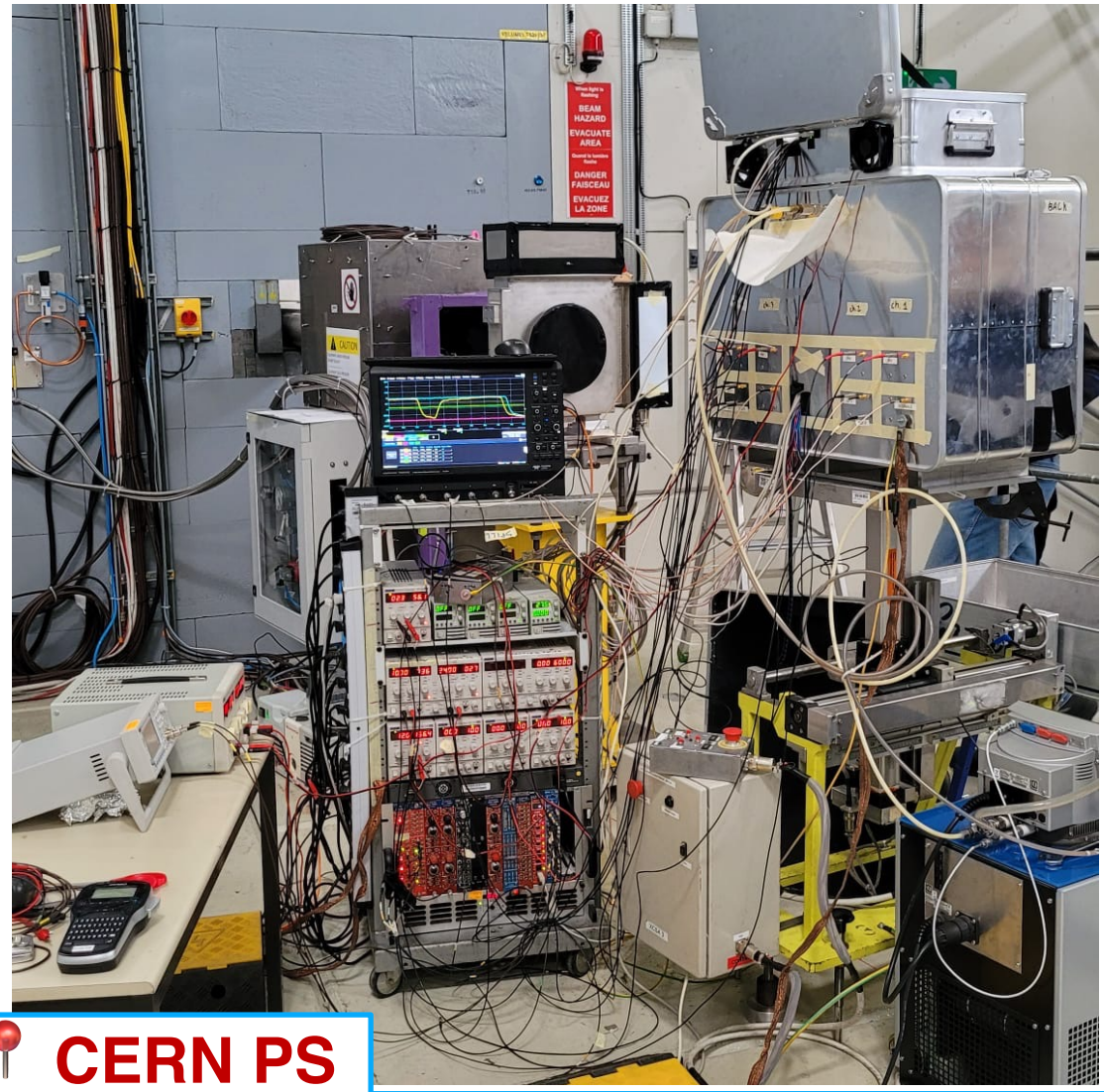
ALICE3 Timing WG meeting

May 13th 2024

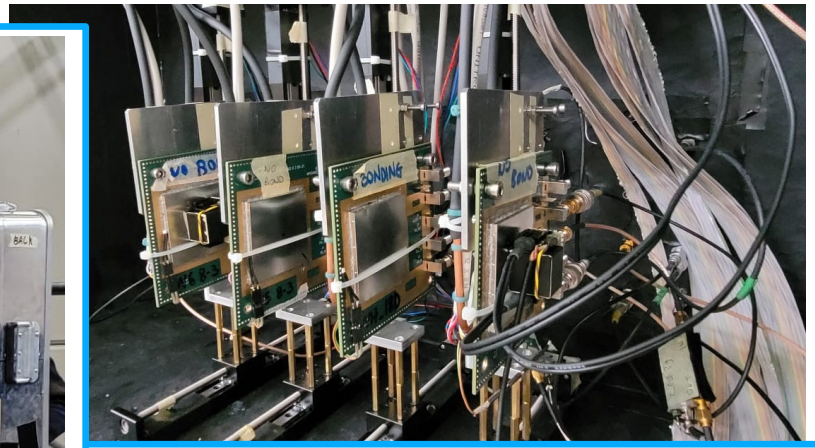
# Beam test April 2024: short summary

Manuel Colocci, Sofia Strazzi

# TEST BEAM SETUP




CERN PS



# ALIGNMENT, TRIGGER AND THRESHOLDS

- The **alignment** was done in the most of the cases with the **oscilloscope**; some last configurations aligned **directly with the picoTDC** looking at the number of events taken by each DUT

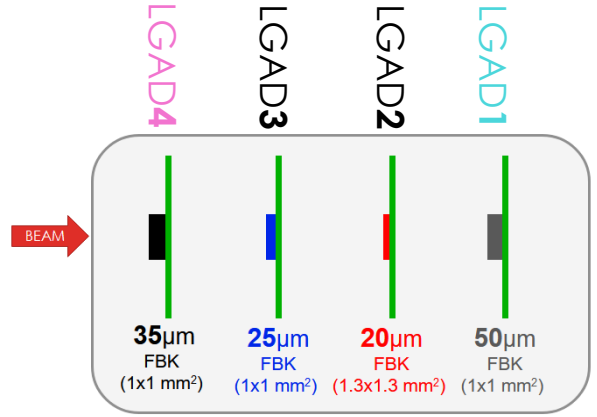
- ~~**Trigger baseline:** external trigger with 4 SiPMs signals discriminated by LIROC, in AND with LogicUnit~~

