MCP-PMT measurements in JLO lab

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Outline

Introduction – TOF at JLO

Lab equipment

Measurements

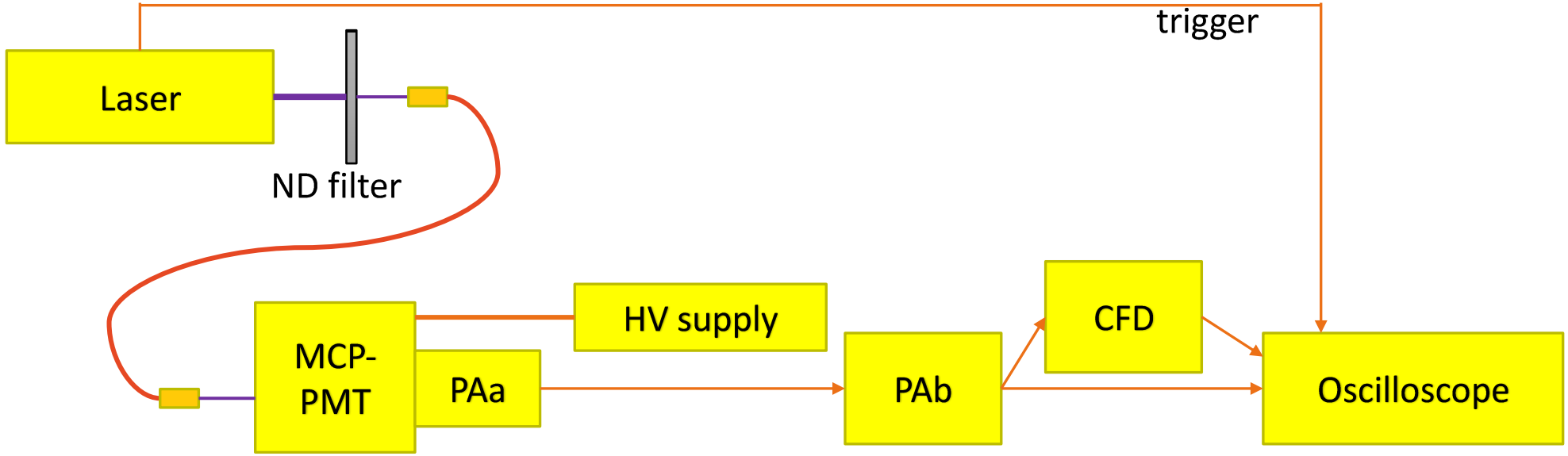
Outlook and summary

TOF at JLO

MCP-PMT measurement using laser – time transit spread (TTS), crosstalk

Electronics optimization – higher gain amplifiers for TTS measurement

Development and simulation of optical TOF part, simulation of MCP-PMT and electronics response



