Status of 3x1x1 Light Studies
Meeting IFAE-Ciemat

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Summary of PMTs calibration

Waveform Example in LAr - ch 0 - 1500V
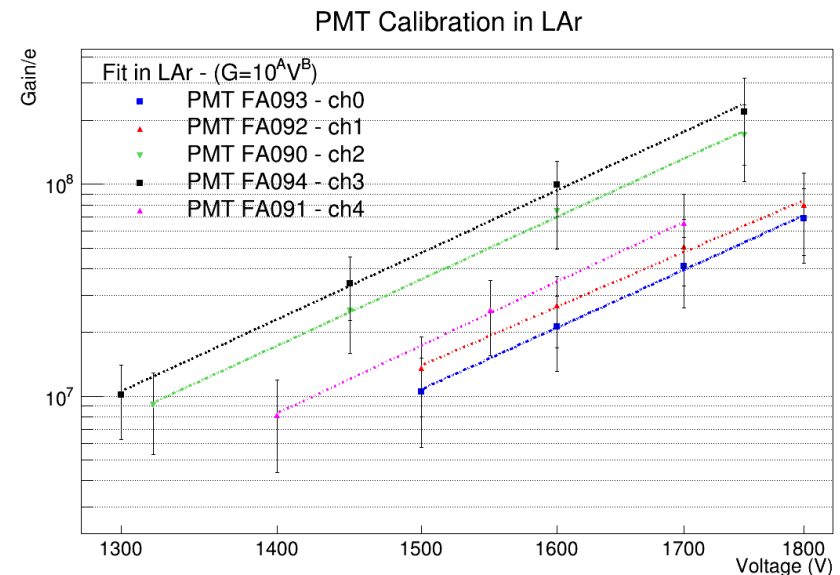
Average baseline

Charge spectrum ch 0, 1500 V
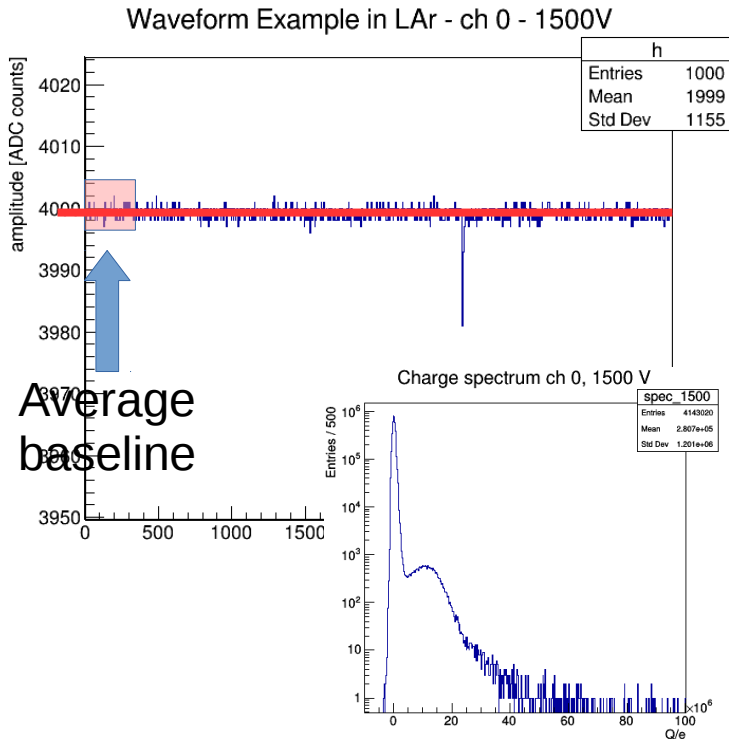
- 3x1x1 PMTs has not been calibrated in Lar with a dedicated set-up, but only in air at Room Temperature.

- We don't have a dedicated calibration system as we will have in the 6x6x6.

- Thus, the calibration has been performed reconstructing the SPE spectrum integrating every fluctuation below the baseline, from data taken with a pulser ("random trigger") inside the detector.

