n3He Target Chamber Voltage Scan

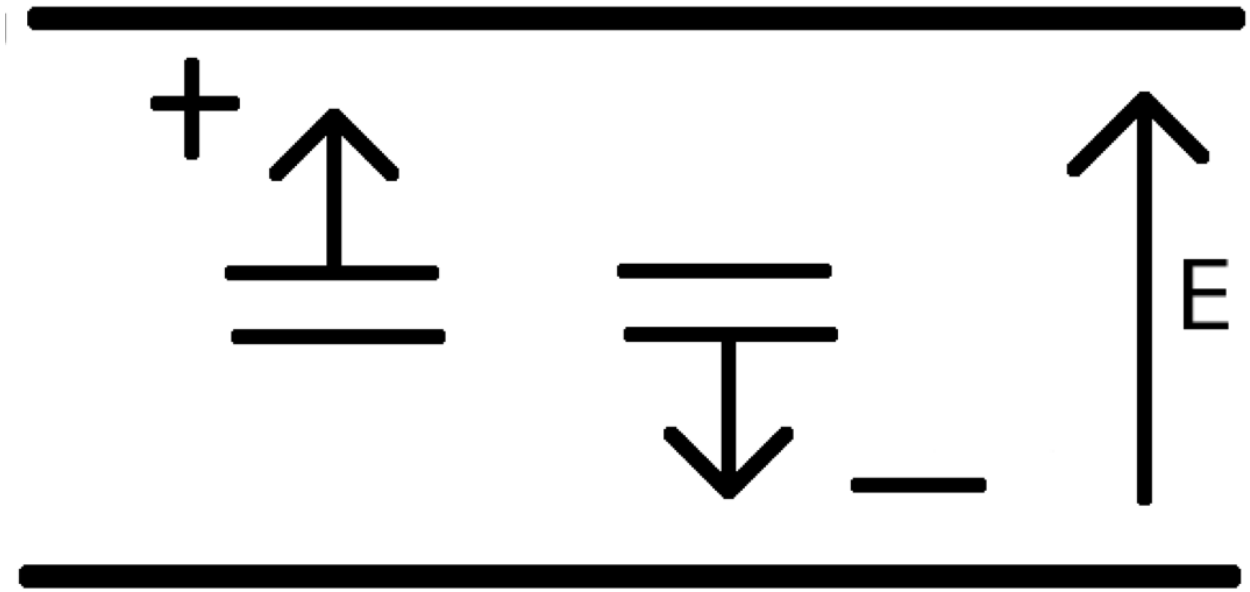
Mark McCrea
University of Manitoba

January 25, 2016

Source and DAQ

- Located at the Oak Ridge National Laboratory (ORNL) in Tennessee
- 60 Hertz pulsed spallation source
- 49 time bins per pulse for Clean DAQs
- 144 chamber wires to read out.
- 1624 time bins per pulse for dirty daq (spin flipper and beam monitor)
- One M1 Monitor

