Status of Photon Detection System in ProtoDUNE-DP and First Light Data

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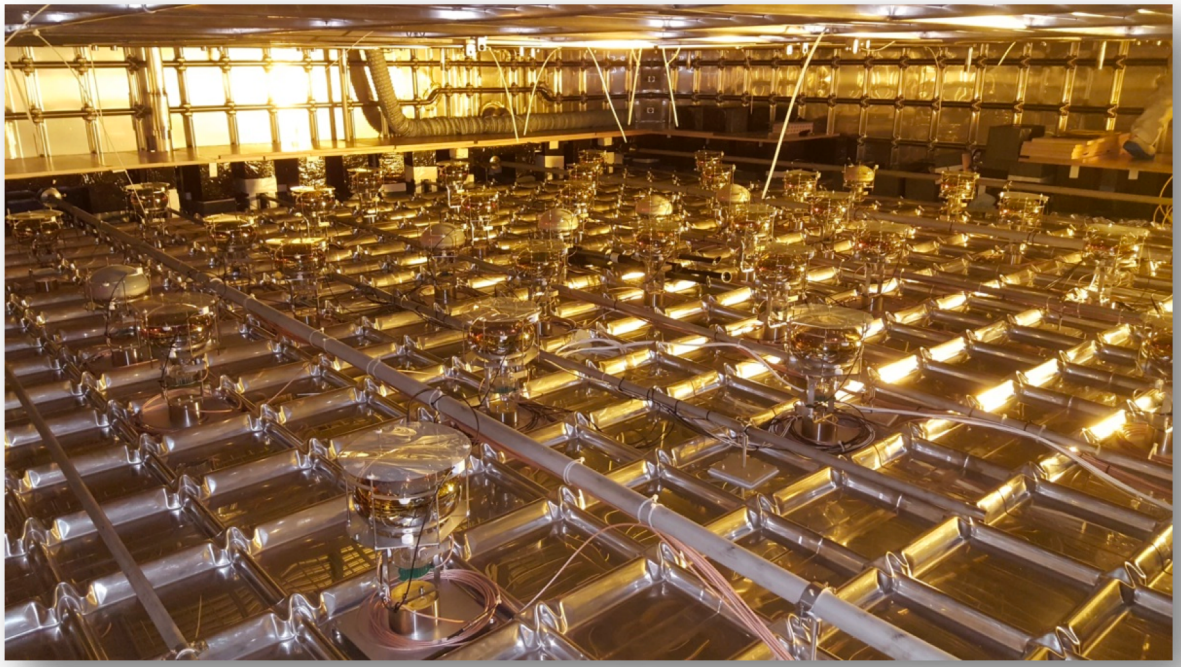
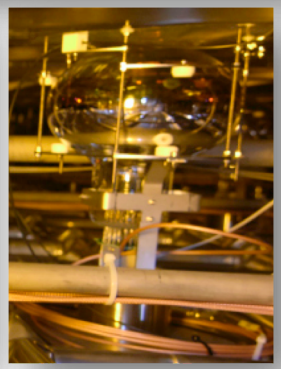
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

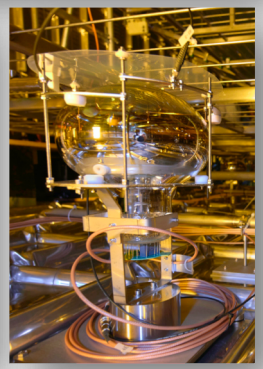
EXCELENCIA MARÍA DE MAEZTU

DUNE

Photon Detection System (PDS)







- ✓ **36** 8" cryogenic **photomultipliers** (PMTs) fully characterized *JINST 13 (2018) T10006*
- ✓ **Wavelength-shifter**: PEN / TPB coating on PMT
- ✓ **Voltage divider base** + single HV-signal cable + splitter (external)
- ✓ **Light calibration system**: LED & fiber based *JINST 14 (2019) T04001*
- ✓ DAQ system (external)