- An increase in the gain for 3 of the PMTs has been observed (in comparison with Room Temperature). To be understood.

For more detail:
See Jose's slides from 4 August 2017 Opera tional Meeting

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PMT Calibration in LAr

Fit in LAr - $(G=10^A V^B)$
- PMT FA093 - ch0
- PMT FA092 - ch1
- PMT FA090 - ch2
- PMT FA094 - ch3
- PMT FA091 - ch4

Summary of PMTs calibration

- We also re-analysed the PMT characterization data taken at Room Temperature.
- The gain values at 1500V obtained from this calibration are:

PMT	Channel	Gain (10^6/e) At Room T	Gain (10^6/e) In LAr	$Gain_{LAr}/Gain_{RT}$
FA093	0	12.3±0.5	11.1±0.4	0.91±0.05
FA092	1	12.5±0.3	13.8±0.6	1.11±0.06
FA090	2	23.8±0.6	36.6±0.9	1.54±0.06
FA094	3	154±13	49±2	0.32±0.03
FA091	4	15.31±0.14	17.1±0.9	1.12±0.06

- Next steps: Analyse the gain stability along the runs.
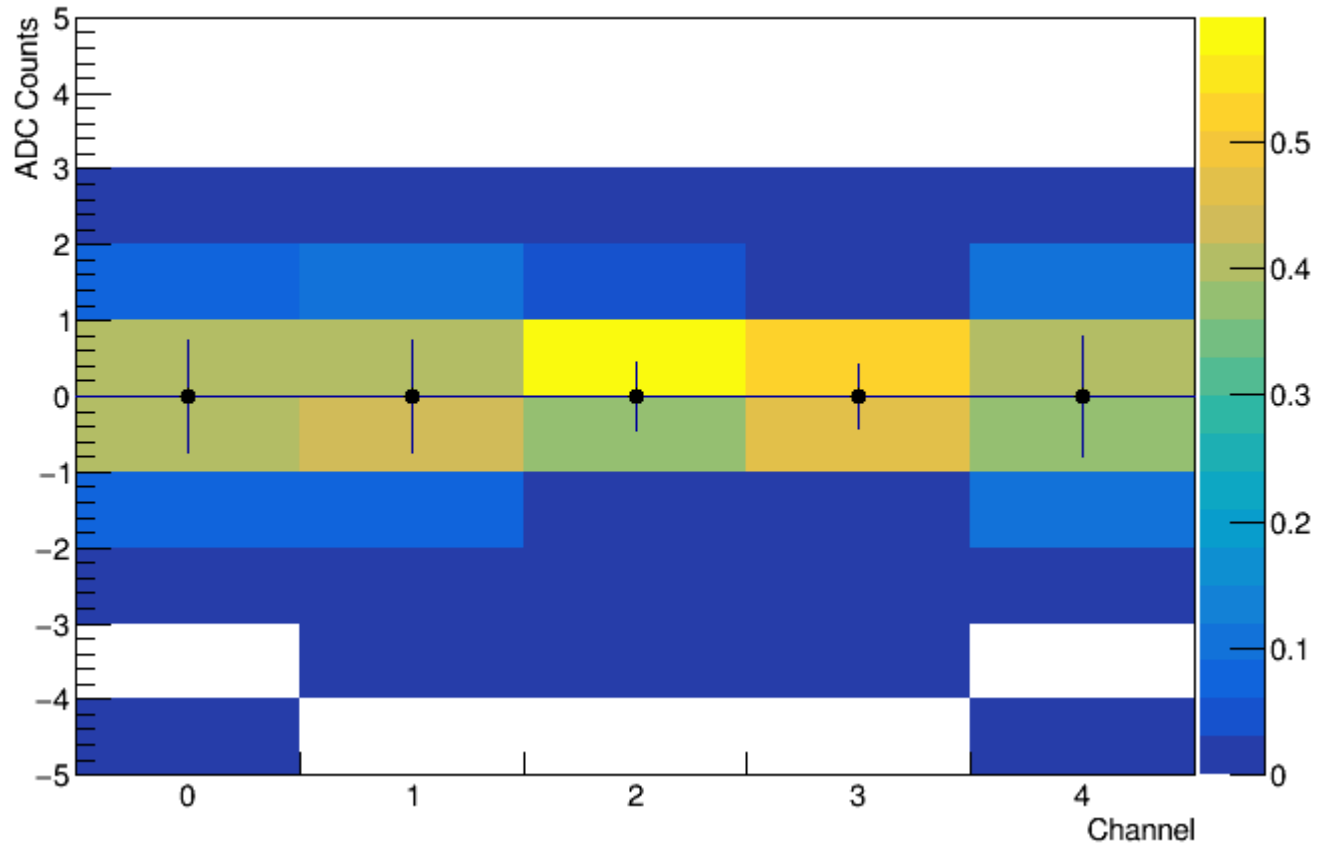
Waveform analysis
Run HV settings:

Run	grid(V)	cath(V)	lemu(V)	lemd(V)	ext_field_l (kV/cm)	amp_field(k V/cm)	drift_field(k V/cm)	Trigger
1610	4	436	0	0	0	0	0	CRT
1618	4	53,331	0	500	-0.49	5	0.53	CRT
1670	4,901	53,526	200	2,700	2.16	25	0.49	CRT
1671	4,951	53,516	200	2,750	2.16	26	0.49	CRT
1672	5,001	52,712	200	2,800	2.16	26	0.48	CRT
1681	5,001	52,721	200	2,800	2.16	26	0.48	PMT
1682	5,001	52,730	200	2,800	2.16	26	0.48	PMT
1683	5,051	52,712	200	2,850	2.16	27	0.48	PMT
1684	5,101	52,913	200	2,900	2.16	27	0.48	PMT
1685	5,051	53,353	200	2,900	2.11	27	0.48	PMT
1686*	2,799	21,210	111	1,644	1.13	15	0.18	PMT
1687	5,001	52,670	250	2,950	2.01	27	0.48	PMT

PMT Voltages: (1200,1200,1100,1100,1200) rest of runs.
                  (1200,1200,1150,1150,1200) *run 1610 and 1618.

* Run 1686 doesn't have HV stable conditions at the Grid and the Cathode.
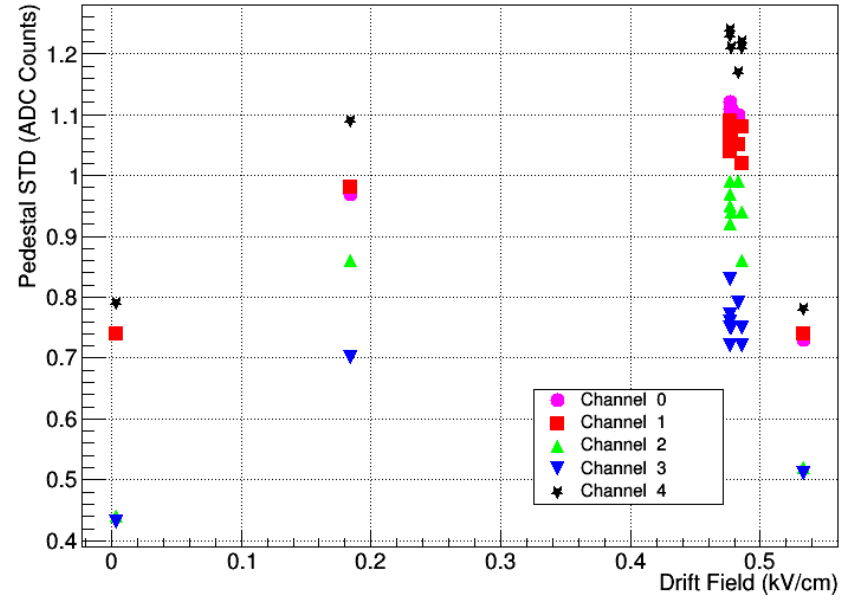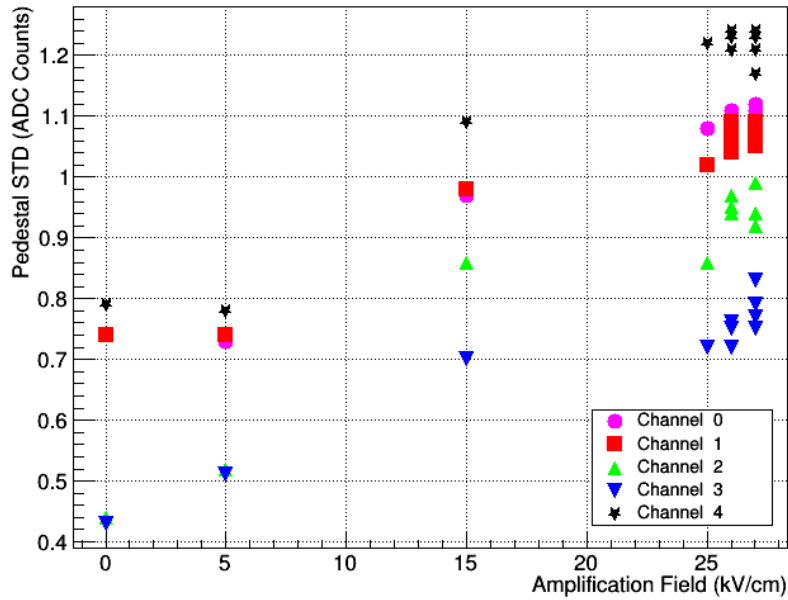
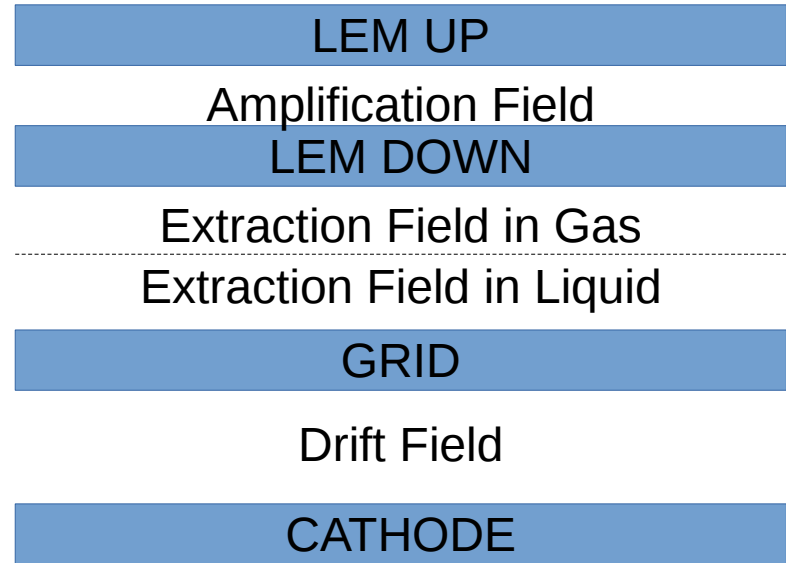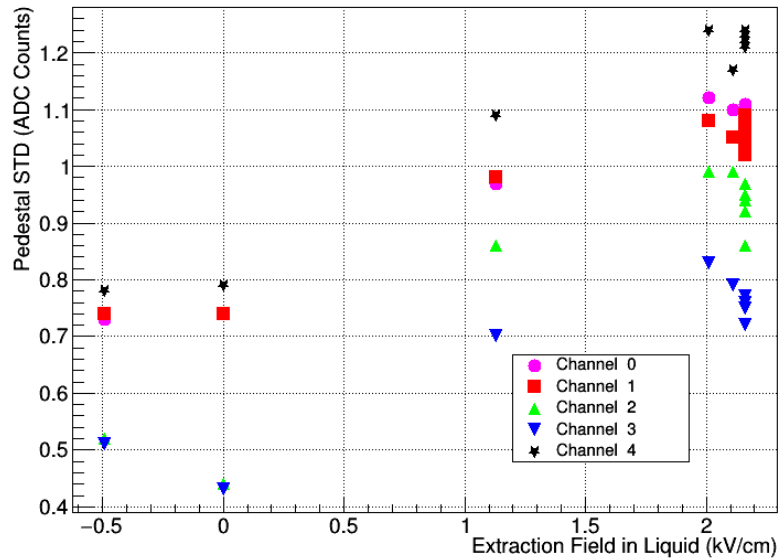# Pedestal characterization

