



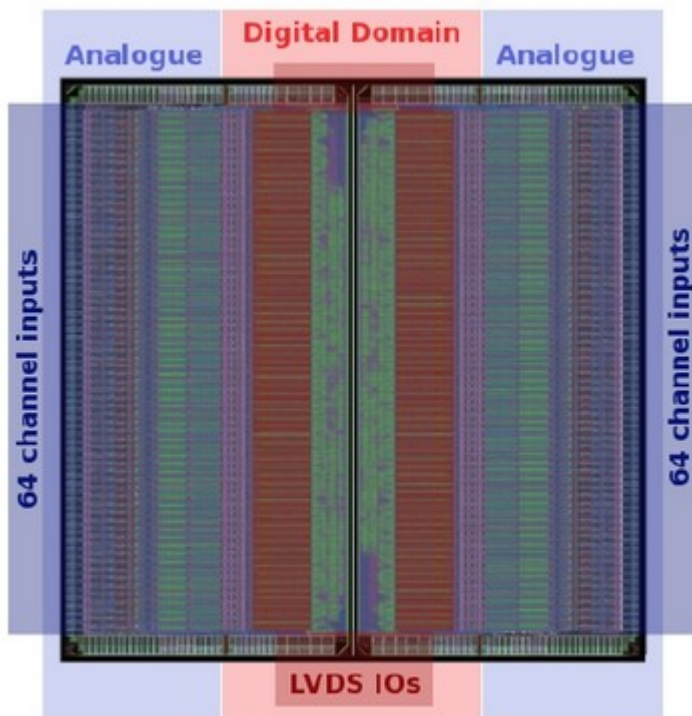
Progress with the TOFPET ASIC readout of the PHOTONIS MCP-PMTs

PANDA Meeting

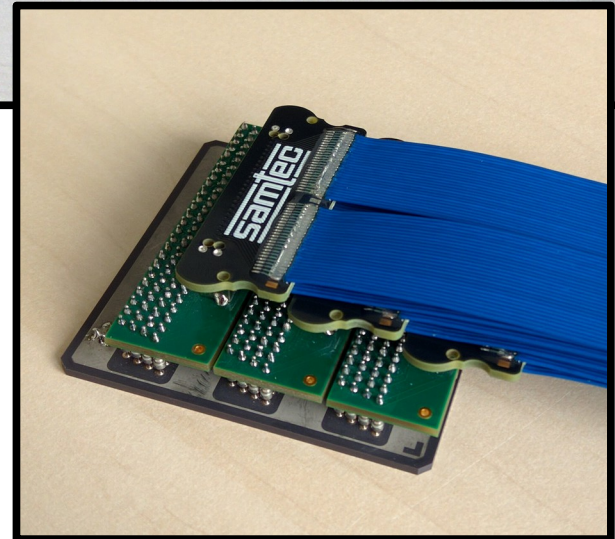
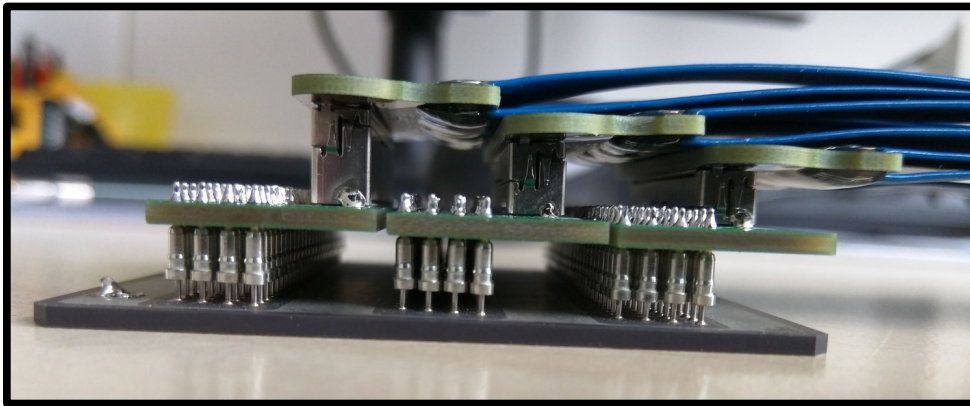
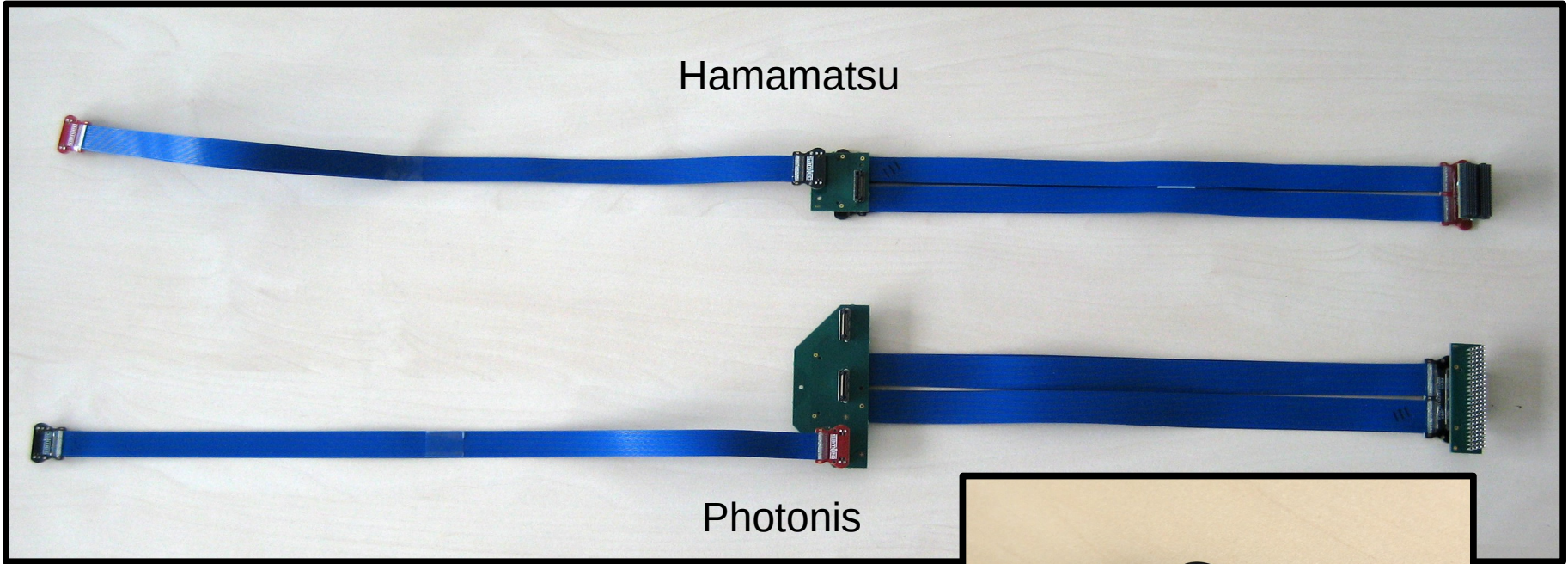


