Beam Off Asymmetry Analysis - Tuesday Runs

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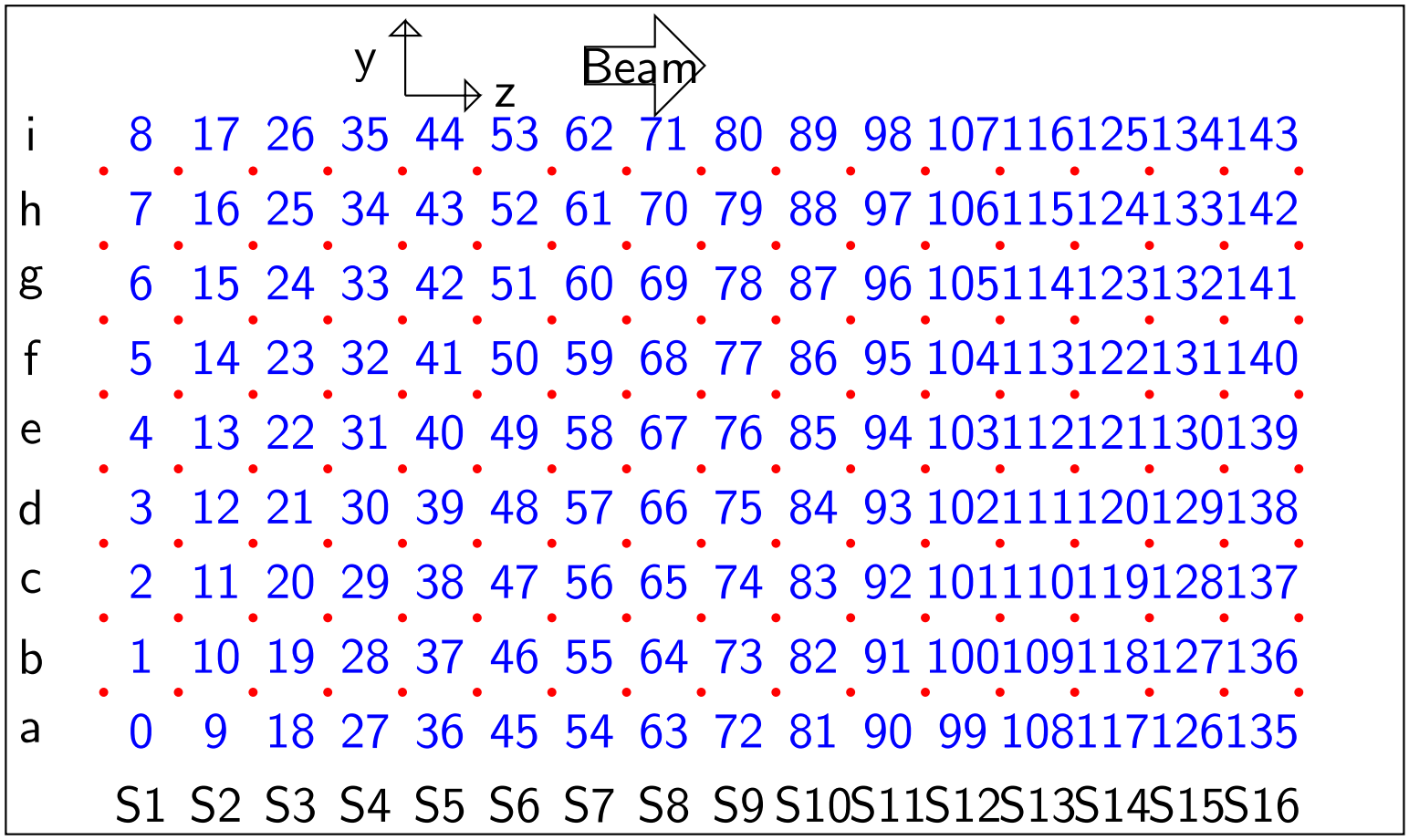
Method

Asymmetry Results
- Summer Runs
- Summer Runs - Noisy Period
- Summer Runs - Quiet Period
- Tuesday Runs

Conclusions

Wire Numbering



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

List of Runs

A list of good beam off runs has been provided by Kabir, and are now on the n3He wiki Instrumental Asym. webpage for reference by the group.

Summer Run List

Date Range	Initial Run	Final Run
2015-06-25	38081	38124
2015-06-26	38125	38215
2015-08-03	38216	38301
2015-08-04	38302	38416
2015-08-10	38417	38493
2015-08-11	38494	38657
2015-08-12	38658	38769

Tuesday Run List

Tuesday Run List		
Date Range	Initial Run	Final Run
T1	17784	17834
T6	26461	26503
T10	45032	45054

Pulse Sum

For the beam monitor and wires a simple pulse sum is used pulse i in run j as:

$$w_{j,i} = \sum_{k=n}^{m} s_{w,j,i}(k), \tag{1}$$

$$q = \frac{n}{49}1624 \qquad r = \frac{m}{49}1624 \tag{2}$$

$$M1_{j,i} = \sum_{k=q}^{r} s_{M1,j,i}(k), \tag{3}$$

with 49 time bins for the target chamber wires n and m define a subset of that range from 0 to 49. The beam monitor has 1624 time bins and the fraction of its time bins used in the sum are chosen to match the a similar fraction of the total time bins as are used from the wires. k is the time bin index, and $s_{j,i}(k)$ is the recorded signal in time bin k, for run number j.

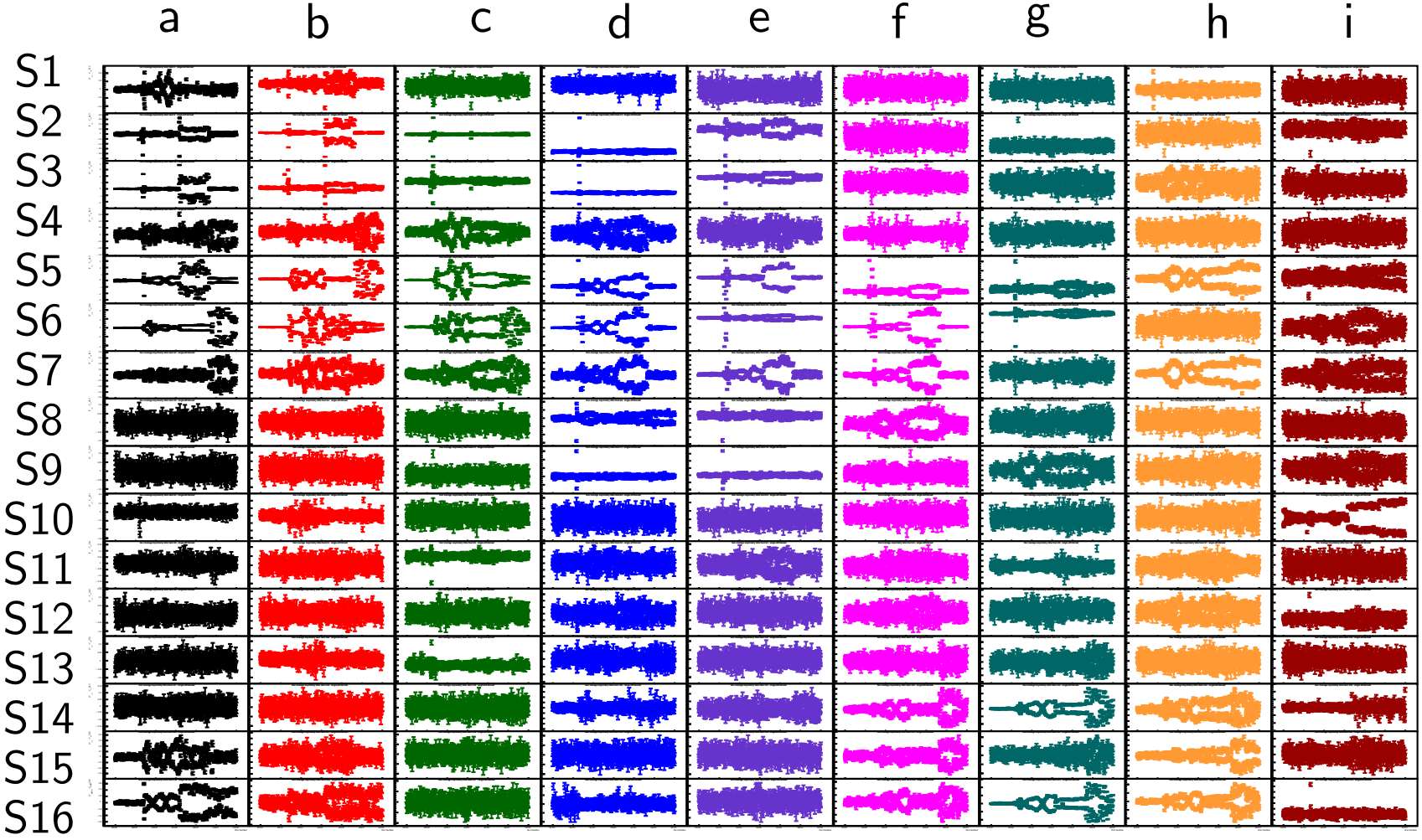
Beam Off Asymmetry Calculation

The single wire instrumental asymmetries were calculated using a simple difference formula normalized by one volt to render it unitless.