ProtoDUNE-DP Status

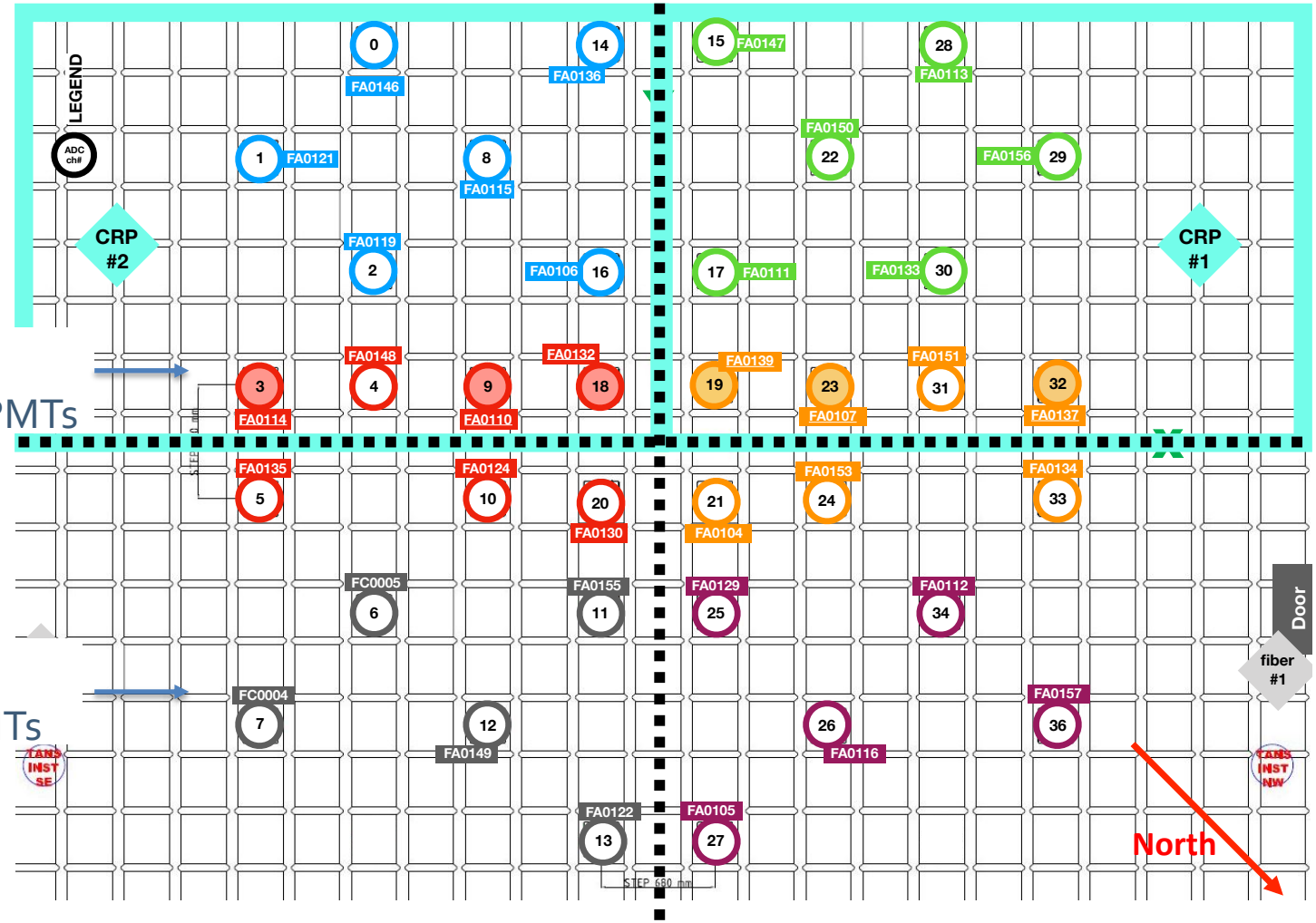
LAr filling on-going

- From July 5 to August 5
- PMTs covered by LAr on July 8
- 4.7 m of LAr on July 30
- Constant monitoring
- No issues so far