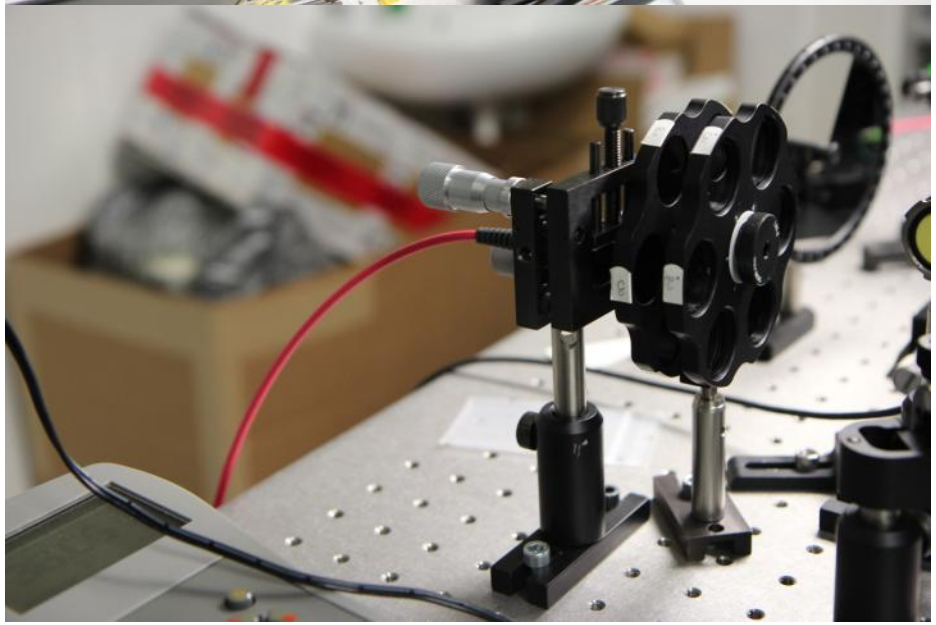
Lab equipment – light source

Laser – Coherent Mira 900

- 840 nm, 420 nm (2nd harmonic), 280 nm (3rd harmonic)
- 50 kHz repetition rate, ~50 fs pulse

Set of neutral density filters to obtain very low intensity signal

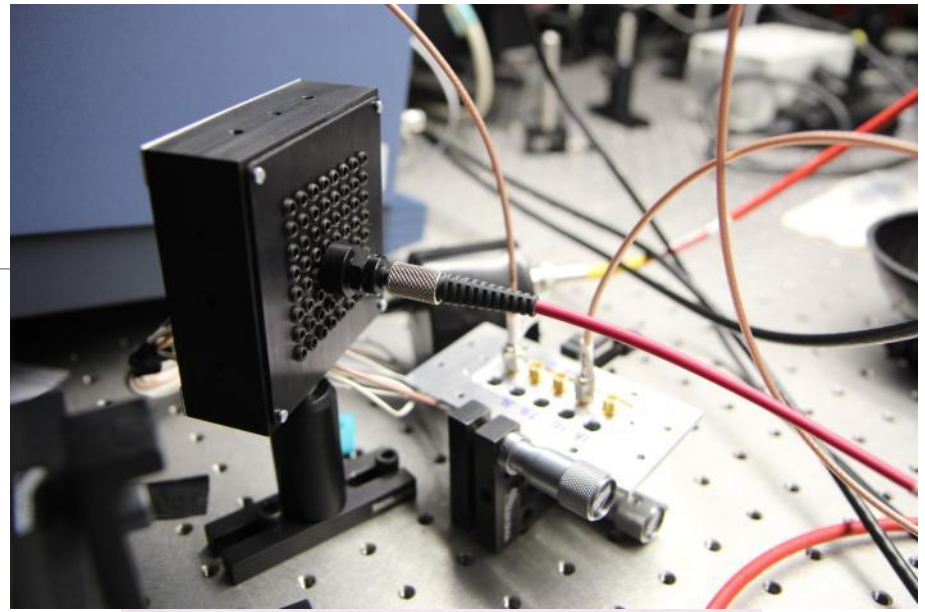
UV optical fiber (200-800 nm)

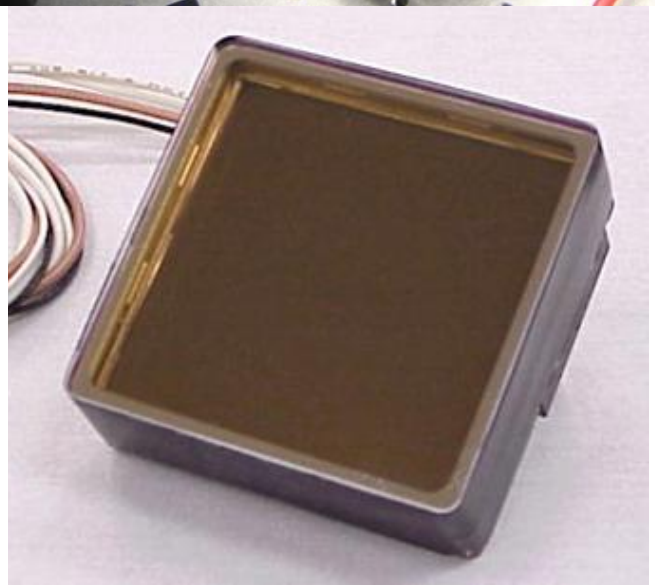


MCP-PMT

Photonis Planacon XP85112

- dual chevron MCP, 10 µm pores, L:D 60:1
- 8x8 array anode, pixel size 5.9x5.9 mm
- Rise time ~0.5 ns, pulse width ~0.7 ns
- TTS ~35-60 ps