$$A_q = \frac{w_{j,i=\text{even}} - w_{j,i=\text{odd}}}{1V} \tag{4}$$

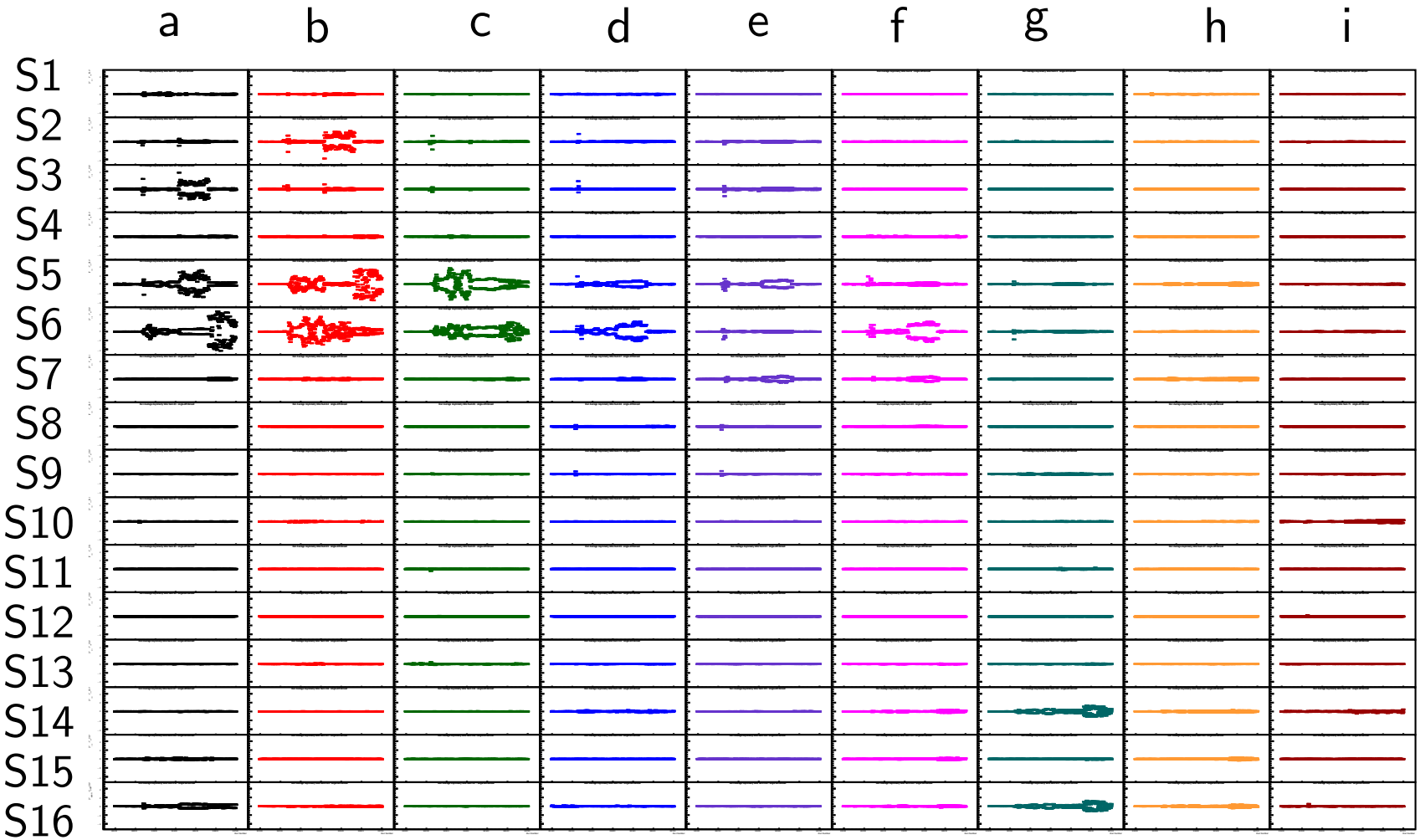
where q is the asymmetry number.
Note: Beam on physics asymmetries were calculated over time bins $5 - 44$
For comparison to the beam on signals and asymmetry a normalization comparable to average beam on signal for each wires can be used, but this has not been used in this analysis as we are mainly examining trends in the asymmetry behavior to try to find its origin.

Summer Runs All - Panel Plot - individual y-axis ranges



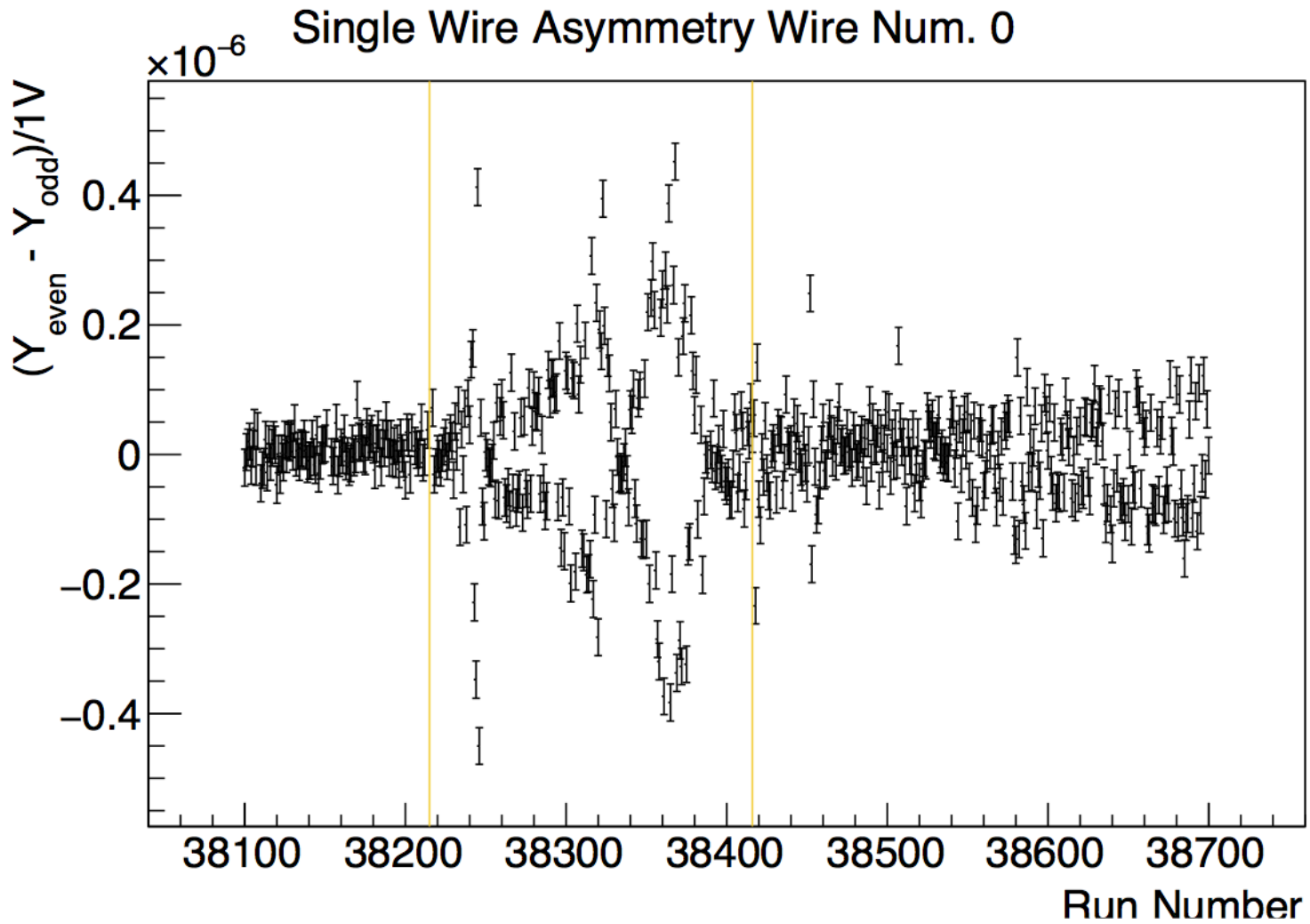
Note: The y-axis is different for all plots.
Calculated for time bin range 5-44 inclusive, error bars are standard error from histogram RMS.

Summer Runs All - Panel Plot - identical y-axis ranges



Note: The y-axis is the **same** for all plots.
Calculated for time bin range 5-44 inclusive, error bars are standard error from histogram RMS.

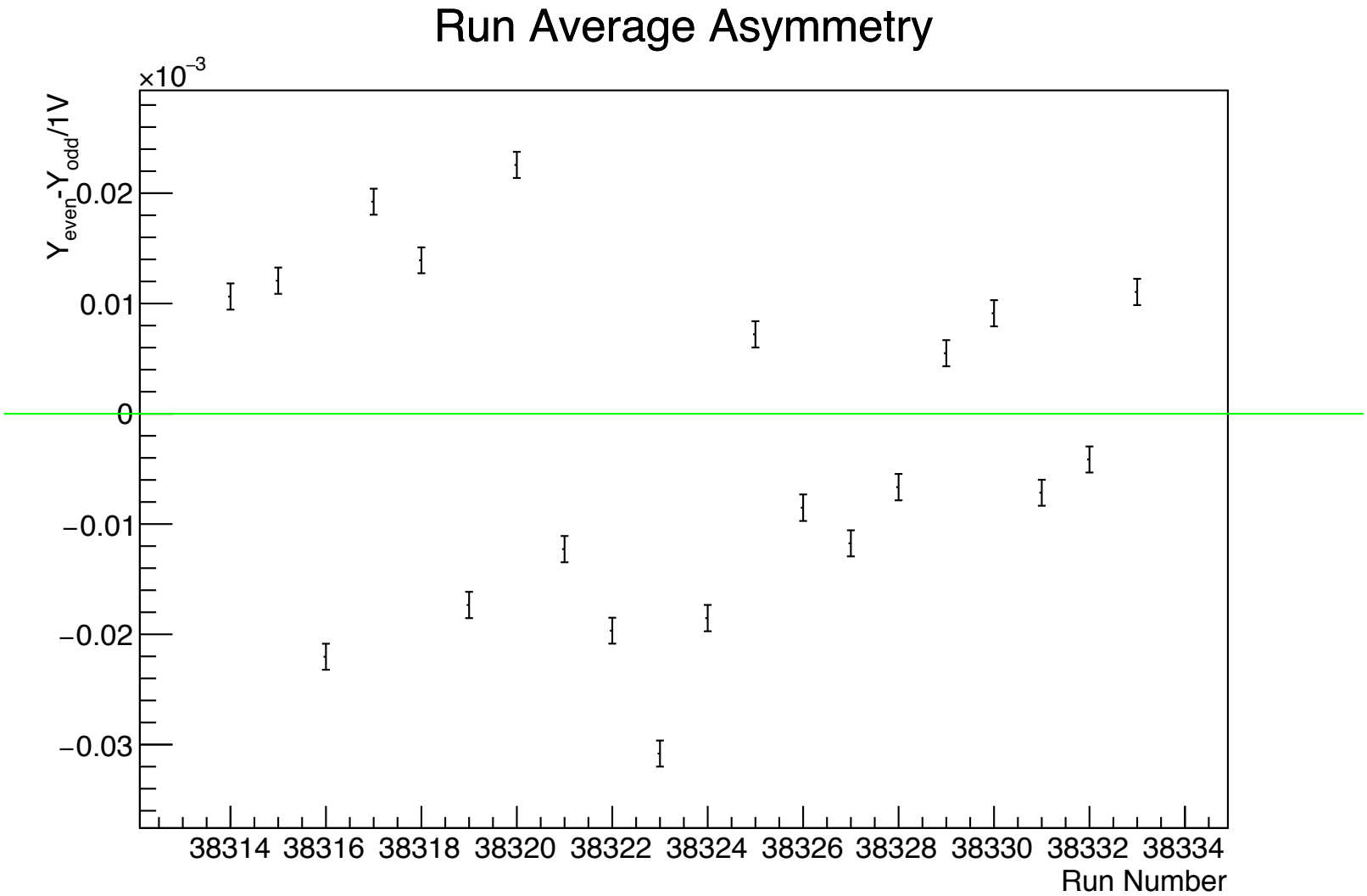
Summer Runs All - Wire 0



Note: The orange lines indicate the transition between summer run series shown on slide 4.