Pedestal vs Channel - Run 1610

Pedestal characterization

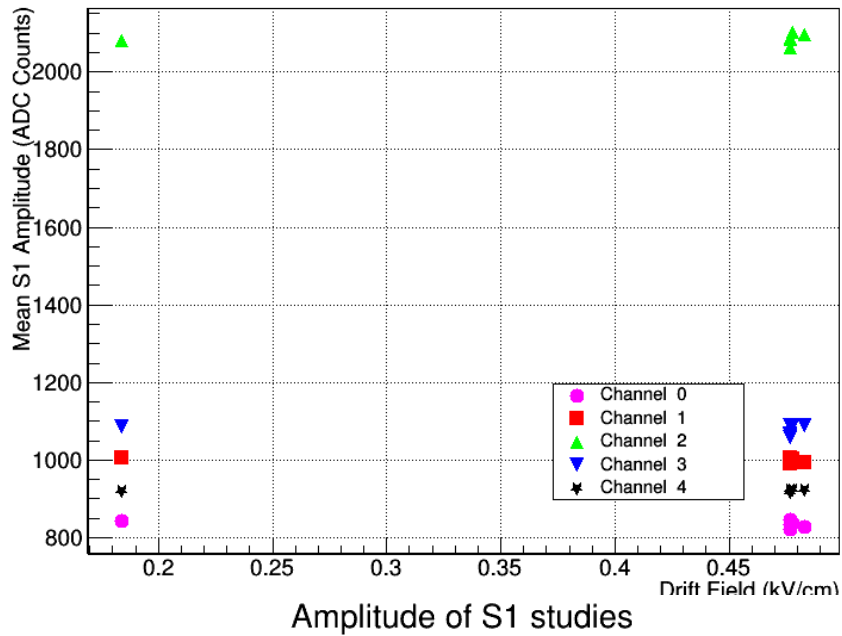CIEMAT

S1 Amplitude characterization

Signal Amplitude vs Channel - Run 1686
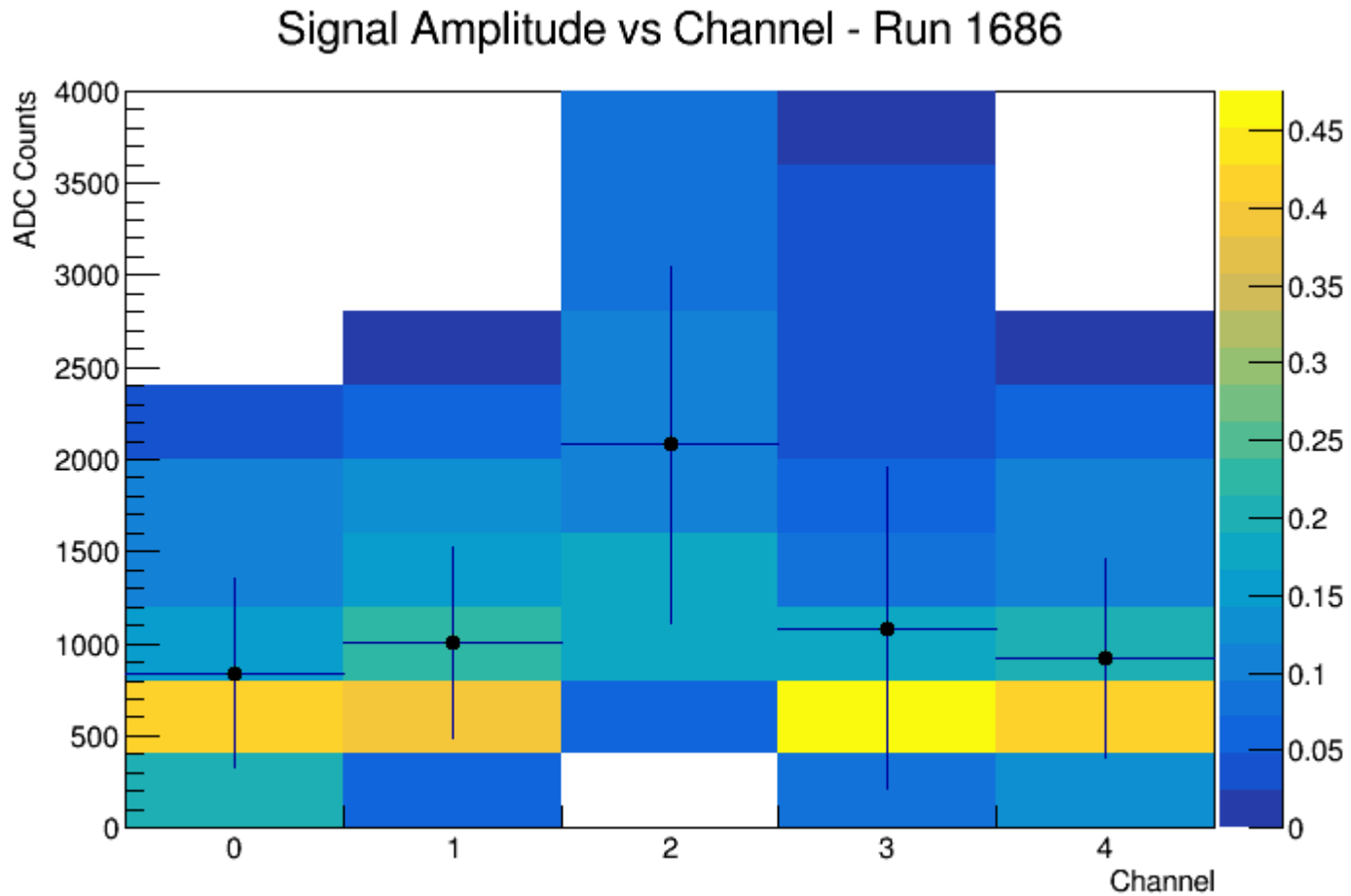
PMT Trigger