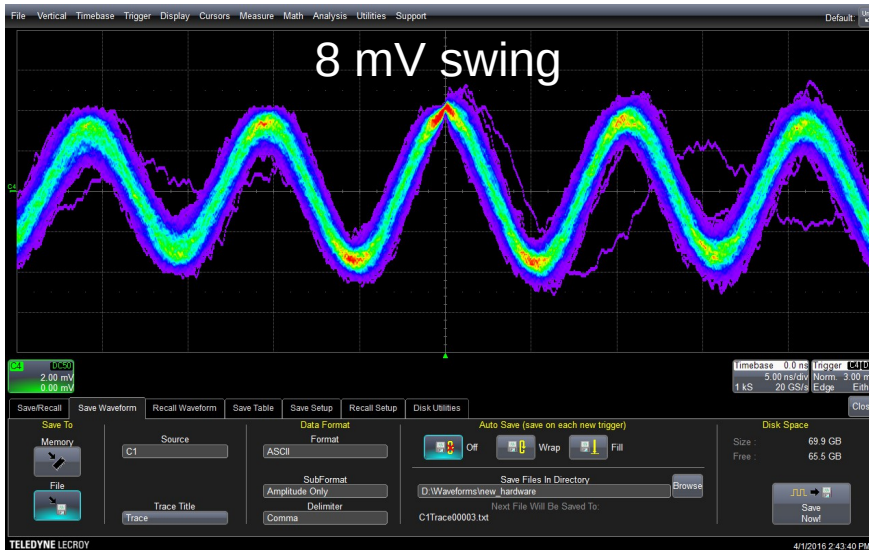
HGS-HIRe *for FAIR*
Helmholtz Graduate School for Hadron and Ion Research

- 25 ps r.m.s. intrinsic time resolution
- Charge measurement with time-over-threshold
- Max Channel Hit rate: 160 kHz
- SNR ($Q_{in} = 100$ fC): 25 dB
- Amplifier noise (in total jitter): 25 ps for 1 p.e. signal
- Max Output Data Rate: 320 Mb/s (640 Mb/s with double-data-rate)
- Power per Channel: 8-11 mW
- Small form factor allows us a space efficient layout

