

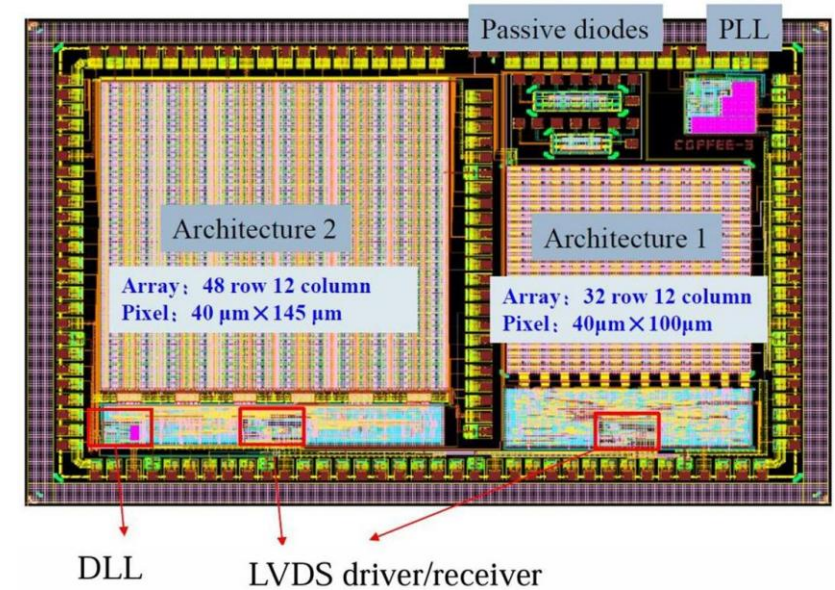
# Update on COFFEE3 Left Matrix Tests

Mengke Cai, Yuman Cai, Kang Liu, Boxin Wang, Zijun Xu,

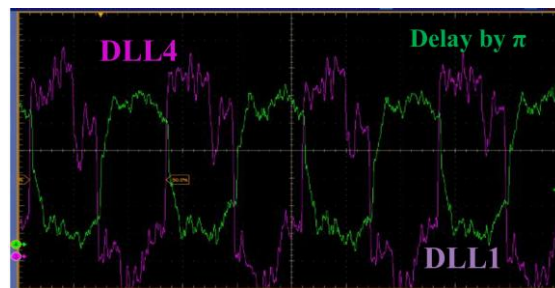
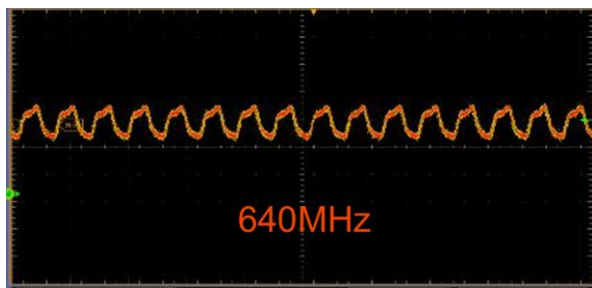
IHEP

2026.04.14

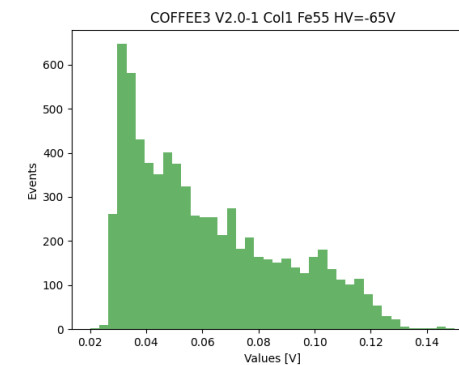
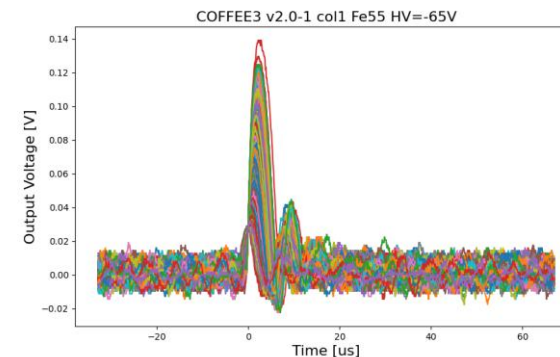
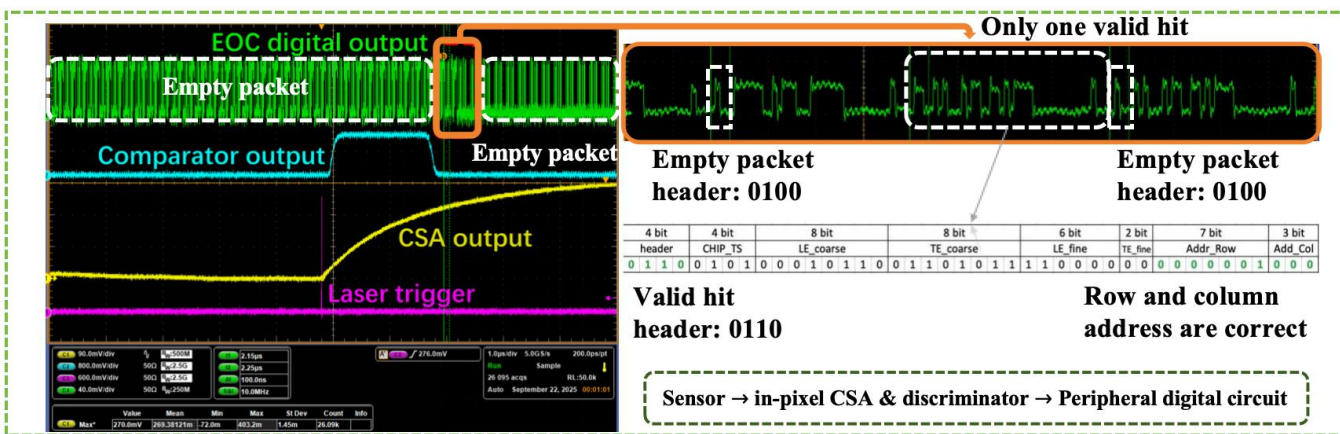
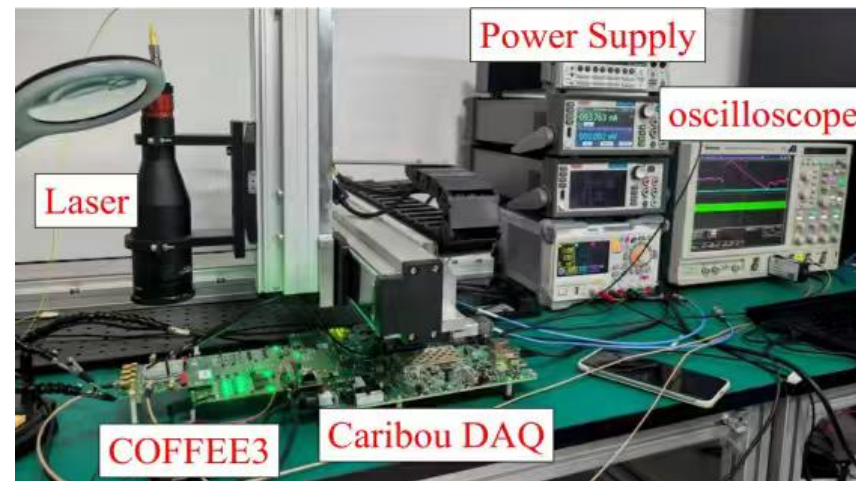
- Previous results
  