Note: This asymmetry is over all wire time bins, numbers 0-48.

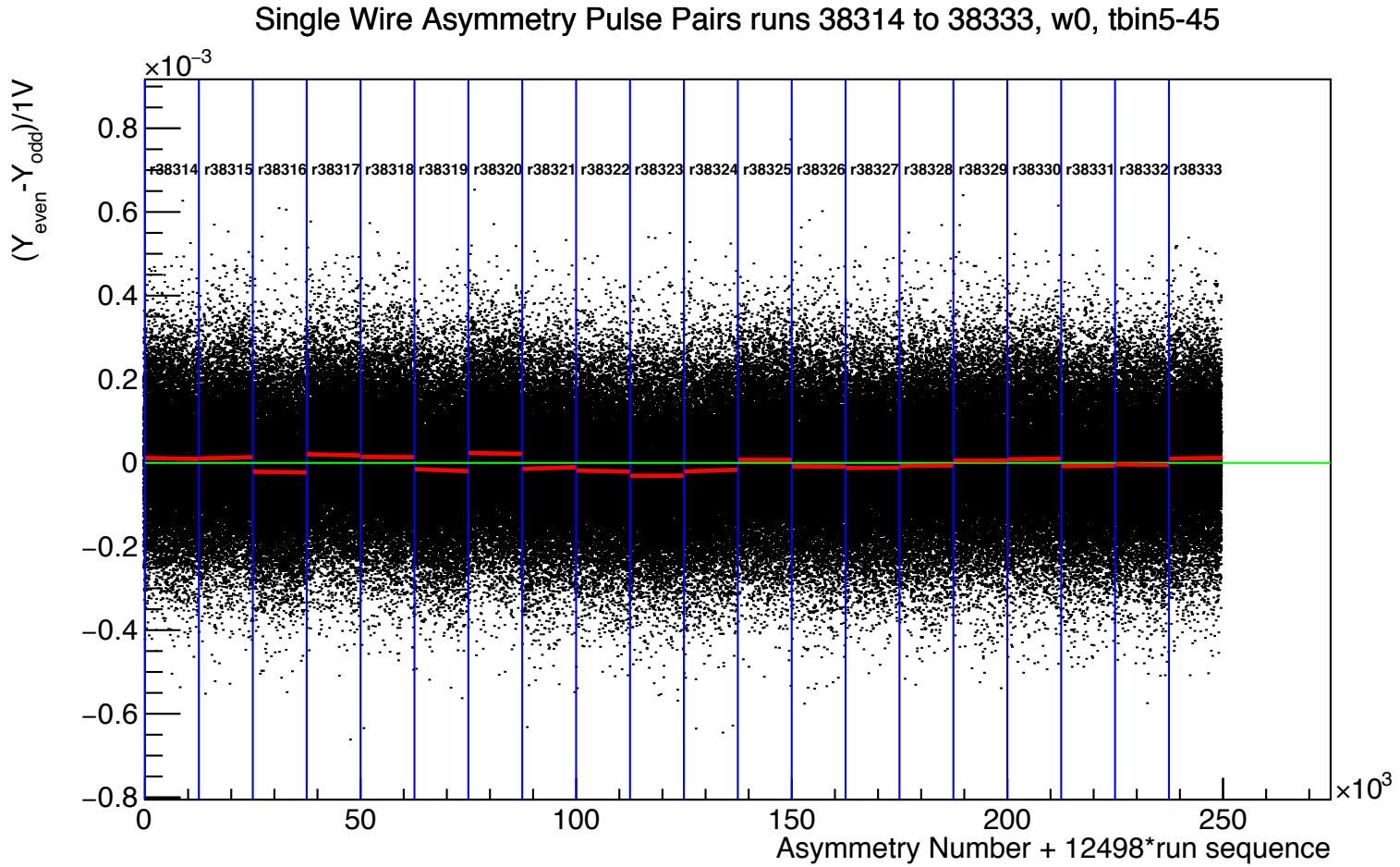
Summer Runs - Noisy Period - Wire 0 - Run Averages



The run average and standard error of the instrumental asymmetry calculated for time bins 5-44.

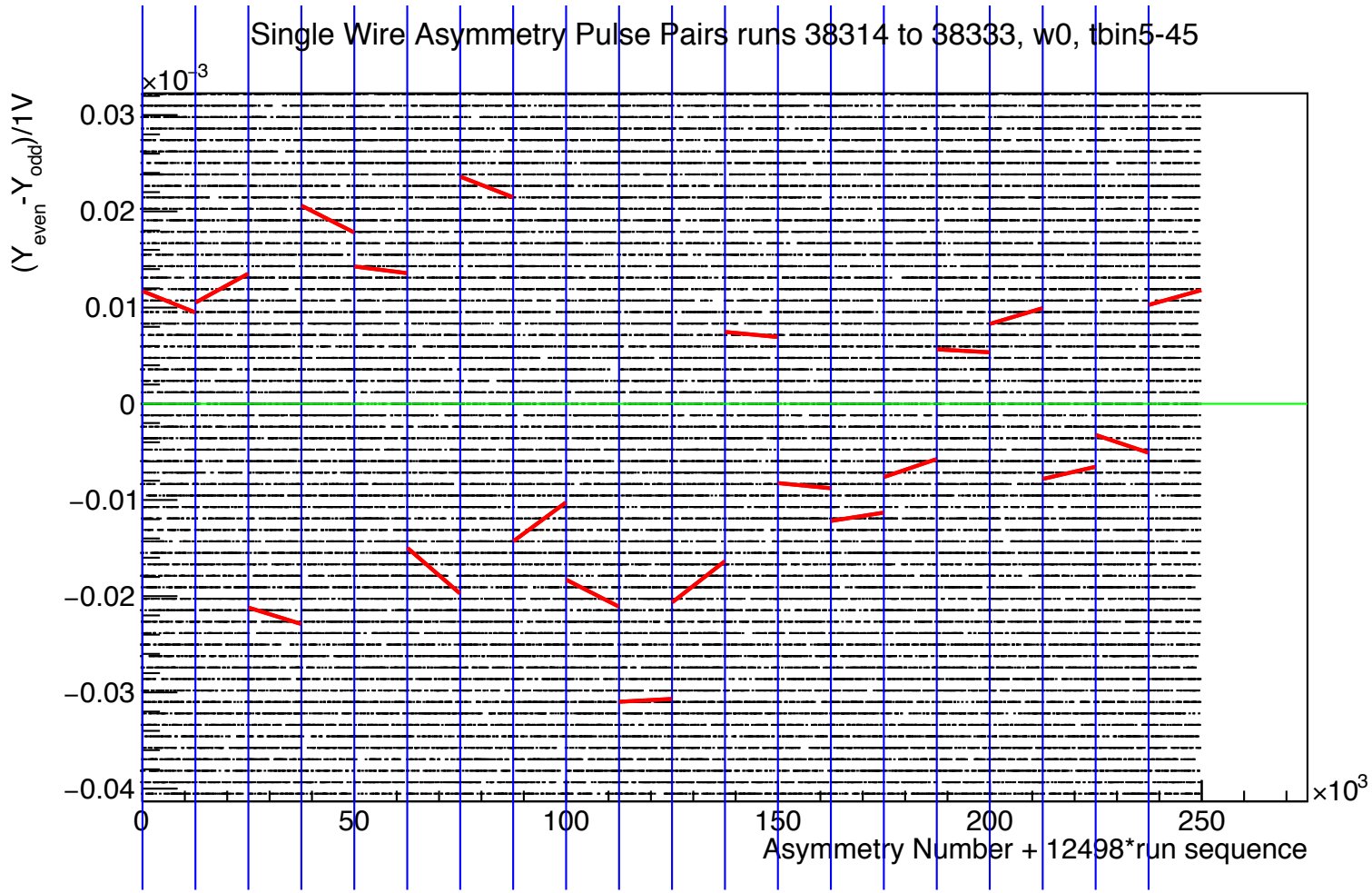
These runs are from near the peak of a diamond in the second summer running period 38216-38416.

