ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

ALICE

INFN
Istituto Nazionale di Fisica Nucleare

April TEST BEAM: summary

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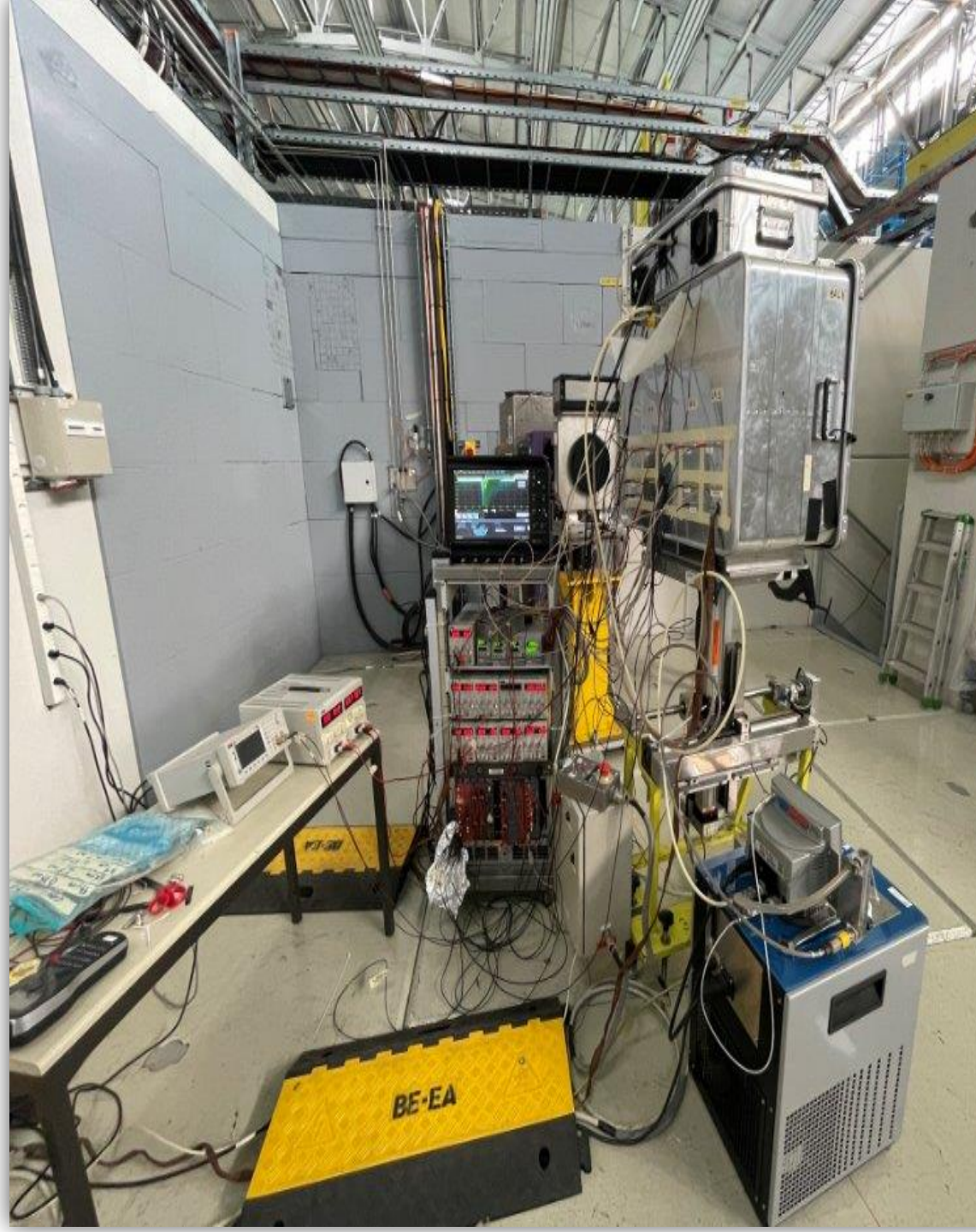
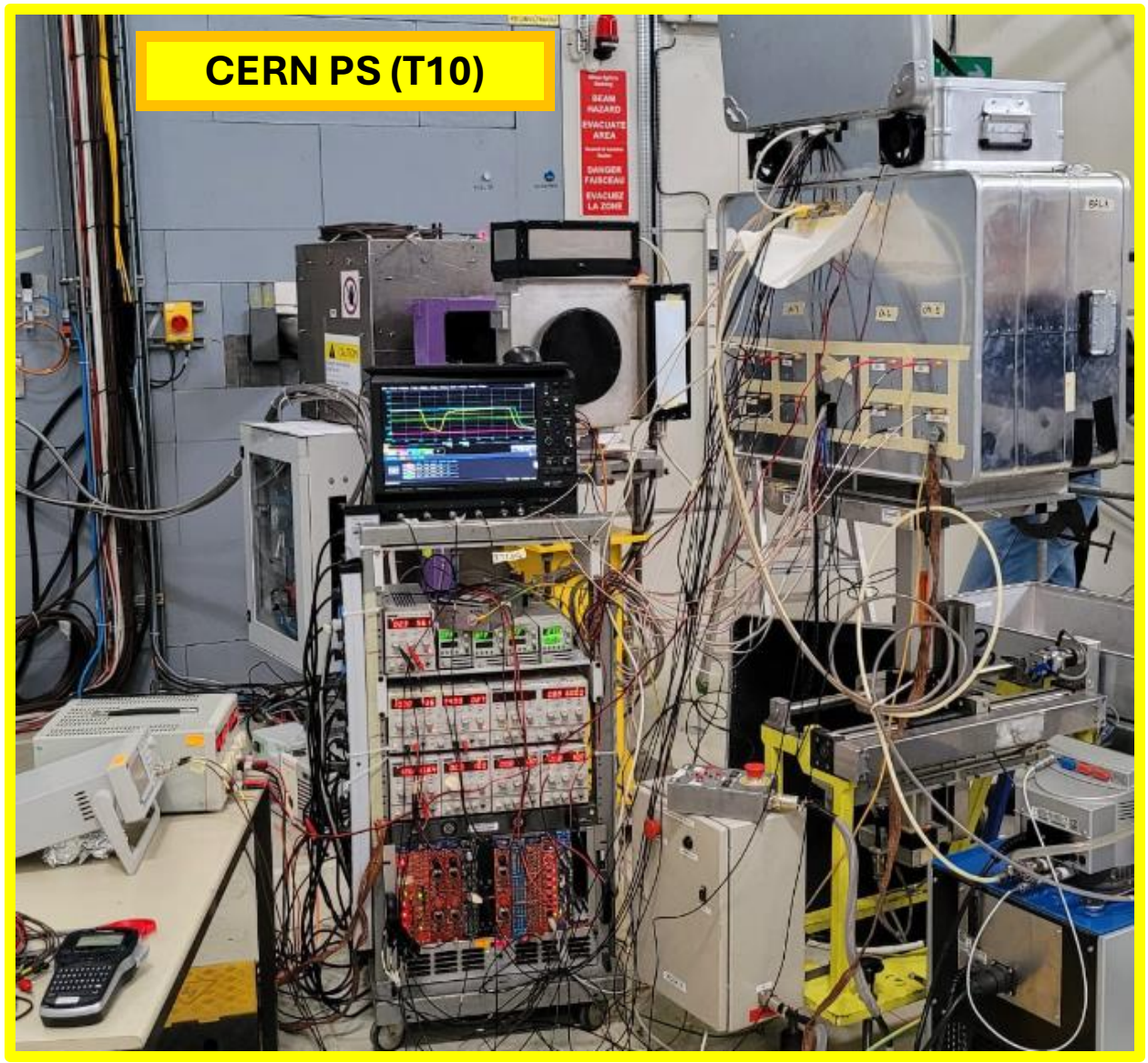
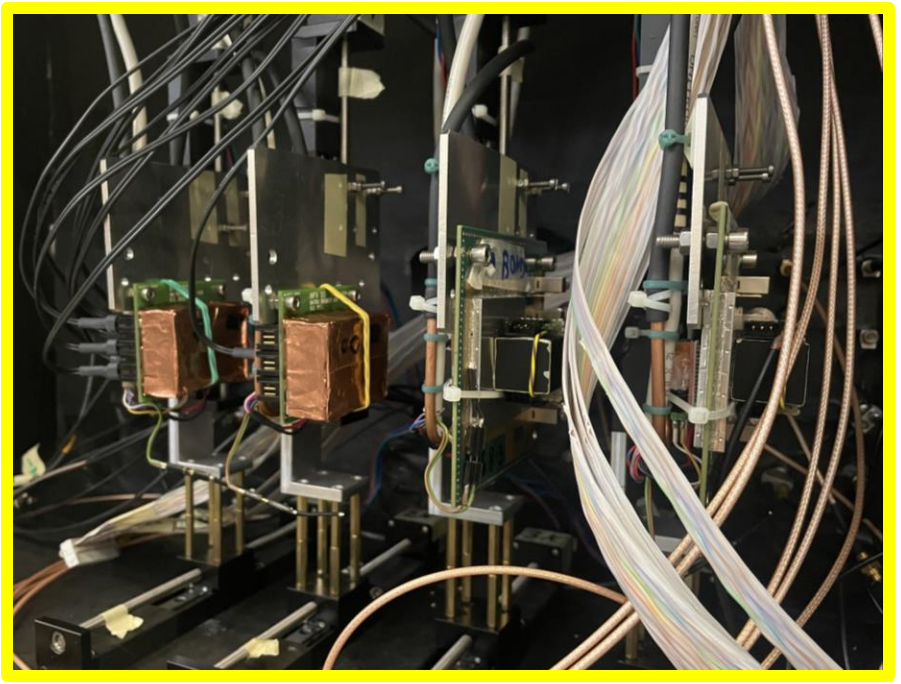
ALICE-ePIC meeting