- Update on the 1<sup>st</sup> (double) column
  - S-curve scanning with laser injection
  
- Update on the 4<sup>th</sup> (double) column
  - CSA reference voltages
  - response to laser injection
  - S-curve scanning with laser injection
  - scan CSA pulse waveform
  
- Summary & next



- Full function of **640 MHz LVDS** & **40 MHz DLL** modules verified.

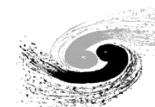


- Full **analogue-digital reading out** chain verified on the 1<sup>st</sup> column.
- CSA response to  $^{55}\text{Fe-}\gamma$  verified on the 1<sup>st</sup> column.



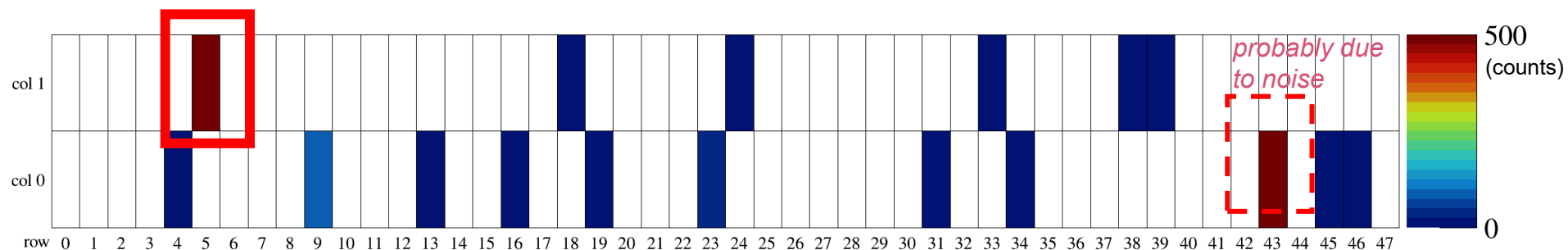
- In [previous slides](#), we were interested in reading-out performance of the left pixel matrix and were highly looking forward to the same tests performed on the 4<sup>th</sup> column. This update will focus on **s-curve of single pixel** & **the 4<sup>th</sup> column**.

# Update on the 1<sup>st</sup> column

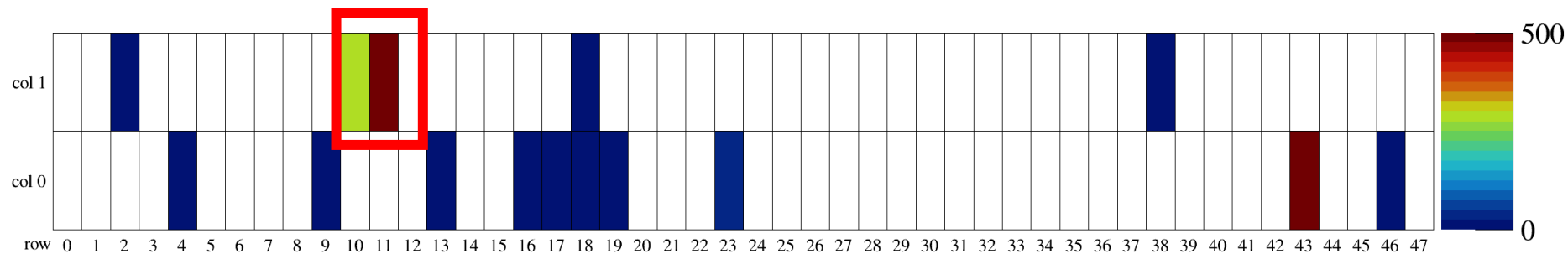


- Before S-curve scanning, **the lens for laser was finely tuned** to minimize the illumination spot.
- At threshold = 1.03 V, the hot pixel address was clear although the whole double-column were unmasked.