  → **Trigger backup:** single coincidence with **one LGAD** (3 channels available on the oscilloscope)

- **Thresholds** could **not** be chosen on the picoTDC using the **direct signals** on the oscilloscope → Necessity to see the signals from LIROC (internal amplification stage)

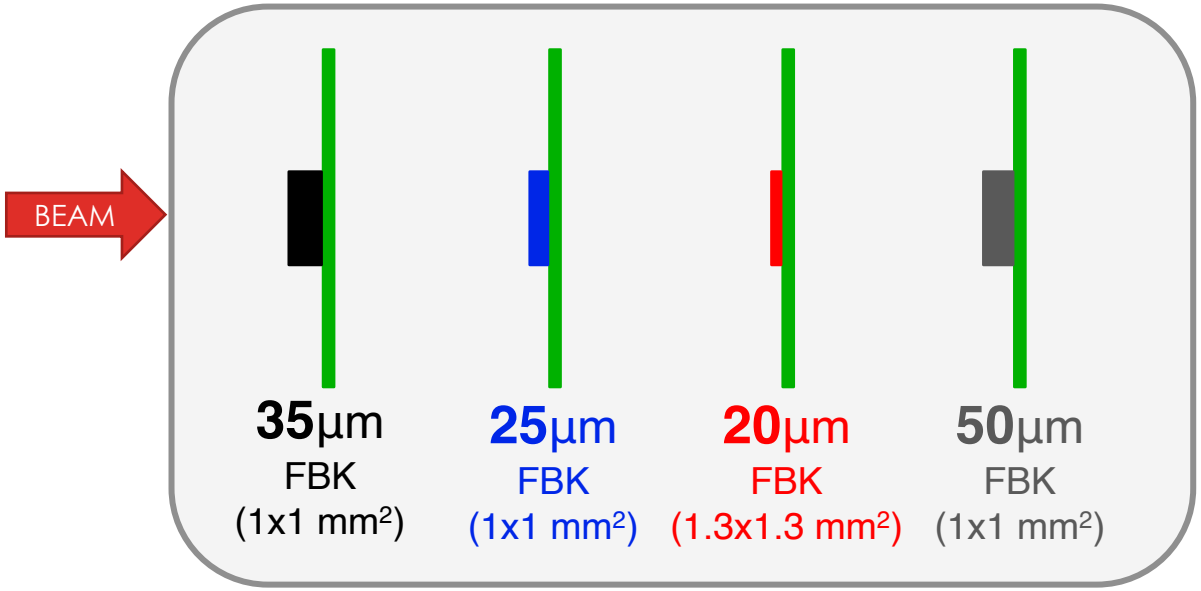
# Trigger at work

**LGAD1** analog signal


**LGAD4** Trigger **signal to picoTDC** (here in NIM format, instead of TTL)

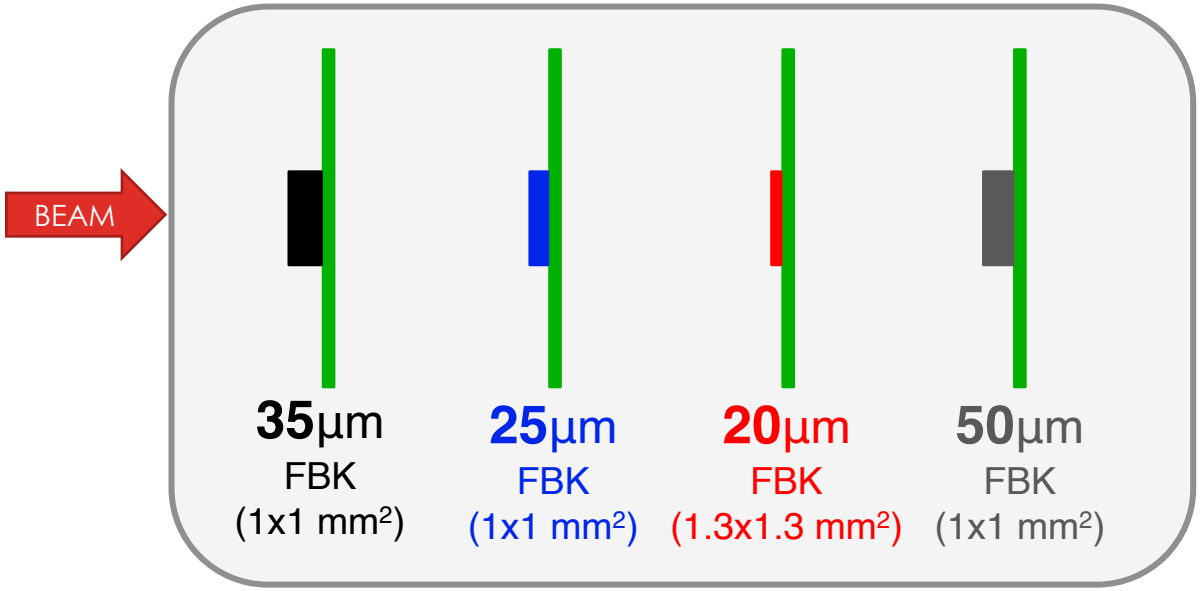
(for reference) In C1: LGAD4 trigger signal directly out the CAEN discriminator (-10 mV threshold) before being stretched and delayed




- Only oscilloscope
- LIROC (oscill. readout)
- LIROC + picoTDC

**→ Comparison of the performance of sensors connected to the different stages of electronics**

- Different number of amplification stages
- Different voltages
- Different threshold on picoTDC