Summer Runs - Noisy Period - Wire 0 - Run Points



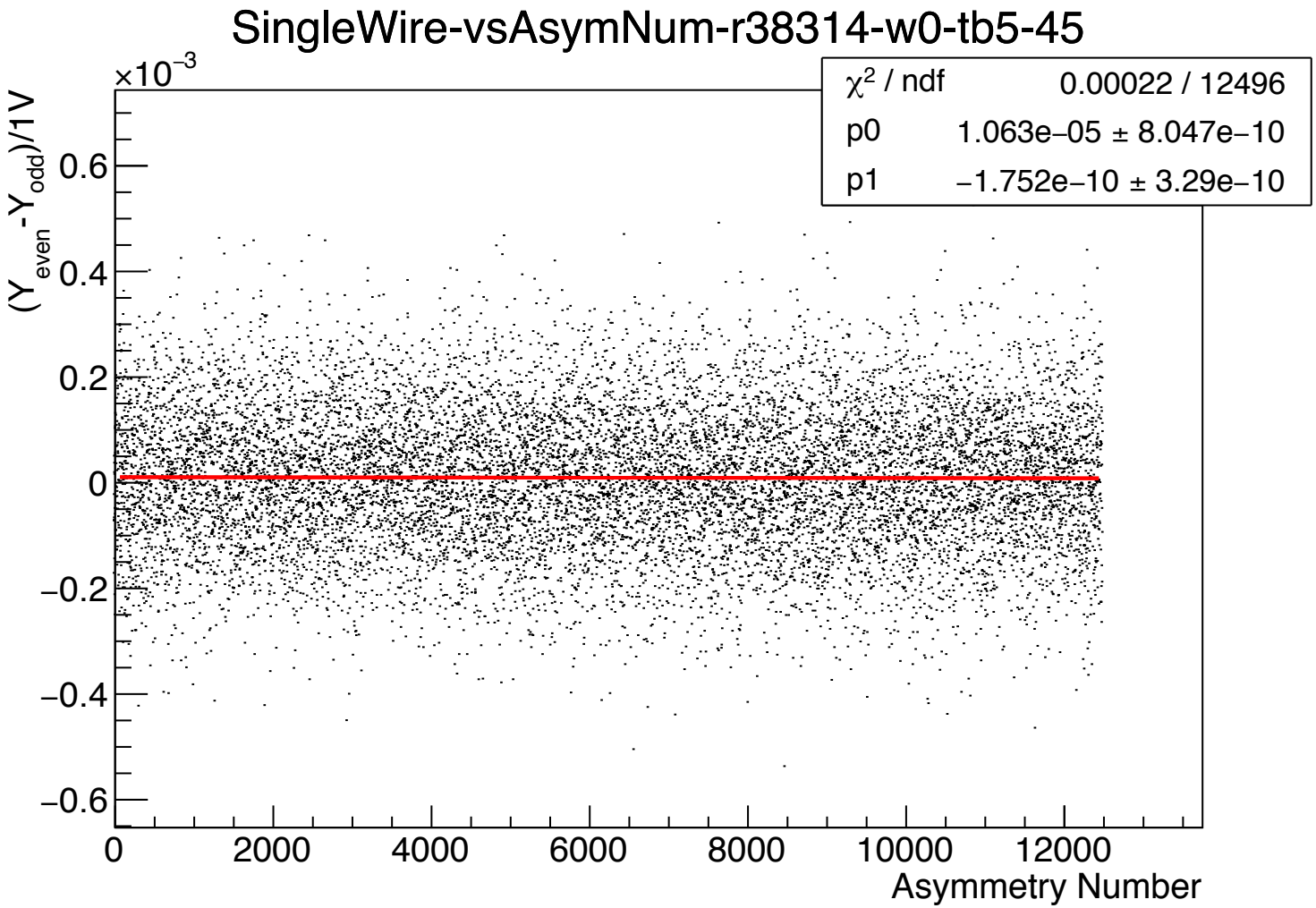
This plot shows all of the 12498 instrumental asymmetries that went into the average of the previous plot for a subset of the overall runs. Blue lines are separations between runs, the green line is a horizontal line at 0, and the red lines are fits made to each run.

Summer Runs - Noisy Period - Wire 0 - Run Points - Zoomed



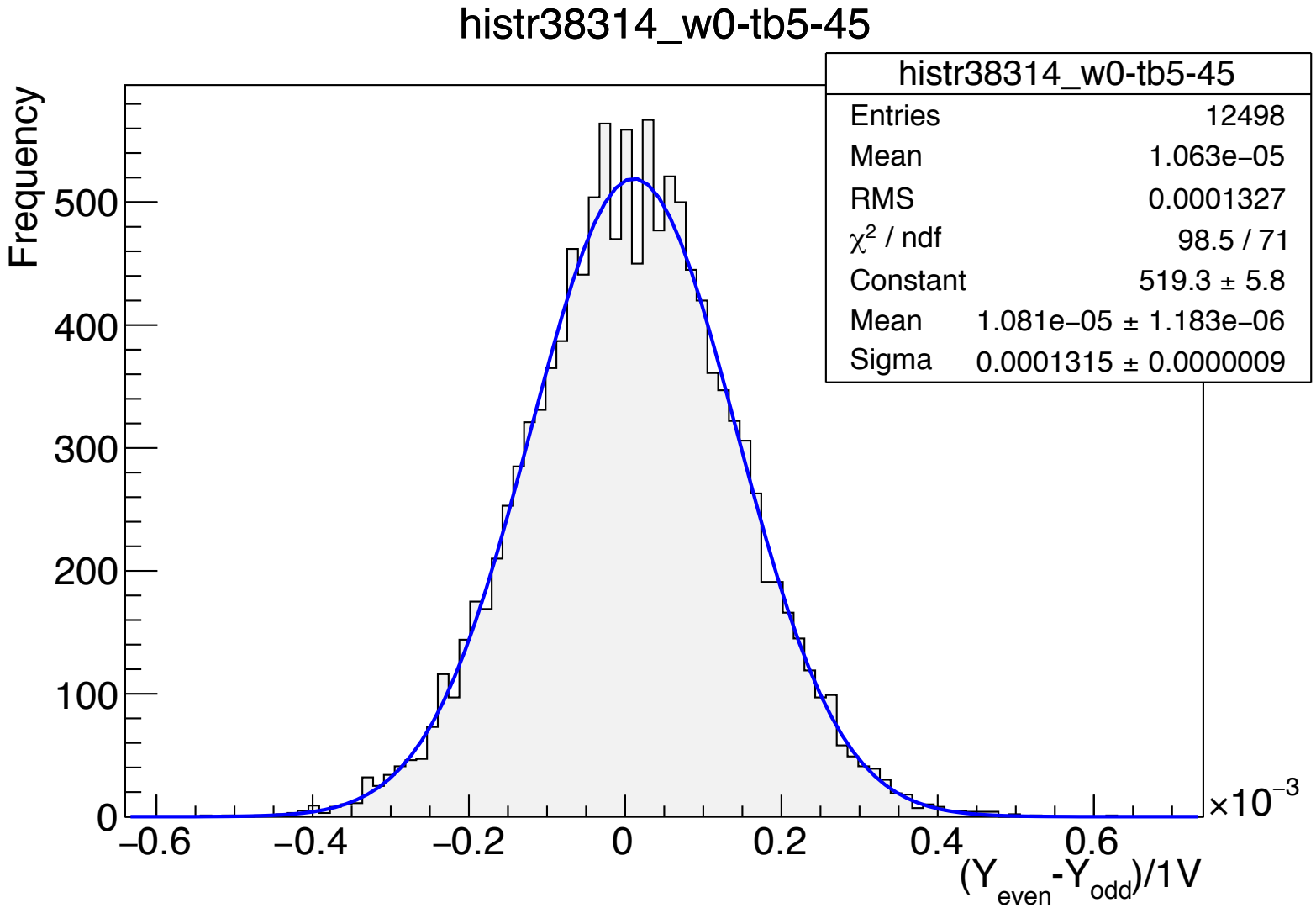
This is the same plot as the previous slide, but zoomed in to show the fit lines.

Summer Runs - Noisy Period - Run 38314 - Wire 0



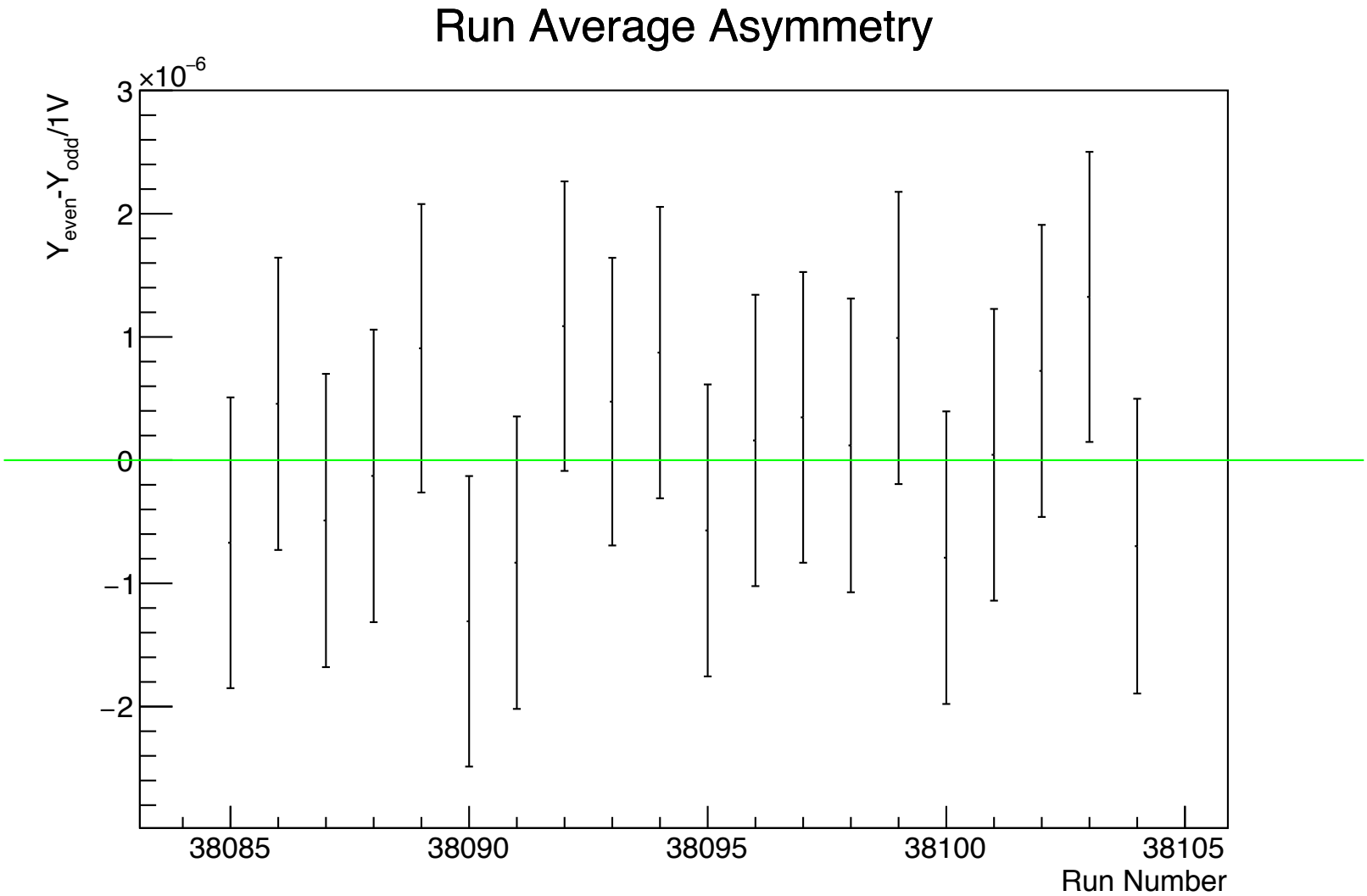
This plot shows the instrumental asymmetries and fitting parameters for one of the runs in the previous two plots.