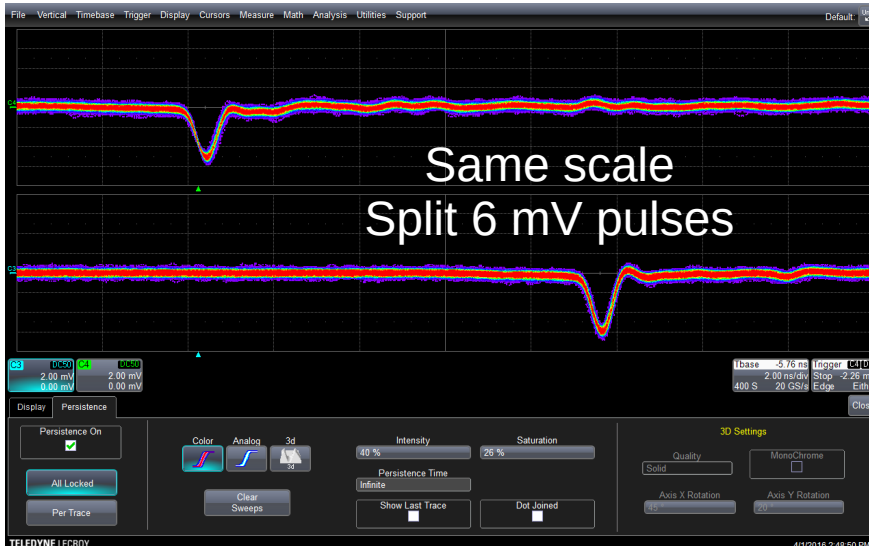


PETsys Electronics

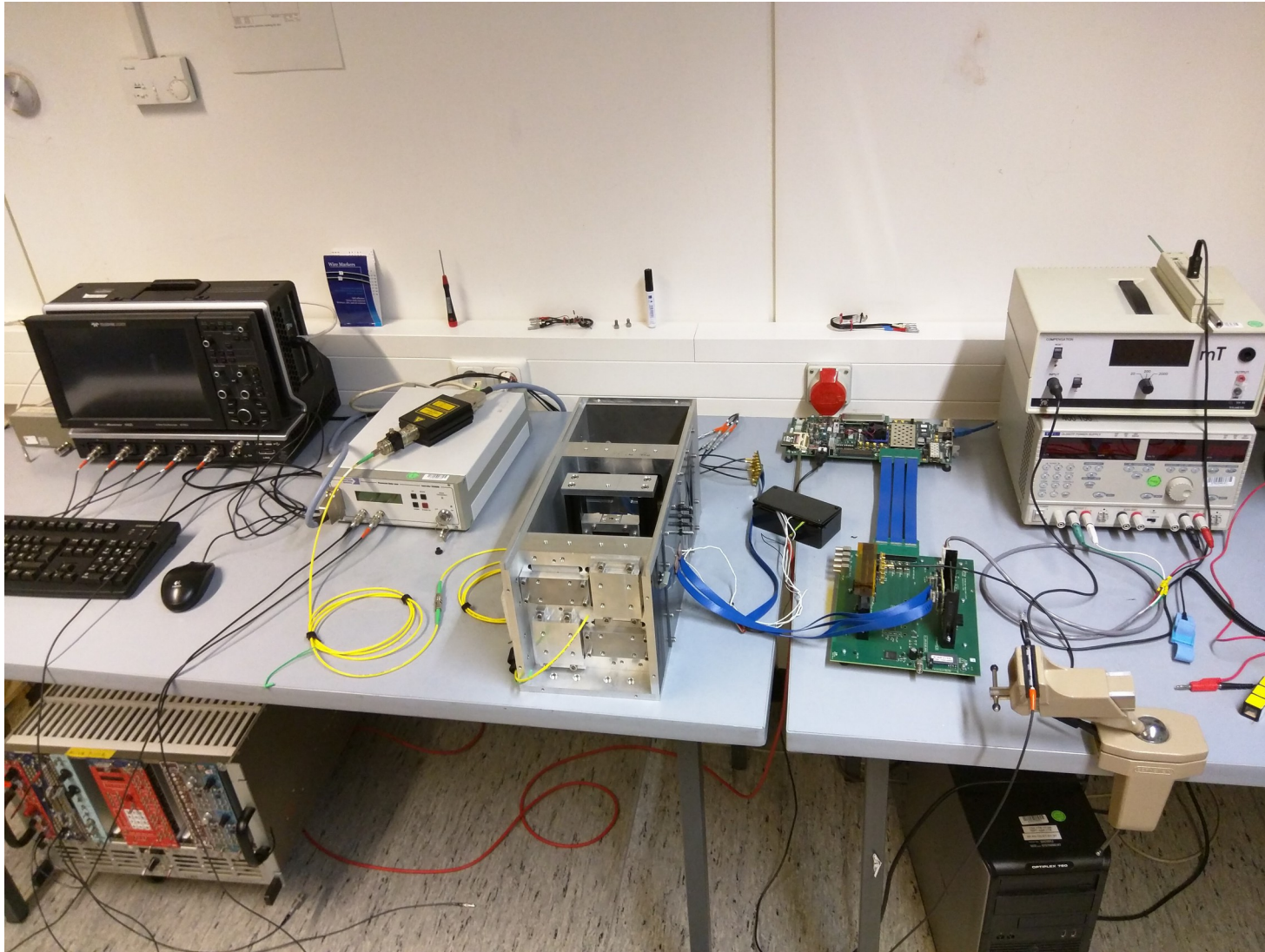


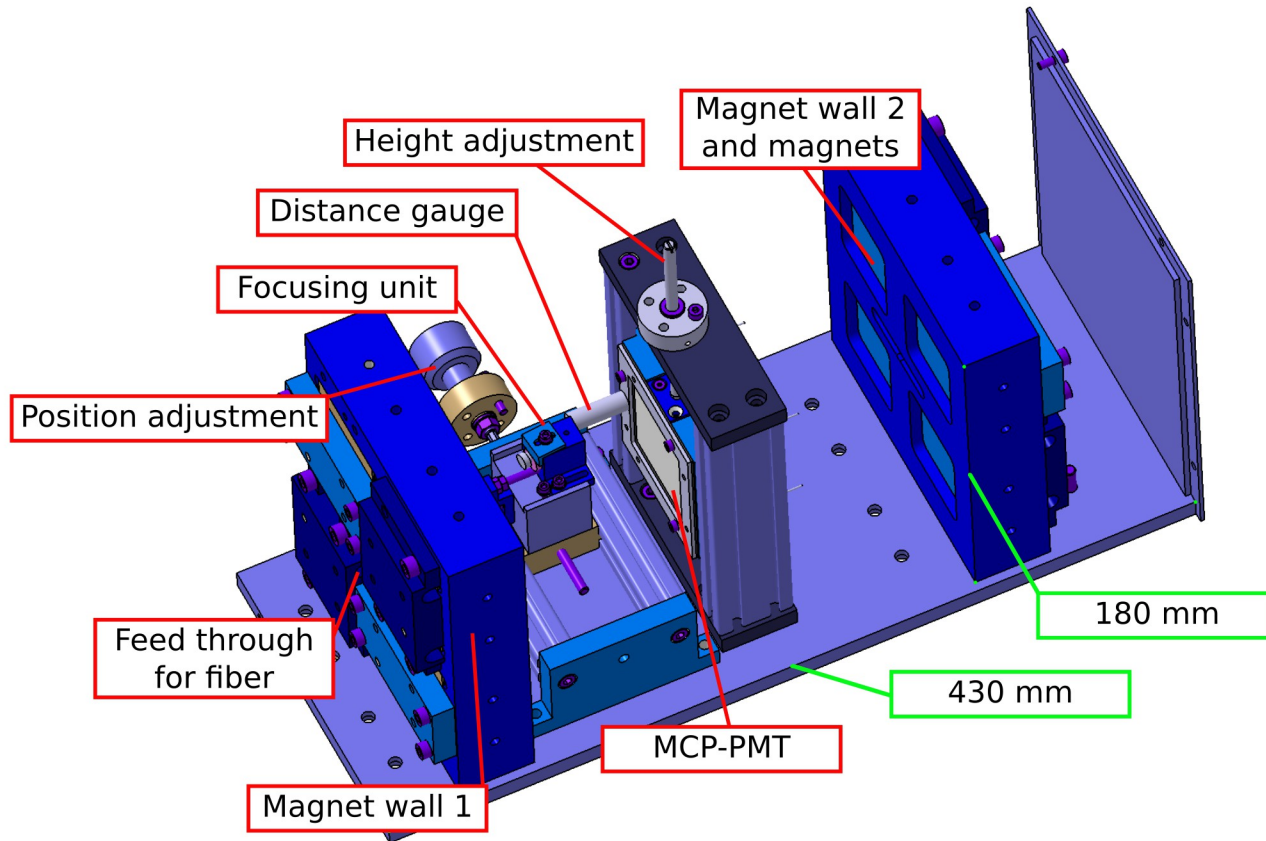


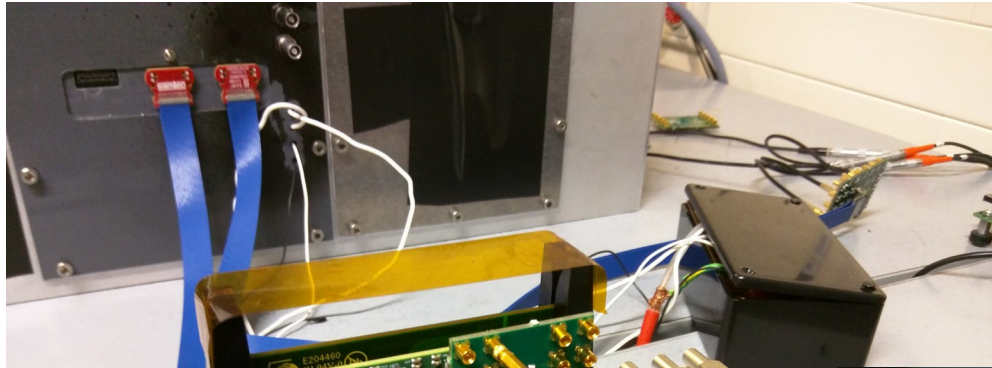
- Flex cables used at CERN Testbeam
- Nothing connected, noise picked up by the unshielded cables
- 8 mV swing at 50 Ohms input resistance is too much. It cuts right into the pulse height spectrum of the MCP-PMT (as you will see on the next slides)