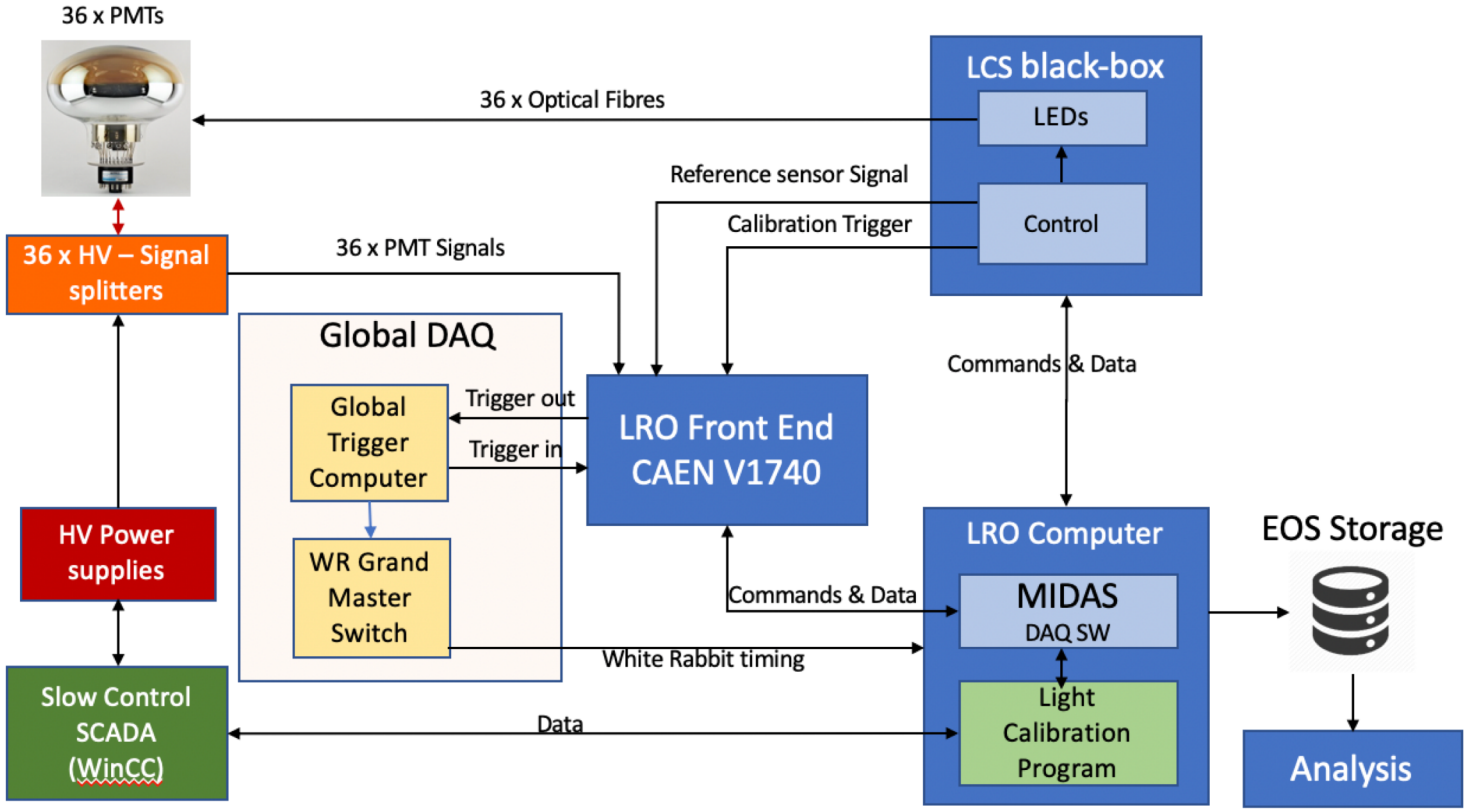
PDS Layout

6x TPB coated PMTs

30x PEN sheet PMTs



Light DAQ



The LRO computer runs MIDAS SW as interface for control and data read-out from the V1740 ADC. It performs the control and data acquisition for PMTs calibration and light signals acquisition.

Light DAQ

HV Splitters

Power supply and ADC

Status:

- Calibration running.
- Acquisition with random trigger working
- Working on the PMT trigger mode: coincidence of selectable PMTs signals over a threshold.
- Working on communication with the slow control for controlling the power supply.

Next steps:

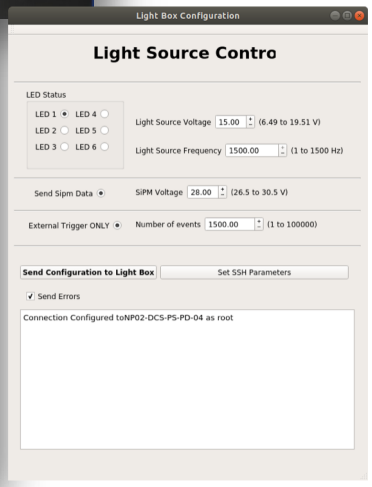
- Integration with global DAQ trigger & timing (August 2019)

