Capacitevely coupled LAPPD cross talk

Trieste test June 2023

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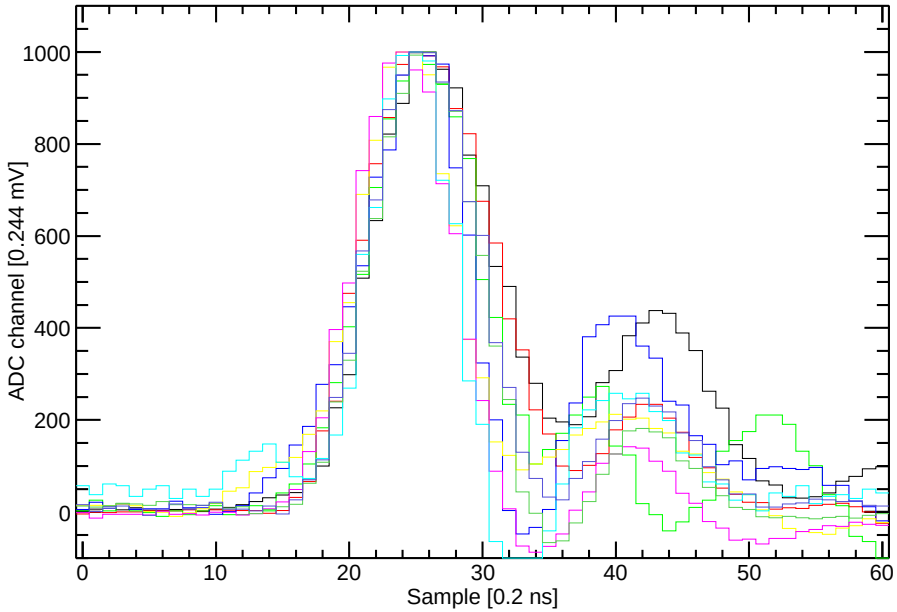
remote

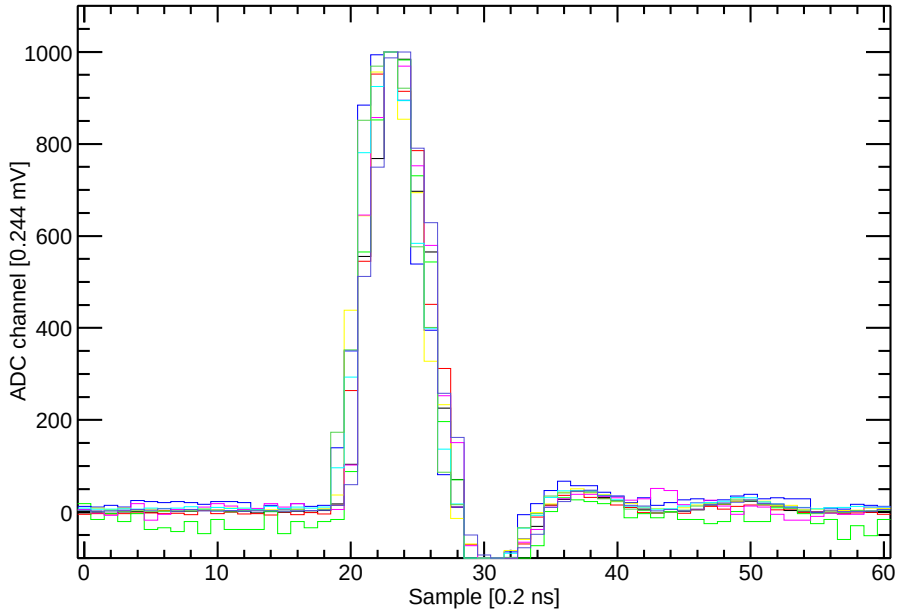
Measured LAPPD signals w.r.t. Hamamatsu MCP

- LAPPD risetime (20-80%) was about 0.75 ns,
- Hamamatsu MCP had 0.4 ns (intrinsic 0.16 ns),
- V1742 digitizer has BW=0.5 GHz →0.45 ns is its intrinsic limit on risetime (20-80%),
- LAPPD 1 inch pad has large capacitance 5 pF, assuming 50Ω load we expected 0.26 ns.