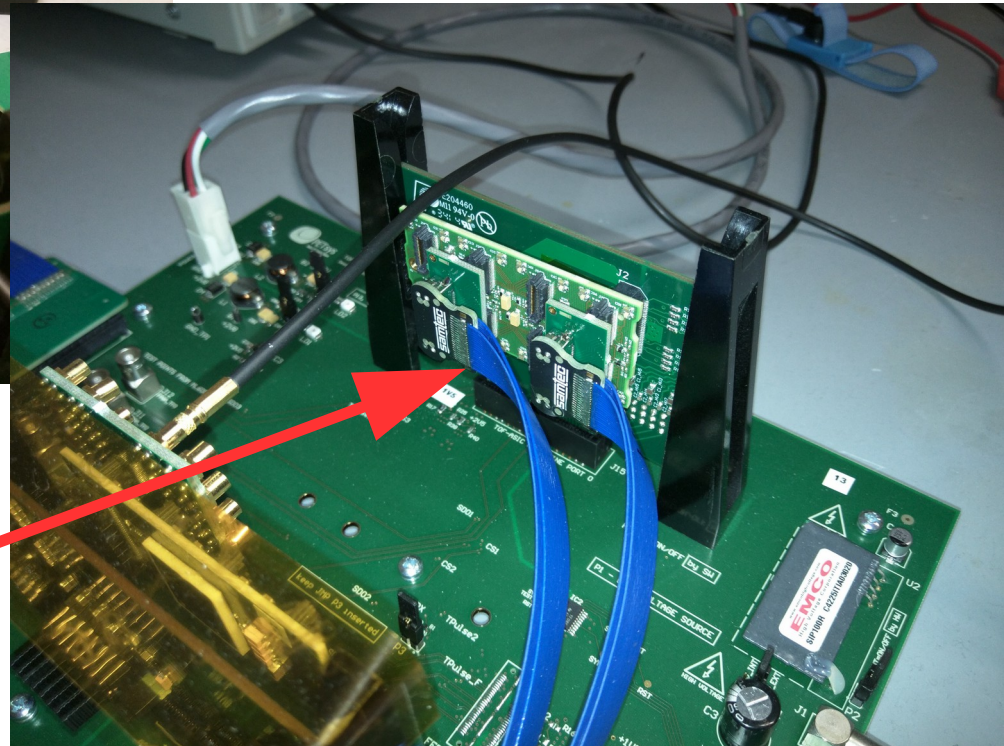
- Full signal chain of the new shielded cables with 6 mV pulses injected.
- One pulse goes into the scope directly through a short LEMO cable (lower trace)
- The other pulse goes through 3 PCBs and 2 SAMTEC cables
- Some attenuation but very fine signal fidelity







The ASICs have to be calibrated with the HV turned off but all the cabling already connected.



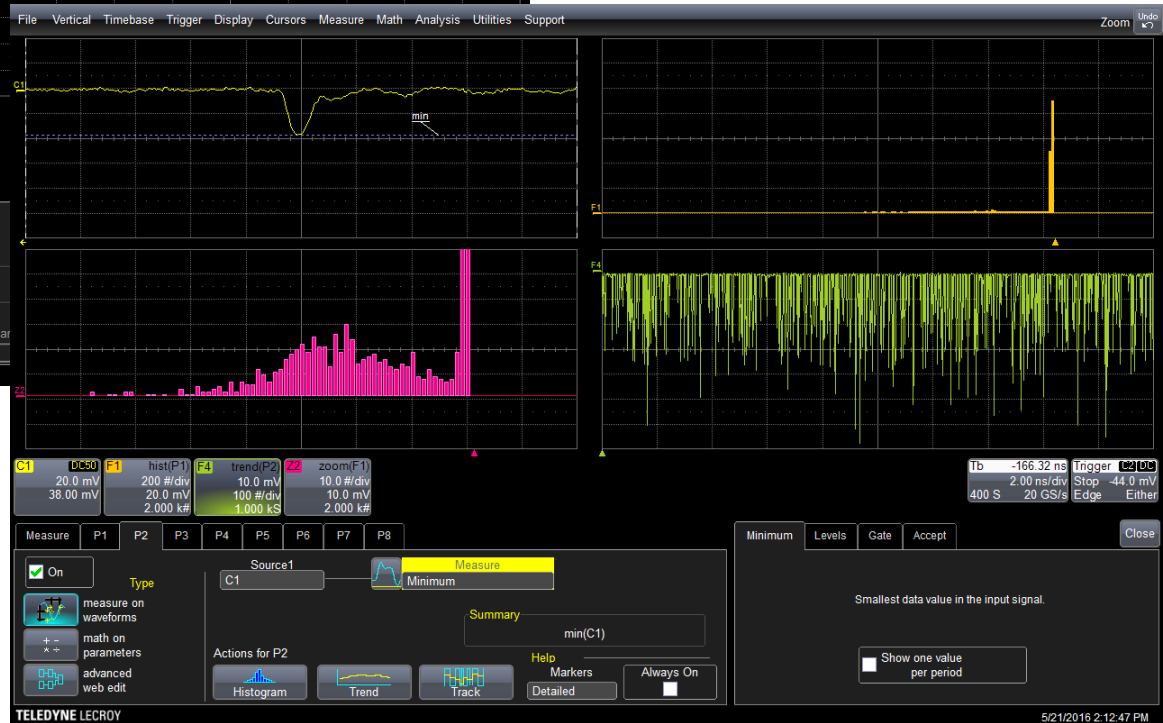
Shaped, capacitively coupled "trigger pulse"

