# Status of CEDARs

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# Current Status

- All photomultipliers exchanged to new ones
  - Currently using Hamamatsu R11265U-204 with ultra-bialkali photocathode (4-channel PMT)
  - PMTs were moved approx. 130 mm back from focal point to increase light spot on the photocathode
  - All PMTs are equipped with active bases to allow for high rate while maintaining reasonable power consumption
  - All signals transmitted in differential mode to minimize interference pickup
  - All PMT assemblies equipped with fiber inputs to allow for monitoring of PMT gain (off-spill)
  - Tests at WUT showed that the PMT+base can easily withstand rates up to 40 MHz at 10 photoelectron pulses (rate limit of laser at WUT). On average we expect approx. 4 photo-electrons per particle.
- Thermal system working perfectly
  - Some noise from chiller visible in signals going to CERN electronics – solved by adding amplifiers before long sections of the cables coming from the hall.

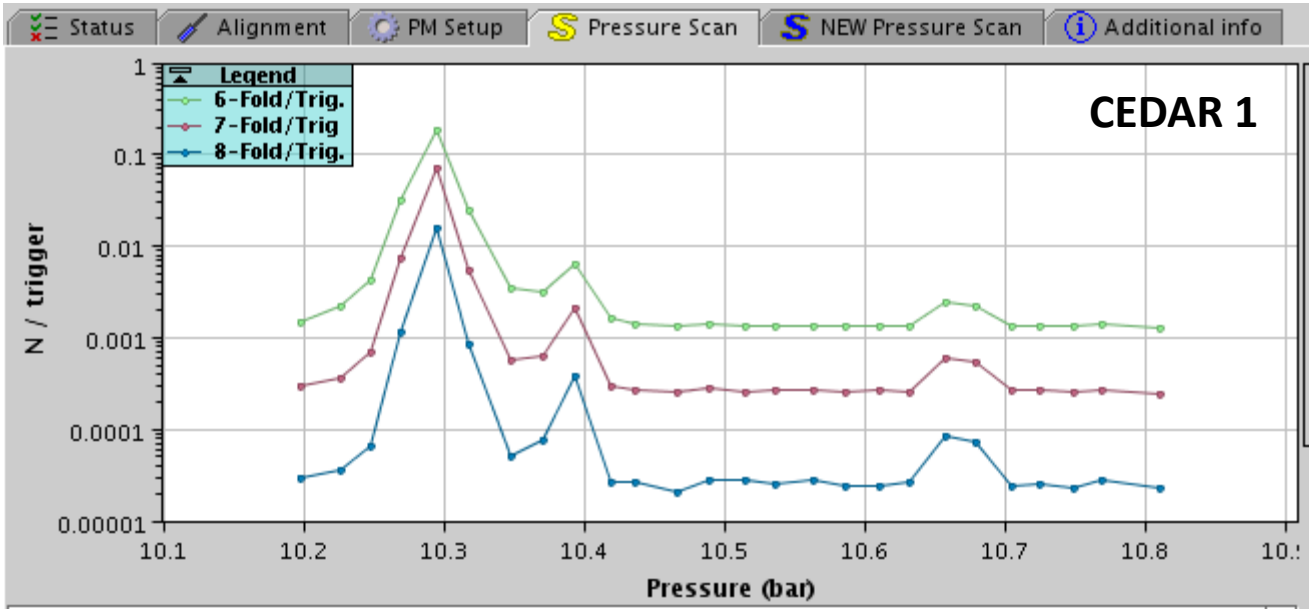
# Current Status

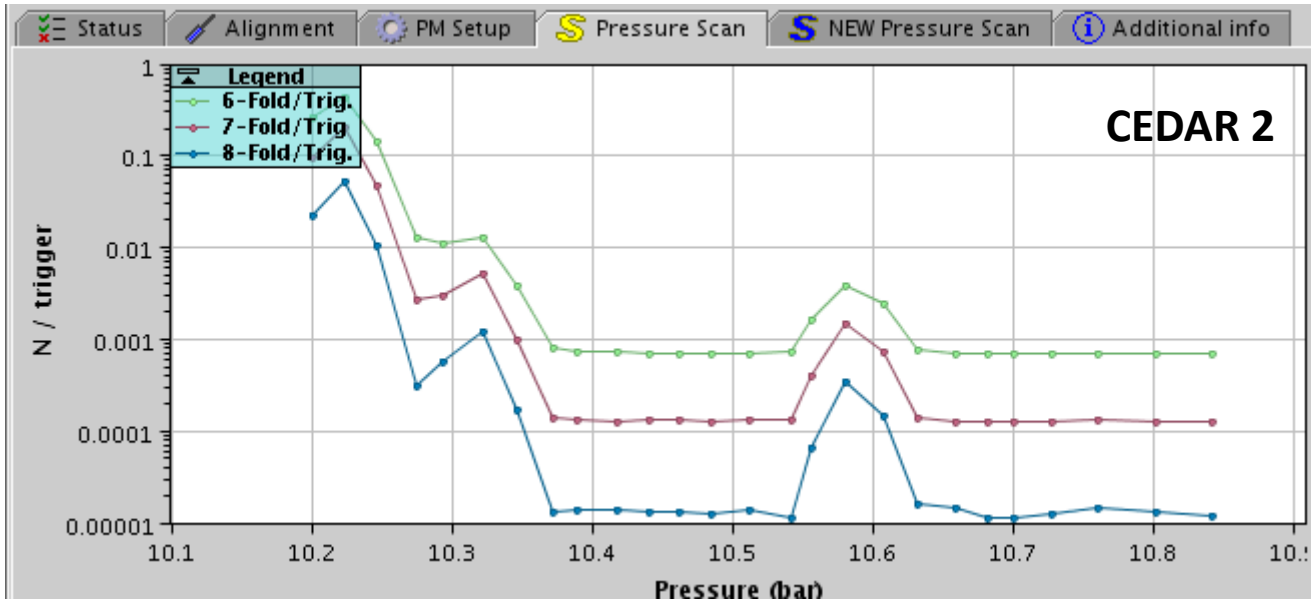
- New readout electronics
  - New FPGA-based TDCs
    - Two types – a ‘fast’ TDC for particle tagging, ‘normal’ TDC for gain monitoring using multiple Time-over-Threshold technique (4 thresholds)
  - New fast discriminators
    - Outputs for CERN electronics and new TDCs
    - Control via MODBUS RTU
  - COMPASS readout not fully functional yet (?) – some problem with rate capacity