Results in agreement with previous TBs ☺

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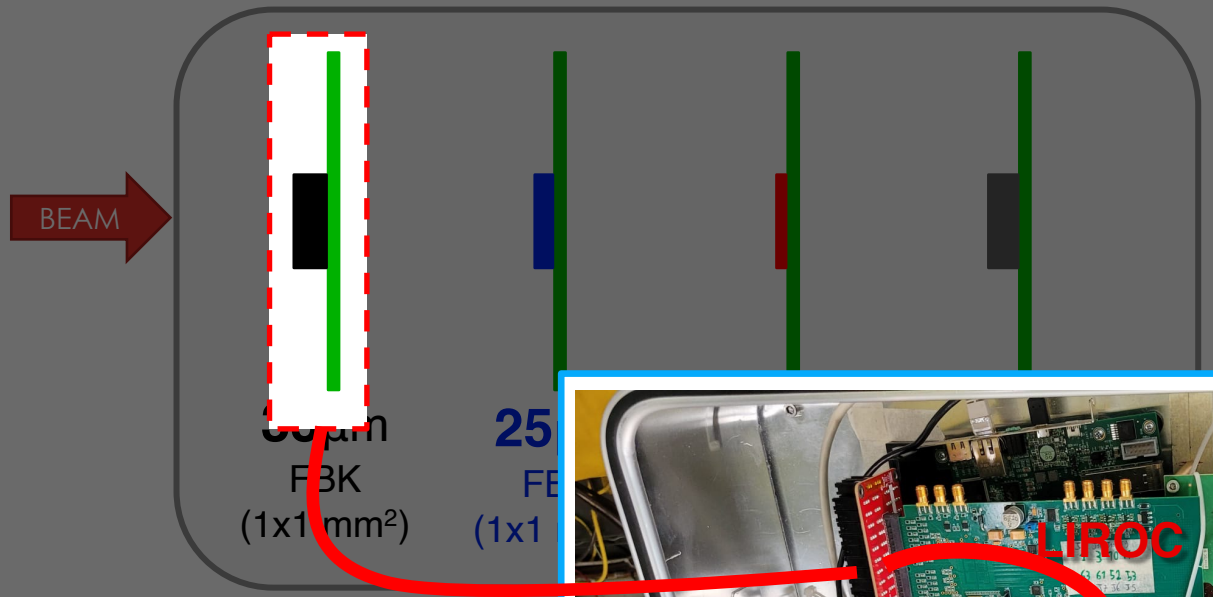
# LGADs

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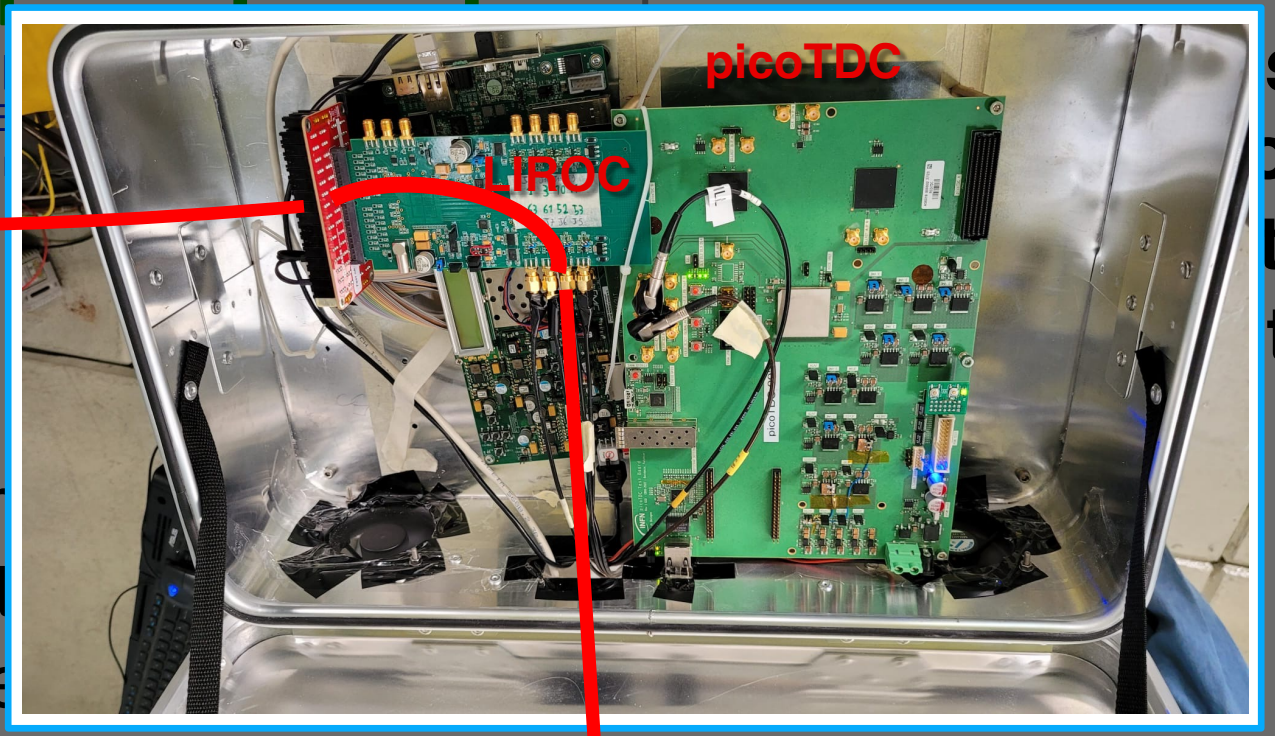
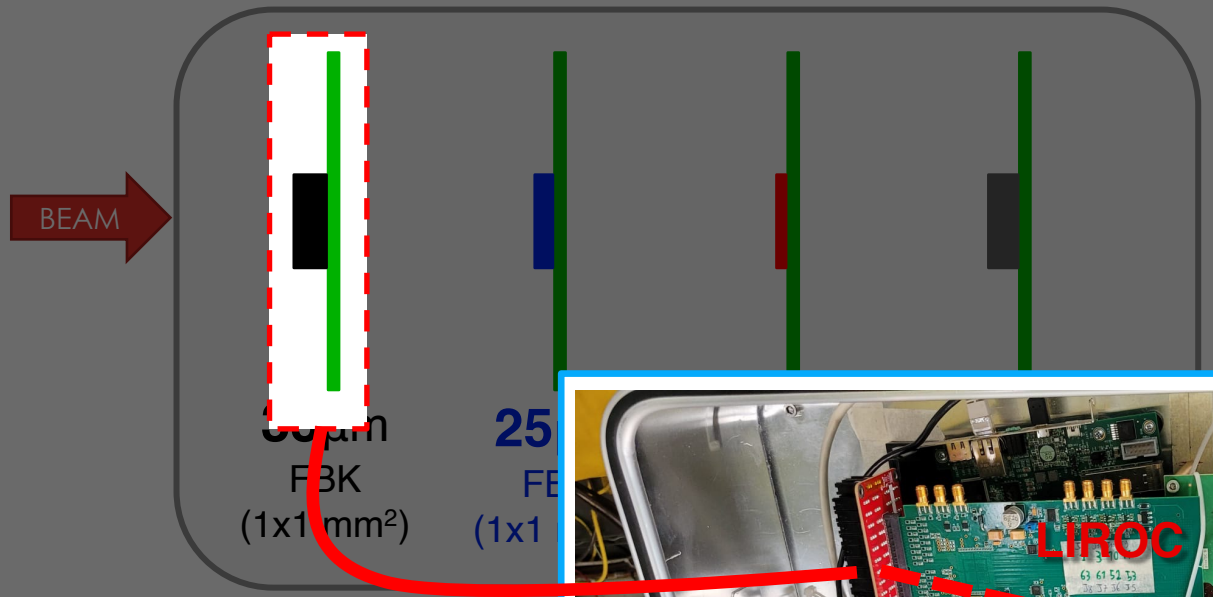