Simple Theory

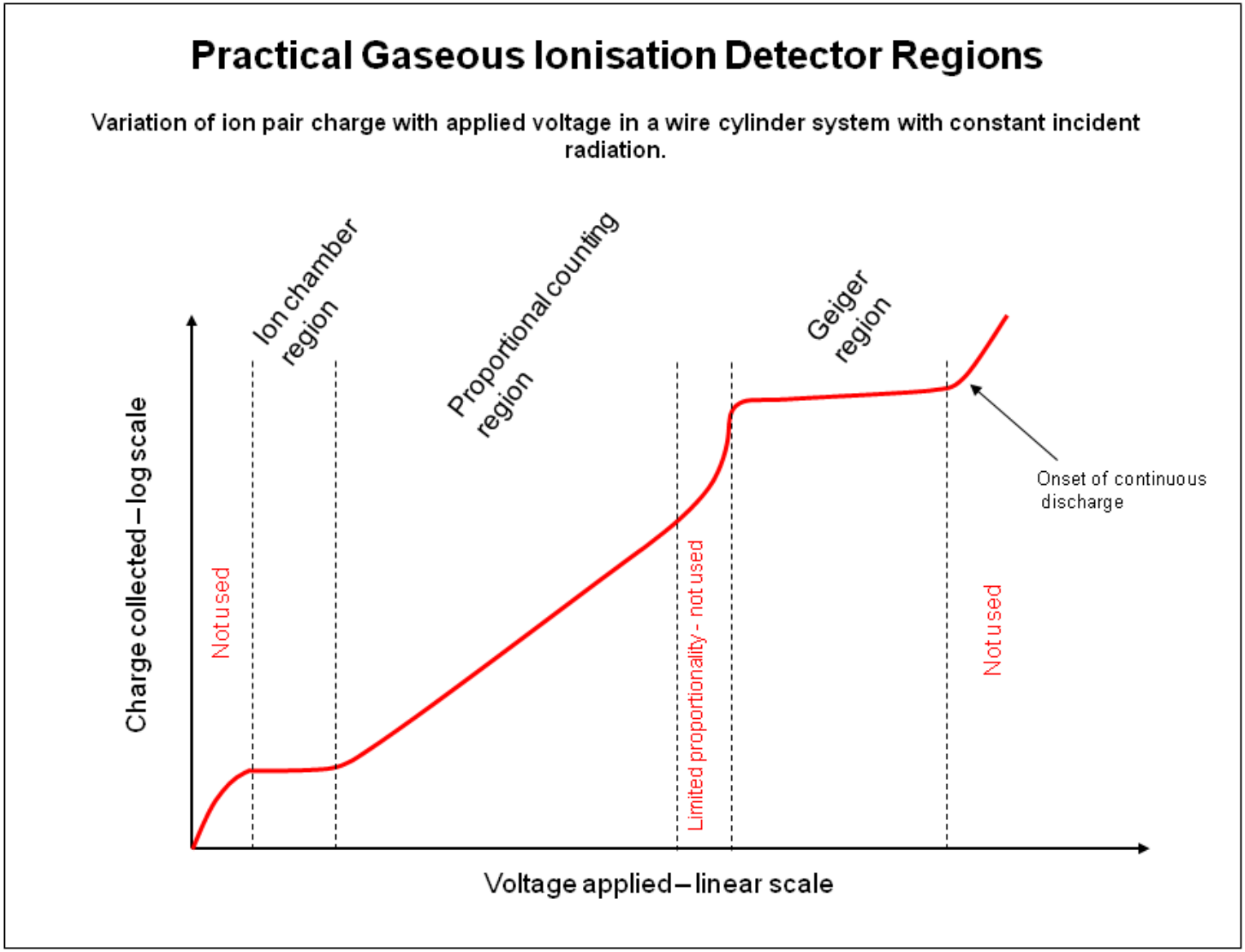


$$U = K_+ E \qquad V = K_- E$$

where

- U is the drift velocity of the positive ions
- V is the drift velocity of the negative ions
- E is the electric field
- K is a proportionality constant for the gas mix, E and charged particle

Basic Modes of Operation



Run Numbers Looked At

BiasVoltage	Run Number
0	57178
0	57181
-52	59817
-86	59819
-99	59821
-150	59823
-201	59825
-250	59827
-253	57185
-300	59829
-303	57187
-337	57177
-351	59831
-355	57193
-397	57195

BiasVoltage	Run Number
-400	59833
-450	59835
-500	59839
-552	59837

Method

- Integrated each pulse in a run for all wires and M1

$$x_{j,i} = \frac{1}{60 \times N} \sum_{k=1}^{N} s_{j,i}(k) \quad N = 49 \text{ or } 1624 \tag{1}$$

where $x_{j,i}$ is the integrated total of the ith pulse in the jth run.

- Average pulse integrals and form standard error for run averages

$$Avg = \langle x_j \rangle = \frac{1}{q} \sum_{i=1}^{q} x_{j,i} \tag{2}$$

$$q = \text{number of uncut entries in run}$$

$$StdErr = \frac{\sigma}{\sqrt{q}} = \frac{1}{\sqrt{q}} \sqrt{\langle x^2 \rangle - \langle x \rangle^2} \tag{3}$$

- M1 cut used to remove dropped pulses if $M1[600] < 0.9\langle M1[600] \rangle$
- M1 and Chamber correlations not accounted for.

Method

A beam off power supply off run was used as the pedestal and designated by $j = 0$. The wire and M1 values were pedestal subtracted before division.

$$R_j = \frac{\langle x_j \rangle - \langle x_0 \rangle}{\langle M1_j \rangle - \langle M1_0 \rangle} \tag{4}$$

Error Propagation:

$$C = A - B \tag{5}$$

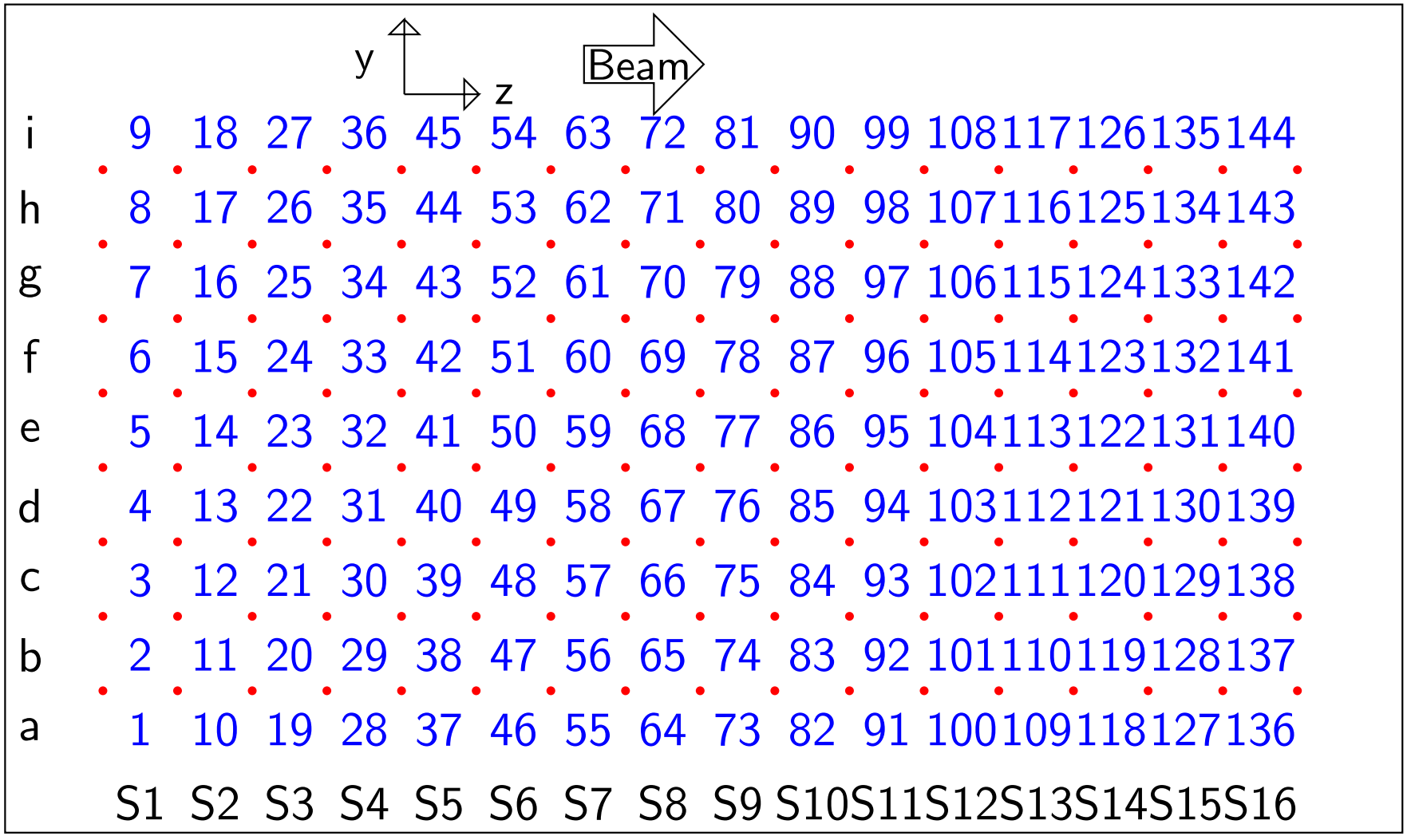
$$\sigma_C = \sqrt{\sigma_A^2 + \sigma_B^2} \tag{6}$$

$$C = \frac{A}{B} \tag{7}$$

$$\sigma_C = \frac{A}{B}\sqrt{\left(\frac{\sigma_A}{A}\right)^2 + \left(\frac{\sigma_B}{B}\right)^2} \tag{8}$$