S1 dependency with HV settings

Amplitude of S1 studies

Amplitude of S1 studies

Amplitude of S1 studies
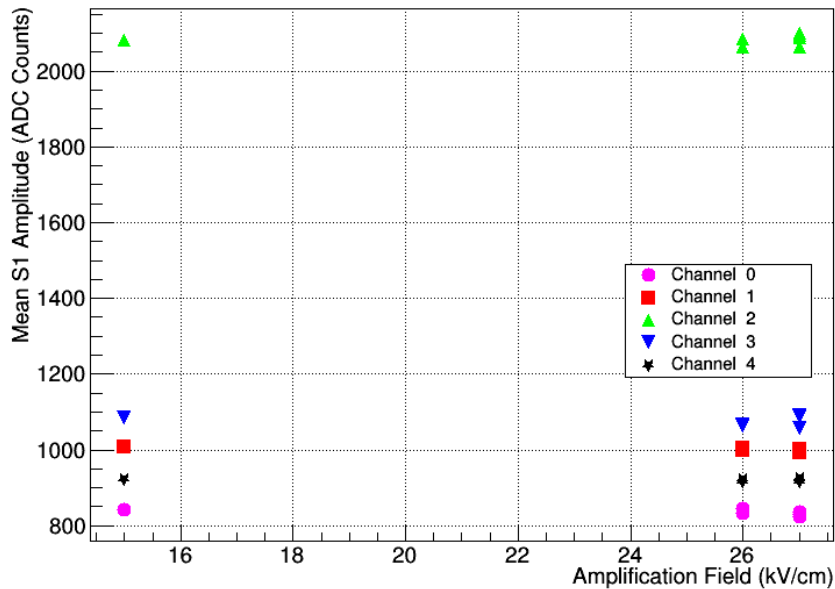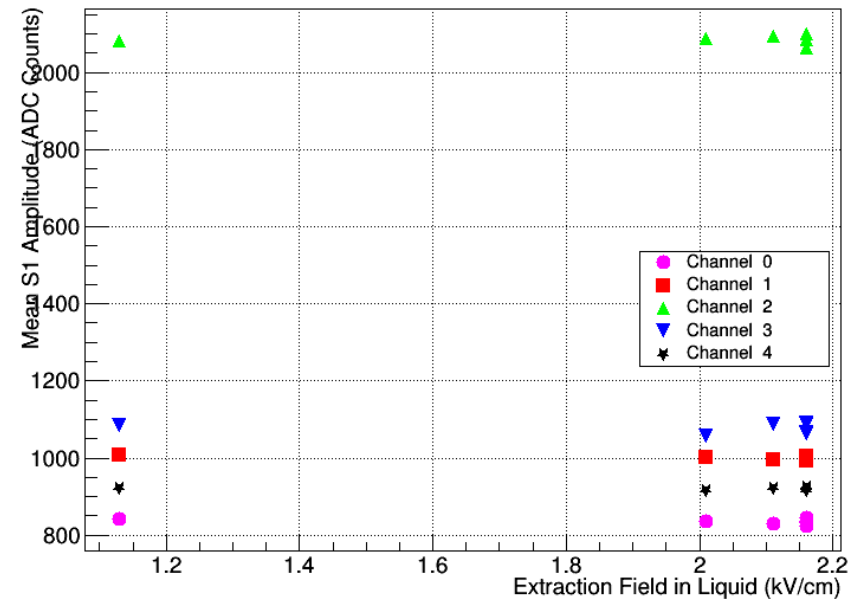
Only PMT Trigger runs.

Channel	Gain (10^6e)
0	1.1±0.1
1	1.5±0.2
2	1.4±1.2
3	1.9±1.5