# LGADs

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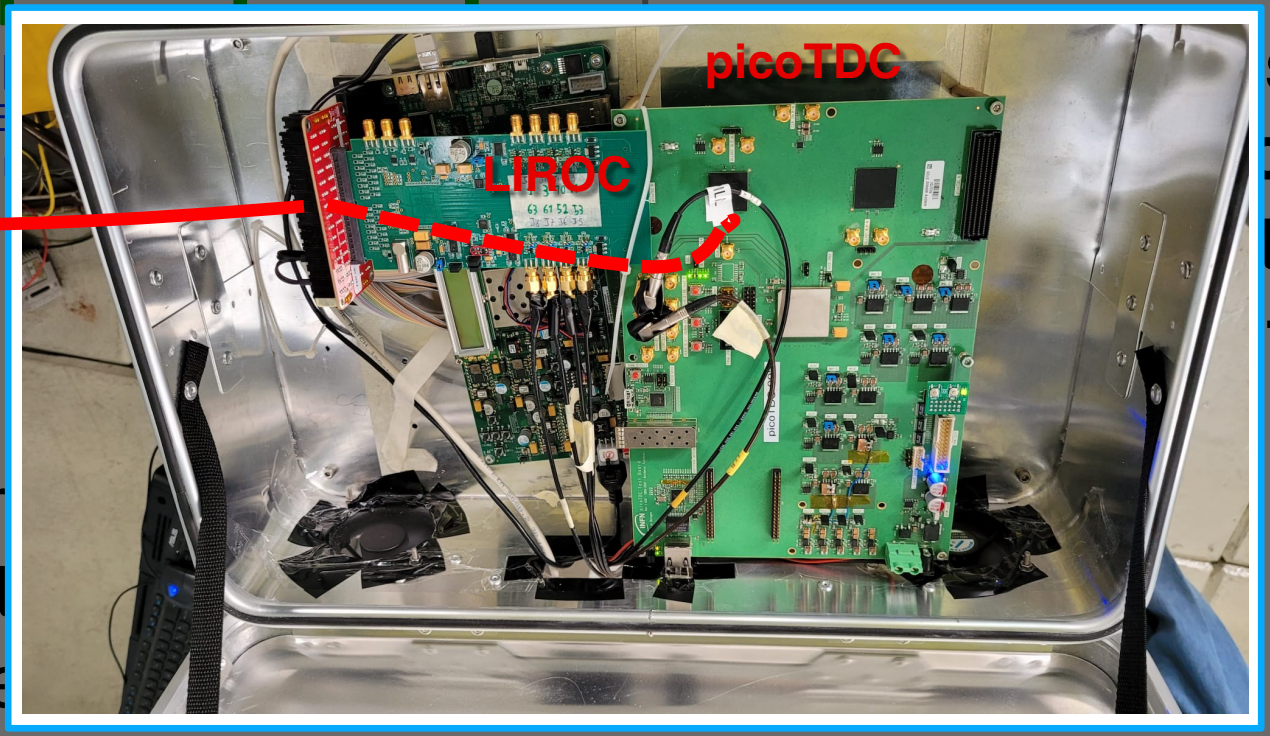


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LGADs

# DAQ at work

```
------- PicoTDC Board Readout Status --- @ 30/04/2024-03:43:55
Run # 104 WAIT SPILL      SOR: 30/04/2024-03:31:45 EOR: 01/01/1970-01:00:00
Events | 01188689 | Buffers 00068390 | Ev/Buffer  17.3
Spill  | Uptime: 158.4 (s) | OFF | Off->On 066 | On->Off 066 |
Memory | Max FPGA buffer size  00001814 | Max hits/event 00000030
-- LAST Spill Stat --- Spill # 066 ----------------------------------------
Duration    2.40 (sec) Events: 18140 Ev. rate 2.400000 [KHz] |
PCI MEM 00243078 | FPGA MEM 000024 | Hit  0
[00] 00004193 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[08] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[16] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[24] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[32] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[40] 00000000 00000000 00000000 00000000 00000000 00000000 00009477 00000000
[48] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[56] 00000000 00000000 00000000 00000000 00011728 00000000 00000000 00000000
-- All Run stat ----------------------------------------------------------
[00] 00273108 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[08] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[16] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[24] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[32] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[40] 00000000 00000000 00000000 00000000 00000000 00000000 00616410 00000000
[48] 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[56] 00000000 00000000 00000000 00000000 00770940 00000000 00000000 00000000
MULT:     0     1     2     3     4     5     6     7     8     9    10
      61424 36475 16085 48840 00000 00000 00000 00000 00000 00000 00000
```