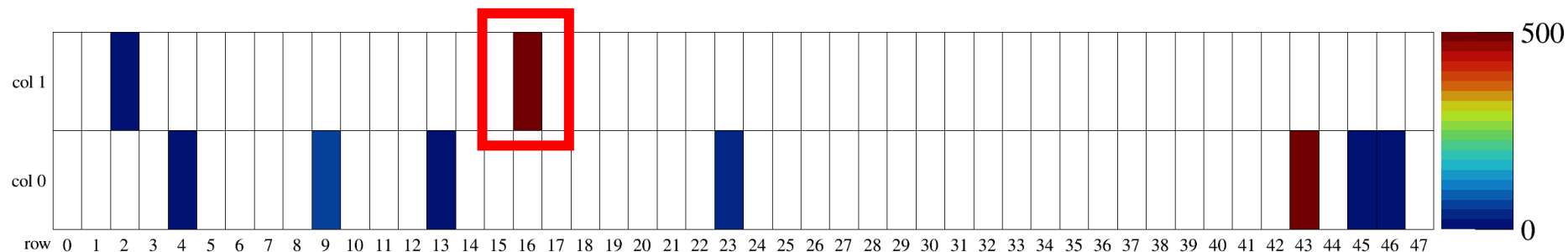
laser position = 0  $\mu\text{m}$



laser position = 200  $\mu\text{m}$

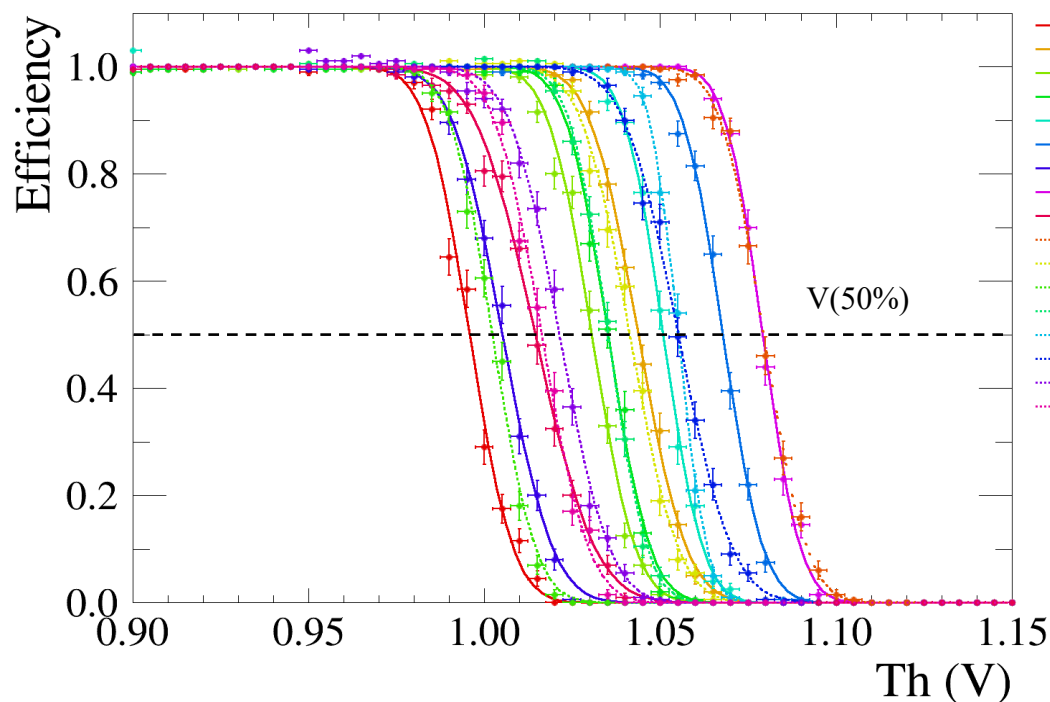


laser position = 400  $\mu\text{m}$

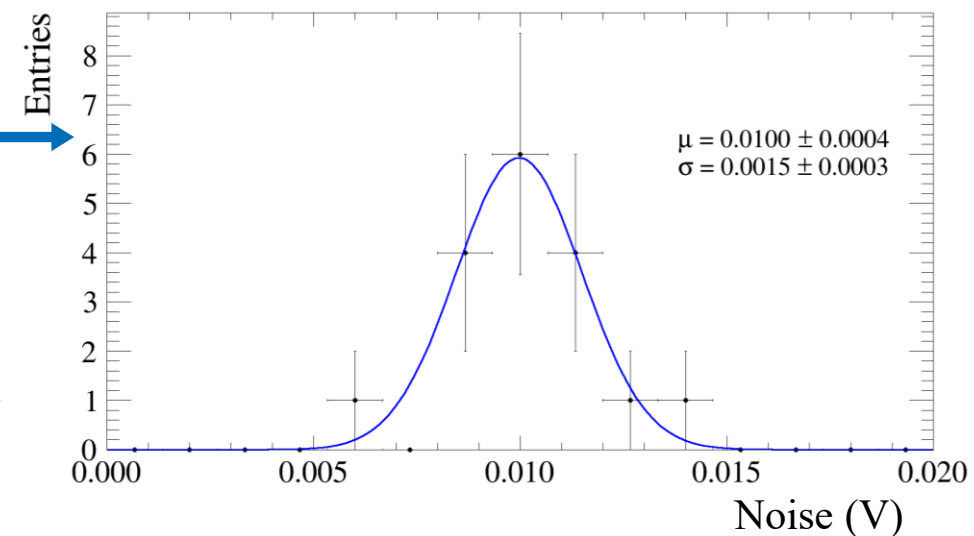
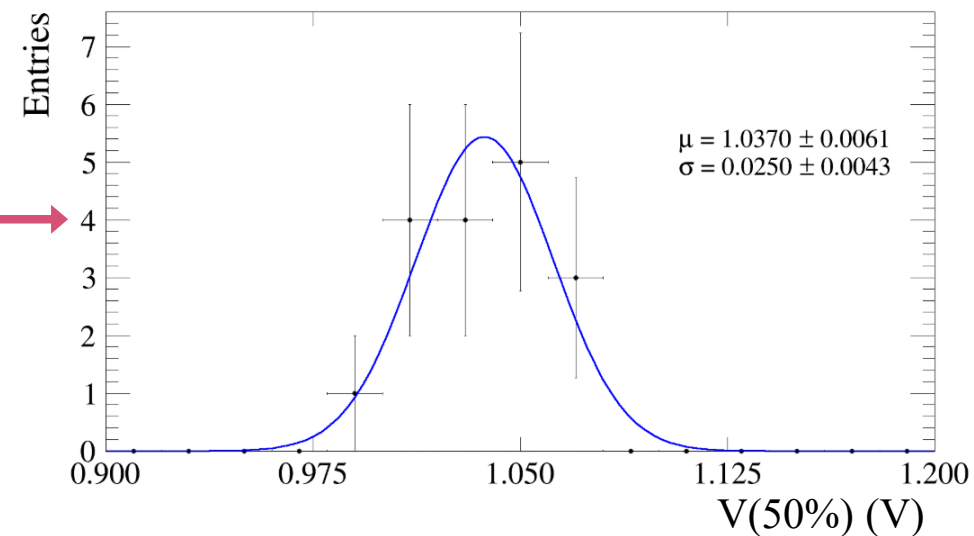