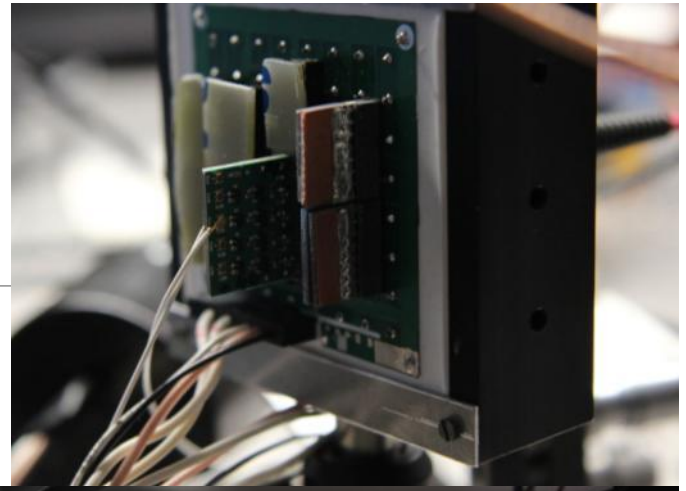
Lab equipment – electronics

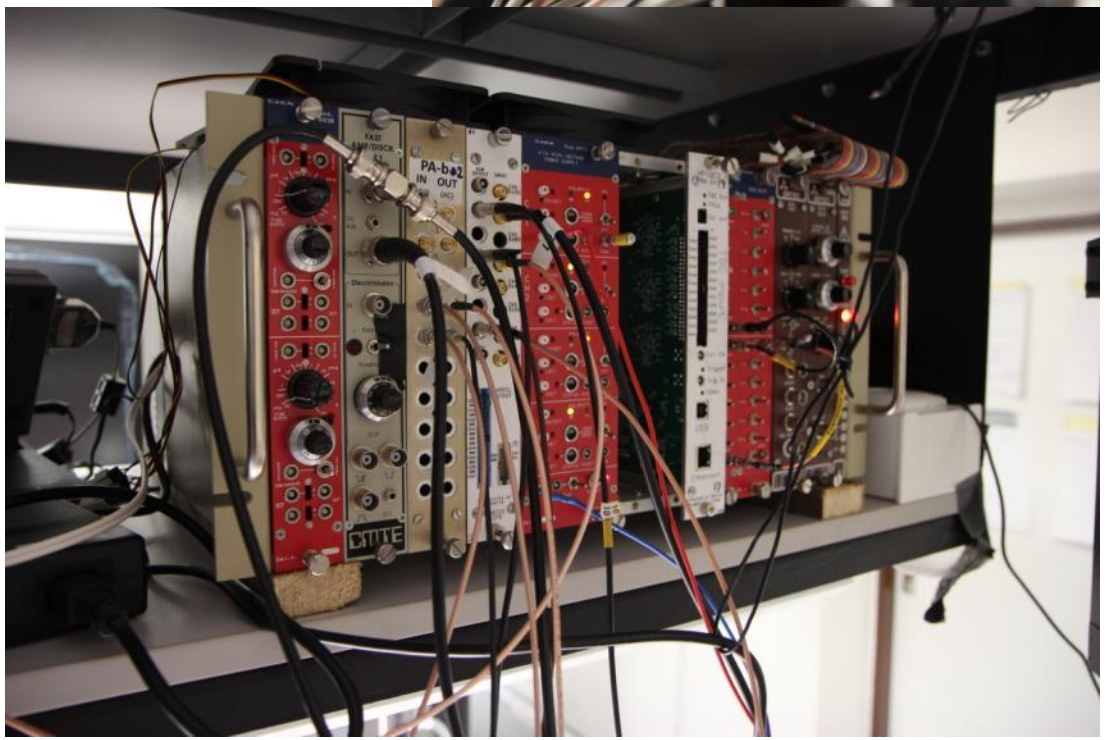
Two stage amplifier – Stony Brook design, total amplification ~40 dB