4	1.6±0.3

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Summary of the waveform studies
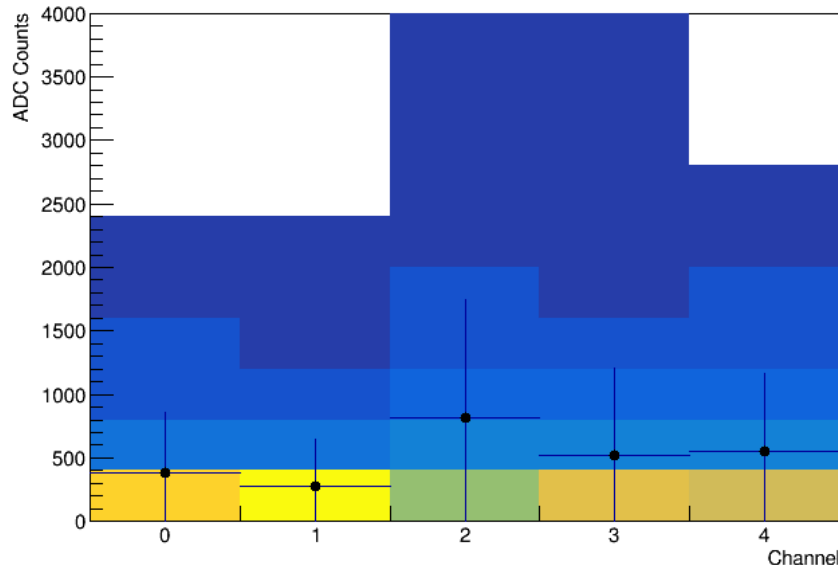
Pedestal studies
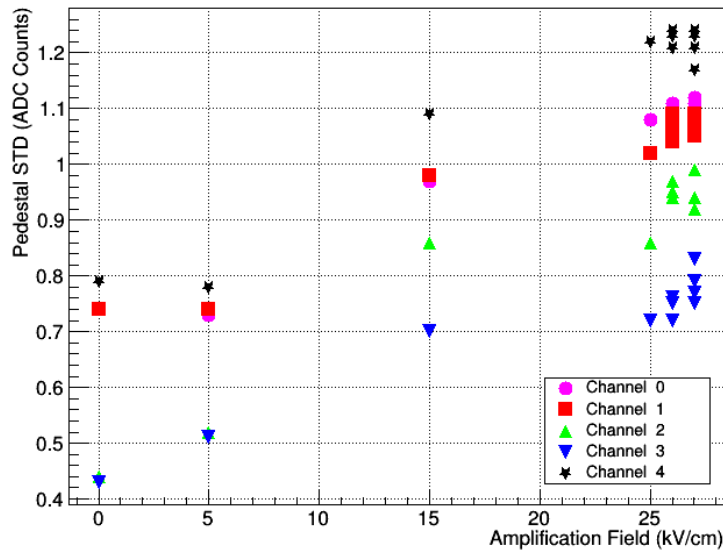
- Pedestal STD remain quite stable (~1ADC), even under high amplification fields.