## □ S-curve scanning

- 17 pixels were selected for s-curve scanning using laser with full-power.
- Each s-curve was fit by ErrorFunction to extract  $\mu(V50\%)$  and  $\sigma(\text{noise})$

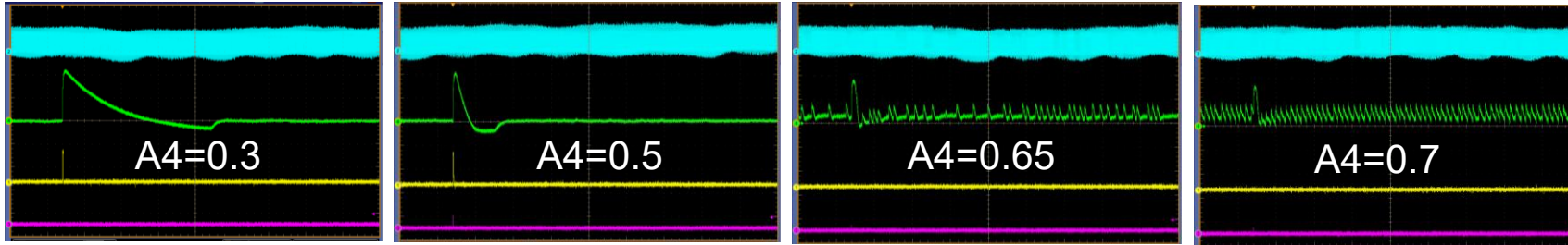


- Fluctuation between pixels is less than 100 mV, which would be offset by in-pixel tuning DAC (TDAC) in future tests.



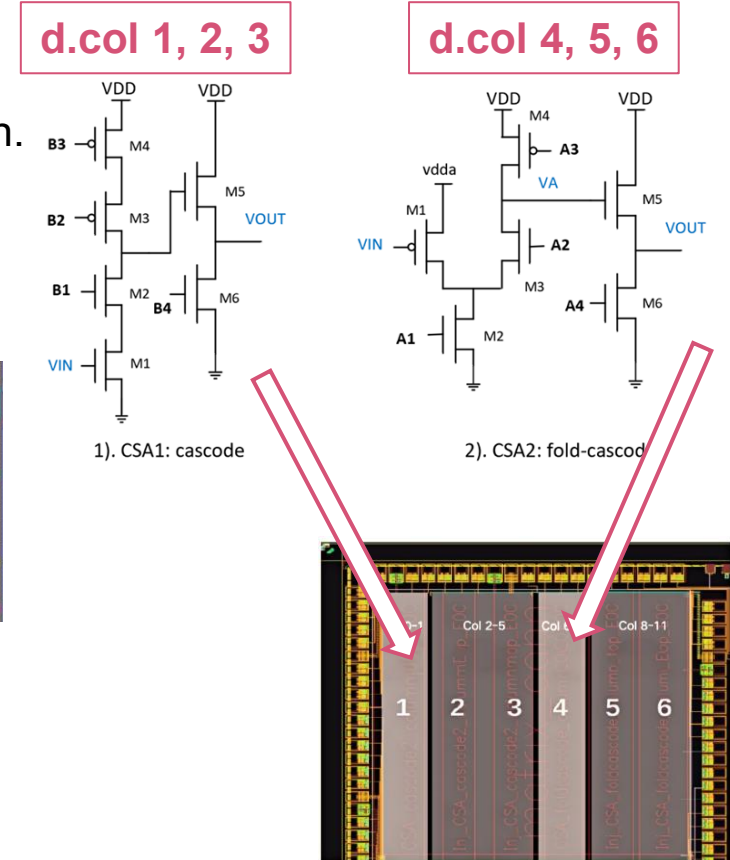
## □ CSA reference voltages

- The CSA design in the 4<sup>th</sup> (double) column is different from that in the 1<sup>st</sup> column.
- Adjusting **A1, A2, A3, A4** will affect CSA output waveform from the 4<sup>th</sup> column.
- Values of A1 - A4 for following tests are:



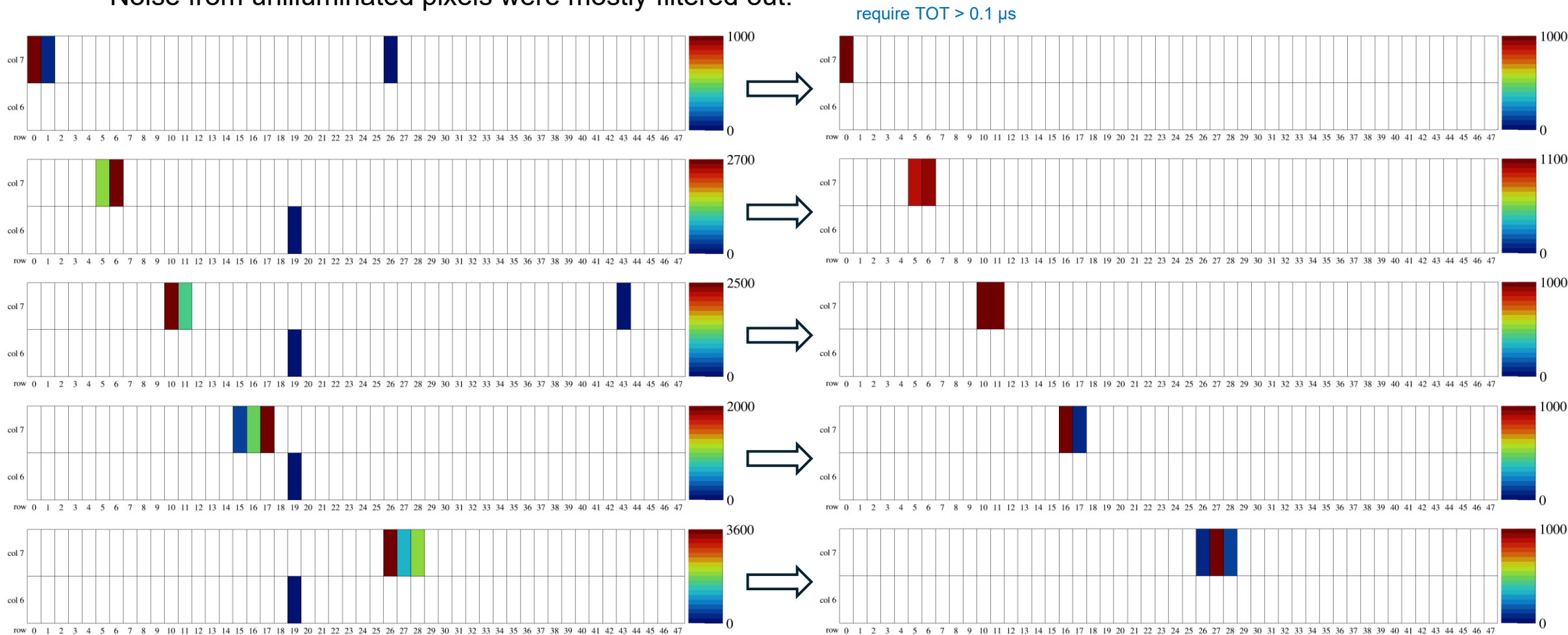
A1	A2	A3	A4
0.530	0.750	0.759	0.300

- Due to the effect from oscilloscope, the CSA waveform displayed is probably not what the chip reads → the comparator TOT is significantly less than CSA falling time.

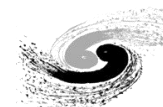


## □ Response to laser injection

- Similar moving & reading test using 1000 times laser injection at **threshold = 1.15 V** with moving step = 200  $\mu\text{m}$
- Noise from unilluminated pixels were mostly filtered out.