Wednesday 29 May 2024



Test beam setup



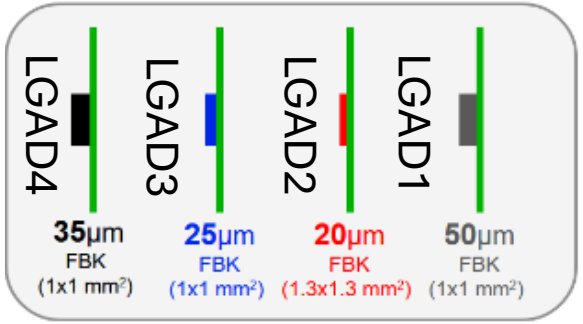


Alignment, trigger, thresholds

- **Alignment**: via oscilloscope; some of the last runs aligned directly with pTDC by looking at number of events on each channel
- **Trigger**: single coincidence of one LGAD (other 3 channels available on oscilloscope)
- **Thresholds**: could not be chosen on pTDC using direct signals on oscilloscope: need to see signals from LIROC

Trigger at work

BEAM

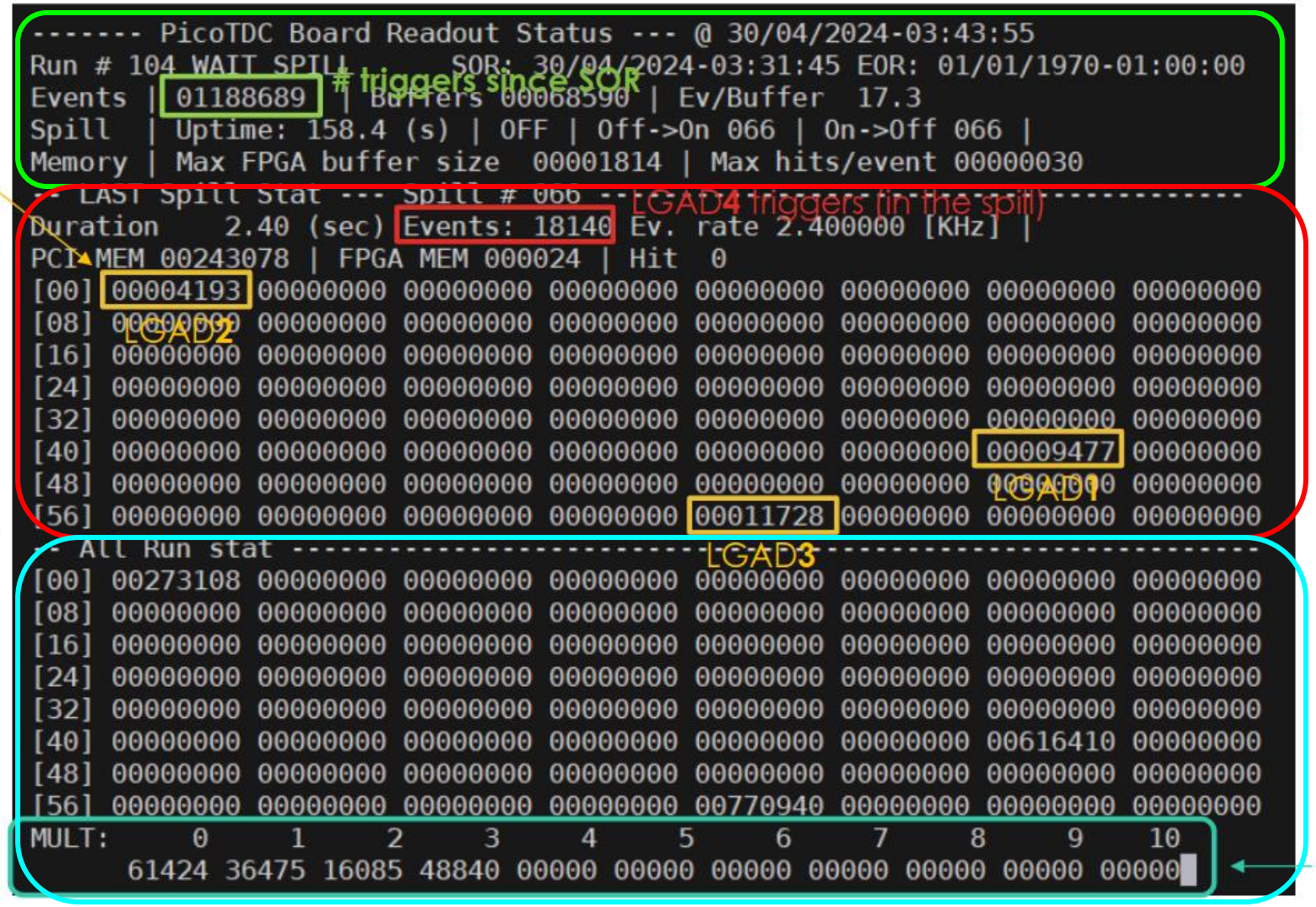


C1: LGAD4 trigger signal directly out of the CAEN discriminitator (-10 mV treshold) before stratching and delaying

C2: LGAD4 trigger signal (NIM format, not TTL) to pTDC

C3: LGAD1 analog signal

DAQ at work



hits per spill
(both leading
& trailing edges)

