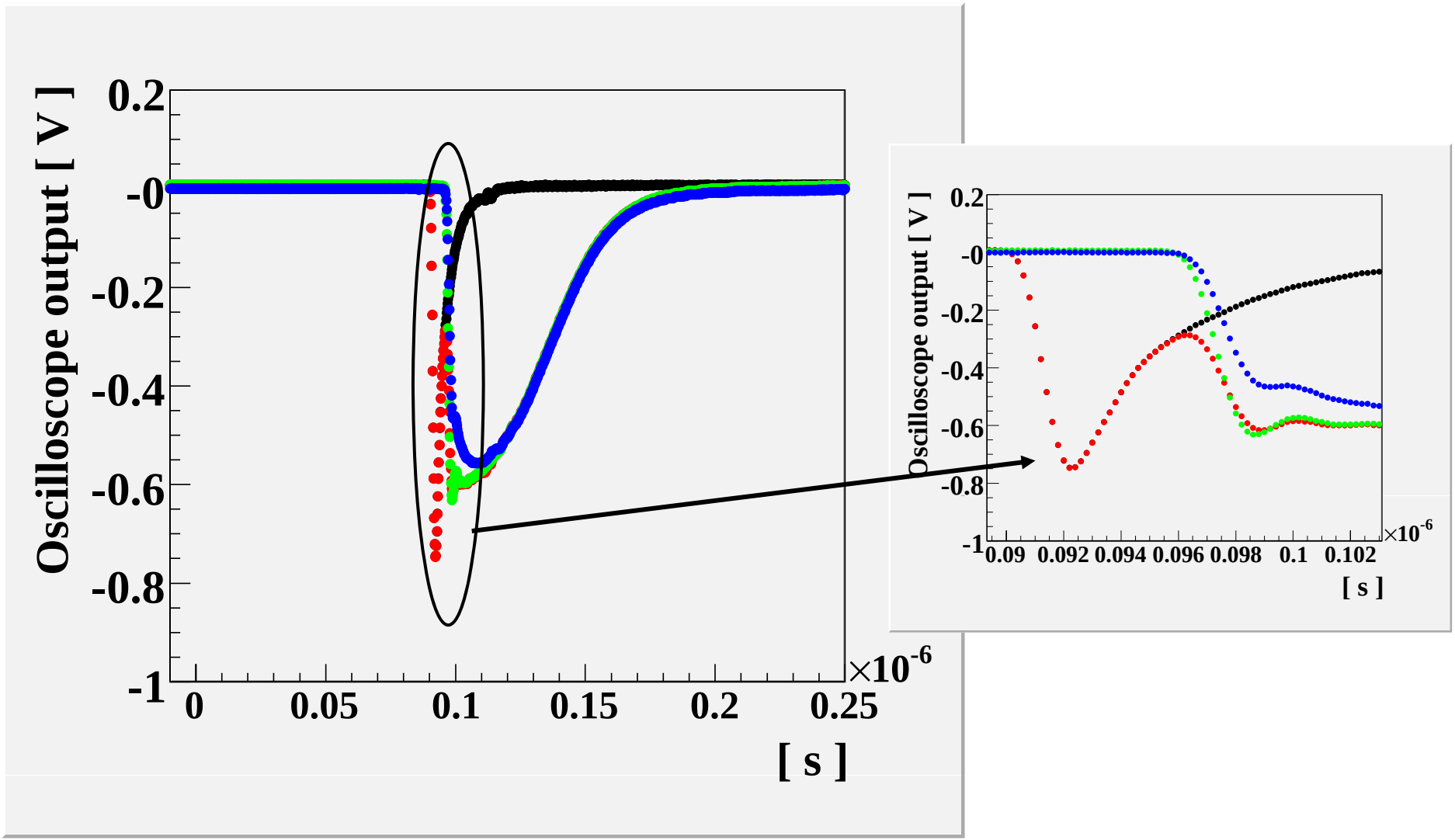
Summary

- MPPC outputs exceed total number of pixels.
- To understand linearity curve, we have to consider recovery time.
- Recovery time is found to be ~4.2 ns.
- Readout circuit (capacitor) give an effect to the recovery time (~μs)

Plans

- Study linearity curve using light pulses with different widths
- Investigate dependence with bias voltage

Back up


Oscilloscope output [V]
0.2
-0
-0.2
-0.4
-0.6
-0.8
-1
0
0.05
0.1
0.15
0.2
0.25
×10-6
[s]
Oscilloscope output [V]
0.2
-0
-0.2
-0.4
-0.6
-0.8
-1
0.09
0.092
0.094
0.096
0.098
0.1
0.102
×10-6
[s]