LAPPD



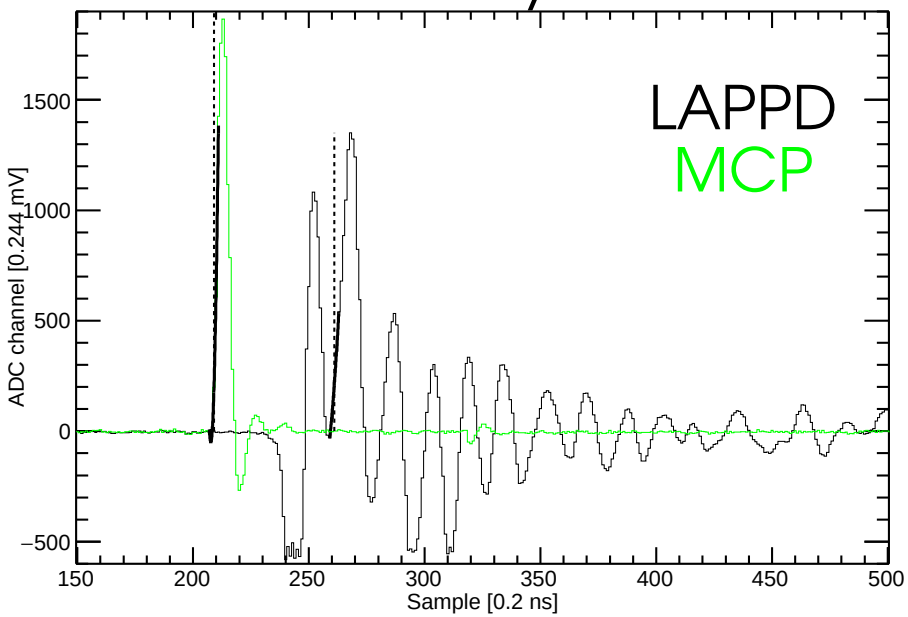
Hamamatsu MCP



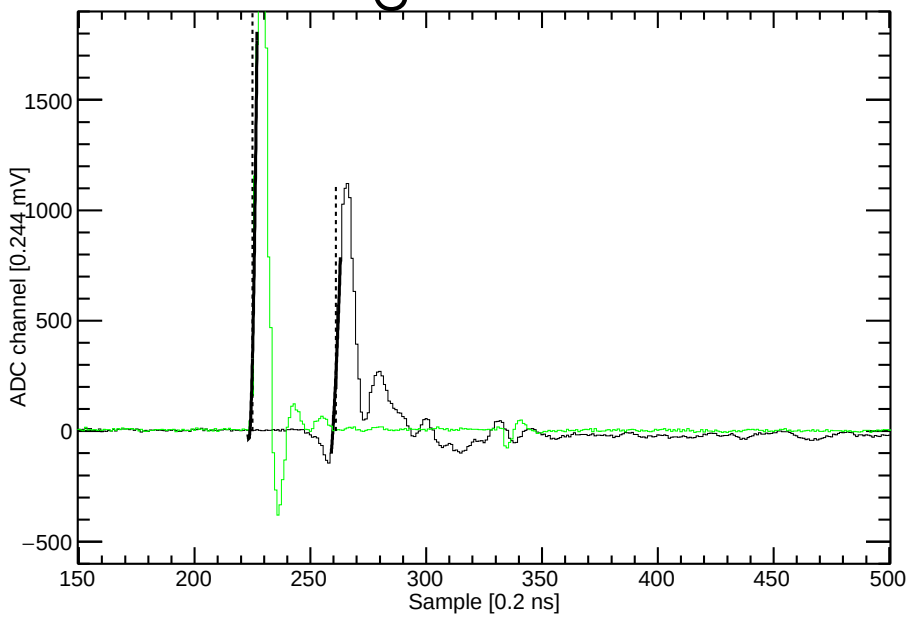
Cross talk on LAPPD at CERN

- in single hit measurements (laser) signals are clean,
- in multiple hit events (Cherenkov ring + beam spot) strong cross talk was observed,
- 30-90% of events have at least one EMI distortion,
- EMI distortion on signal affects rising edge (timing),
- in affected events 17/31 channels are distorted.