# triggers since SOR

LGAD4 triggers (in the spill)

LGAD2

LGAD1

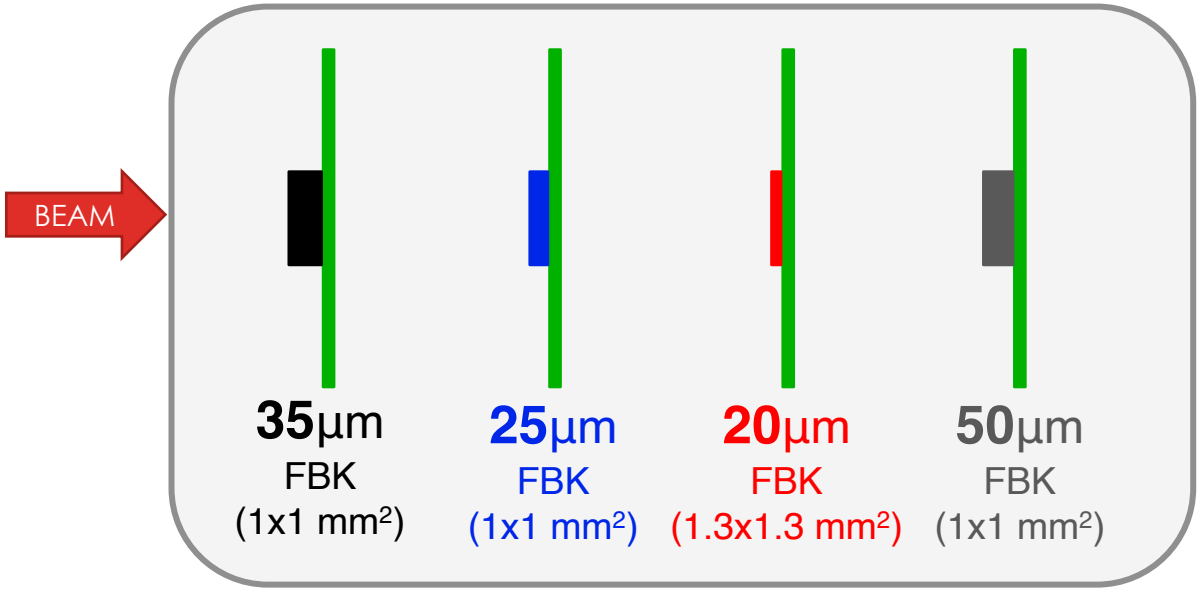
LGAD3

**# hits per spill**
(both leading & trailing edges)

Per spill

Since SOR

# events when 0, 1, 2, etc channels fired

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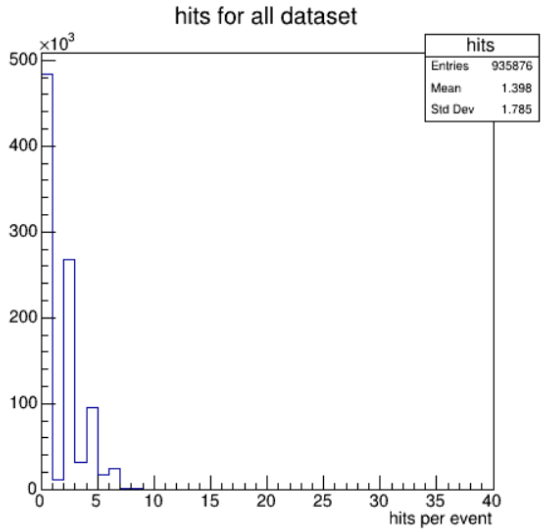
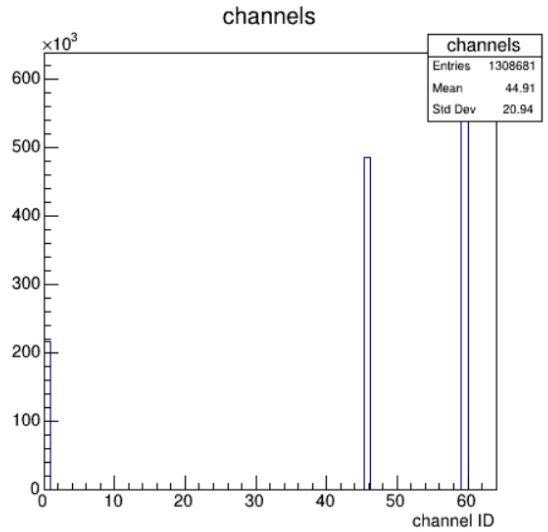
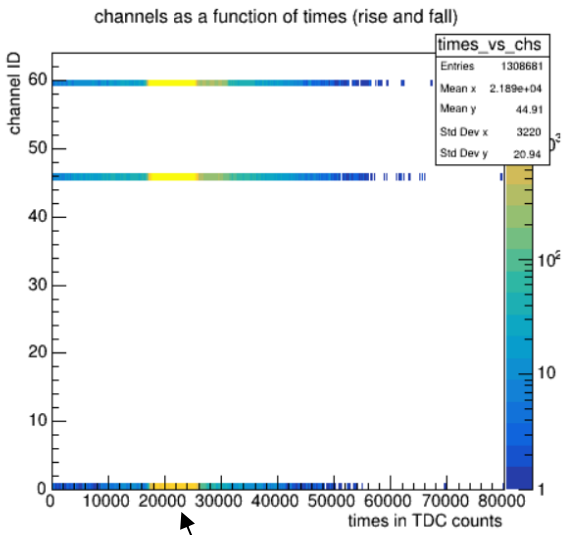
# FAST QA ANALYSIS