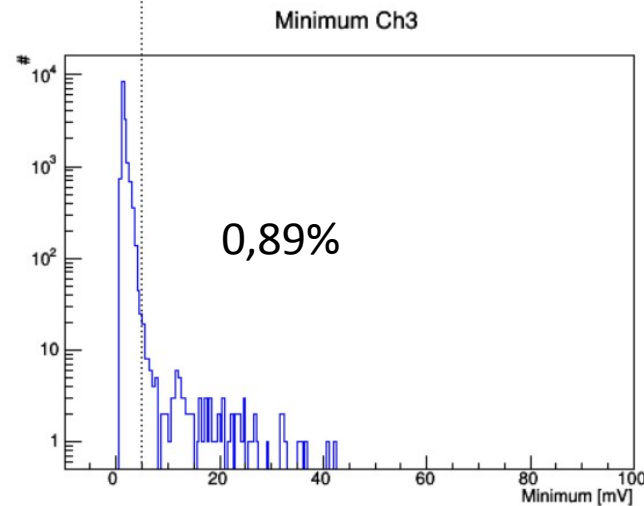
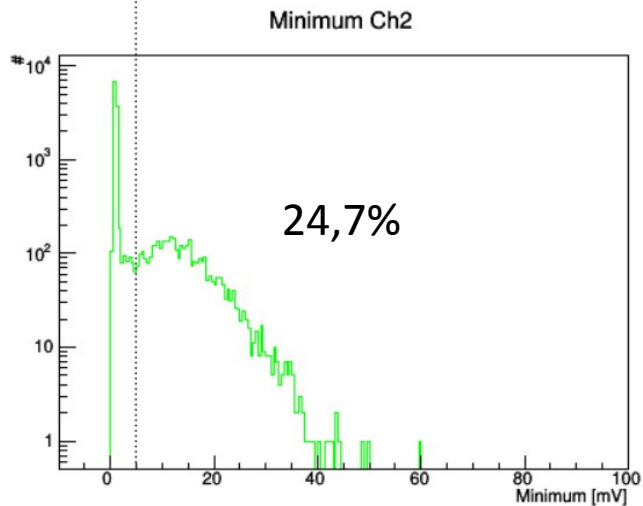
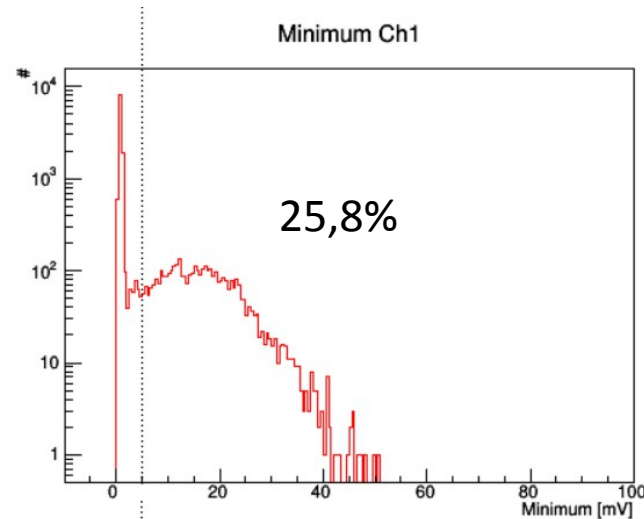
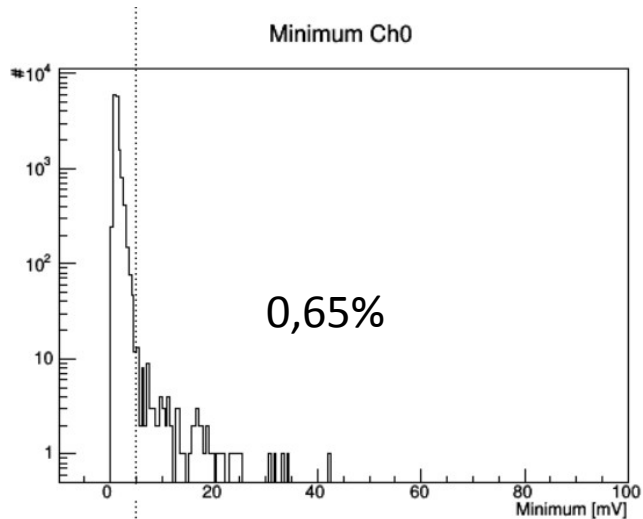
Signal line from the MCP PMT



- Finding the position where the laser is centered above one anode

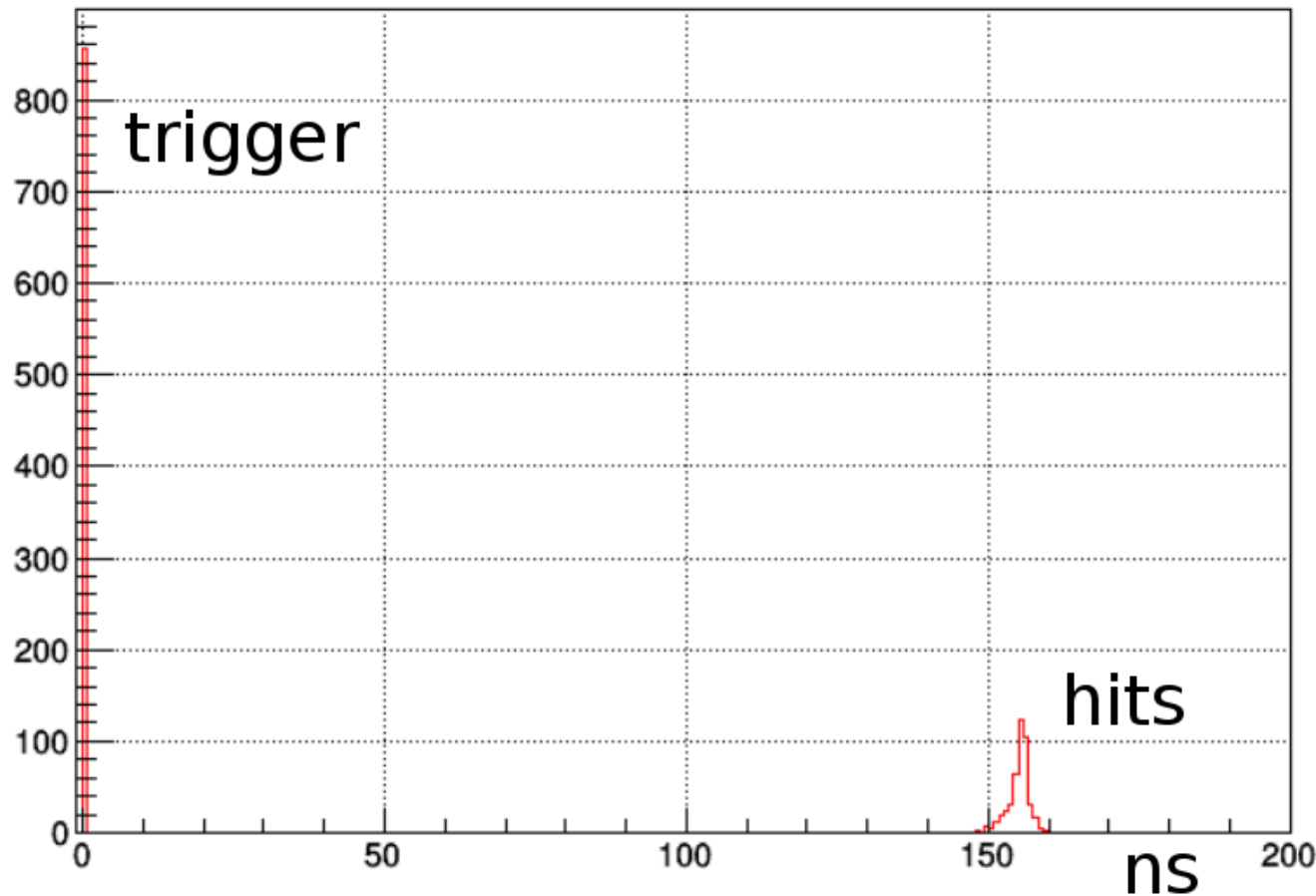
- Tune the laser intensity down to single photon