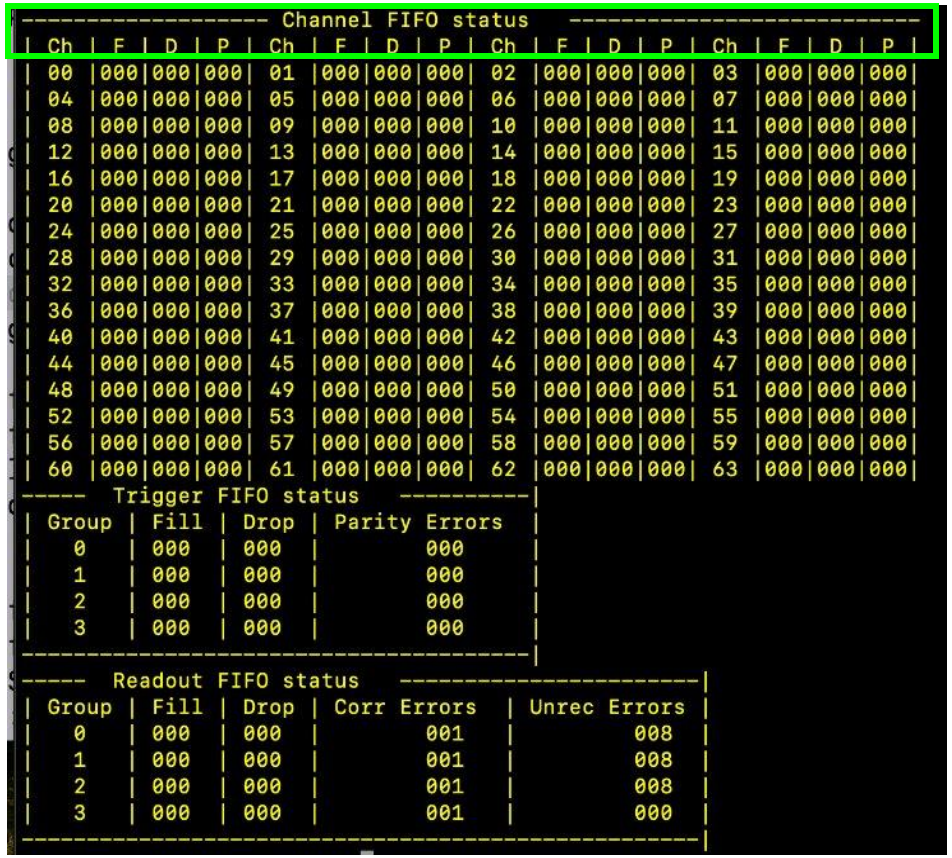
General infos of the run

Stats collected during last spill

Stats collected since start of run

events when 0, 1, 2, etc channels fired

DAQ at work: FIFO status



Channel FIFO status

Ch	F	D	P	Ch	F	D	P	Ch	F	D	P	Ch	F	D	P
00	000	000	000	01	000	000	000	02	000	000	000	03	000	000	000
04	000	000	000	05	000	000	000	06	000	000	000	07	000	000	000
08	000	000	000	09	000	000	000	10	000	000	000	11	000	000	000
12	000	000	000	13	000	000	000	14	000	000	000	15	000	000	000
16	000	000	000	17	000	000	000	18	000	000	000	19	000	000	000
20	000	000	000	21	000	000	000	22	000	000	000	23	000	000	000
24	000	000	000	25	000	000	000	26	000	000	000	27	000	000	000
28	000	000	000	29	000	000	000	30	000	000	000	31	000	000	000
32	000	000	000	33	000	000	000	34	000	000	000	35	000	000	000
36	000	000	000	37	000	000	000	38	000	000	000	39	000	000	000
40	000	000	000	41	000	000	000	42	000	000	000	43	000	000	000
44	000	000	000	45	000	000	000	46	000	000	000	47	000	000	000
48	000	000	000	49	000	000	000	50	000	000	000	51	000	000	000
52	000	000	000	53	000	000	000	54	000	000	000	55	000	000	000
56	000	000	000	57	000	000	000	58	000	000	000	59	000	000	000
60	000	000	000	61	000	000	000	62	000	000	000	63	000	000	000

Trigger FIFO status

Group	Fill	Drop	Parity Errors
0	000	000	000
1	000	000	000
2	000	000	000
3	000	000	000

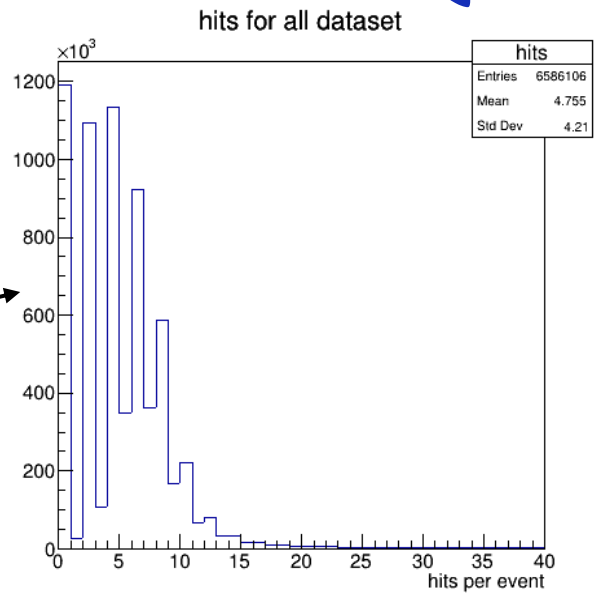
Readout FIFO status

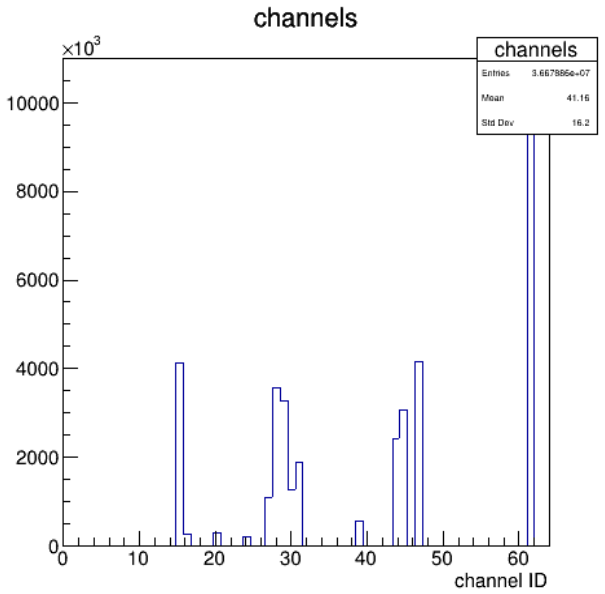
Group	Fill	Drop	Corr Errors	Unrec Errors
0	000	000	001	008
1	000	000	001	008
2	000	000	001	008
3	000	000	001	000

At some point we started looking at every run start to the FIFO status of the channels: looking at fill and dropped counters we evaluated the **noise** and decided the **threshold**

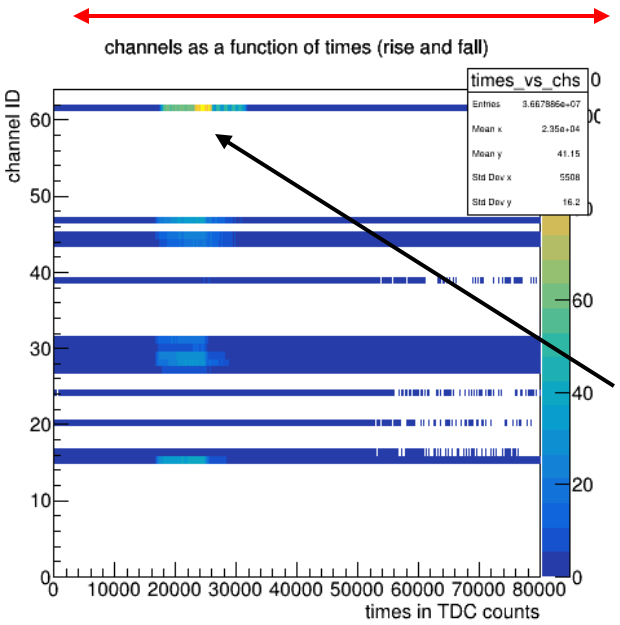
Online fast QA

CHECK to make in the first mins of run (there are runs with too low thresholds and too many hits per event)