EMI-only



Signal+EMI

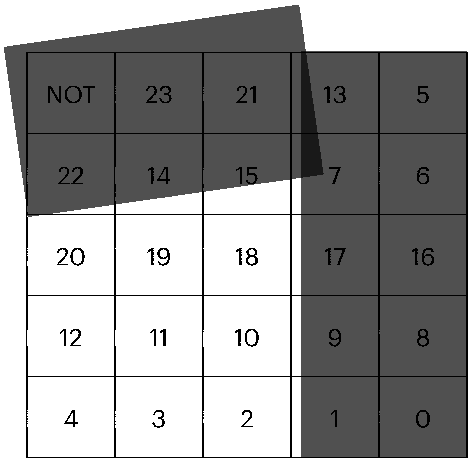


Cross talk test on LAPPD in Trieste

- LAPPD N.153 with HV conf.: 100/825/200/900/200,
- readout PCB with pads soldered to connectors,
- measured 5×5 array of 6.2 mm pitch pads,
- pulsed laser source at 300 Hz, high amplitude,
- laser focused on ch11, laser spot is $<500\mu$m,
- ch11 is connected directly to V1742 digitizer,
- all other channels are amplified.

LAPPD#153 Pad Type: C
(6 mm by 6 mm, pitch 6.2 mm)