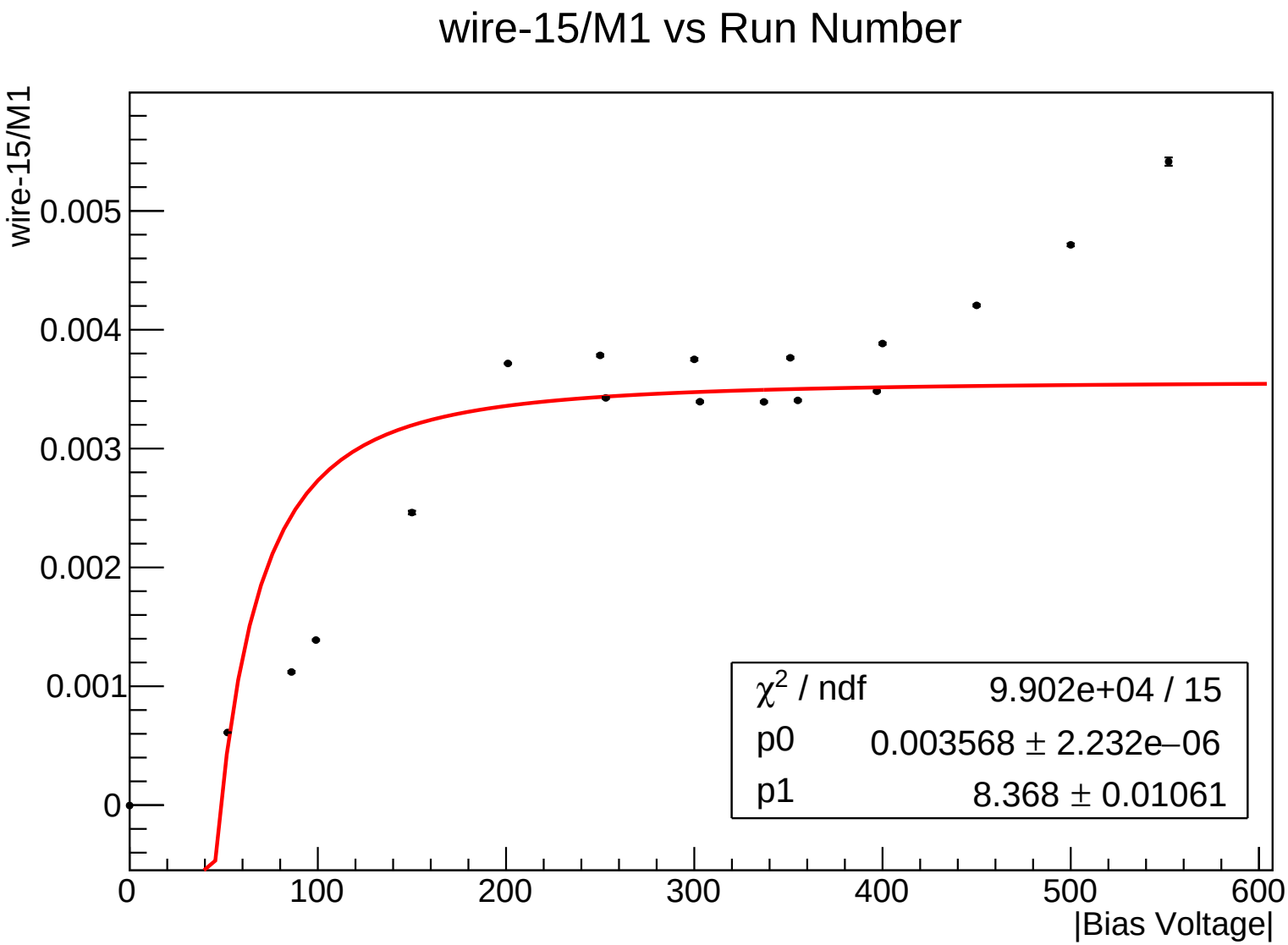
where σ is the uncertainty for the values.