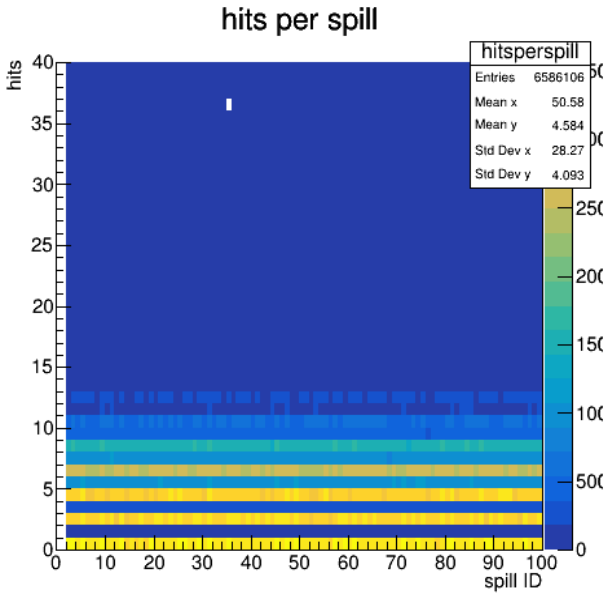


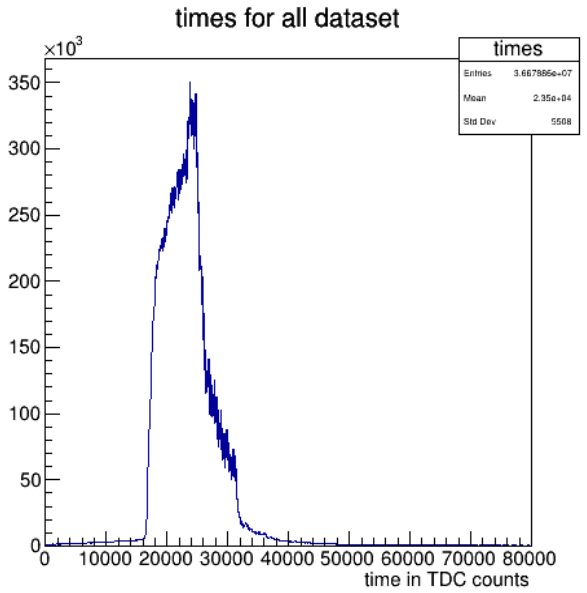
250 ns

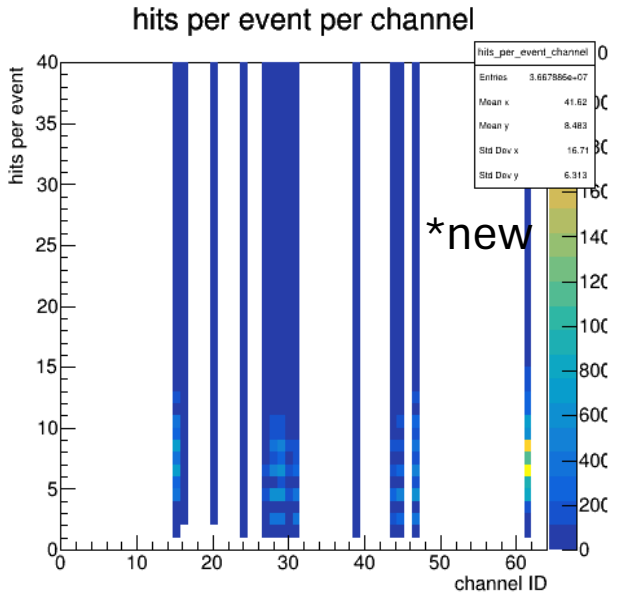


1 TDC count = 3 ps

LGAD trigger (within readout window, discriminated)







*new

Runs summary

LGADs (20,25,30,50 um) runs

- only oscilloscope (in agreement with previous TBs)
- LIROC on oscilloscope (8 of 64 channels dedicated to oscilloscope read out)
- LIROC+pTDC
  - Different stages of electronics tested (different number of amplification stages)
  - Different voltages
  - Different threshold on pTDC

CMOS runs

- Matrix A1
  - different top and bottom voltages

SiPM runs

- Matrix and single SiPM with 1 mm Silicone resin, matrix of 3 mm Silicone resin
  - different thresholds, voltage, gain
  - Only 1 run on LIROC, all the others on pTDC