- Record 15k pulses at low intensity and record pulse height spectrum of four neighboring anodes with scope
- Count pulses above 5 mV and divide by total number of pulses → photon rate
- How much will the ASIC see?**

Counts

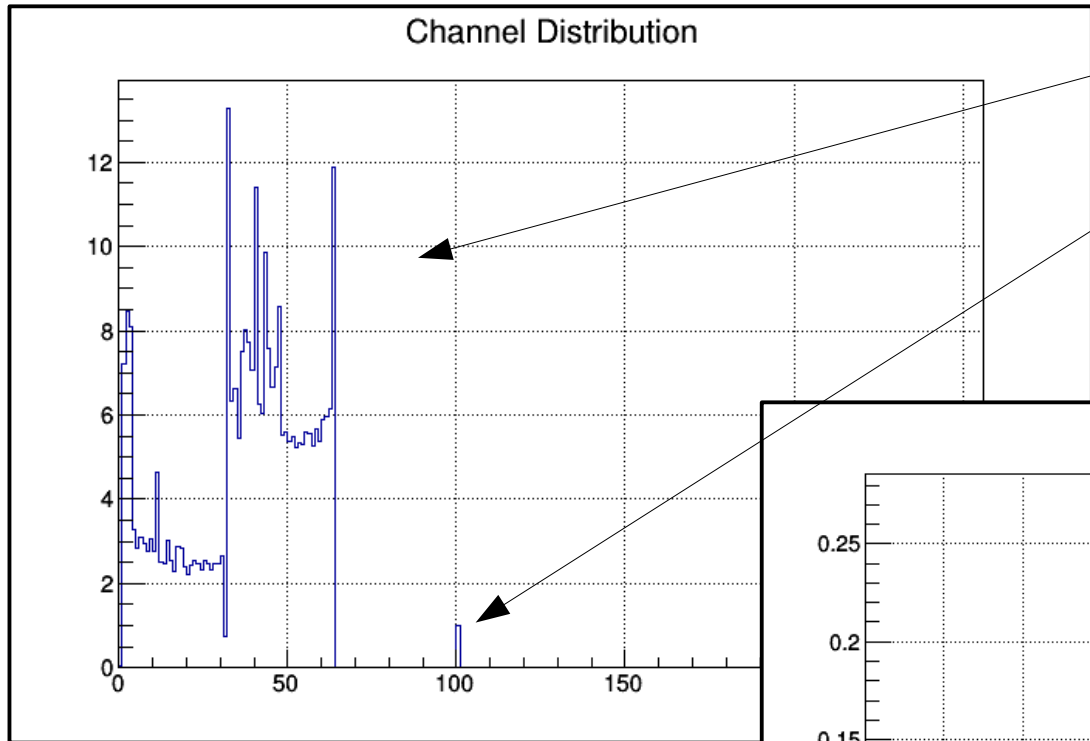


Took 10 seconds at
100 Hz laser rate, free
running
(expecting 1k events)

**Global inefficiency of
<15% in detecting the
trigger pulses**

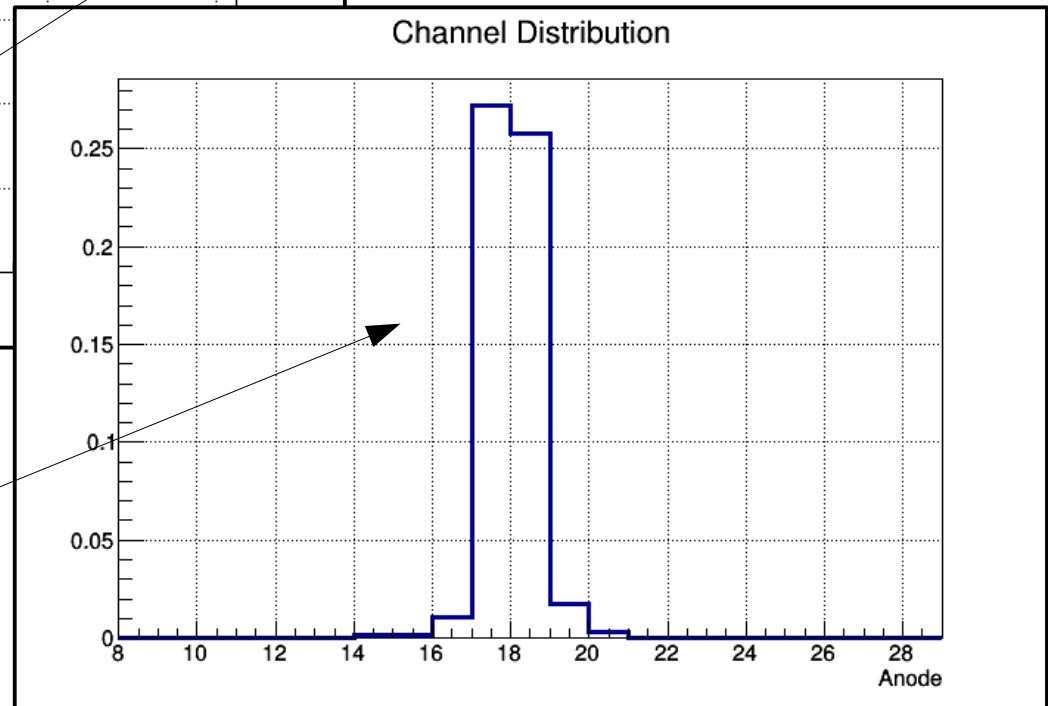
**The trigger pulses are
identical! They
should be detected
always or never, but
not sometimes**