Light Calibration System

Light source

Light box

Fibers



Light source control program

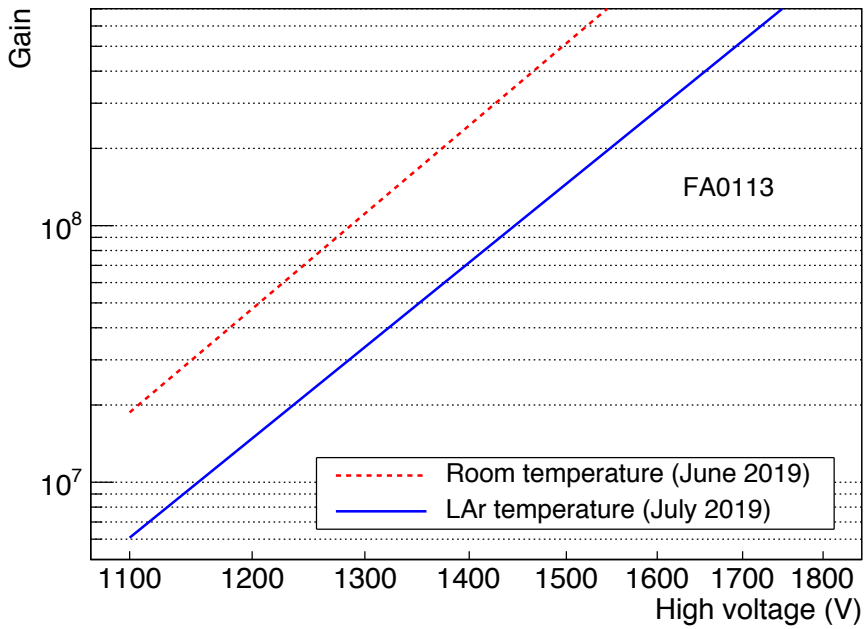
Status:

- LED & fiber based: *JINST 14 (2019) T04001*
- Calibration hardware and software running.
- Taken first calibration runs at GAr (June) and LAr (July 2019)

Next steps:

- Test upper fibers (diffuse light from top)

Light Calibration System

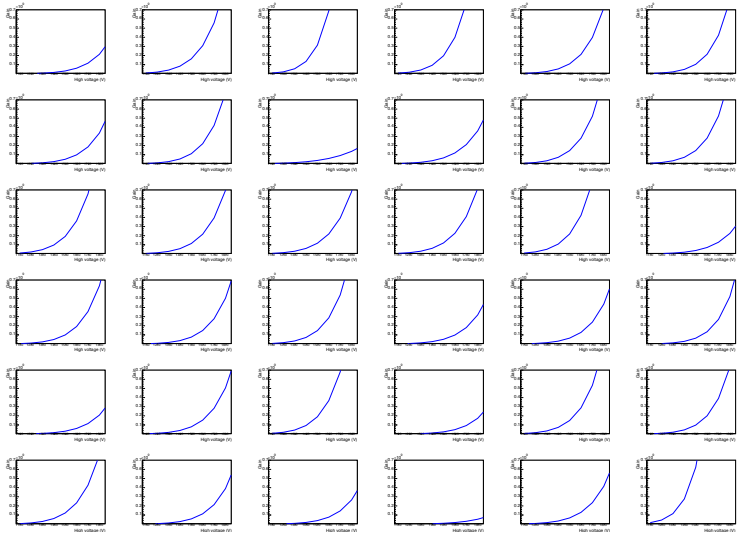


Example: G vs V for one PMT in GAr and LAr

Status:

- PMTs calibrated in ProtoDUNE-DP
  - Room temperature (GAr)
  - LAr temperature
- HV set to all 36 PMTs to operate at 10^7 gain

G vs V for 36 PMTs in LAr



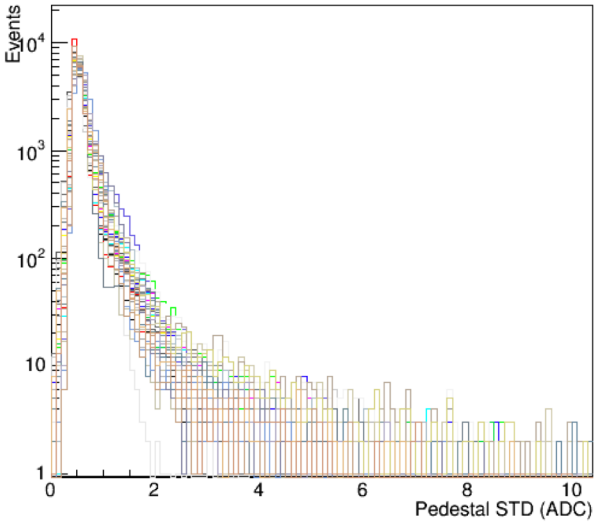
Next steps:

- Periodic calibrations → monitor gain

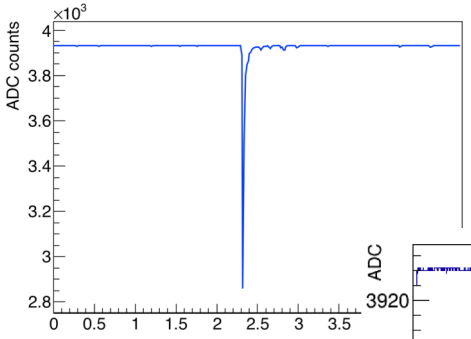
First Light Data

Data taken:

- GAr and LAr scintillation light w/o field
- Trigger:
  - Random trigger
  - PMT trigger
- All PMTs are operative
- Low noise: <1 ADC count pedestal STD

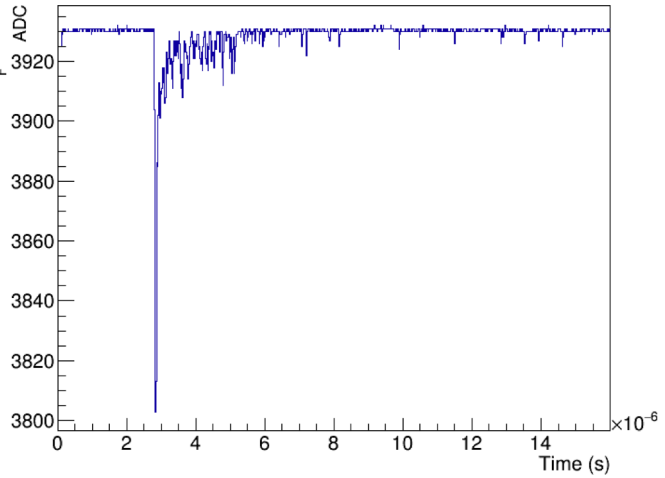


PMT STD



Example: PMT event in GAr

Example: PMT event in LAr

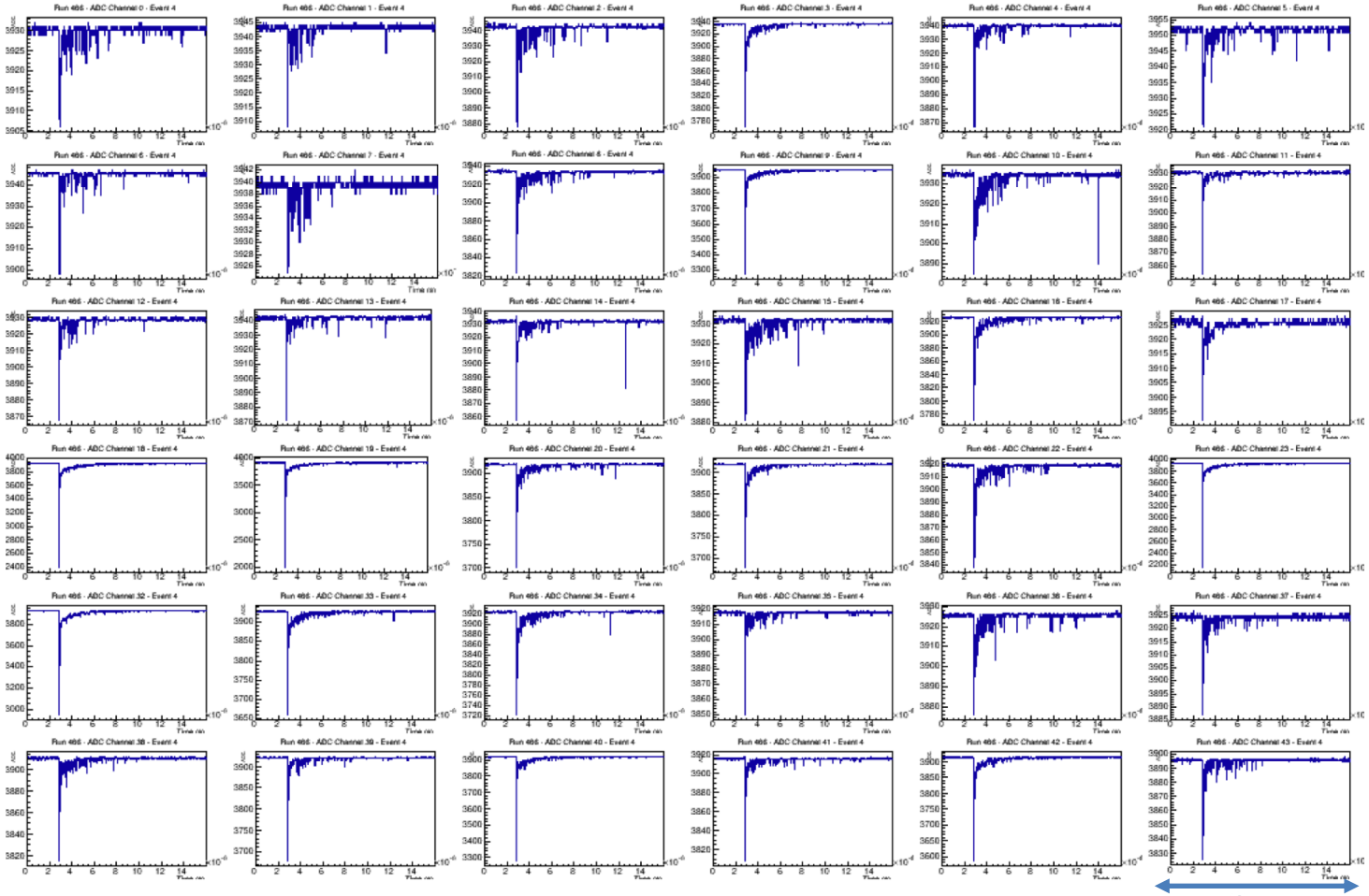


Working on:

- Optimum trigger configuration: different configurations and thresholds to be tested