- Positive based PMTs have smaller pedestal fluctuations.

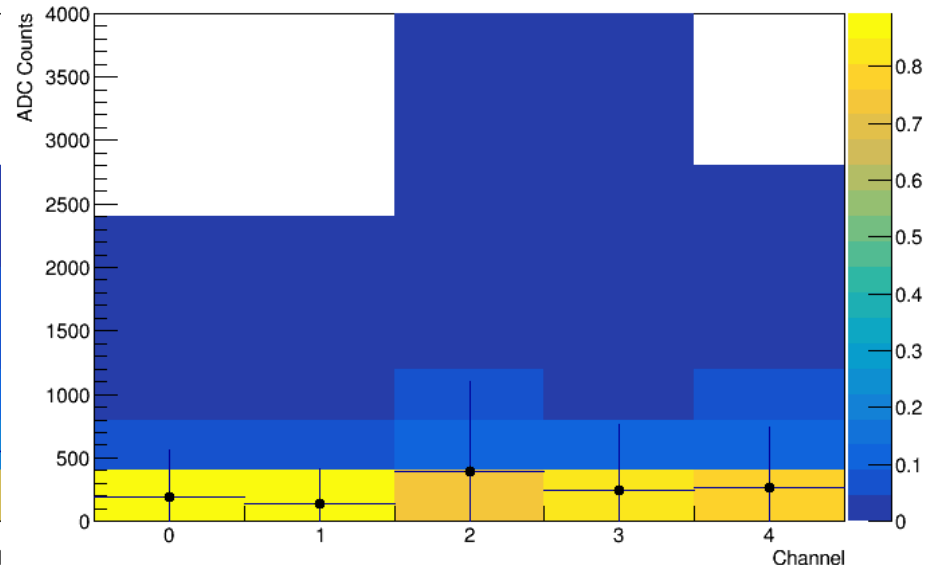| Negative based PMTs:	Channel 0, 1 & 4
Positive based PMTs:	Channel 2 & 3

No Drift Field
Signal Amplitude vs Channel - Run 1610

Drift Field 0.53kV/cm
Signal Amplitude vs Channel - Run 1618

As the drift field increase, the S1 amplitude is reduced, since less recombination occurs.

Summary of the waveform studies

- The self-trigger provides a larger S1 signal than the CRT Trigger.

- With the CRT Trigger, the S1 amplitude decreases as the Drift Field increases.

- With the PMT Trigger, the S1 amplitude remains stable under different HV configurations.

- Positive based PMTs show a wider distribution.

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