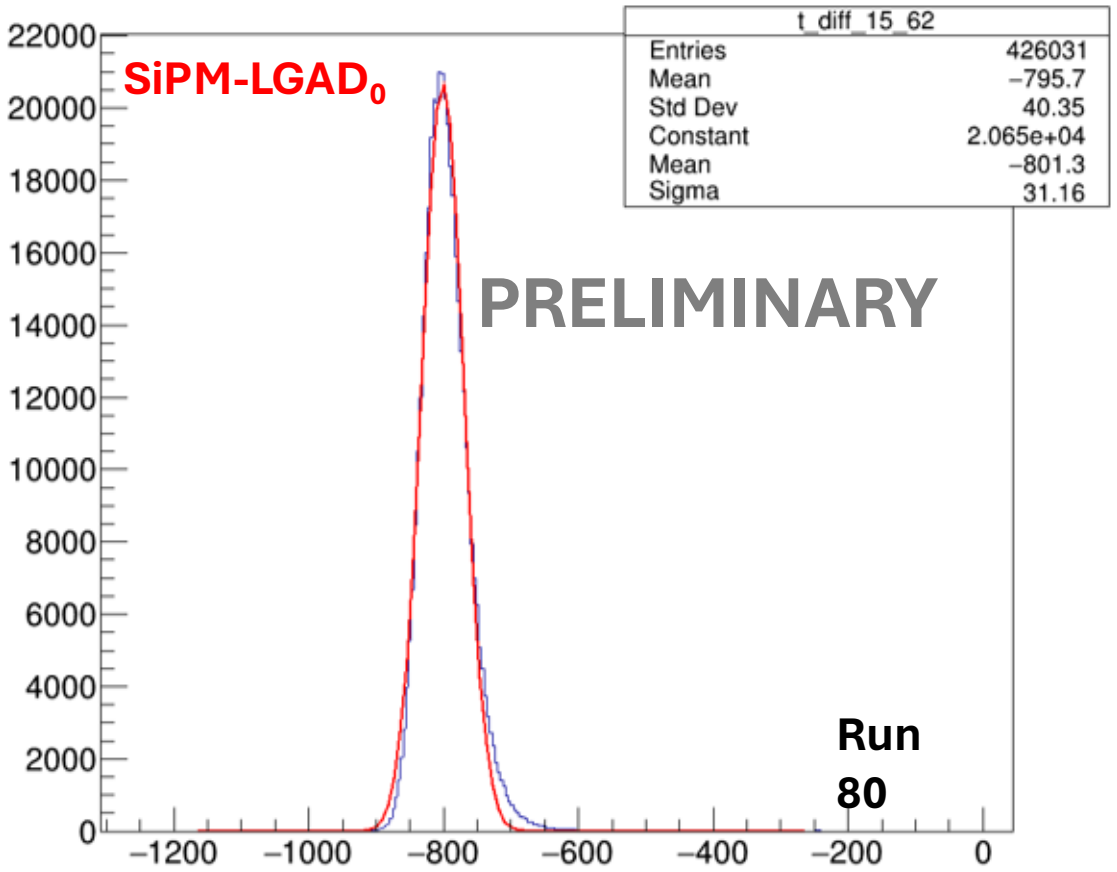
LGAD

SiPM

CMOS

LGAD trigger

Time resolution histograms SIPM-LGAD



Look: at pTDC level all contributions enter (sensor, amplification, LIROC discrimination, pTDC digitazation)

The one of LIROC is substantial while pTDC is few ps.

σ_{TDC} = 31 TDC counts
σ = 93 ps
σ_{DUT} = 61 ps

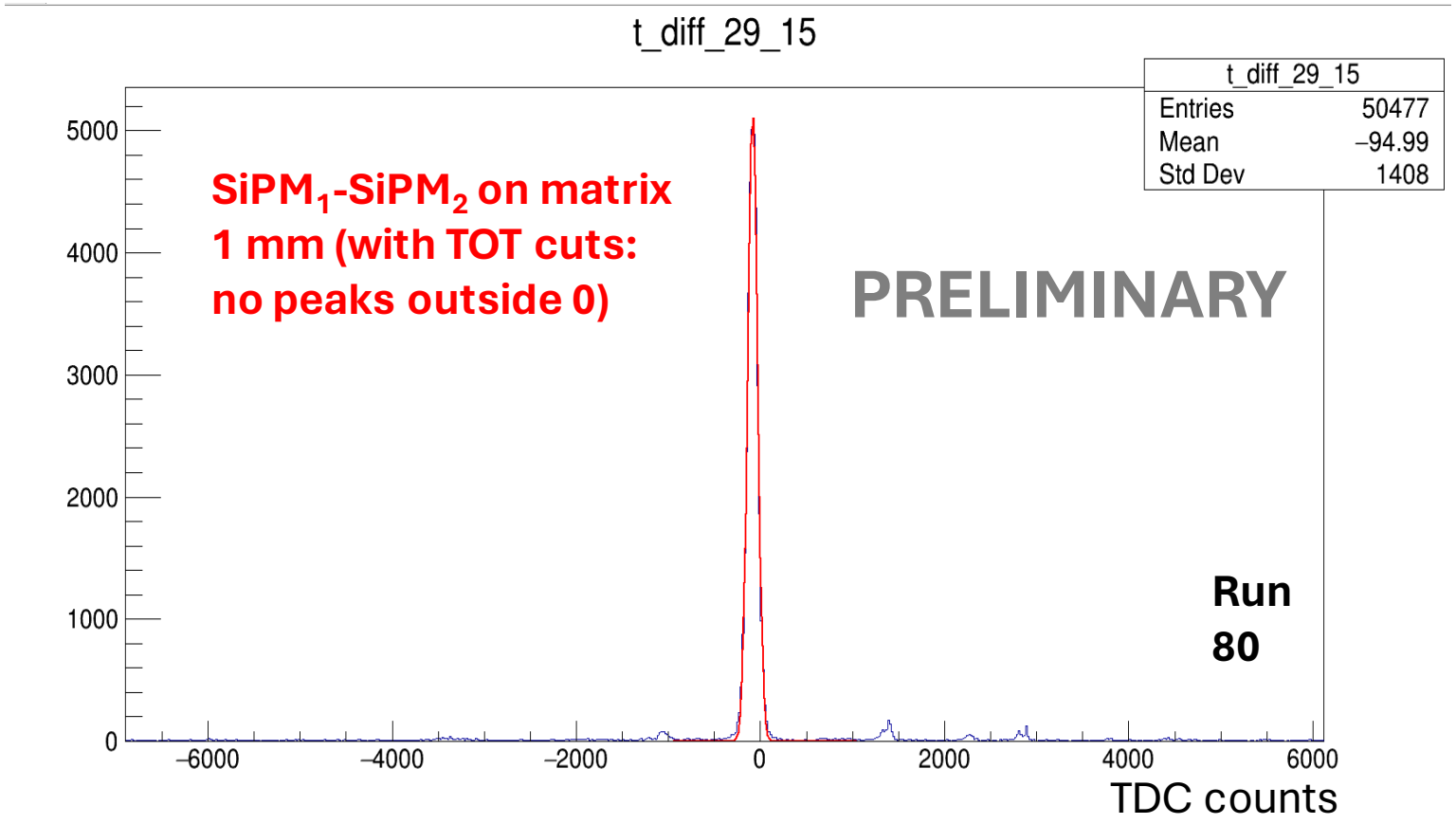
--> with LGAD this value seems pretty stable with **TOT cuts**

$\sigma_{DUT\ MEAN\ MATRIX}$ = 74 ps

Time resolution histograms between SIPMs on same matrix

--> With SiPM of a same matrix the time resolution value seems less stable **but**

we are **sure** that we are **cutting right on TOT as we observe a peak on 0 pTDC counts**



TDC counts

$SIPM_i$-$SIPM_{central}$

(with same TOT cuts for every SIPM)

56

54

65 (seems noisy)

44

42

70 (seems noisy)