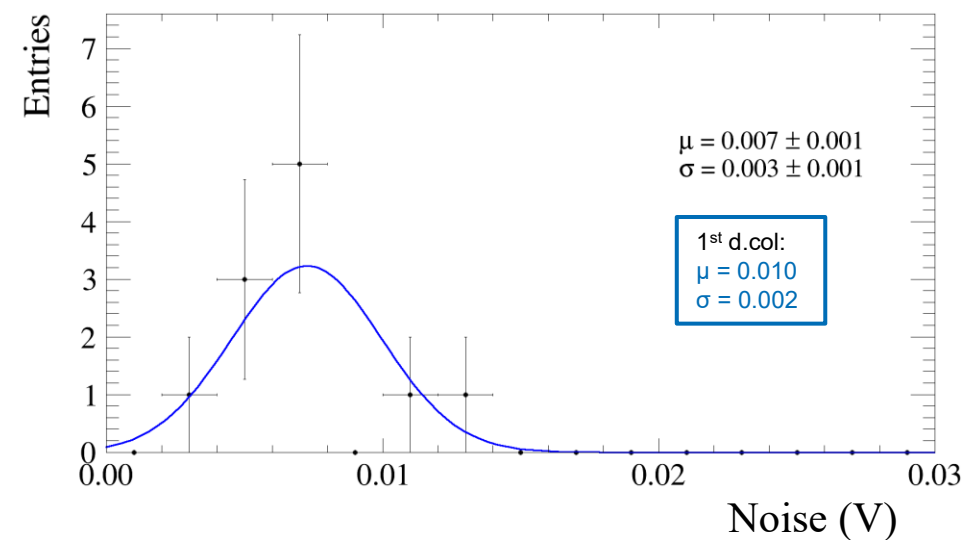
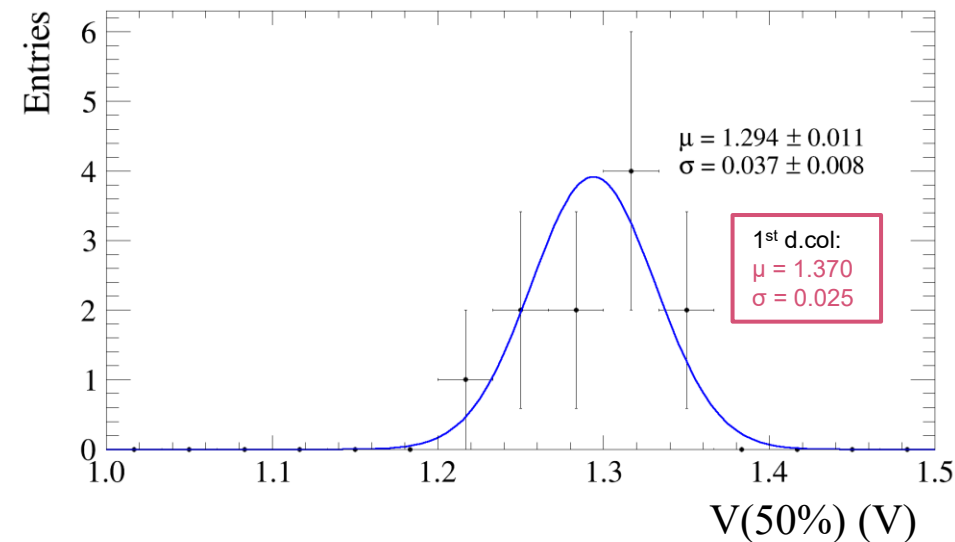
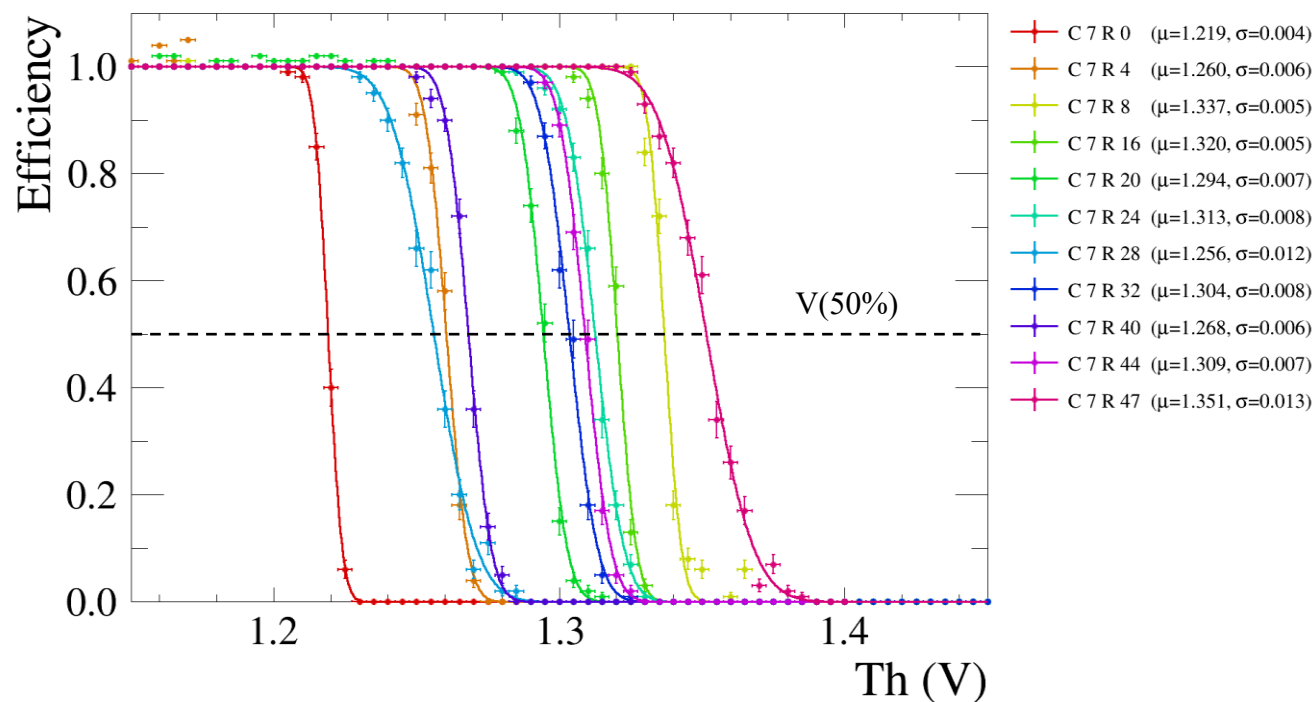


# Update on the 4<sup>th</sup> column



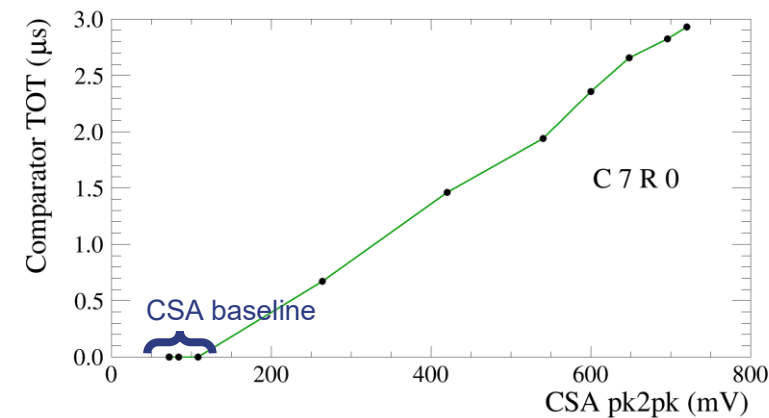
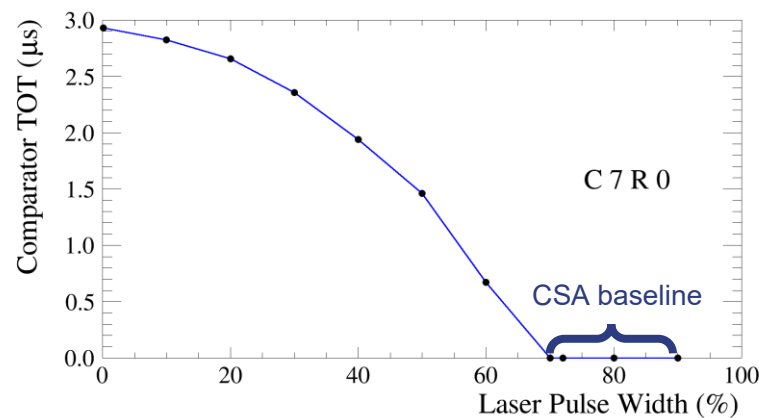
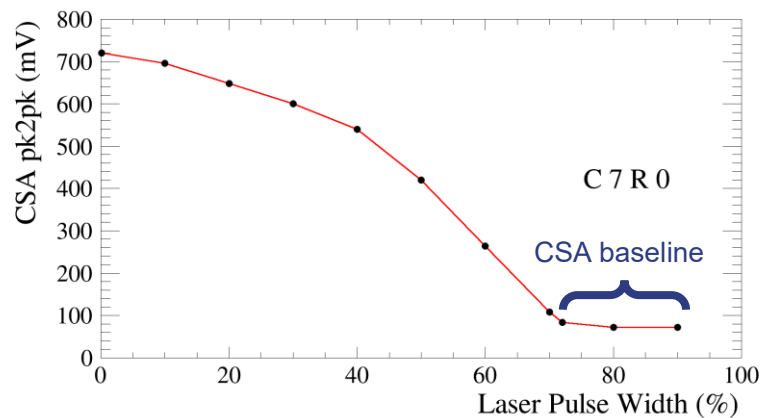
## □ S-curve scanning