Summer Runs - Noisy Period - Run 38314 - Wire 0



This is a histogram of the instrumental asymmetries calculated over a run that was graphed on the previous slide.

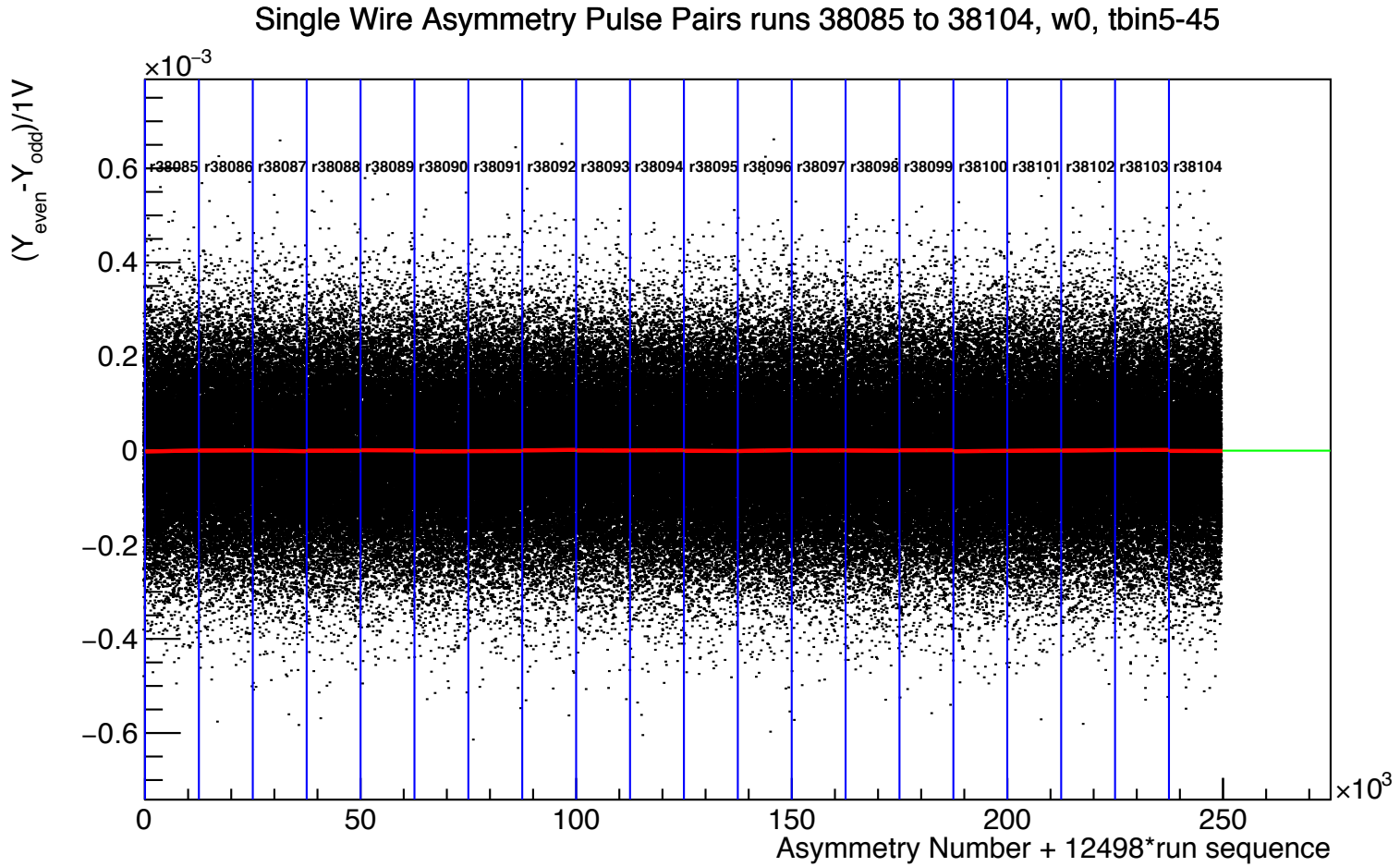
Summer Runs - Quiet Period - Wire 0 - Run Averages



The run average and standard error of the instrumental asymmetry calculated for time bins 5-44.

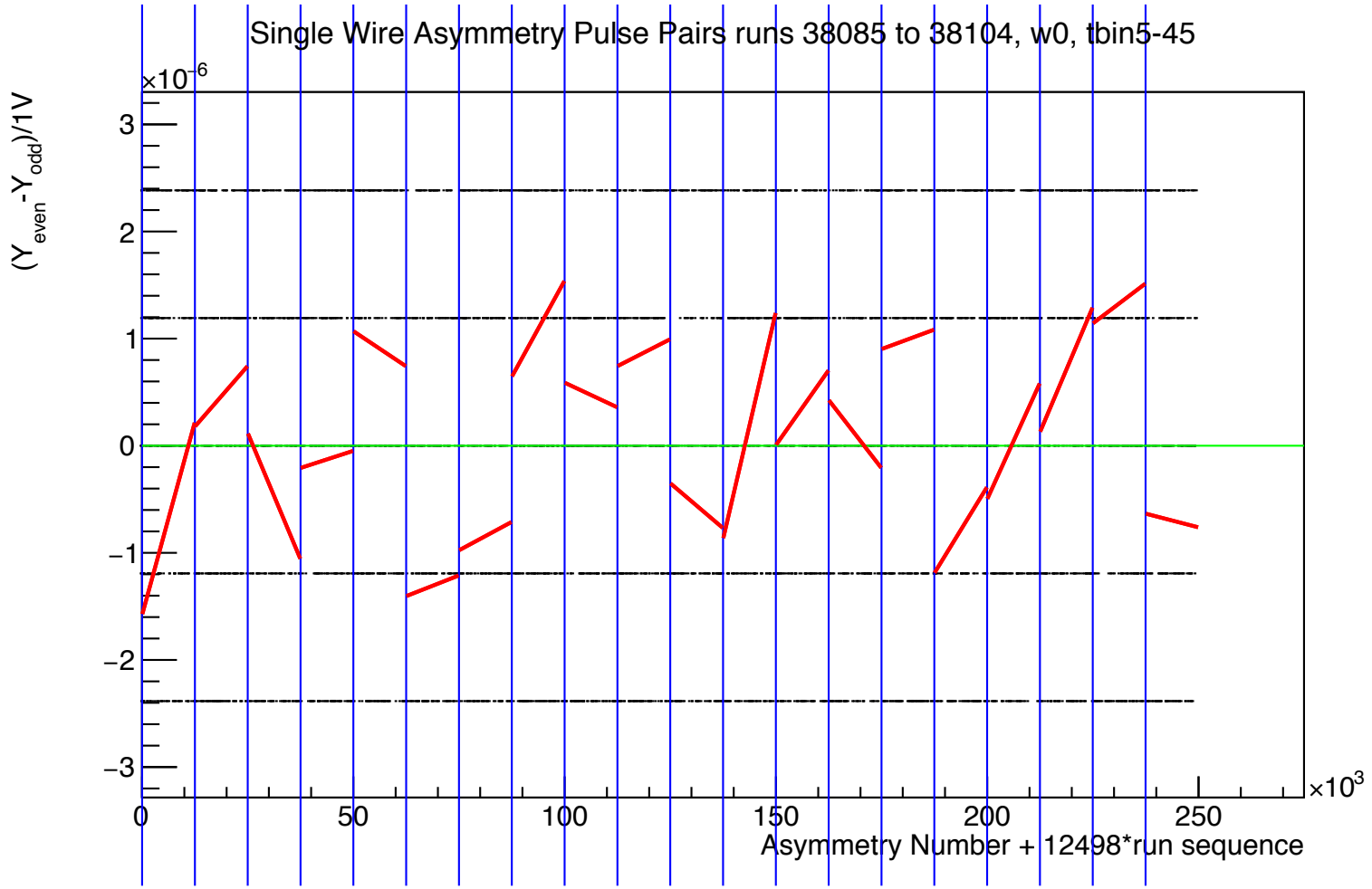
The quiet period is from the start of the summer running period

Summer Runs - Quiet Period - Wire 0 - Run Points



This plot shows all of the 12498 instrumental asymmetries that went into the average of the previous plot for a subset of the overall runs. Blue lines are separations between runs, the green line is a horizontal line at 0, and the red lines are fits made to each run.