CFD – University of Alberta

HV supply – CAEN N472 (0-6 kV, 1 mA, 4 ch)

Oscilloscope – LeCroy WavePro 7200A (2 GHz, 20 GS/s)





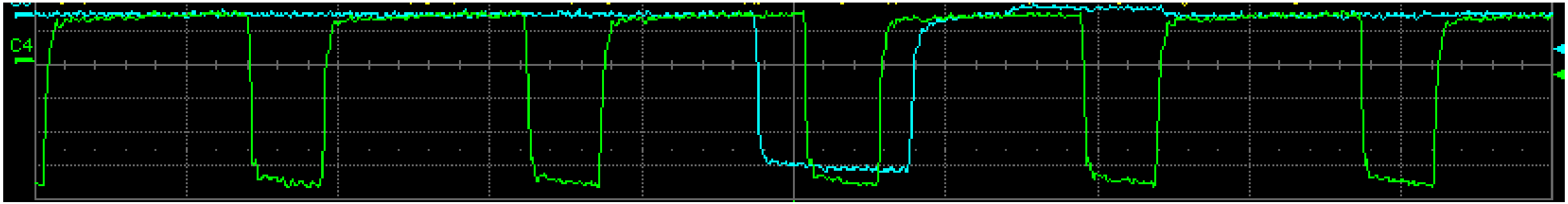
Trigger setup

Laser trigger output – jitter ~20 ps

Output of PIN diode available – stable 50 MHz signal, laser fires on each 1000th pulse

Using combined trigger – arming on laser trigger and triggering on the first following PIN signal