NOT	23	21	13	5
22	14	15	7	6
20	19	18	17	16
12	11	10	9	8
4	3	2	1	0

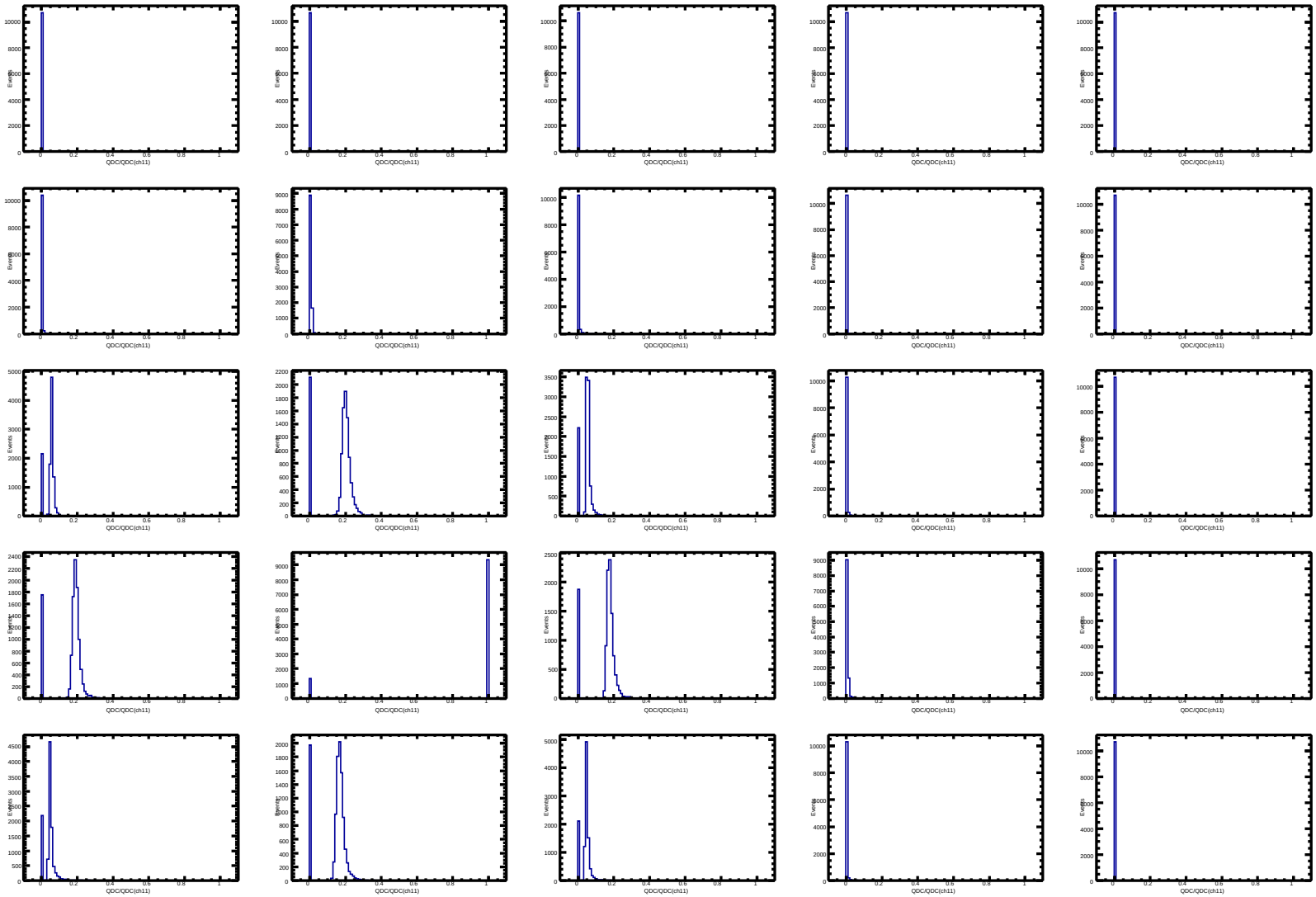


the numbers are CAEN channel numbers: ch_x

Looking towards PC window, PC-HV on top

Relative ADC map of measured LAPPD channels

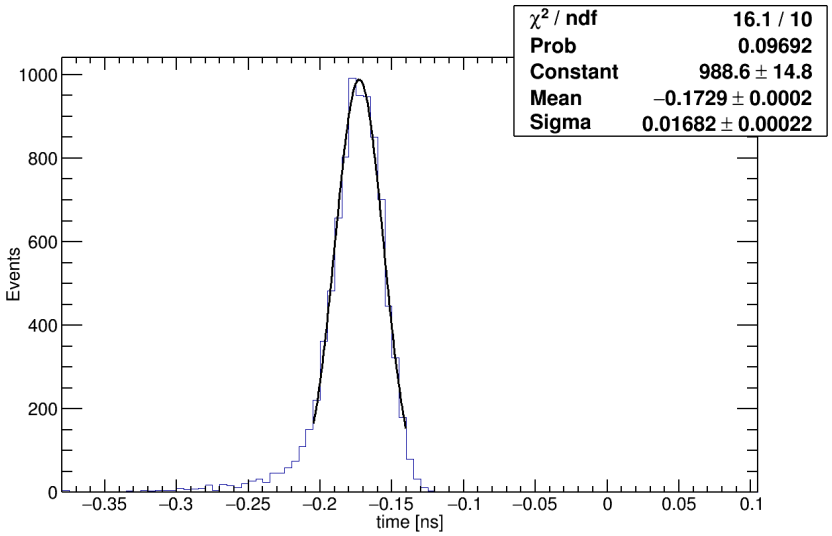
- vertical and horizontal pads collect 18%±1%, diagonal pads get 5%±0.5% (→R avalanche 4.6 mm)



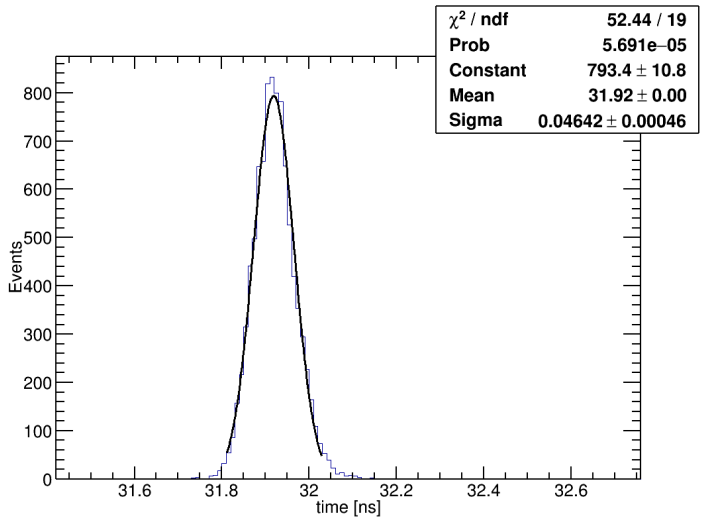
Timing of LAPPD

- σ(ch11-ch10)=17 ps $\rightarrow$ LAPPD TTS=12 ps for 11.3 pC/3*10^6*1e=23 photons, TTS SPE=58 ps;
- with 20 μm pore LAPPD N.124 at CERN TTS SPE=75 ps;
- σ(ch11-TR01)=46 ps $\rightarrow$ LDH-P-C-405 laser pulse width of $<$50 ps.