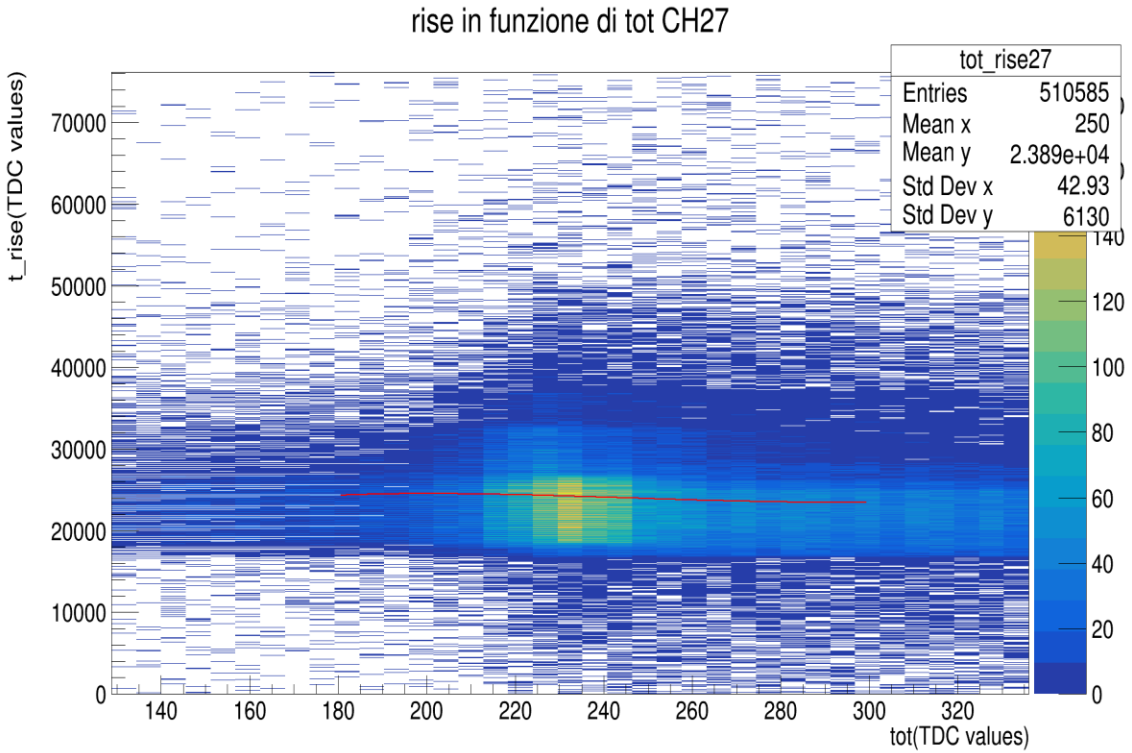
57

65 (seems noisy)

WITHOUT NOISY SIPMsconsidering RADQ(2):

$\sigma_{DUT\ MEAN\ MATRIX}$ = 100 ps

TOT correction still loading



- R_{ADC}=Original rising time in ADC counts
- R_{corr} = Corrected rising time after applying the correction
- TOT
- f(TOT)
- **$R_{corr}=R_{ADC}-f(TOT)$**

Outlook

- Readout with pTDC extremely stable (thanks to the picoTeam!)
- Fast QA helpful: additional checks at the beginning of the run to be implemented and always check full and dropped counters of every channel
- Not easy to discriminate signals with opposite polarity (CMOS, SIPMs are positive, LGAD are negative) on same LIROC
- All pTDC and qa histos on CERNbox EOS project
- LIROC runs still stored locally

Preparation of next test beam (June 2024)

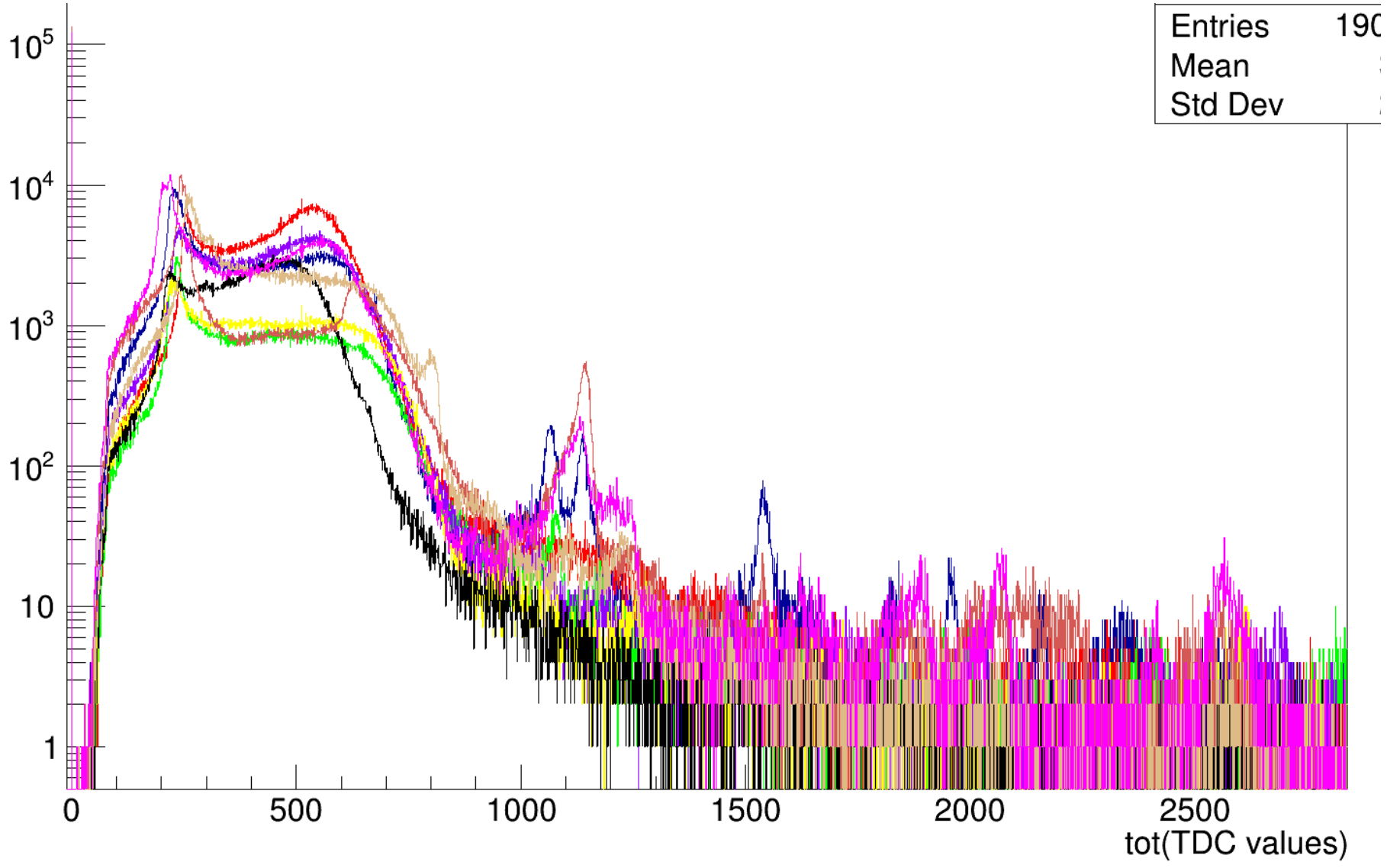
- Different polarity signals: adapating for **2 LIROCs (hardware AND software)**
- Addition of a 5th micro-positioner (positioned then fixed)
- Worst case: 20 CHs to read (2 negative, 18 positive signals), if not feasible single and matrix SiPMs
- LgadS matrix for potential CT effects
- Probably we will not have telescope integrated in pTDC