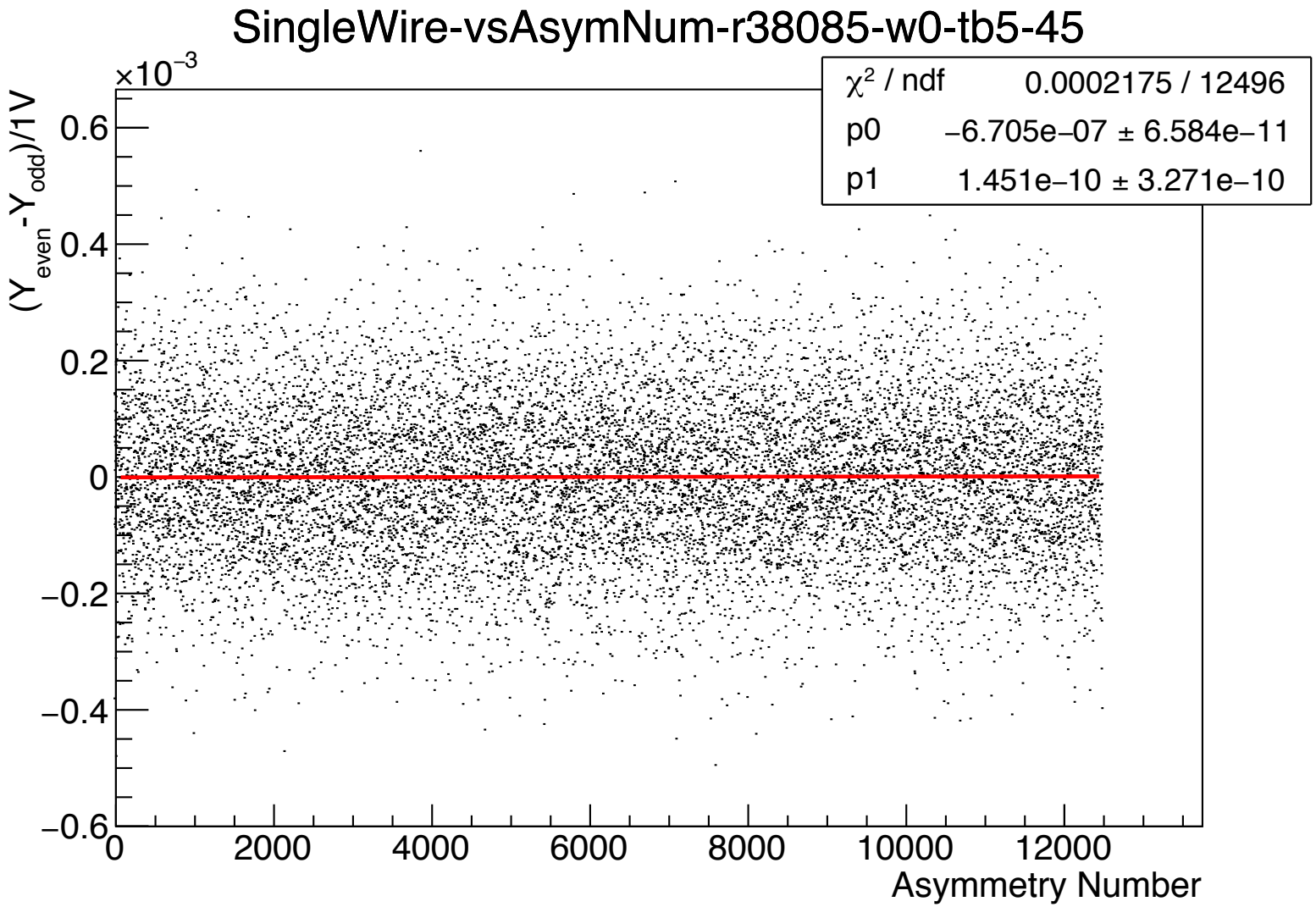
Summer Runs - Quiet Period - Wire 0 - Run Points - Zoomed



This is the same plot as the previous slide, but zoomed in to show the fit lines.

Note the difference in the y-scale compared to the noisy period

Summer Runs - Quiet Period - Run 38314 - Wire 0



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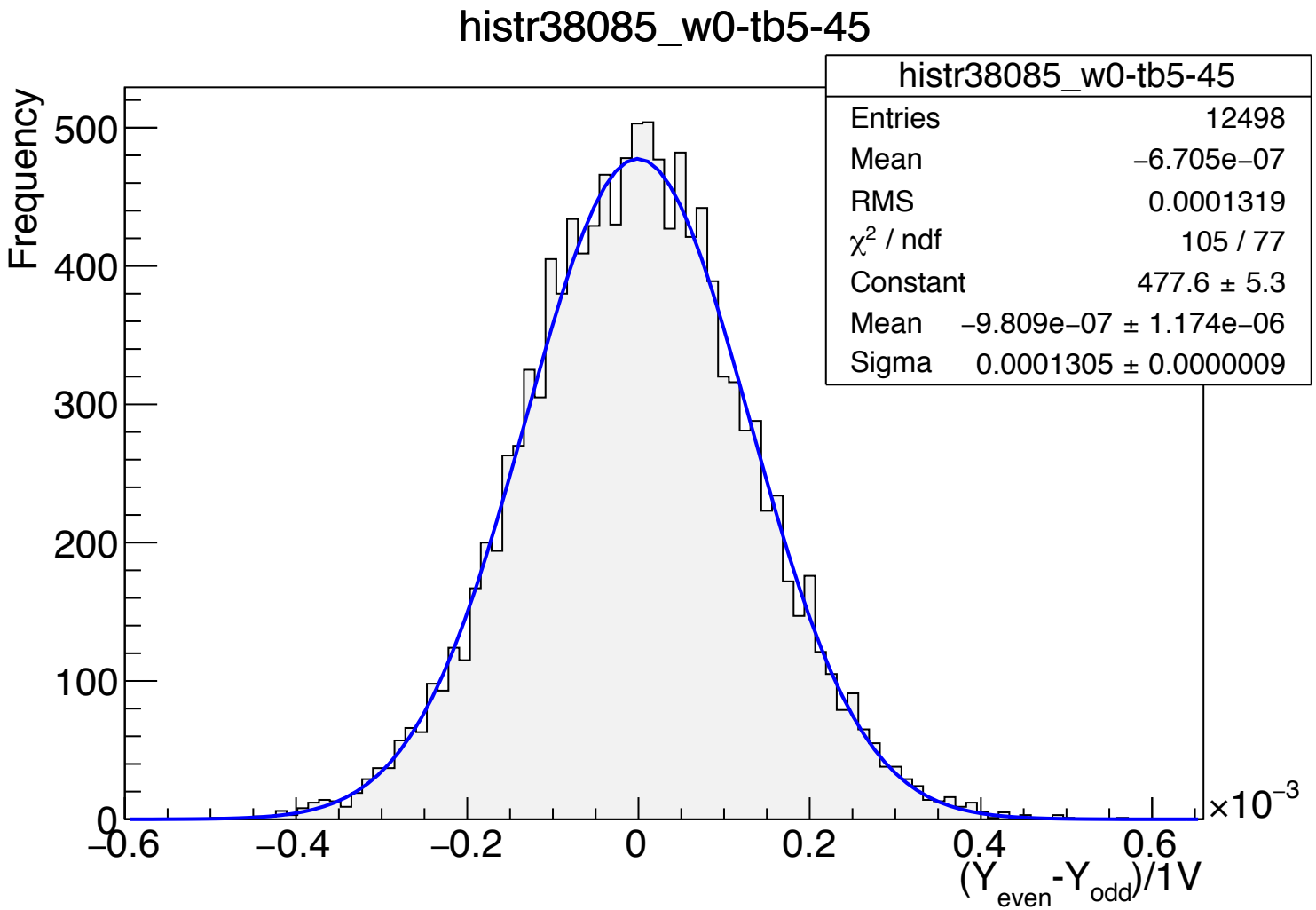
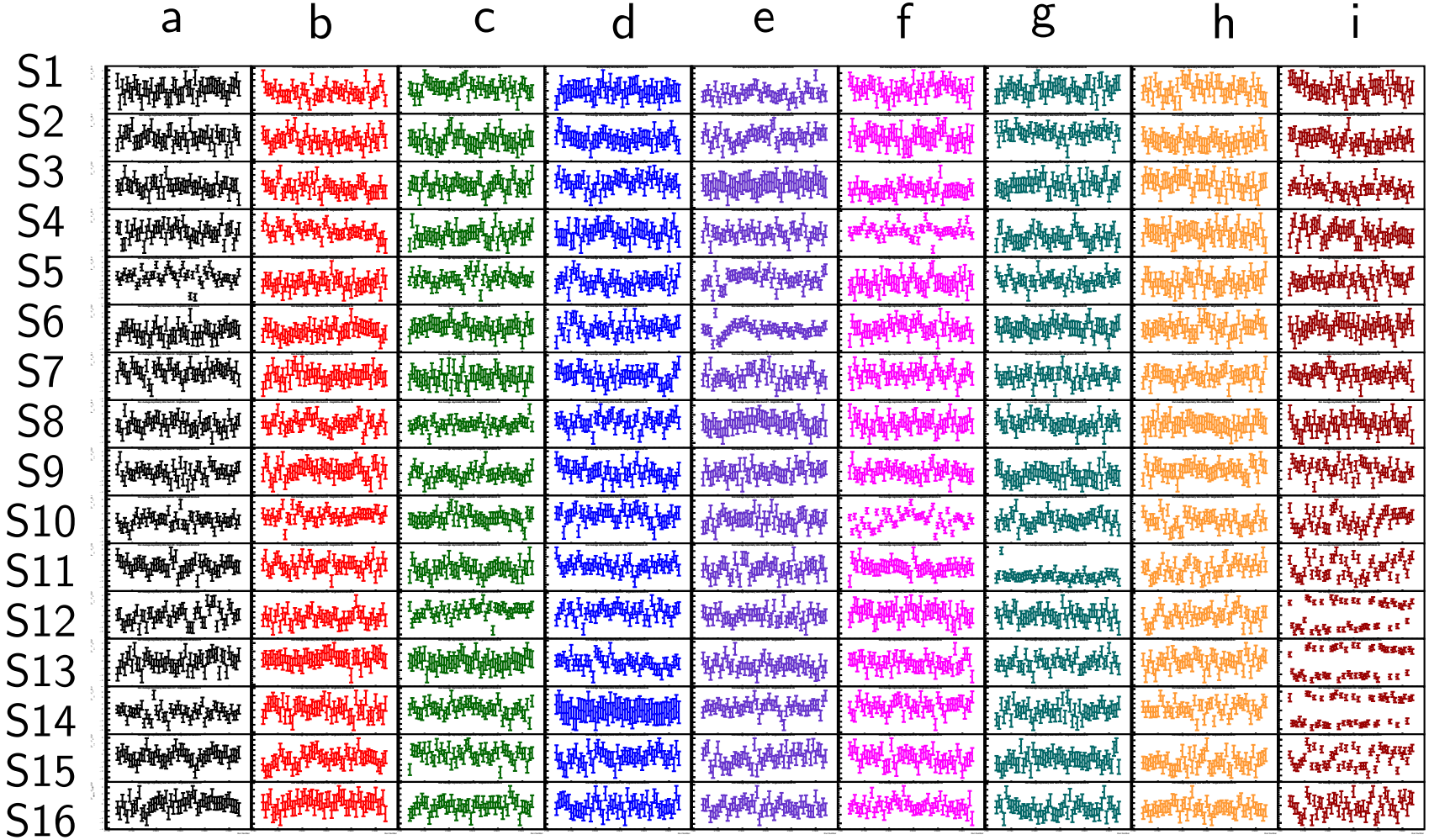
Summer Runs - Quiet Period - Run 38314 - 0