- Compared with the 1<sup>st</sup> column the  $\sigma(\text{Noise})$  is lower in general.
- But the fluctuation between pixels is more significant.



## Tests using weak laser

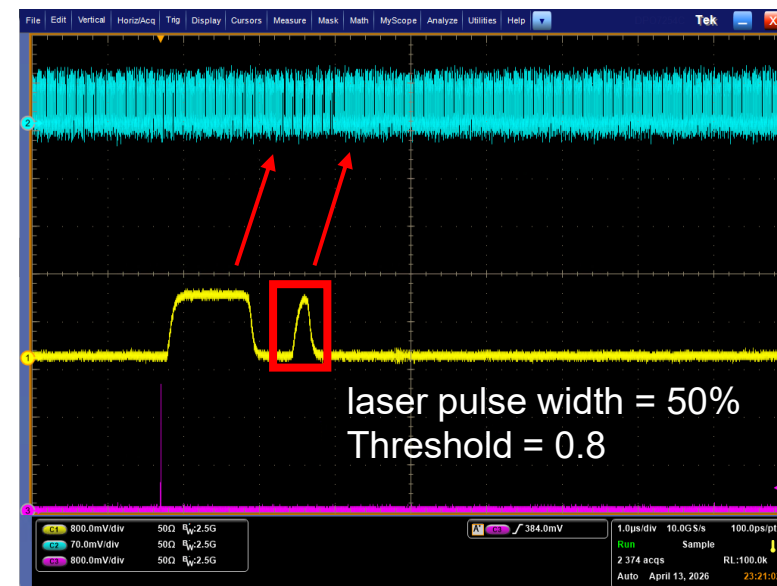
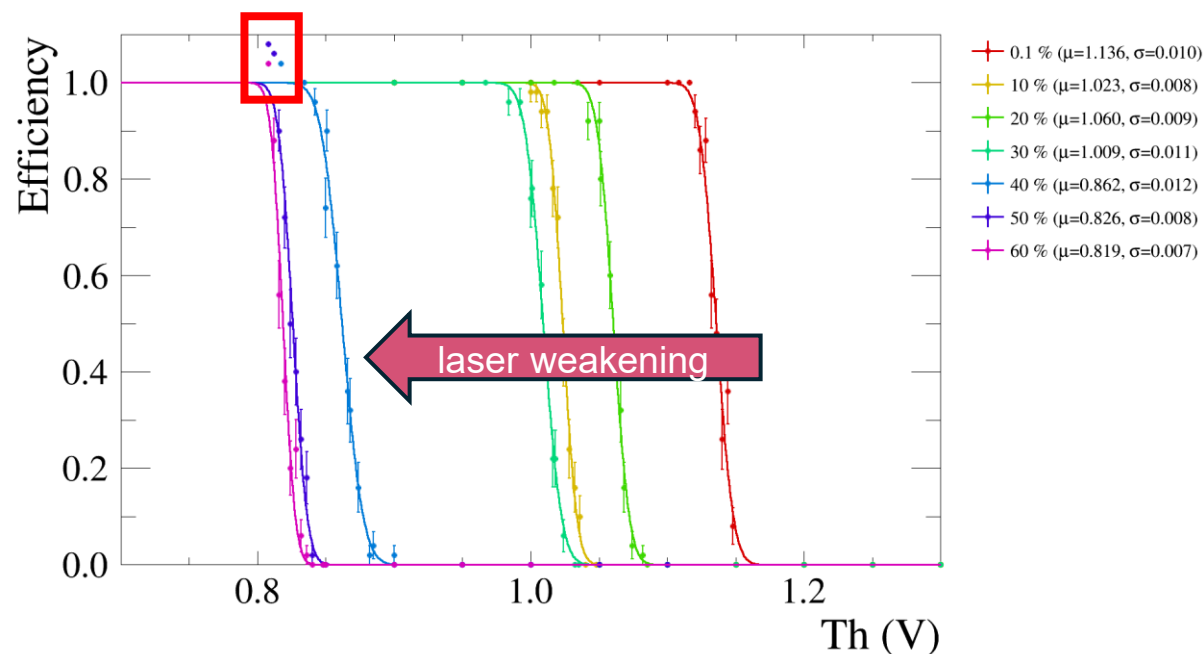
- To better simulate particle hits (especially MIP), laser intensity must be weakened.
- The intensity of a single laser pulse was inversely controlled by the “Pulse Width”.