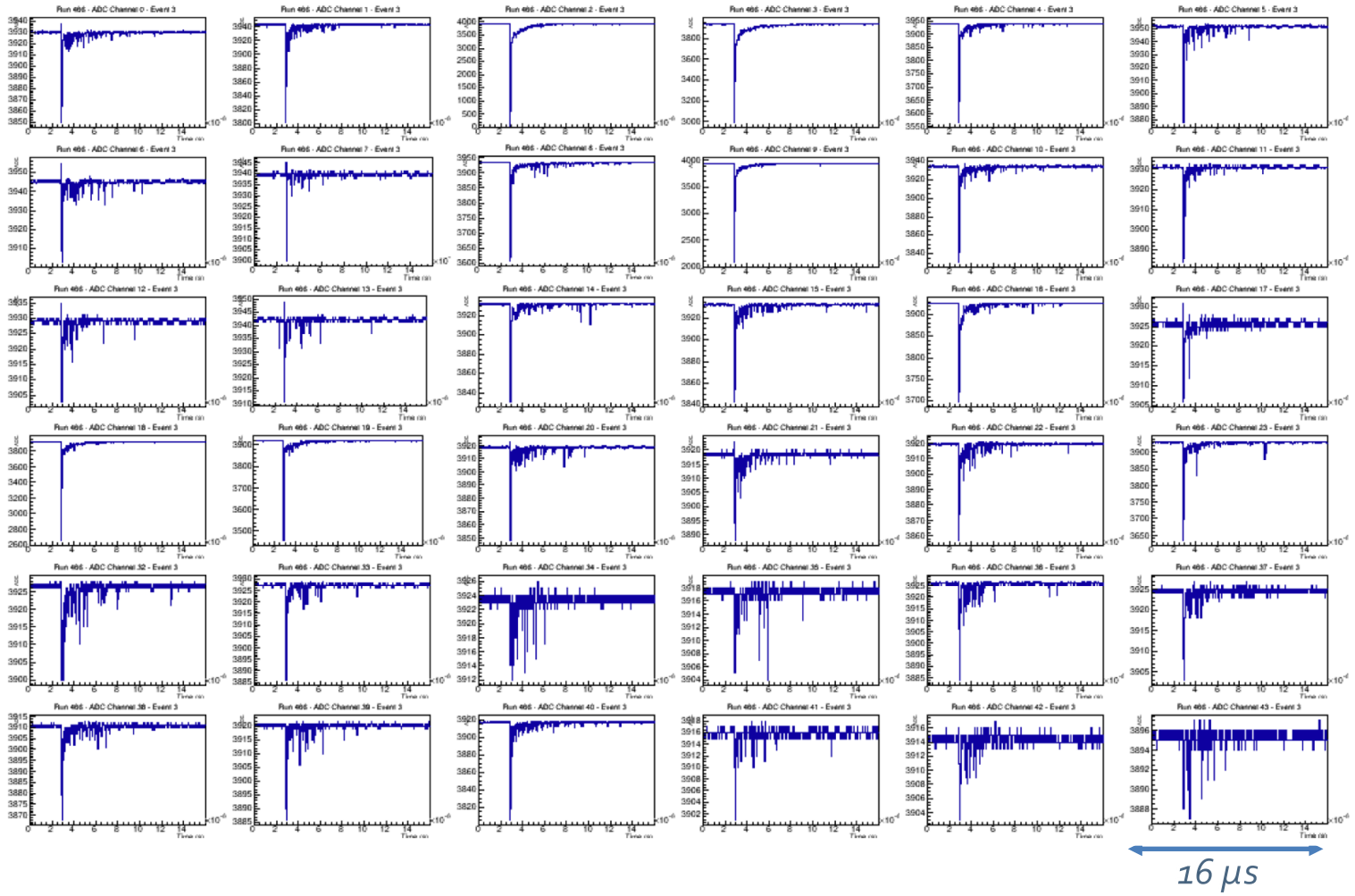
First Light Data

Event example 1: All 36 PMTs detect a light signal at the same time (PMT trigger – run 466)



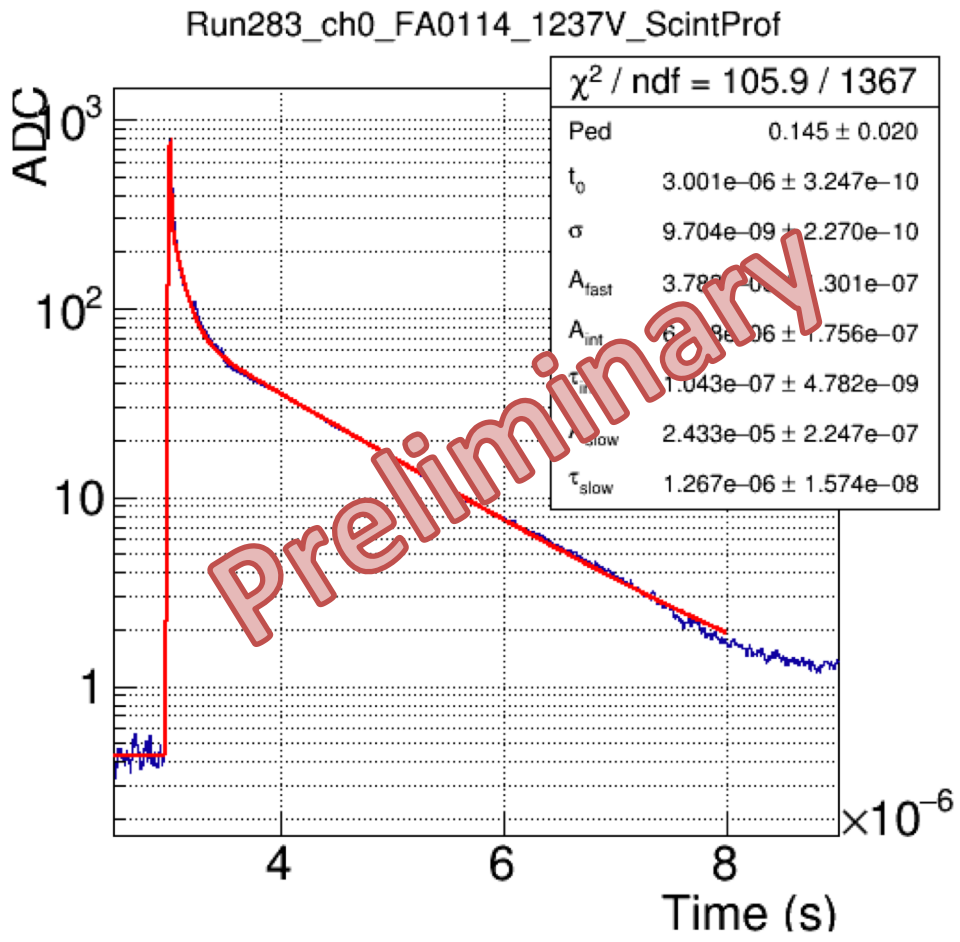
First Light Data

Event example 2: All 36 PMTs detect a light signal at the same time (PMT trigger – run466)



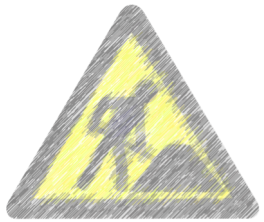
First Light Data

Average waveform for one PMT (PMT trigger)



Working on:

- Average waveform to estimate purity



Next steps:

- Drift field HV scanning
- LEM HV scanning
- Charge-light matched data
- Charge data taking with light trigger