Wire Indices

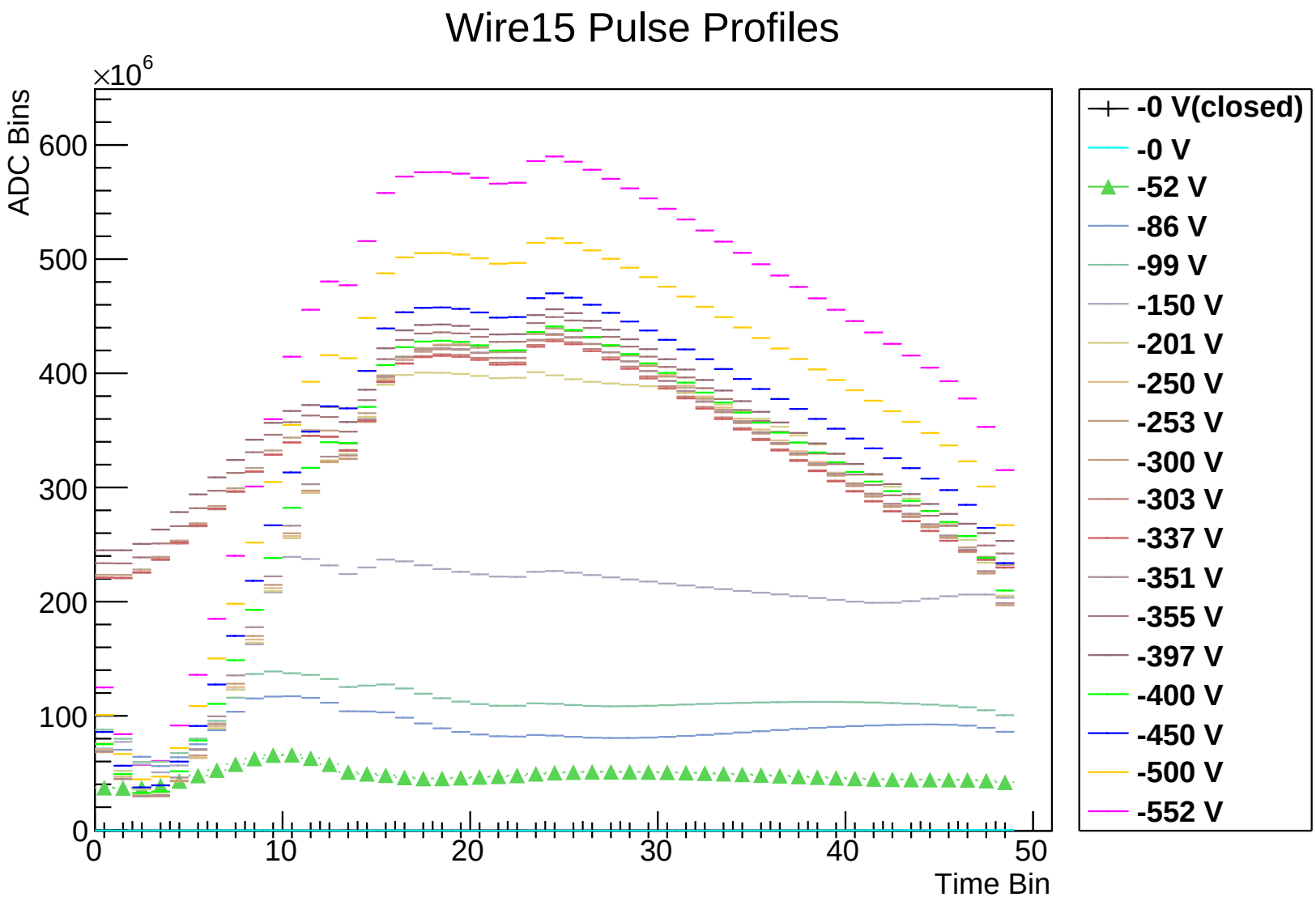


- HV 17 HV Frames with 8 wires each
- Signal 16 signal Frames with 9 wires each

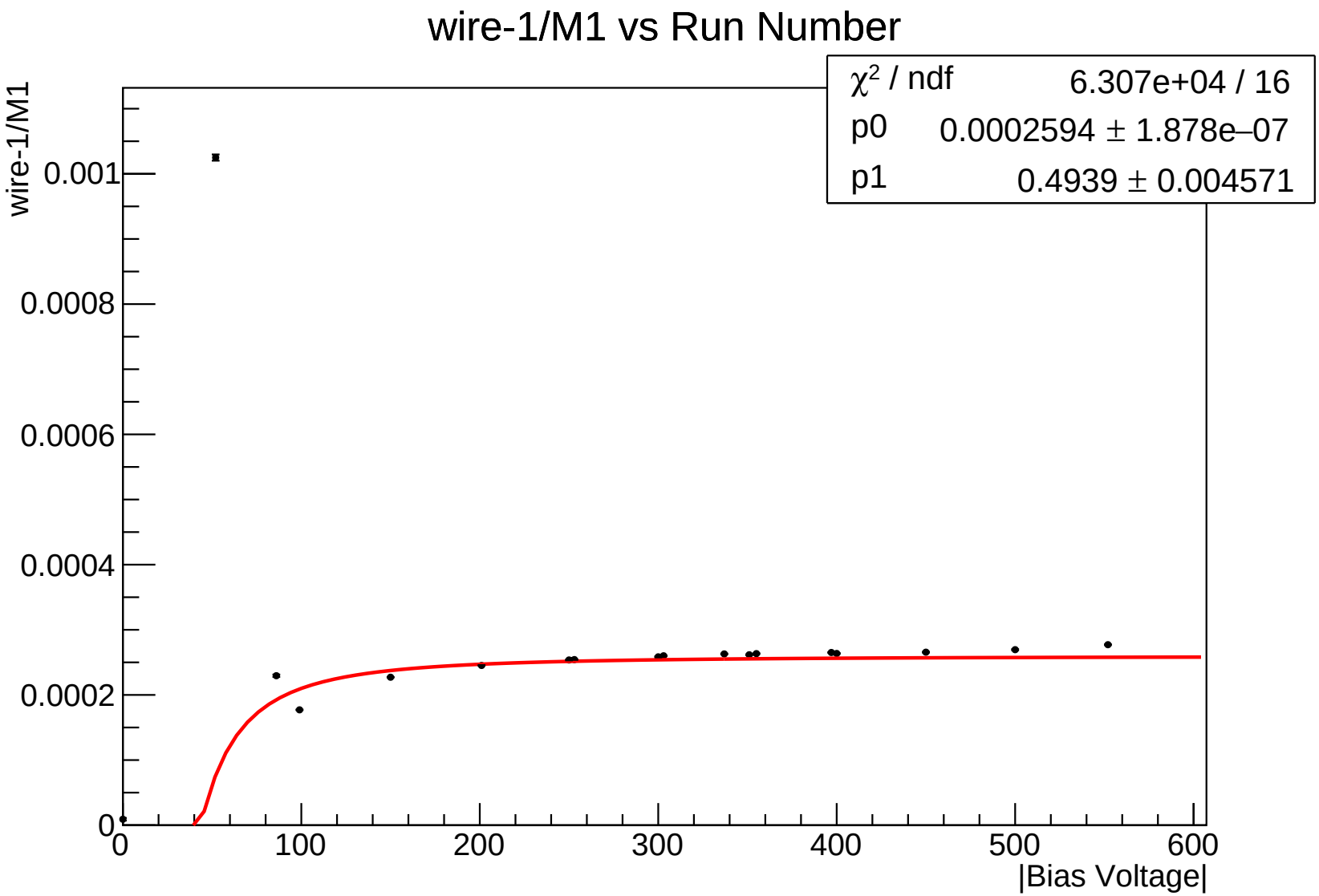
Wire 15 - Volt Scan Results



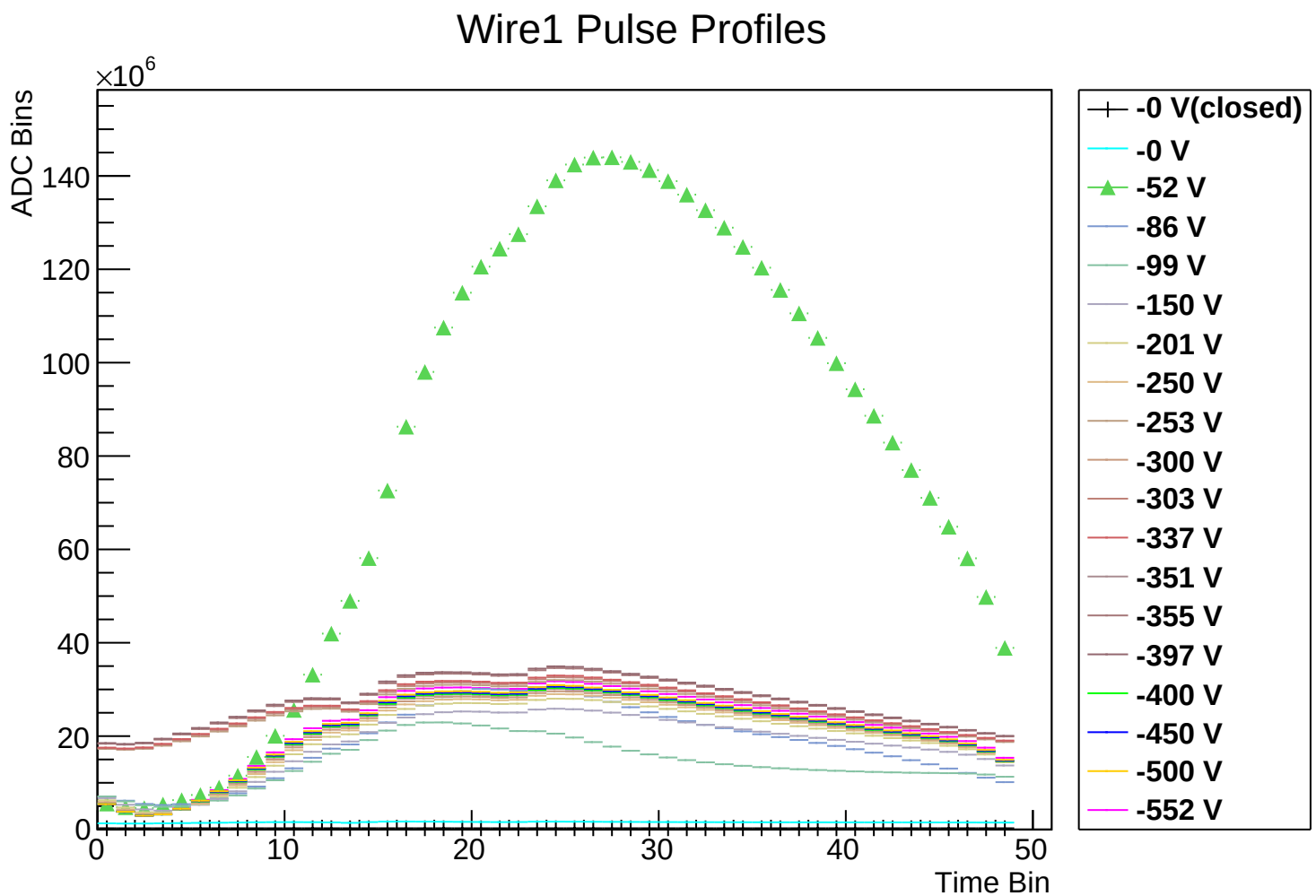
Wire 15 - Pulse Overlay



Wire 1 - Volt Scan Results

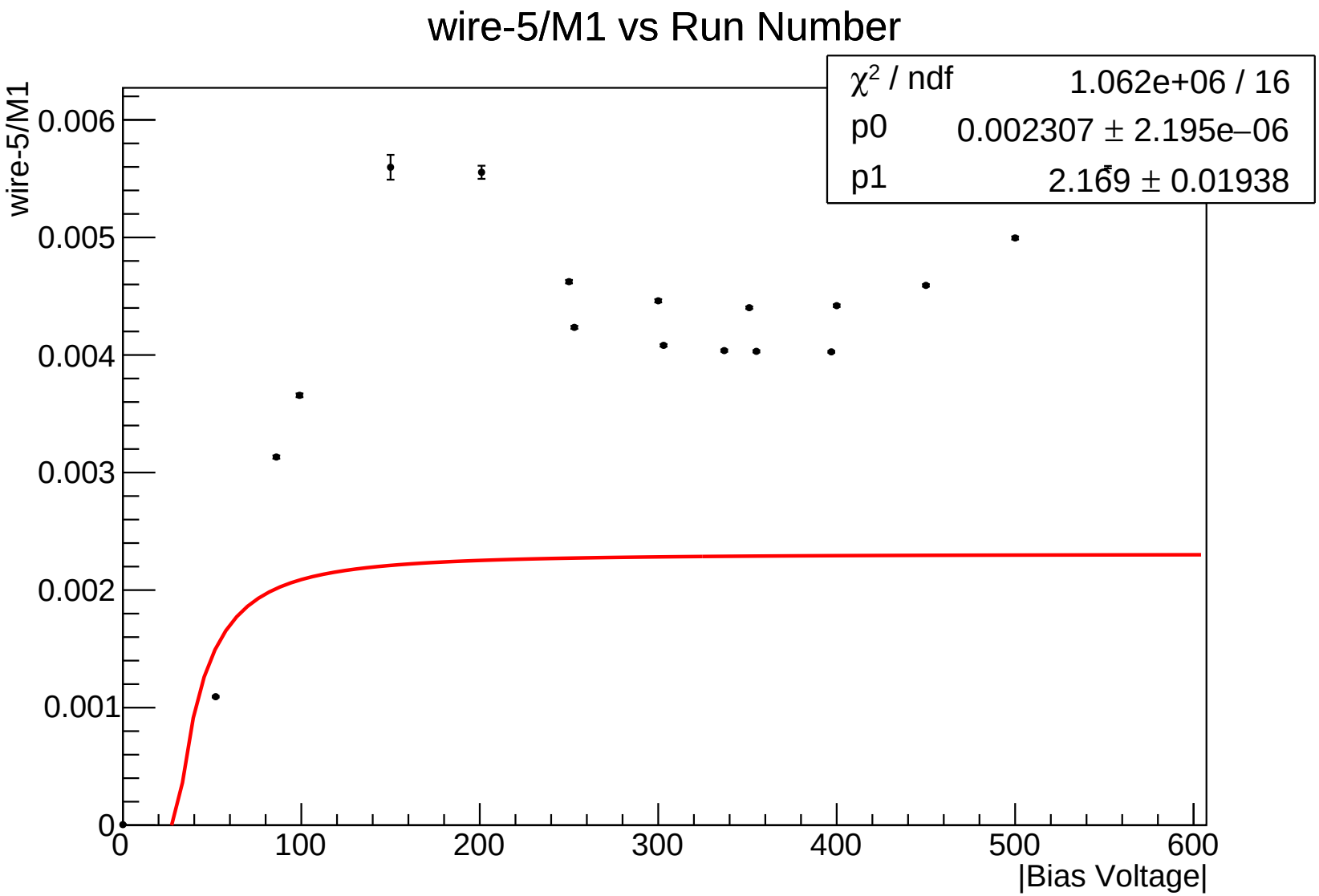


Wire 1 - Pulse Overlay

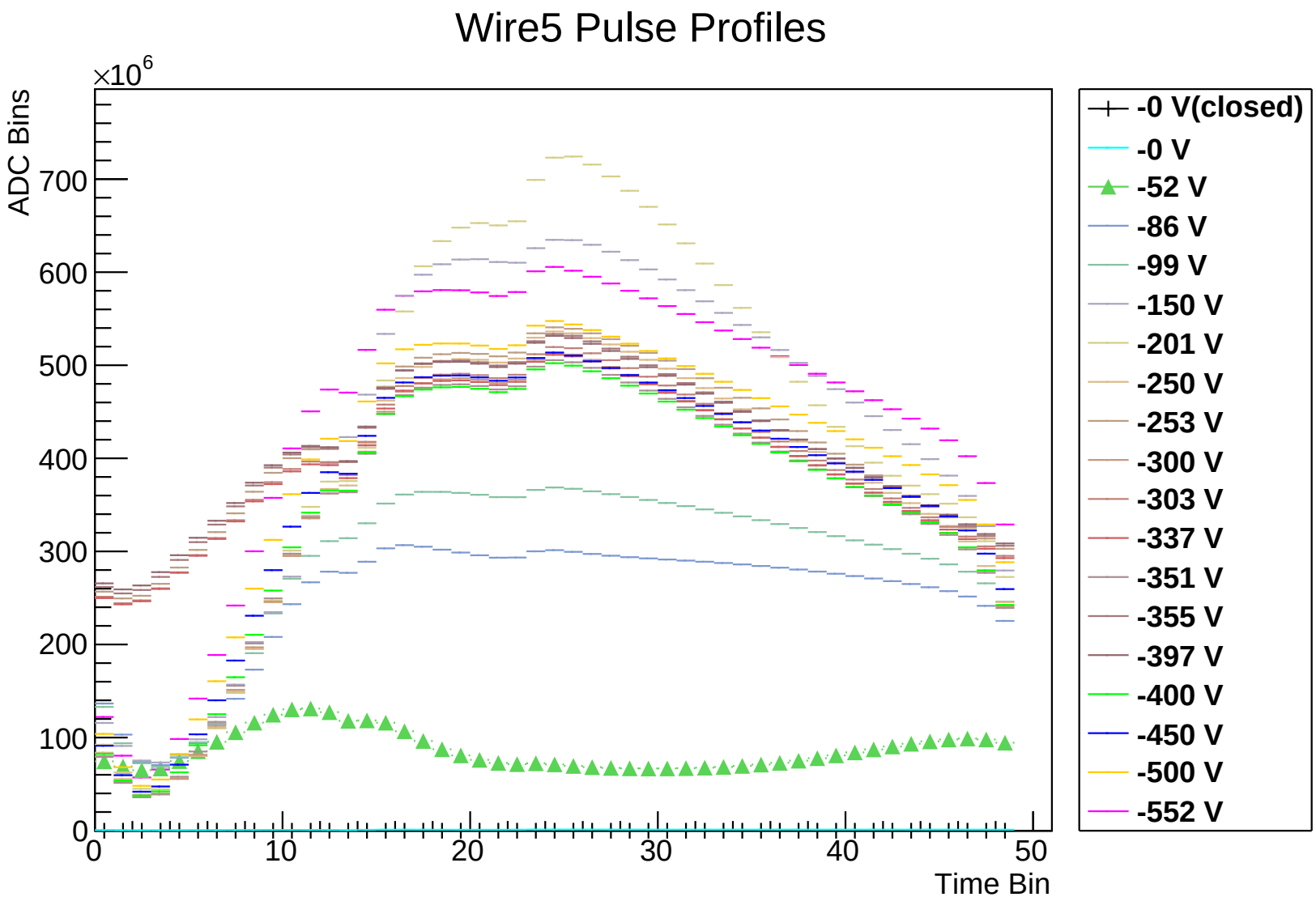