Jitter < 9 ps



Measurements

Time Transit Spread

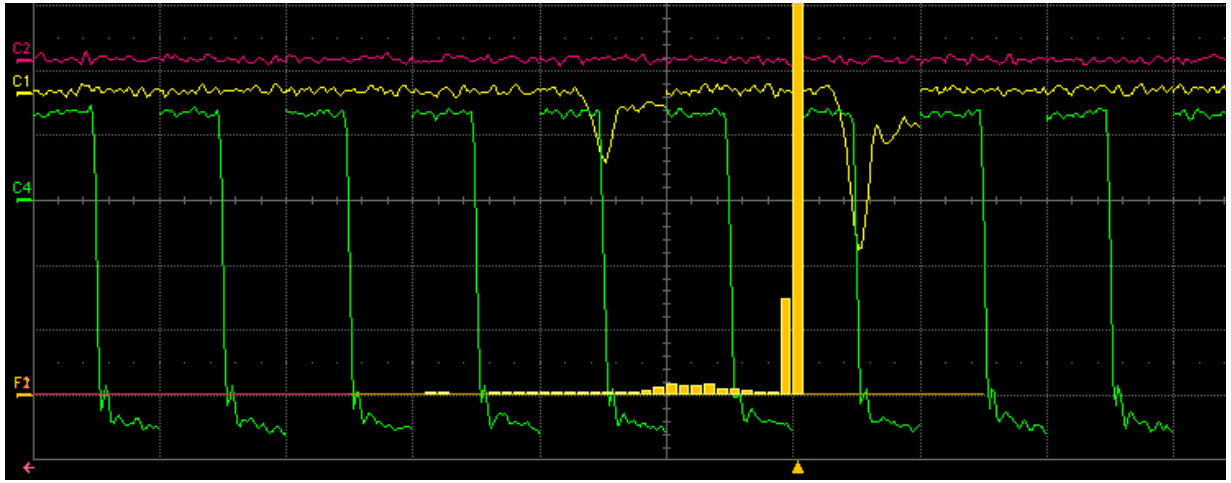
Crosstalk

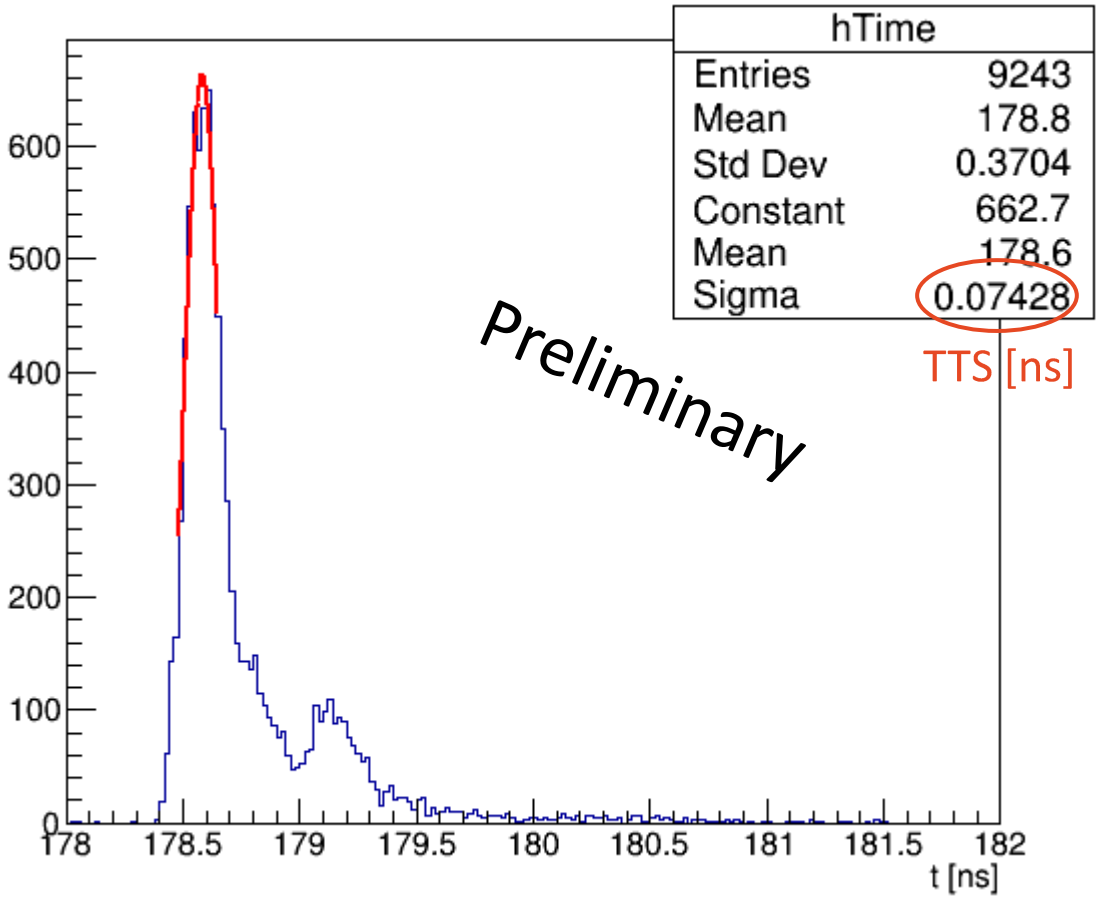
Load influence on PMT signal

TOF at JLO – Time Transit Spread

Low intensity (single photon) laser signal shined on the center of a MCP-PMT pixel