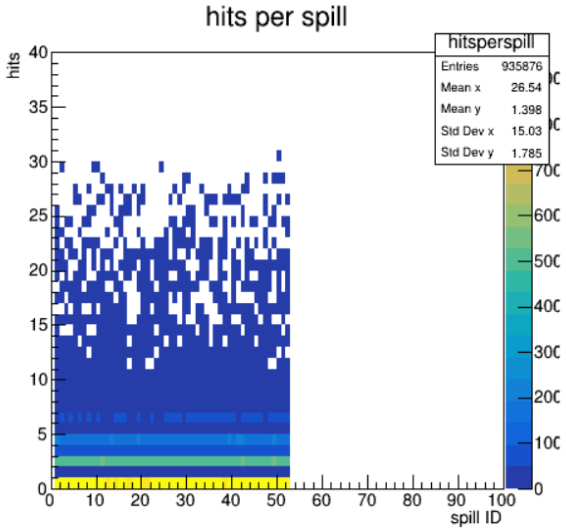


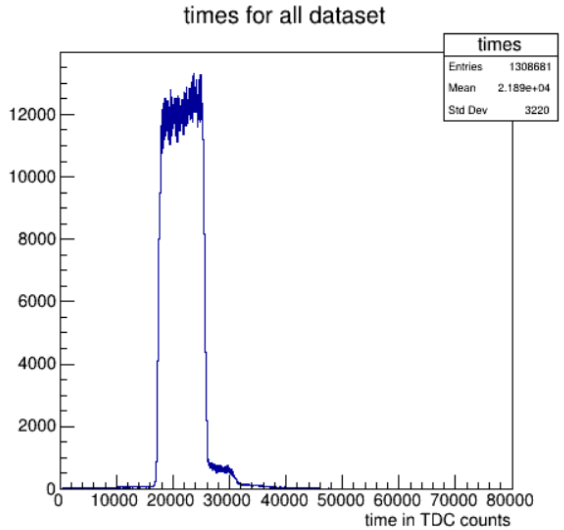




250 ns




1 TDC count = 3 ps

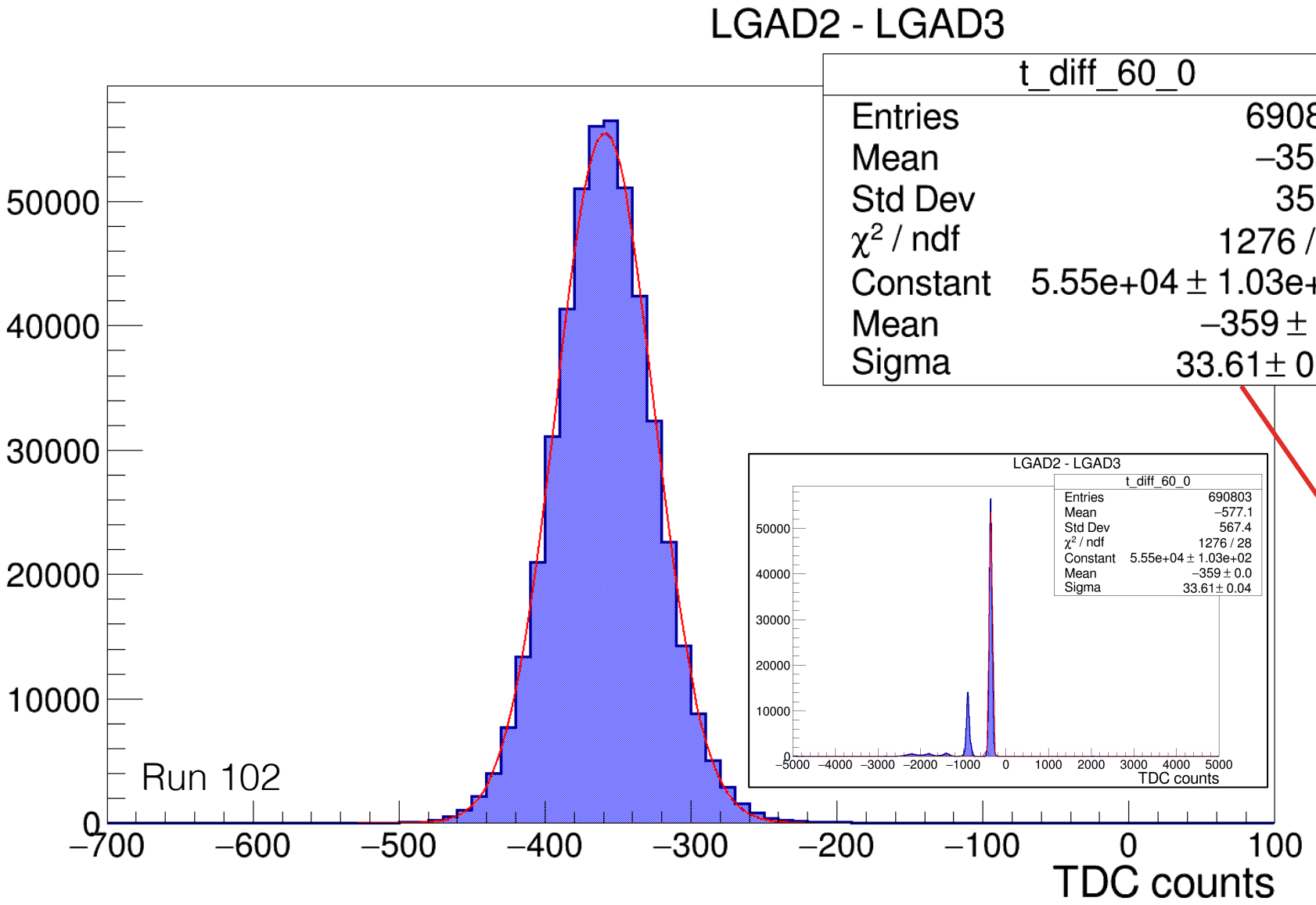



LGAD signals within the readout window and well discriminated (**OK**)

To be included:
hit multiplicity vs channel

# FAST QA ANALYSIS




All contributions enter here (!)