Note: These are not pedestal subtracted and the same relative trends are seen here with regards to -56V peak height.

Wire 5 - Volt Scan Results



Wire 5 - Pulse Overlay



Trends

- row 1: first point (-52V) is high in most wires, this is repeated in other rows but mainly outside two, rows 1 and 9.
- row 2: second two points (-86V and -99V) are high along with occasional -52V point.
- row 3: 3, 30, 39 have -86V and -99V deviations
  48,57,66 have -52V deviations.
  wire 129 curves downward instead of upward, seems to be inverted overall.
- row 4: 4, 40, 49 have -86V and -99V deviations,
- row 5: wires 5, 41, 50 have -86V and -99V deviations
- row 6: wires 51, 69 have -86V and -99V deviations
- row 7: 7, 43, 53 have -86V and -99V deviations
  70 61 have -52V deviations
  wire 142 inverted
- row 8: 8,17,26,35 have -86V and -99V deviations,
- row 9: 9,18,27,36,45,54,63 -52V deviations

Summary

- Voltage Scan covered 0 to -550V
- operating voltage was -353V
- Some multiplication at this voltage
- Some odd results at low voltage
- deviations mainly at front and outer wires
- approximatelly 1/3 of wires had some kind of deviation
- cause is unknown
- two voltage scans done weeks apart in 250-350 range gave very similar results
- Probably had stable running with small multiplication during experiment.