- Pk2Pk of CSA baseline** is about 72 mV, corresponding to noise  $\sigma \approx 10$  mV.
- Linear correlation between TOT and CSA** pulse Pk2Pk was observed.

## □ Tests using weak laser injection

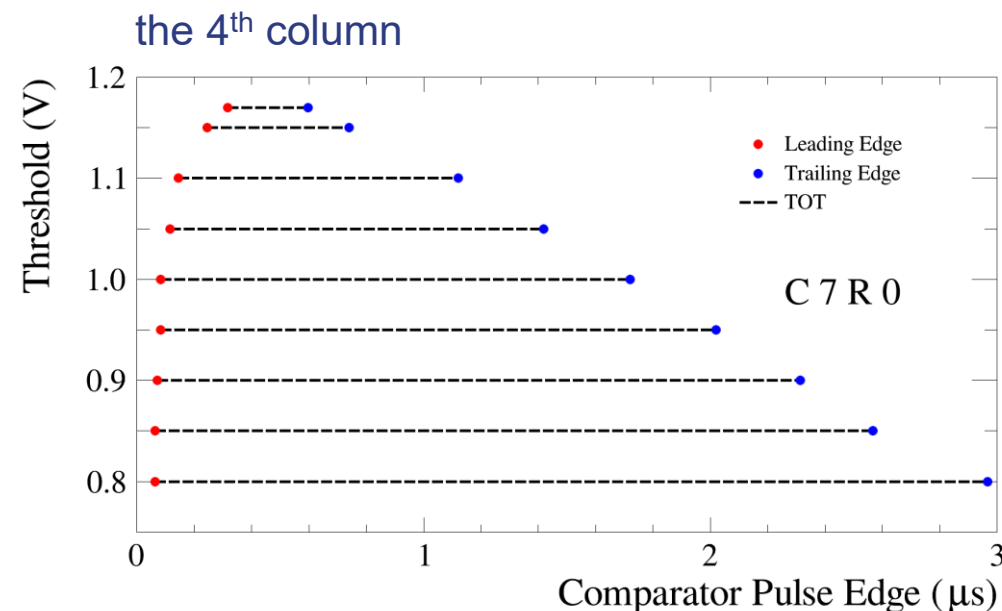
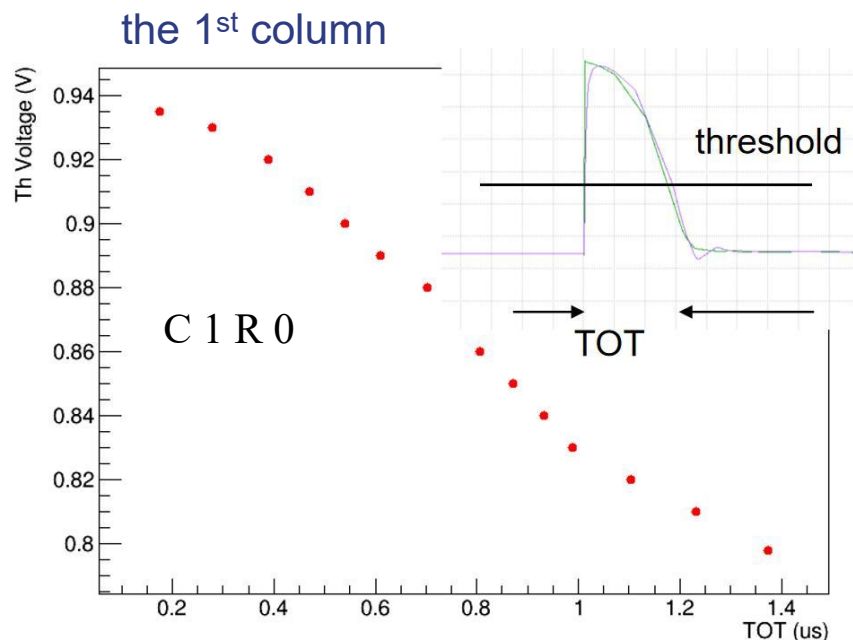
- S-curves of pixel C7R0 were also evaluated using weak laser injection.
- Fittings show that the  $\mu(V50\%)$  decreases as laser turning weaker, but  $\sigma(\text{noise})$  keeps basically unchanged.



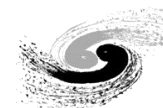
- This is a preliminary test, decision of laser intensity equivalent to a particle hit should be combined with future tests using radiation source (<sup>55</sup>Fe, <sup>90</sup>Sr, etc.) and beam test.

## □ Threshold scan to infer CSA output waveform inside the chip

- Due to effect from oscilloscope, the true waveform from CSA cannot be read directly.
- TOT of comparator at certain threshold can be count as a slice of CSA pulse, providing information of true CSA waveform.
- The same test was once performed on the 1<sup>st</sup> column.



- At current reference voltage configuration, the laser (0.1% width) injection gives **CSA pulse ~ 1 $\mu$ s for 1<sup>st</sup>**  
**and 3  $\mu$ s for 4<sup>th</sup> column.**



- ❑ The S-curve scan on the **1<sup>st</sup> (double) column** shows  **$V_{50\%} \approx 1.037 \text{ V}$**  and **noise  $\sigma \approx 10 \text{ mV}$**  for most pixels.
- ❑ The S-curve scan on the **4<sup>th</sup> (double) column** shows  **$V_{50\%} \approx 1.294 \text{ V}$**  and **noise  $\sigma \approx 7 \text{ mV}$**  for most pixels.
- ❑ The laser (0.1% width) injection gives **CSA pulse  $\sim 1 \mu\text{s}$  for 1<sup>st</sup> and  $3 \mu\text{s}$  for 4<sup>th</sup> (double) column.**
  
- ❑ **Individual pixel TDAC** tuning is in preparation.
- ❑ Radiation source, X-ray and test beam are in preparation