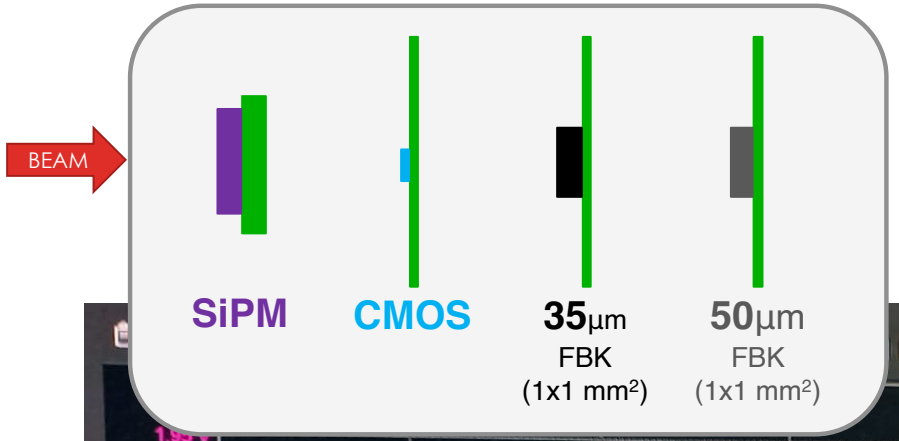
- Sensor
- Amplification
- Discrimination (LIROC)
- Digitization (picoTDC)