Summary

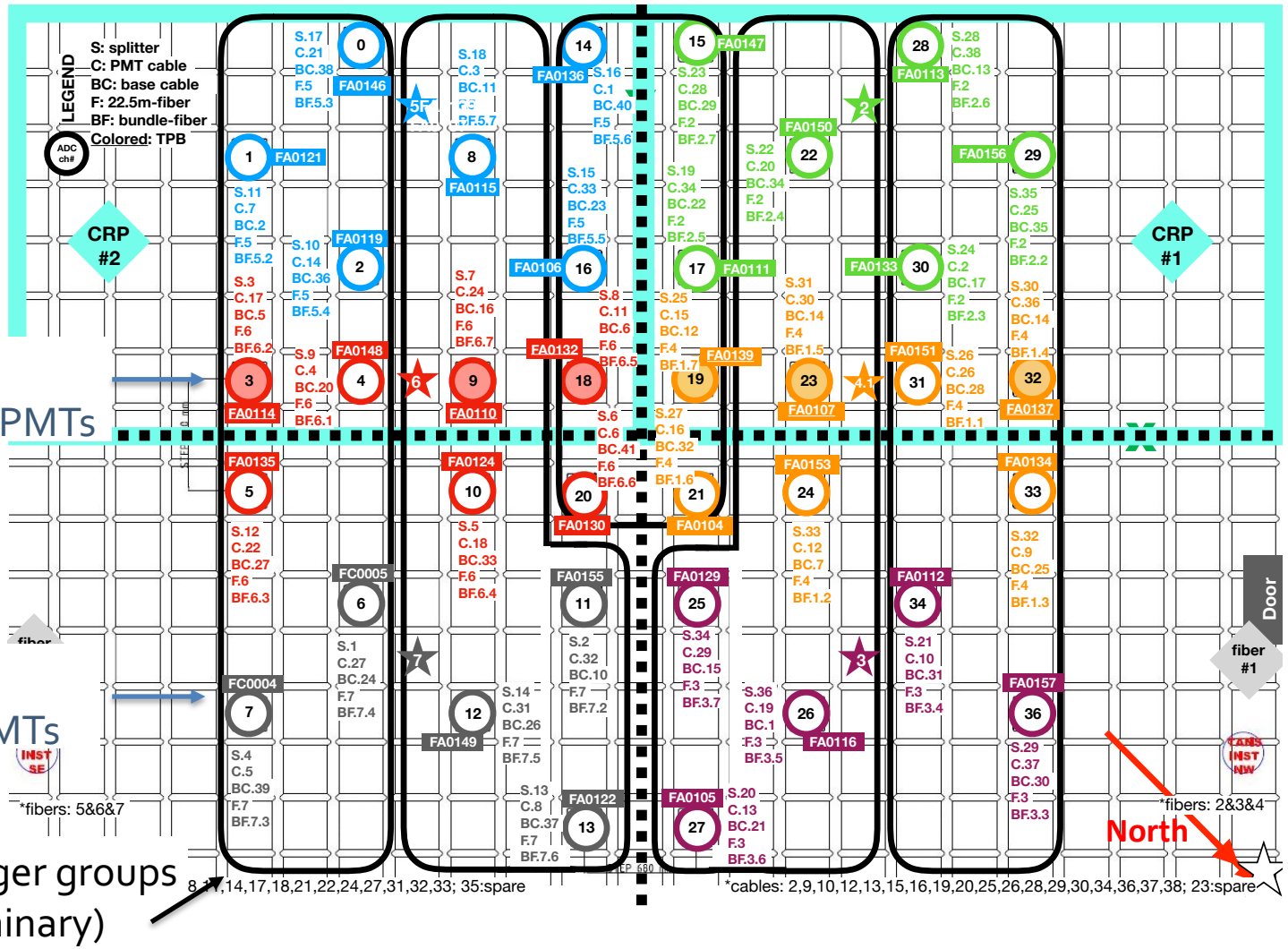
PDS installation
Completed

Data taking in GAr and LAr w/o field
June-July 2019

Data taking in LAr w field
August 2019


BACK-UP

PDS Layout


LEGEND
S: splitter
C: PMT cable
BC: base cable
F: 22.5m-fiber
BF: bundle-fiber
Colored: TPB
ADC ch#
CRP #2
CRP #1
6x TPB coated PMTs
30x PEN sheet PMTs
5x trigger groups (preliminary)
*fibers: 5&6&7
*fibers: 2&3&4
*cables: 2,9,10,12,13,15,16,19,20,25,26,28,29,30,34,36,37,38; 23:spare
8,11,14,17,18,21,22,24,27,31,32,33; 35:spare
North
Door
fiber #1
FA0146
FA0121
FA0119
FA0148
FA0114
FA0135
FC0005
FC0004
FA0149
FA0155
FA0132
FA0136
FA0106
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