Measured spread in time of pulse arival compared to trigger



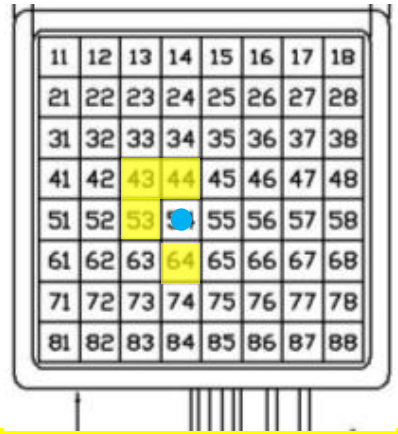


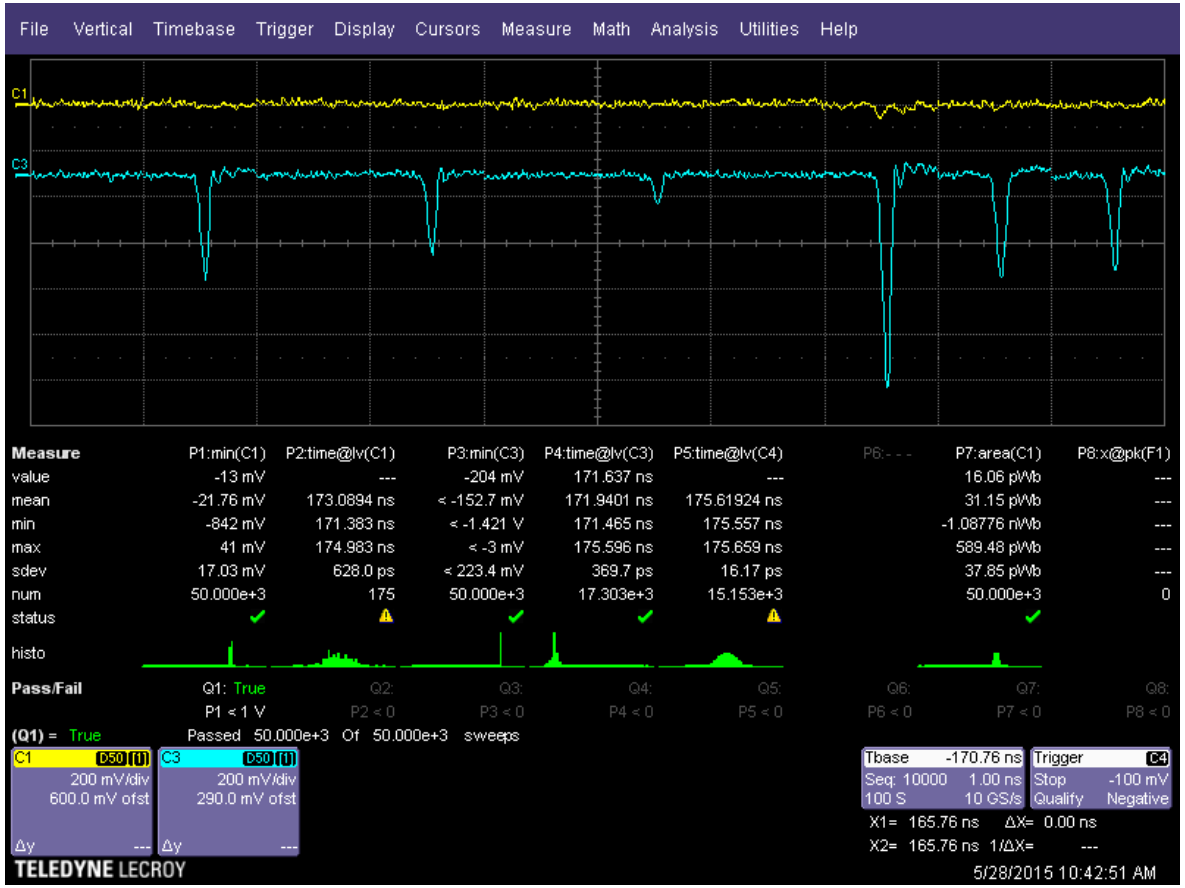
TOF at JLO – Cross talk

Laser directed at one channel, measuring response in neighboring channels

Current setup illuminates only central part of a MCP-PMT pixel – low cross talk

To characterize MCP-PMT better, we need to scan over the sensitive area using programmable moving table – in preparation