The one of LIROC is substantial, picoTDC is few ps (*See Pietro slides)*

$\sigma = 33 \times 3 = 99$ ps

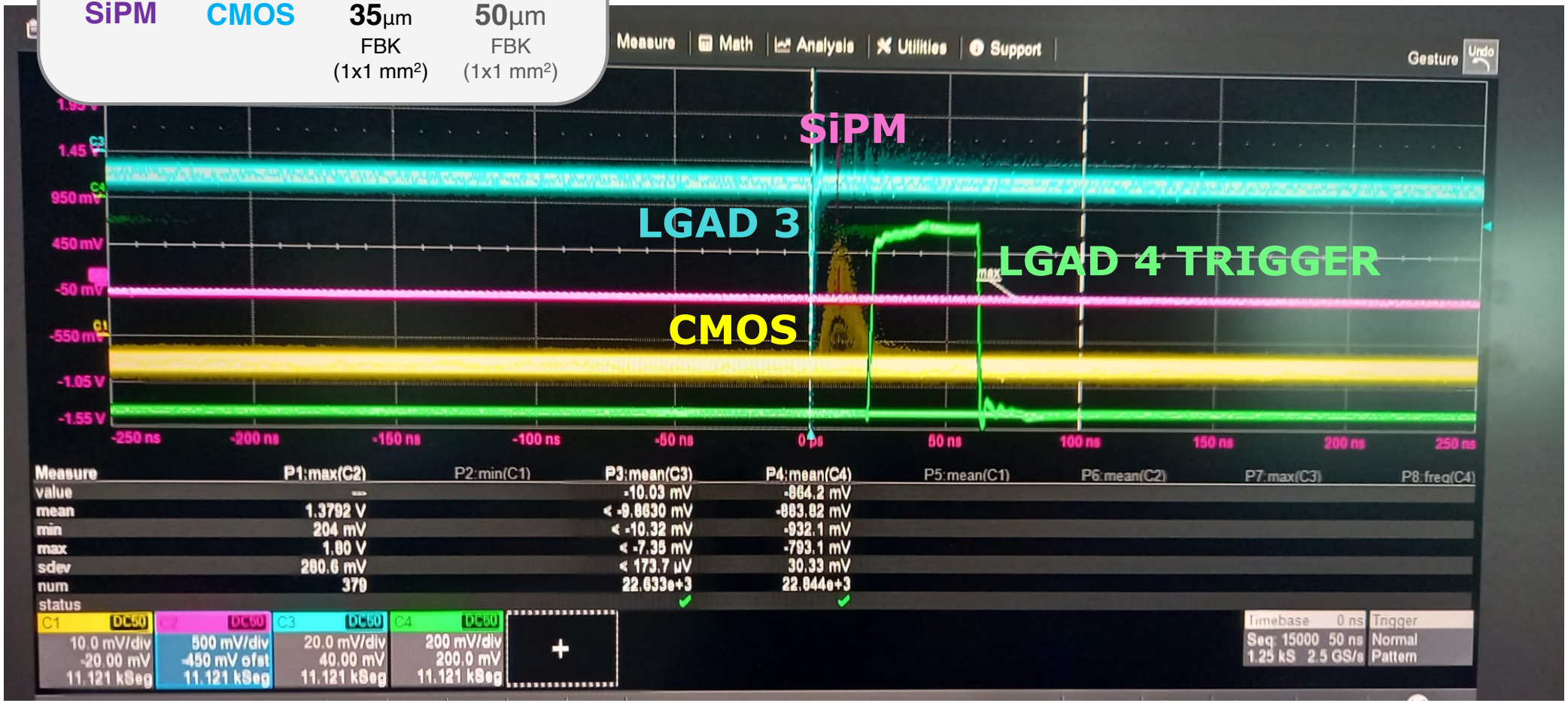
→ $\sigma_{DUT} = 99/\sqrt{2}$

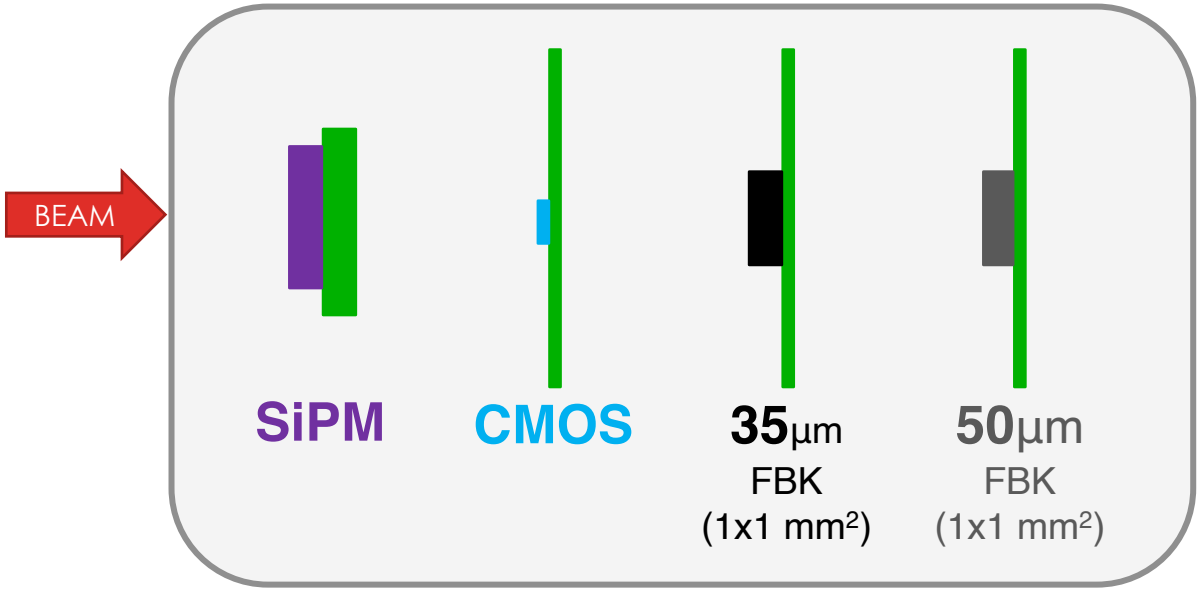
$= 70$ ps




# CMOS matrix 1a flavor A1

- Different top and bottom voltages






- SR1 (1 mm resin) Single
- SR1 (1 mm resin) Matrix
- SR3 (3 mm resin) Single

→ **Comparison**
**- Different resins**
**- Matrix VS single**

- Different voltages
- Different thresholds on picoTDC
- Different PA_Gain

# OUTLOOK

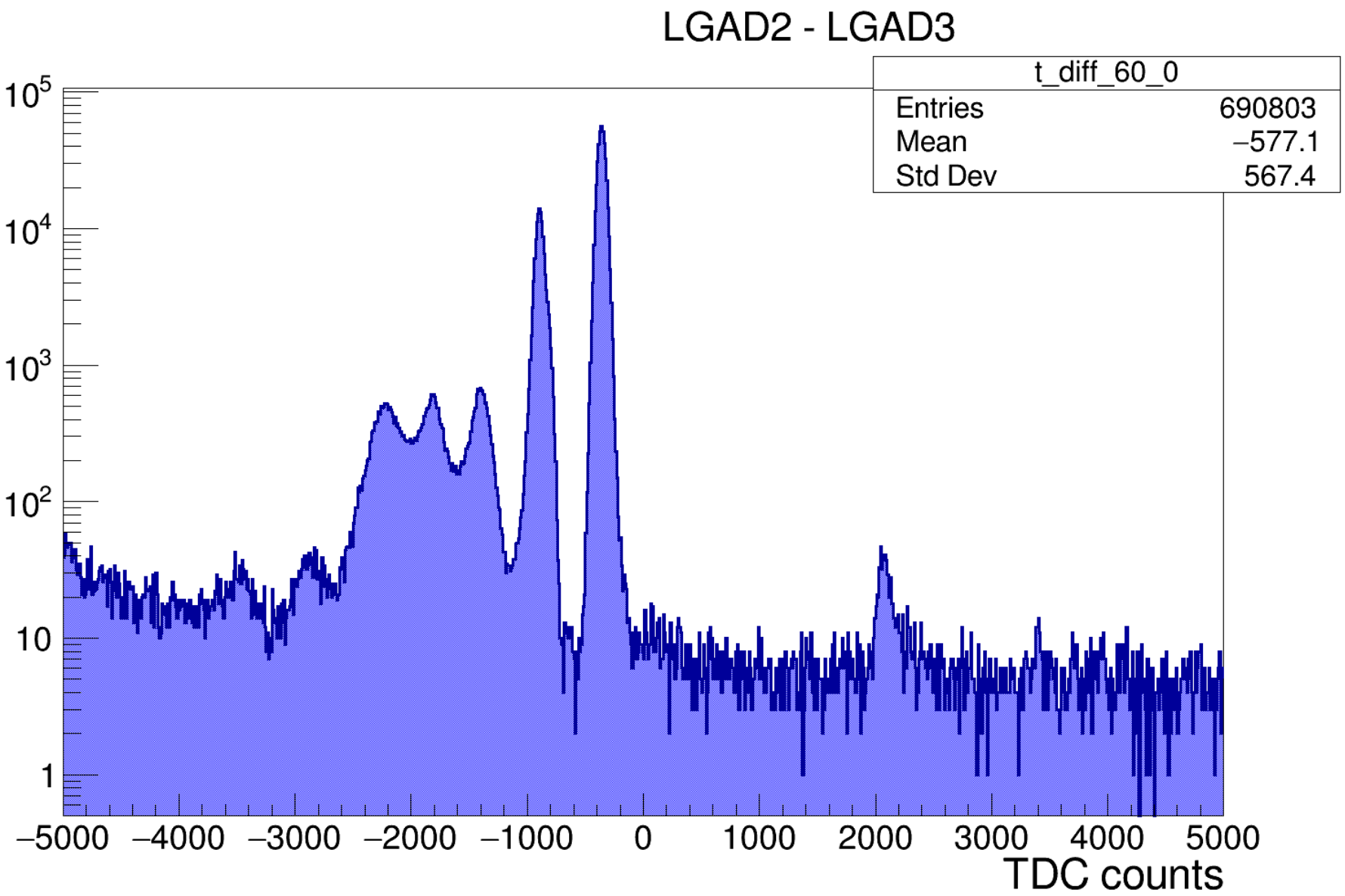
- **Readout** with picoTDC extremely **stable** (thanks to the picoTeam!)
- **Fast QA analysis very helpful** → additional checks for the next beam test to be implemented
- Not easy to discriminate **positive** (CMOS, SiPMs) **and negative** (LGAD) signals on the same LIROC board → possibility of 2 LIROCs?
- **Data** to be analyzed, moved on: /eos/project/a/alice3timing/testbeams/2024_04
- Other data included those of crosstalk effects still stored locally, including LIROC runs

## Next Beam Test:

- *26 June – 10 July (already approved)*
- *16 October – 30 October (draft)*

Always main users without parasitics

# Backup slides


LGAD2 - LGAD3
t_diff_60_0
Entries 690803
Mean −577.1
Std Dev 567.4
10^5
10^4
10^3
10^2
10
1
−5000 −4000 −3000 −2000 −1000 0 1000 2000 3000 4000 5000
TDC counts