ch11-ch10

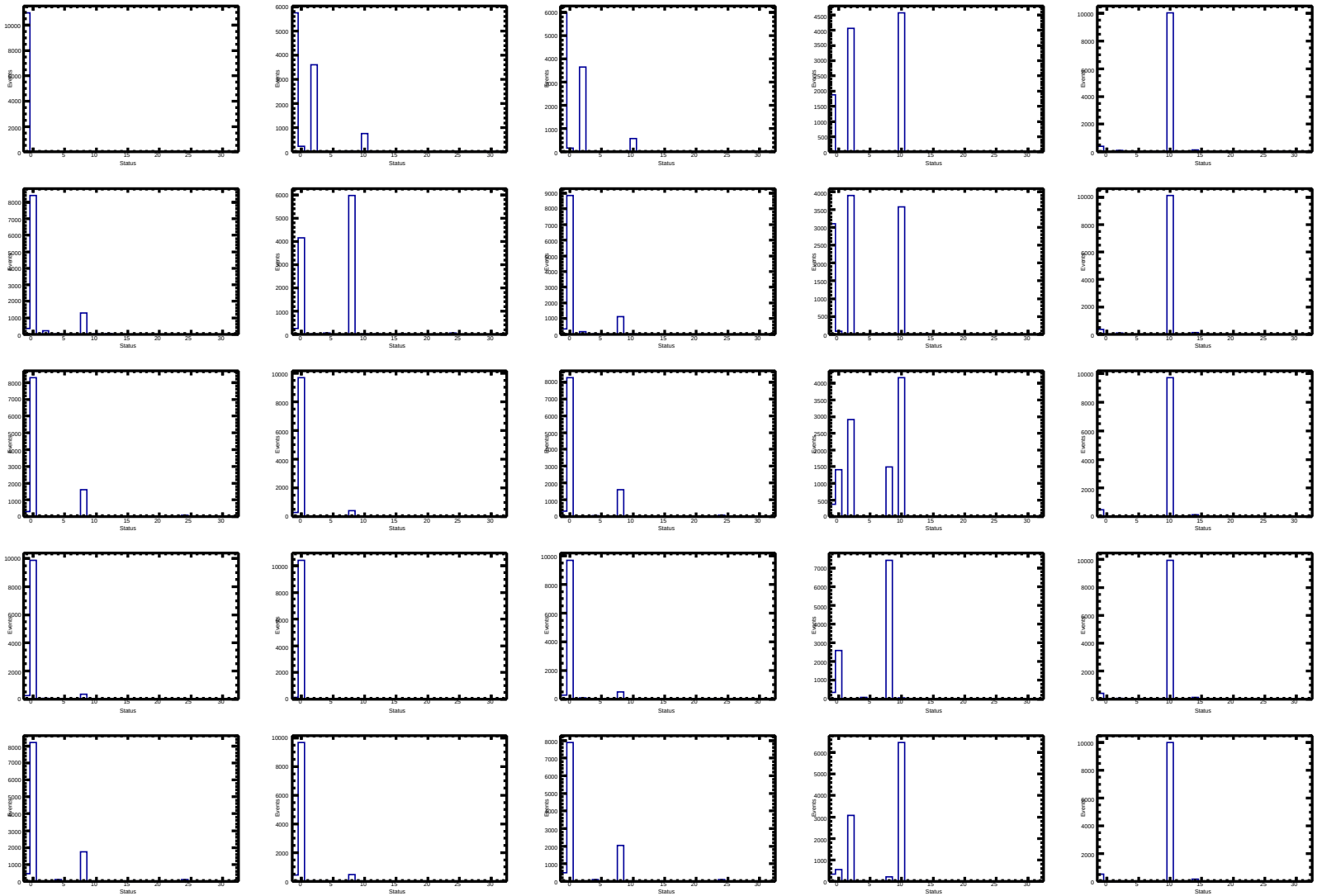


ch11-TR01



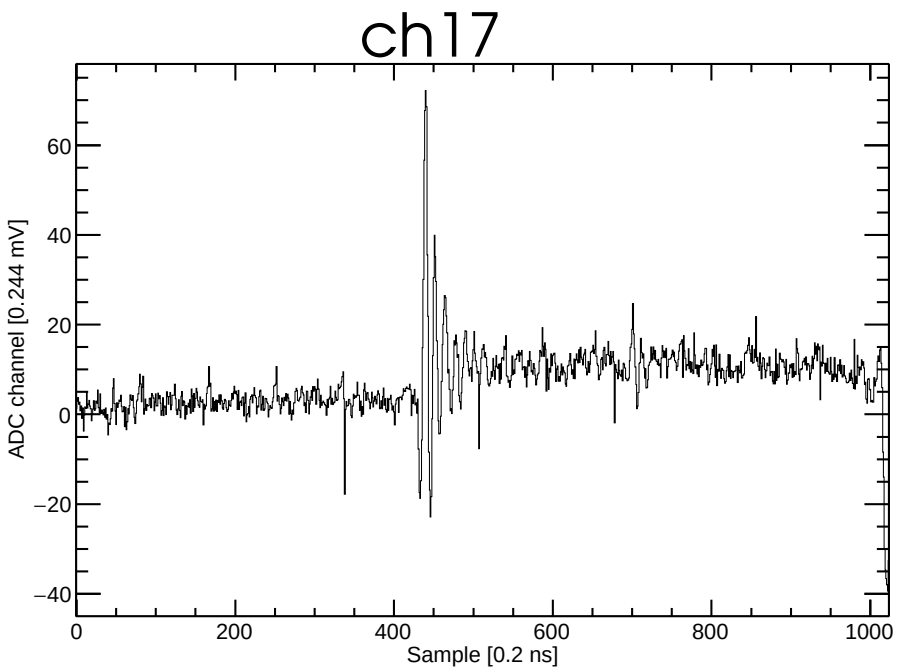
Trieste LAPPD cross-talk map

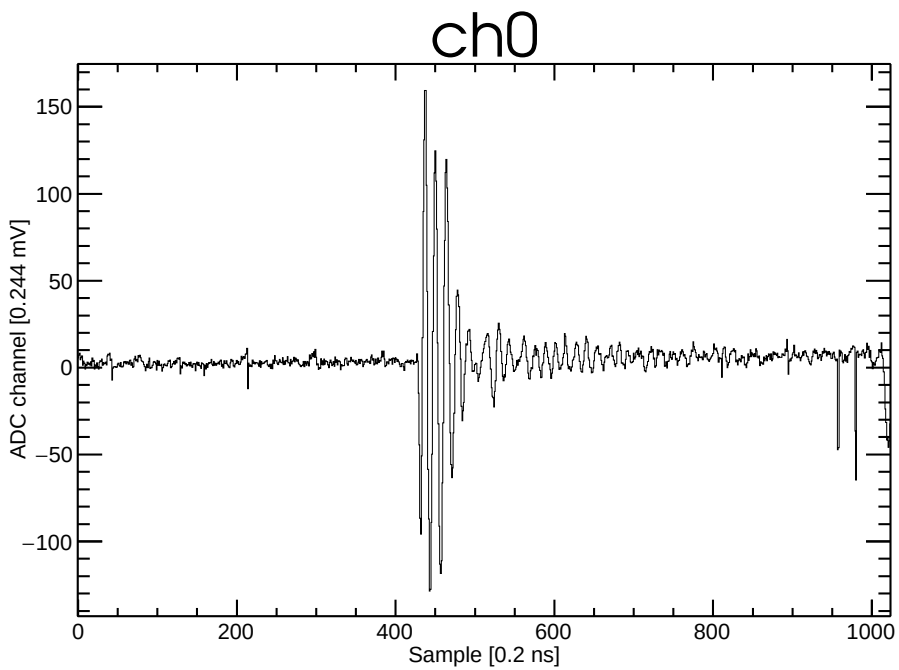
- status=2,4,8 (10=2+8) - cross-talk signatures.



Cross talk on LAPPD in Trieste

- Cross talk in channels far from laser spot is about 1% in amplitude.