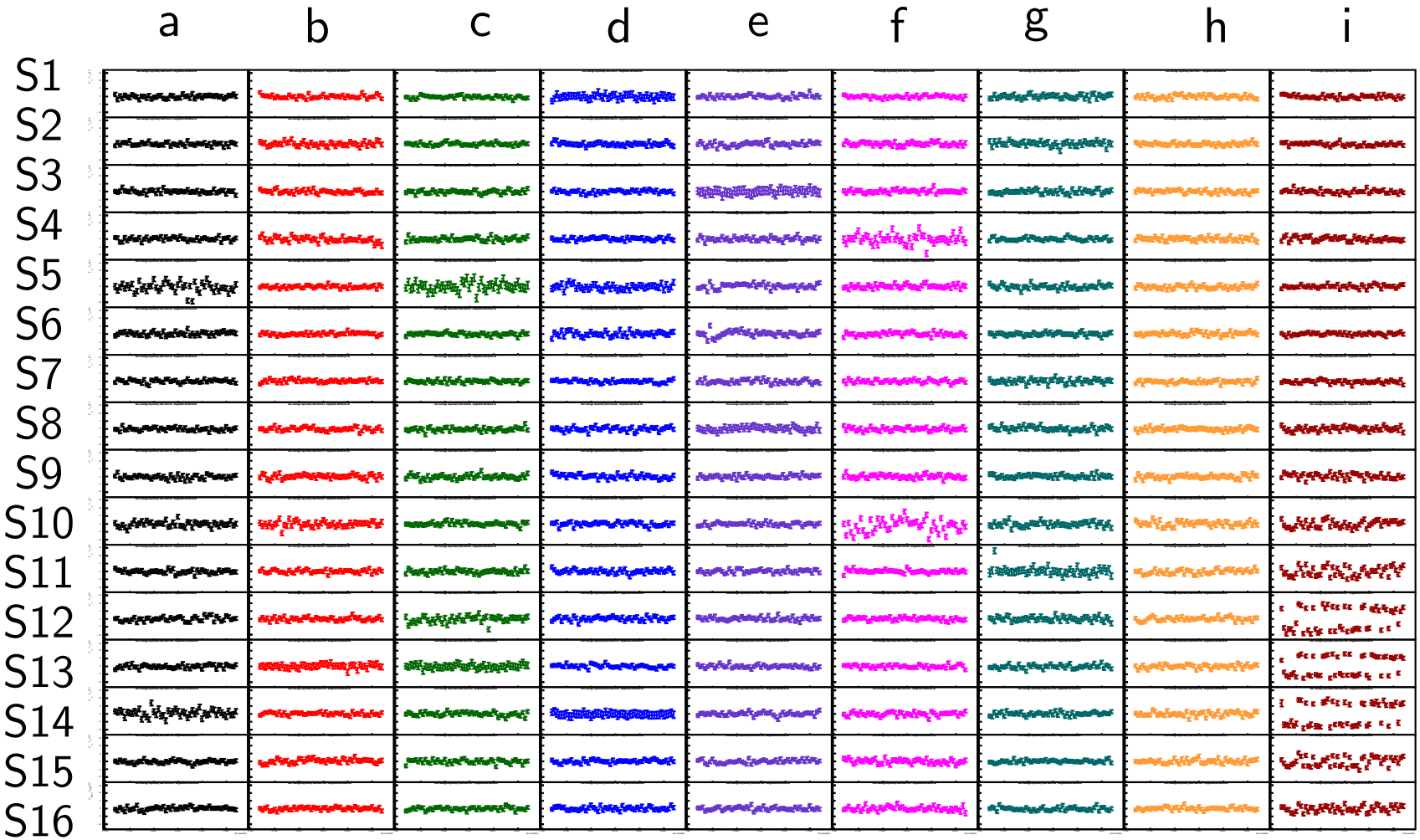
This is a histogram of the instrumental asymmetries calculated over a run that was graphed on the previous slide.

Tuesday 1 - Panel Plot - individual y-axis ranges



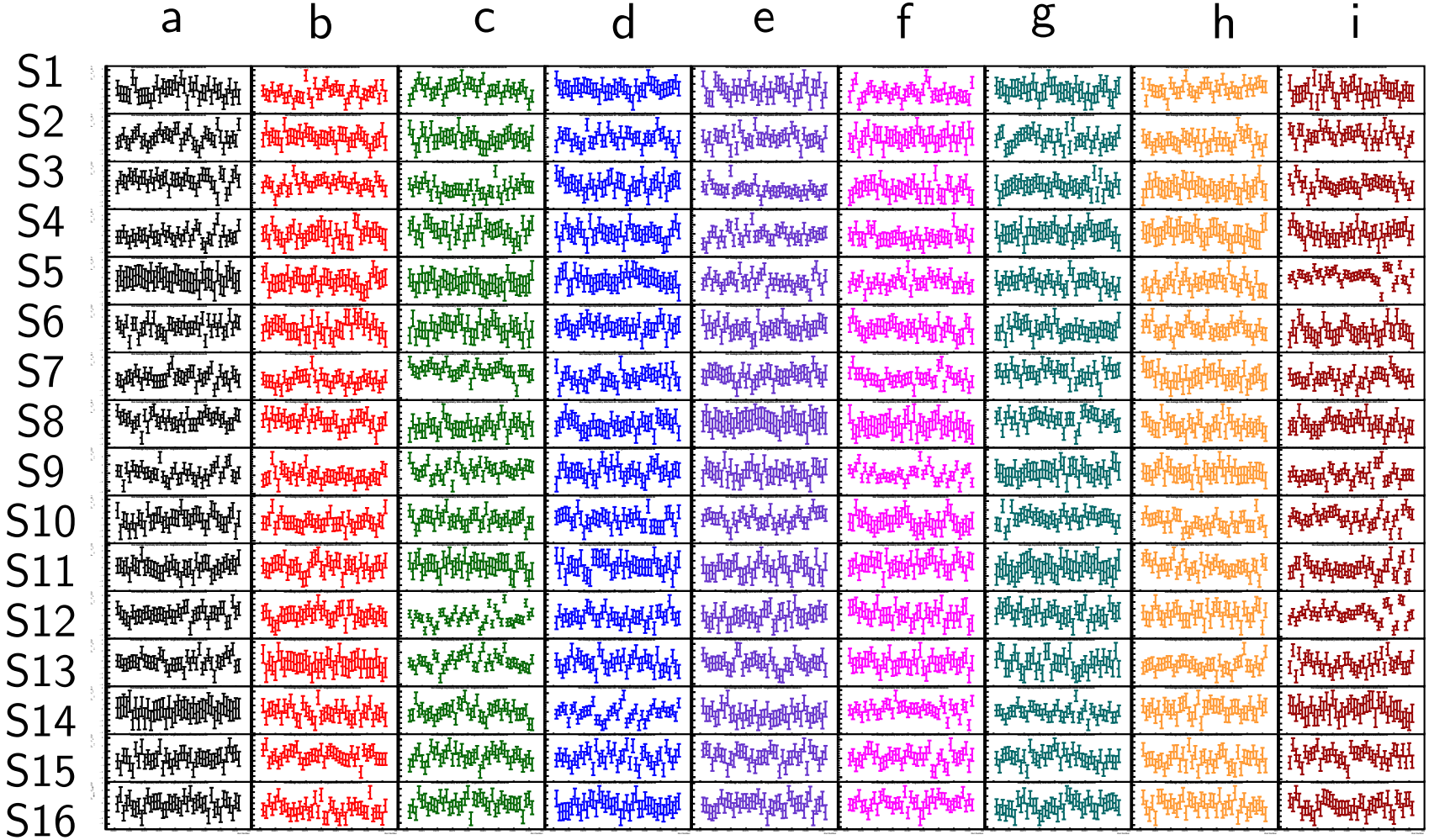
Note: The y-axis is the different for all plots.
Calculated for time bin range 5-44 inclusive, error bars are standard error from histogram RMS.