- Gain monitoring
  - Signal from flasher split into multiple fibers going to PMT assemblies
  - Photodiode for normalization of each pulse
  - Not yet implemented due to ‘accident’ during installation – board was burned by unfortunate short of supply voltage
  - Student is working on a fix

# Current Status

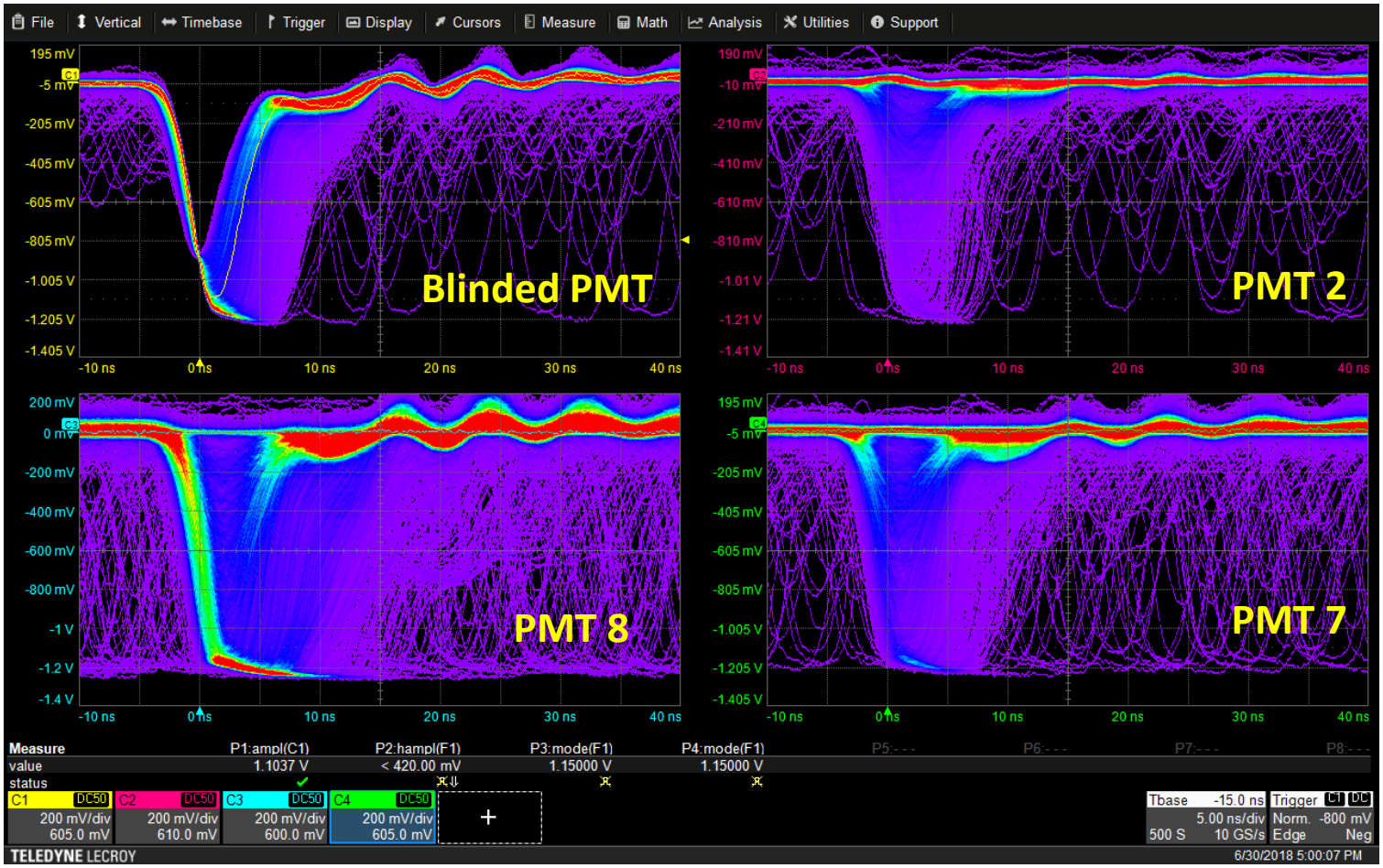
- PMT voltage equalized
- CEDARs aligned
- Pressure scans were made using CERN electronics, we clearly see peaks from pions, kaons and anti-protons
  - Somehow low efficiency – could be due to relatively high thresholds.
  - We will investigate further once we have COMPASS readout working. Tests at WUT showed that with new electronics we can trigger even on single photoelectron pulses (recommended threshold from simulation is 0.8 p.e.)
- We see large (over 10 p.e., in some cases over 100 p.e.) pulses coincident between PMTs that are not originating from within the detector
  - Pulses are not coincident with trigger from scintillators
  - Suspect Cherenkov light from particles passing through the PMT glass bulb
  - Must be secondary particles produced by something upstream of the CEDARs. Confirmed by fully closing the diaphragm and replacing one PMT assembly with an assembly with blinded PMT – we still saw signal coincident with other PMTs
  - This is a problem, as this phenomenon significantly increases current load of PMTs – for CEDAR 1 we need to run two top PMTs roughly 60% above manufacturer specified limit.