It looks like the ASIC is
blind at certain points
in his clock cycle



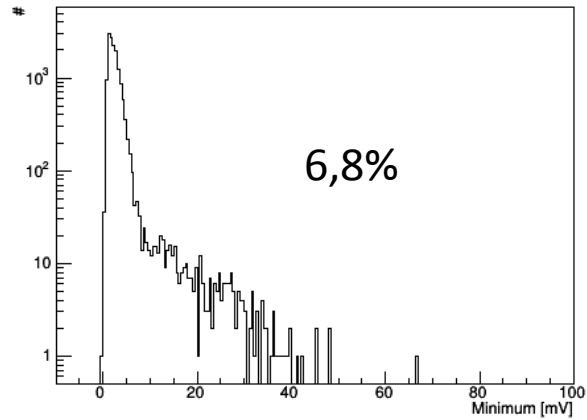
No time cuts applied → Dark Counts dominate

Trigger

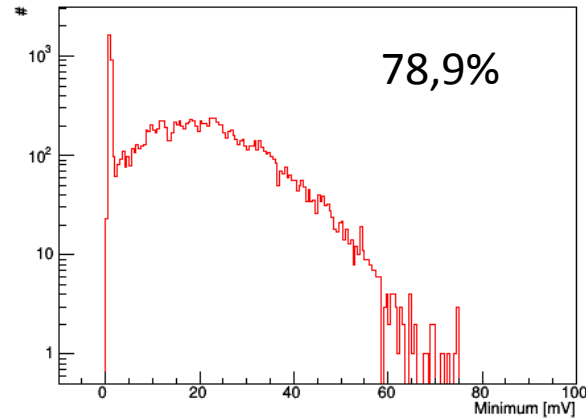


Apply time cuts → Only four channels survive and rates agree very well with scope measurement!