LASER test

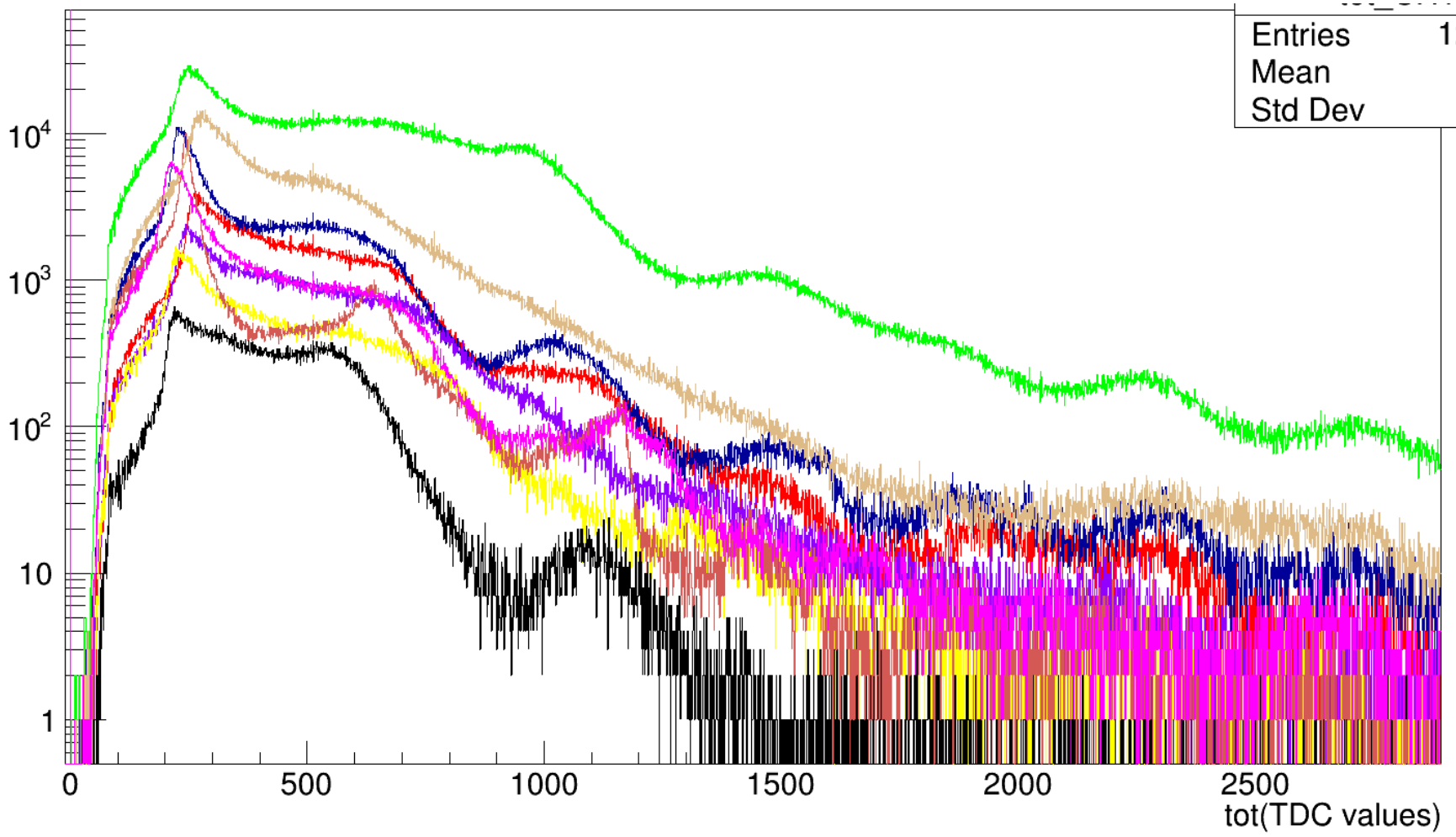
- **SIPM study of DCR** (to understand differences in the analysis)
- SiPM on LIROC on oscilloscope
- **SiPM on pTDC to study Crosstalk** between channels with laser

Backup slides

TOT distribution before at –46 mV



TOT distribution after radiation at –46 mV



Higher TOT entries at tot>1000 counts for one sipm (CH27, M3) as SIPM undergoes radiation damage (more DC --> higher baseline fluctuations)
In any case i would cut them as before keeping only the right TOT peak