# Pressure Scans (LD = 0.34 mm)



# Unexpected Coincident Signals




- Blinded PMT on top of PMT 1 and PMT 8;
- Trigger on blinded PMT, at roughly 10 p.e.; LD closed; P = 10.9 bar
- Signal is absent without the beam
- Rate over 20 p.e. is over 60 kHz with high intensity beam; measured with scope, so it could be higher due to limits of trigger frequency of the scope

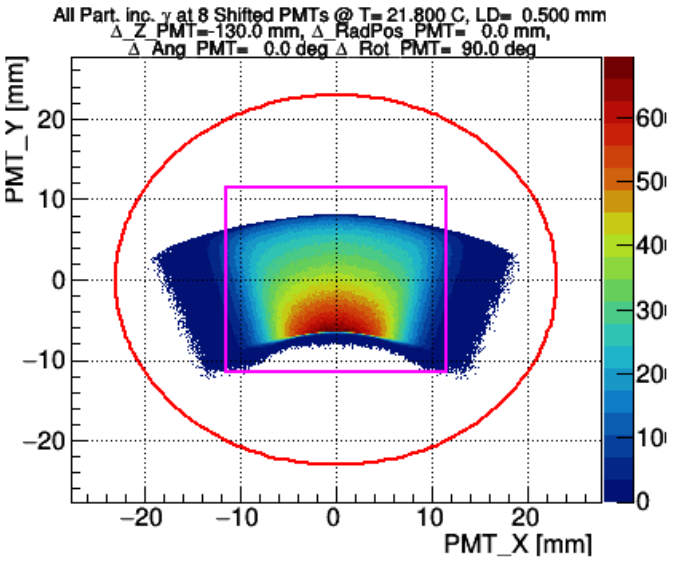
# Recent Updates (July – August)

- New Monte-Carlo results from Flavio
- Vladimir prepared monitorin tool that reads data from CEDARs
- Robert prepared script for threshold scan using COMPASS DAQ
  - Threshold scan has been done and we now have settings that are just above the noise of the discriminator
  - Failed to run at these settings, as there was no signal registered at ‘tagging’ TDC. Potential reasons:
    - Firmware issue (known problem, ongoing work)
    - Hardware failure at the base (ongoing investigation)