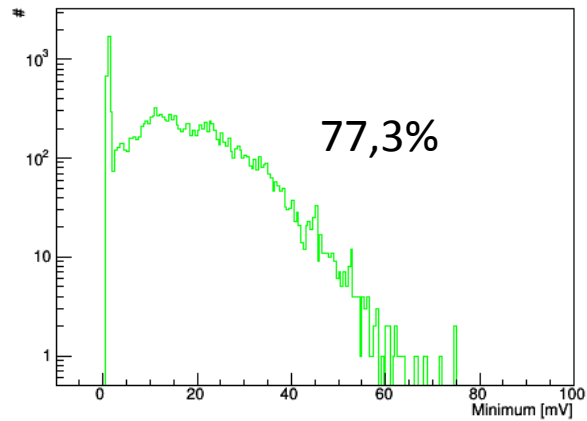
Minimum Ch0



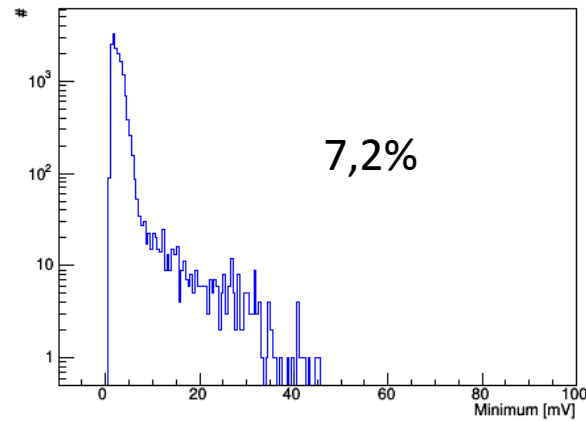
Minimum Ch1



Minimum Ch2



Minimum Ch3



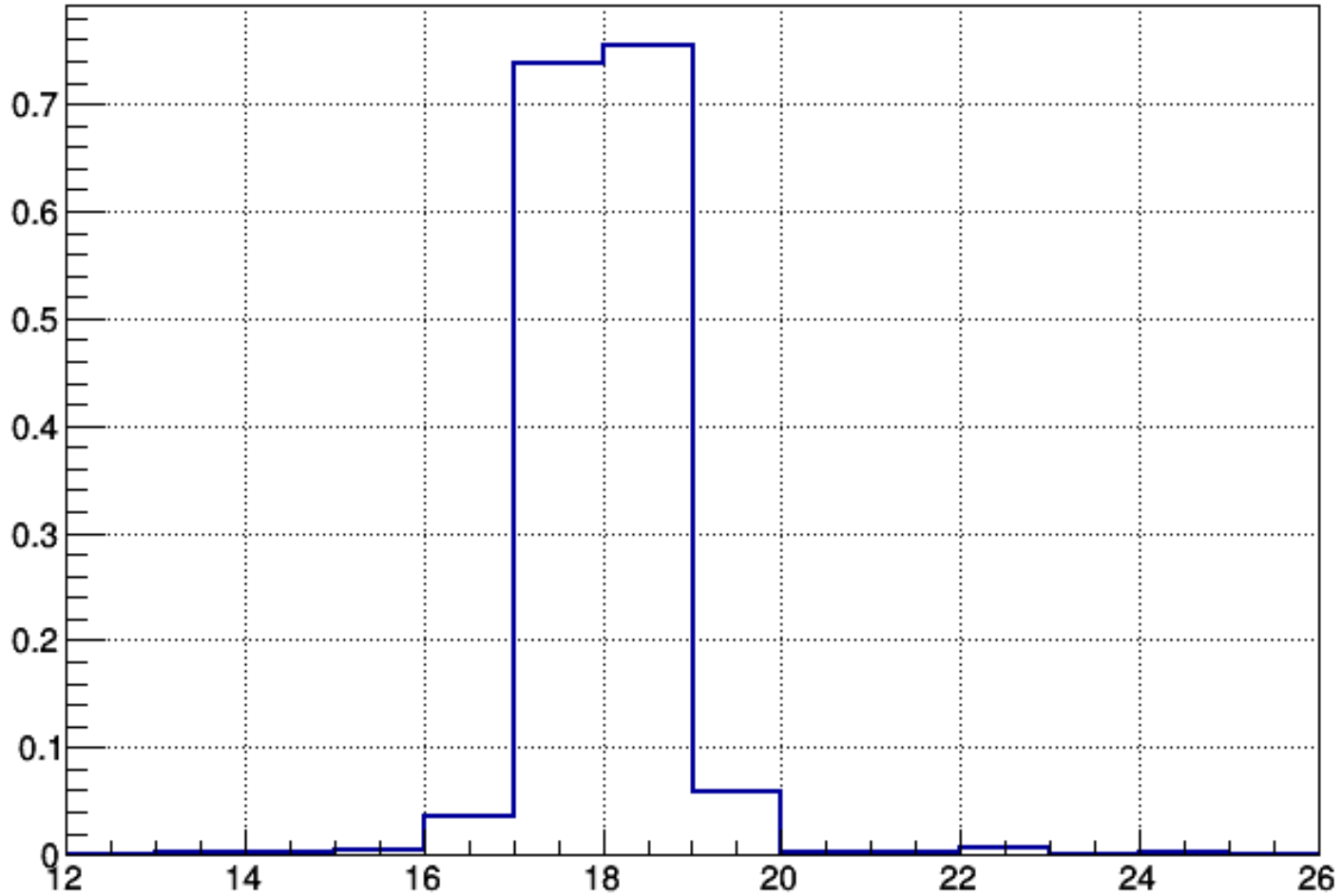
Cross check with more photons/pulse:

Let's crank up the laser!

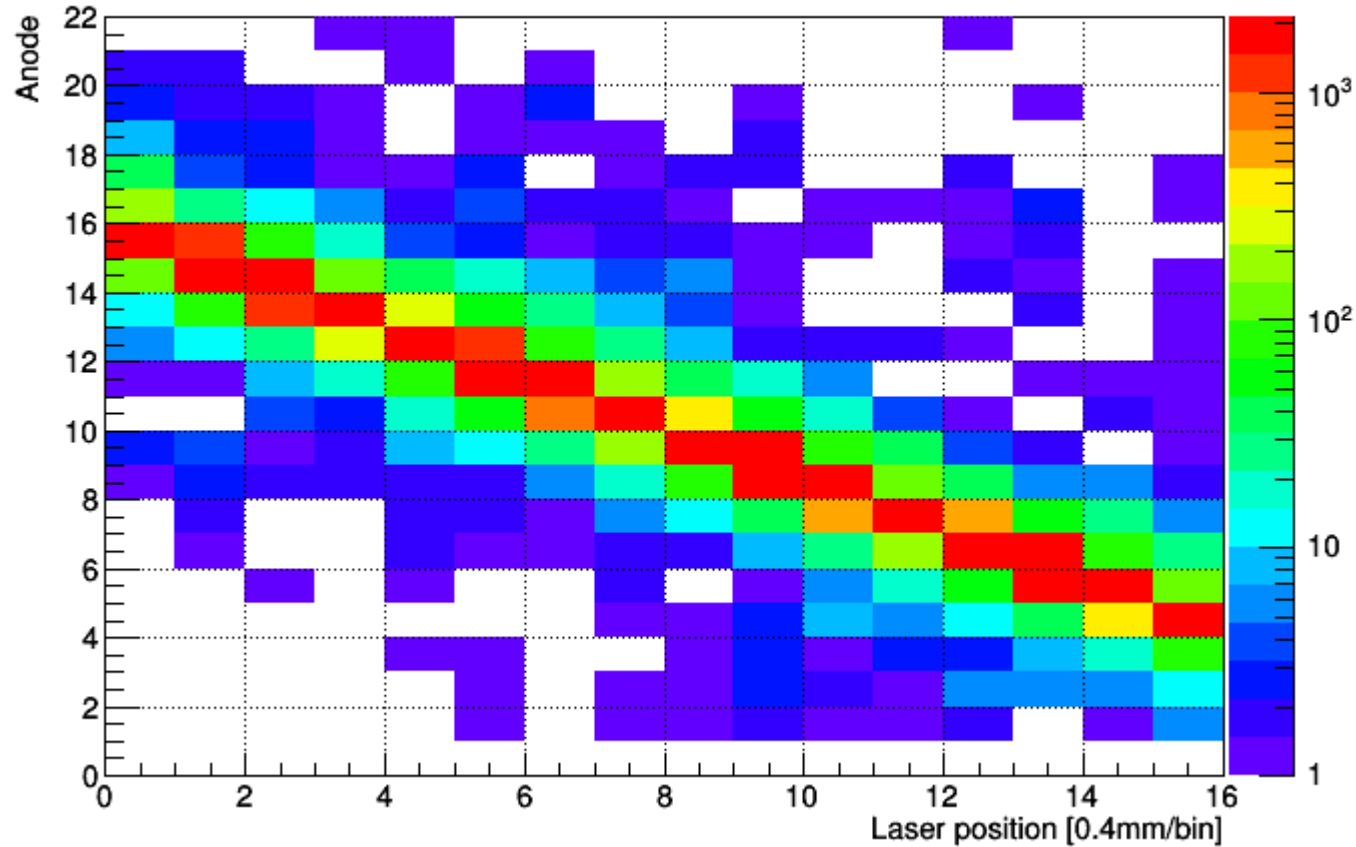


Channel Distribution

Again, nice agreement



Efficiency seems alright, let's move the laser!



- ASIC readout works now
- Global detection efficiency somewhat reduced
 - Counting relative to triggered events in nice agreement with expectations from scope measurements
 - Position resolution will be further analysed
 - Hamamatsu sensor will be evaluated
 - Stronger magnetic fields (1T)

THANK YOU