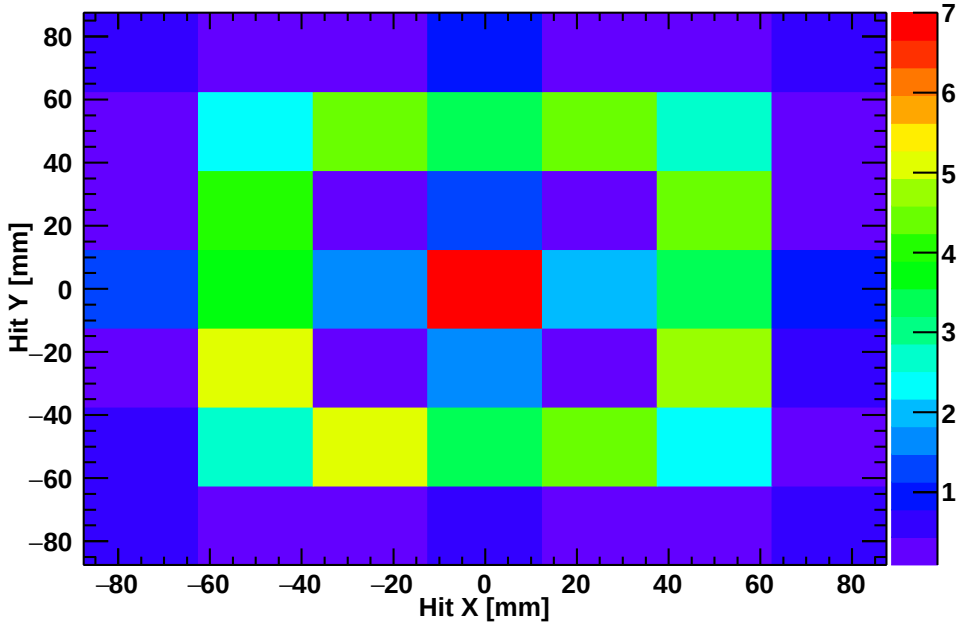




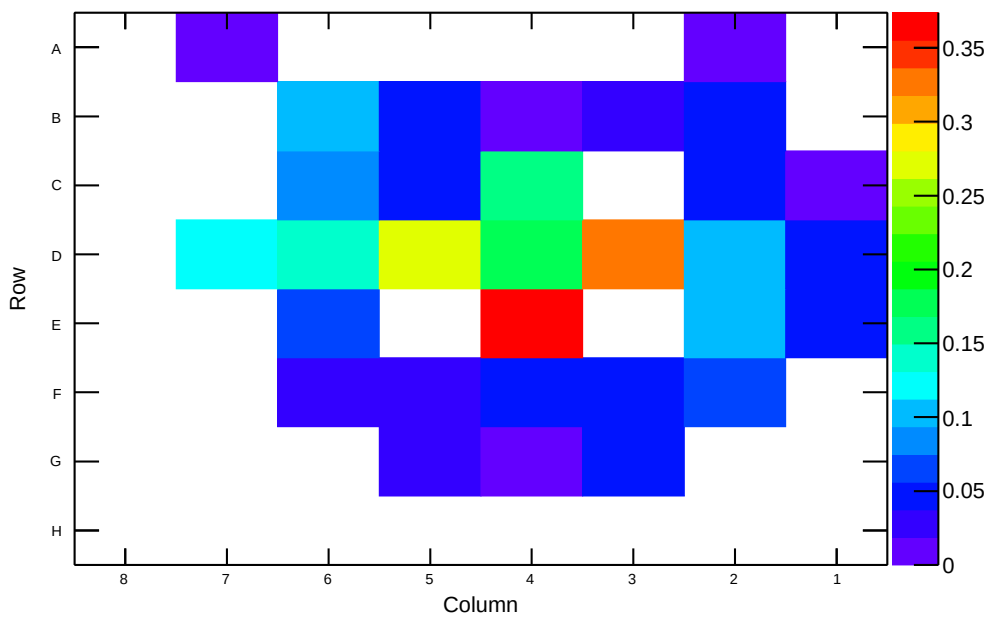
Cherenkov ring

- Cherenkov ring was observed,
- normalization of average is affected by cross-talk,
- beam spot was suppressed by a factor of 10 (grease+black tape on the window),
- 32 channels are barely sufficient to cover entire ring (25 mm pads, ring radius 60 mm).

Geant4 (p.e.)



CERN PS T10 h^+ 8 GeV $Q[pC]$



beam spot 316 p.e.