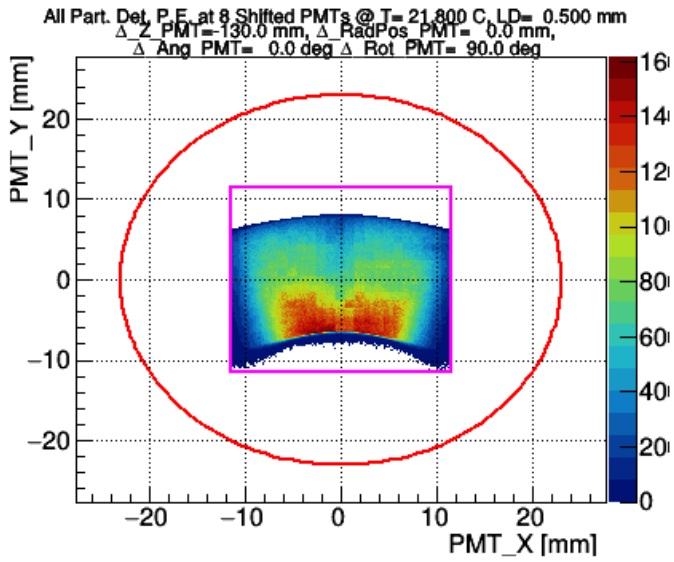
# Monte Carlo Predictions

- New results from Monte-Carlo by Flavio
- If the PMT is hit during an event, then average number of PMT pads that get the hit is two
- Average number of photons that hit photocathode (pressure set to kaon) is approx. 6, which gives on average two photoelectrons
  - Recommended threshold is 0.8 p.e.

**Incident photons**



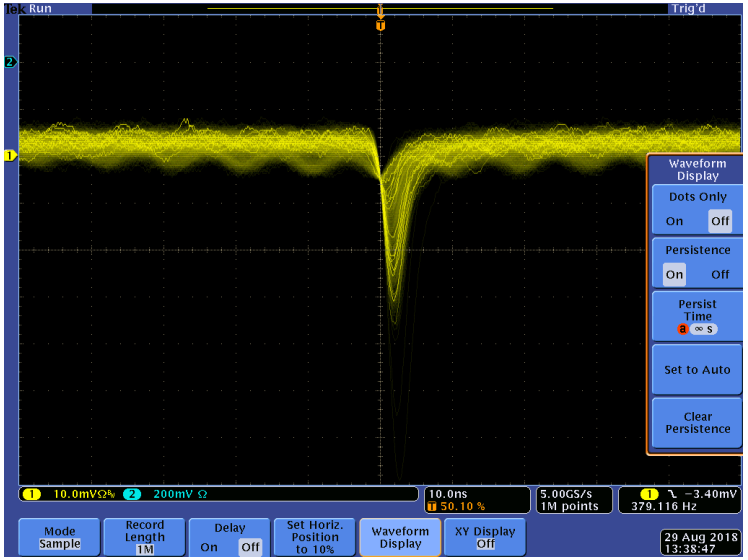

**Registered photoelectrons**



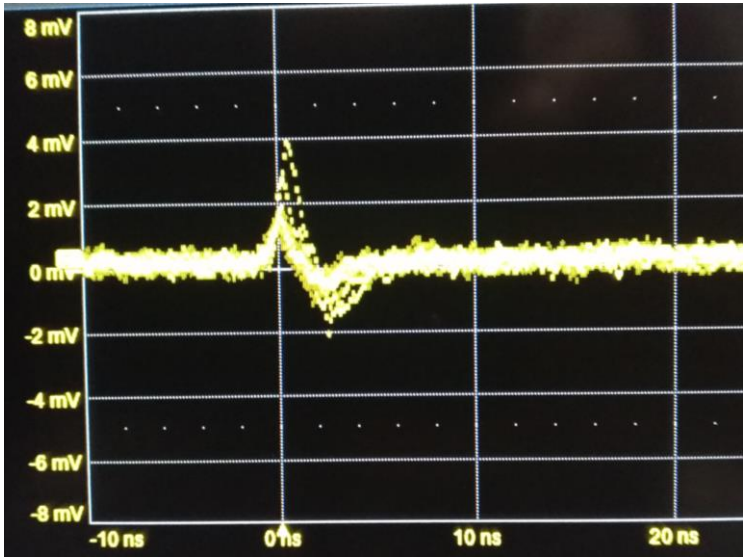
# Signals from the Base

- We did quick check of signals at the output of the base
- Noticed wrong shape and way too low amplitude
- Not clear yet if this was an error made during measurement or an actual problem
  - Probe verified to be OK
- Conflicting information
  - Bad signals seen by Janusz Marzec using scope and differential probe
  - Good signals seen by Moritz at the sum outputs (?)
  - Working on this issue now
- We are sure this is not active divider failure, as we checked that a failed HV transistor kill signal from whole PMT
  - Suspect potential damage to amplifiers

Signal from test base and PMT




Signal seen during last MD



# Trending Plots