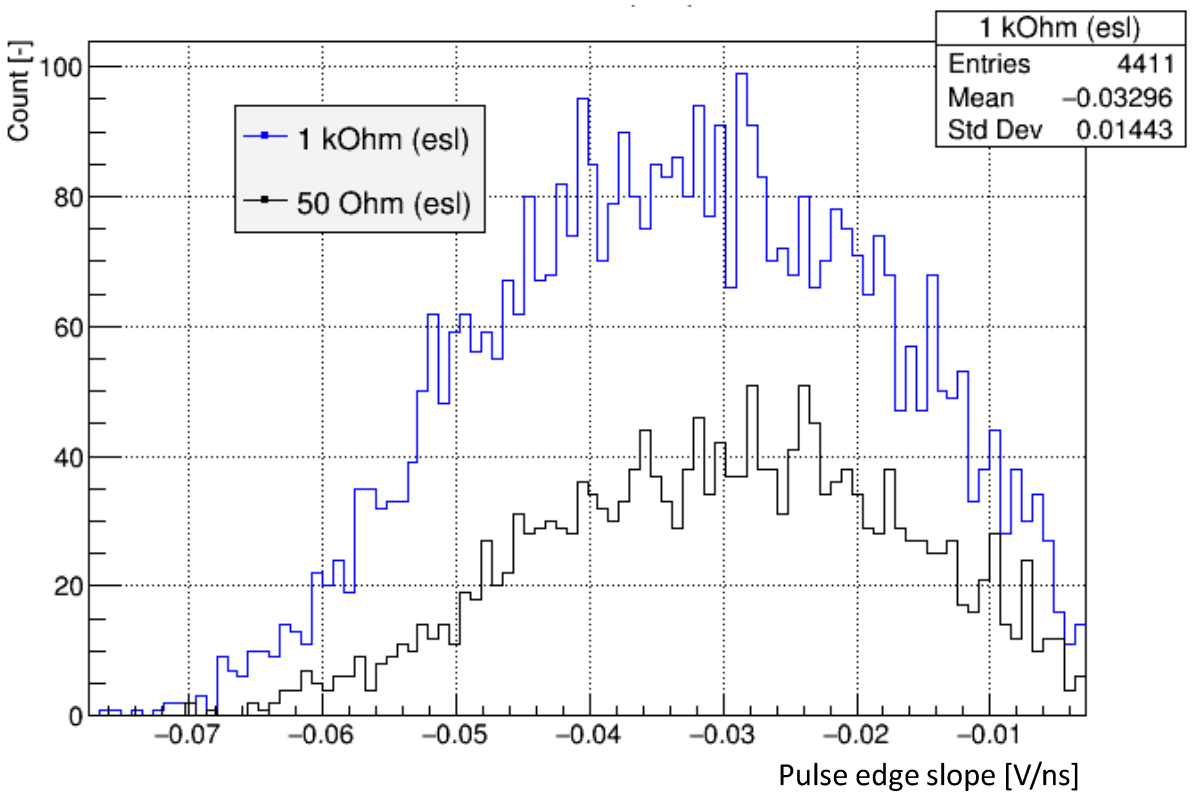
Load influence on PMT signal

MCP-PMT output connected through variable load to oscilloscope

Shape of the pulse analysed

Measured with 50 Ω and 1 kΩ load

1 kΩ leads to higher (~20%) and wider (3x) pulse



Outlook

TTS – higher gain amplifier under construction

Wavelength dependence – measurements on 280 nm and 420 nm, possible tuning for other wavelenghts

Crosstalk – linear/XY stage measurement

Photon counting – avalanche diodes

HPTDC for DAQ

Measurements of optical part for TOF Cerenkov detector

Summary

We have setup a test bench for MCP-PMTs

TTS and crosstalk (row/column scan in preparation) measurements possible

Measurements on shorter wavelengths (down to 280 nm) to follow

Thank you for your attention

We thank Andrew Brandt and Michael Rijssenbeek for their support

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