Tuesday 1 - Panel Plot - identical y-axis ranges



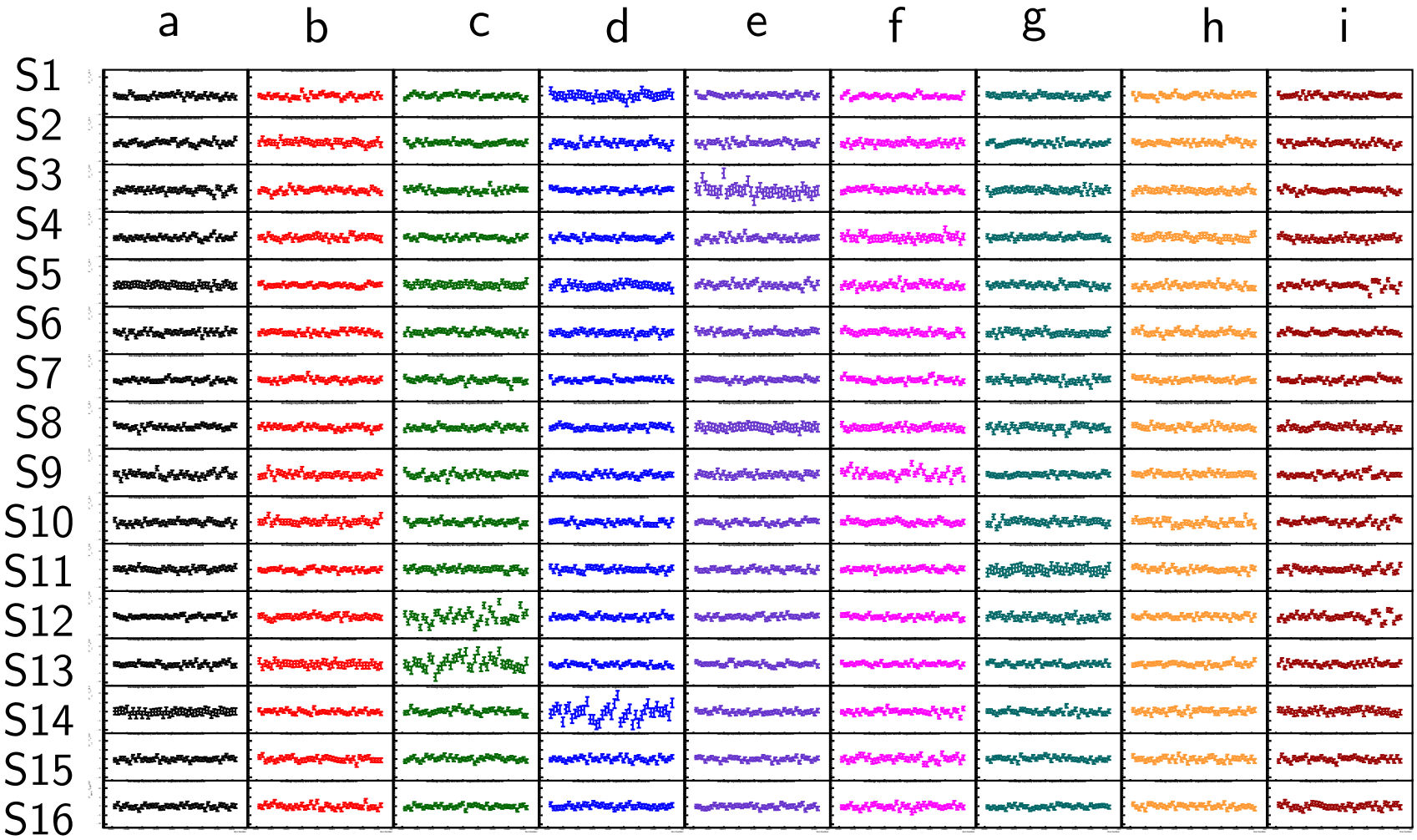
Note: The y-axis is the **same** for all plots.
Calculated for time bin range 5-44 inclusive, error bars are standard error from histogram RMS.

Tuesday 6 - Panel Plot - individual y-axis ranges



Note: The y-axis is the different for all plots.
Calculated for time bin range 5-44 inclusive, error bars are standard error from histogram RMS.

Tuesday 6 - Panel Plot - identical y-axis ranges



Note: The y-axis is the **same** for all plots.
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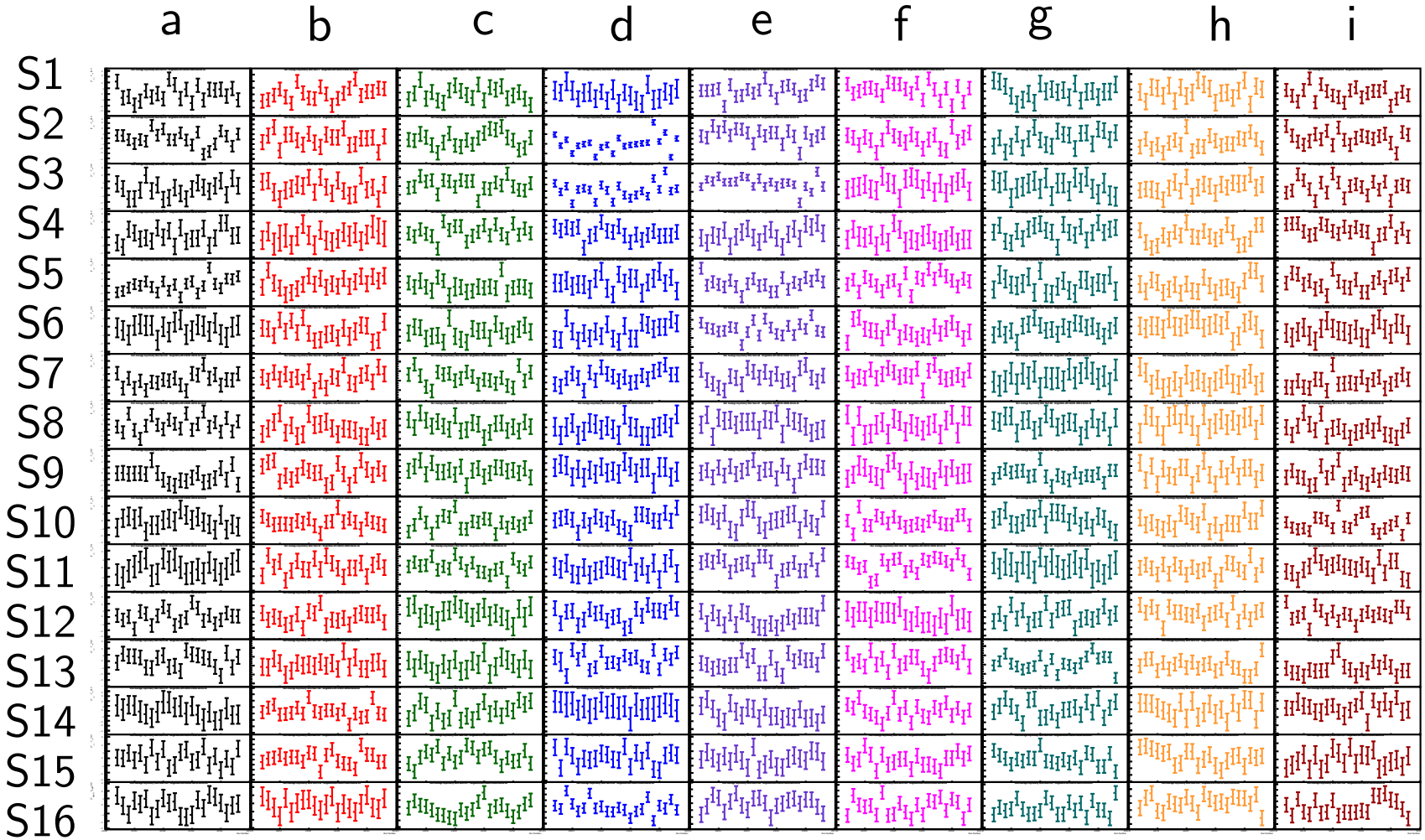
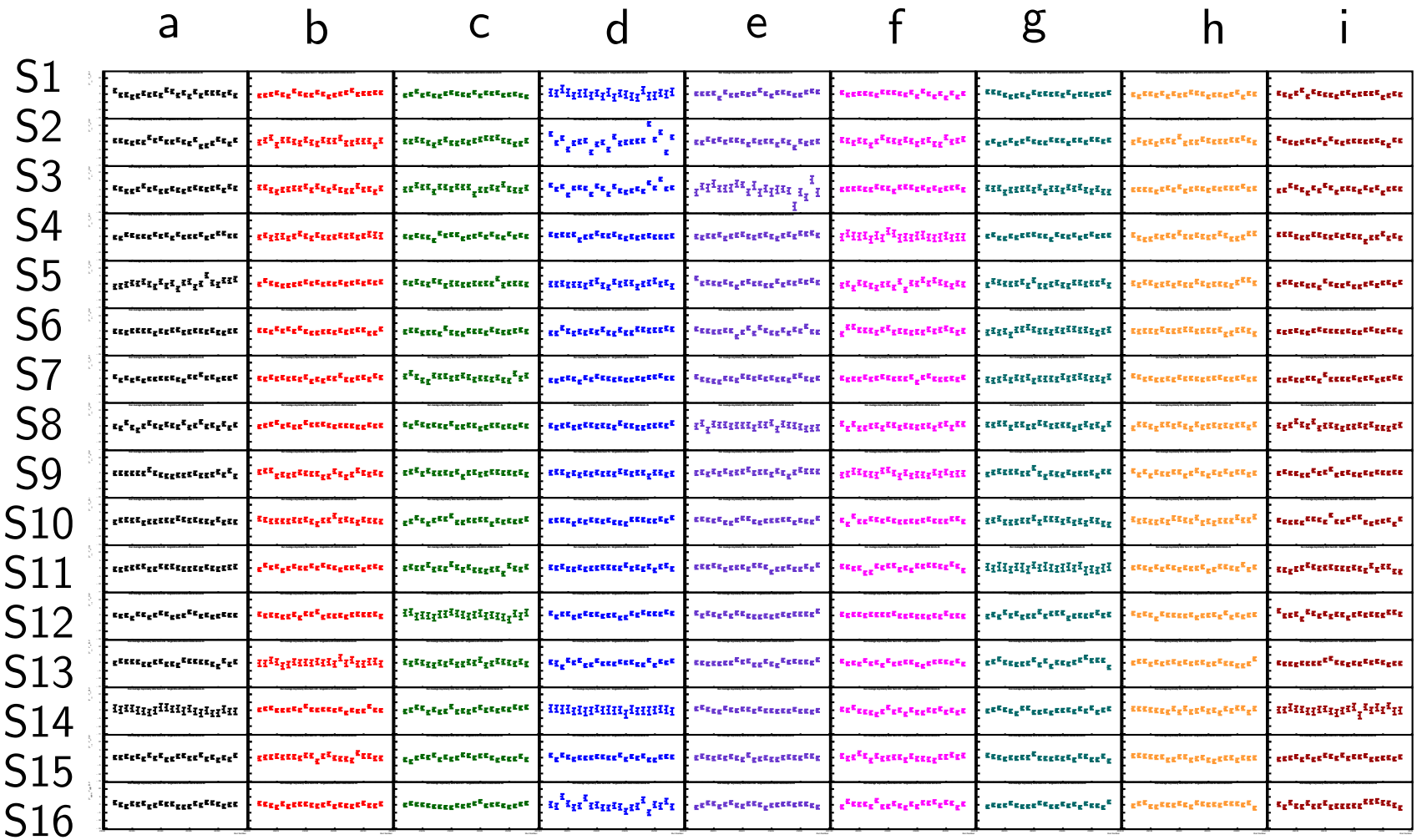
Tuesday 10 - Panel Plot - individual y-axis ranges



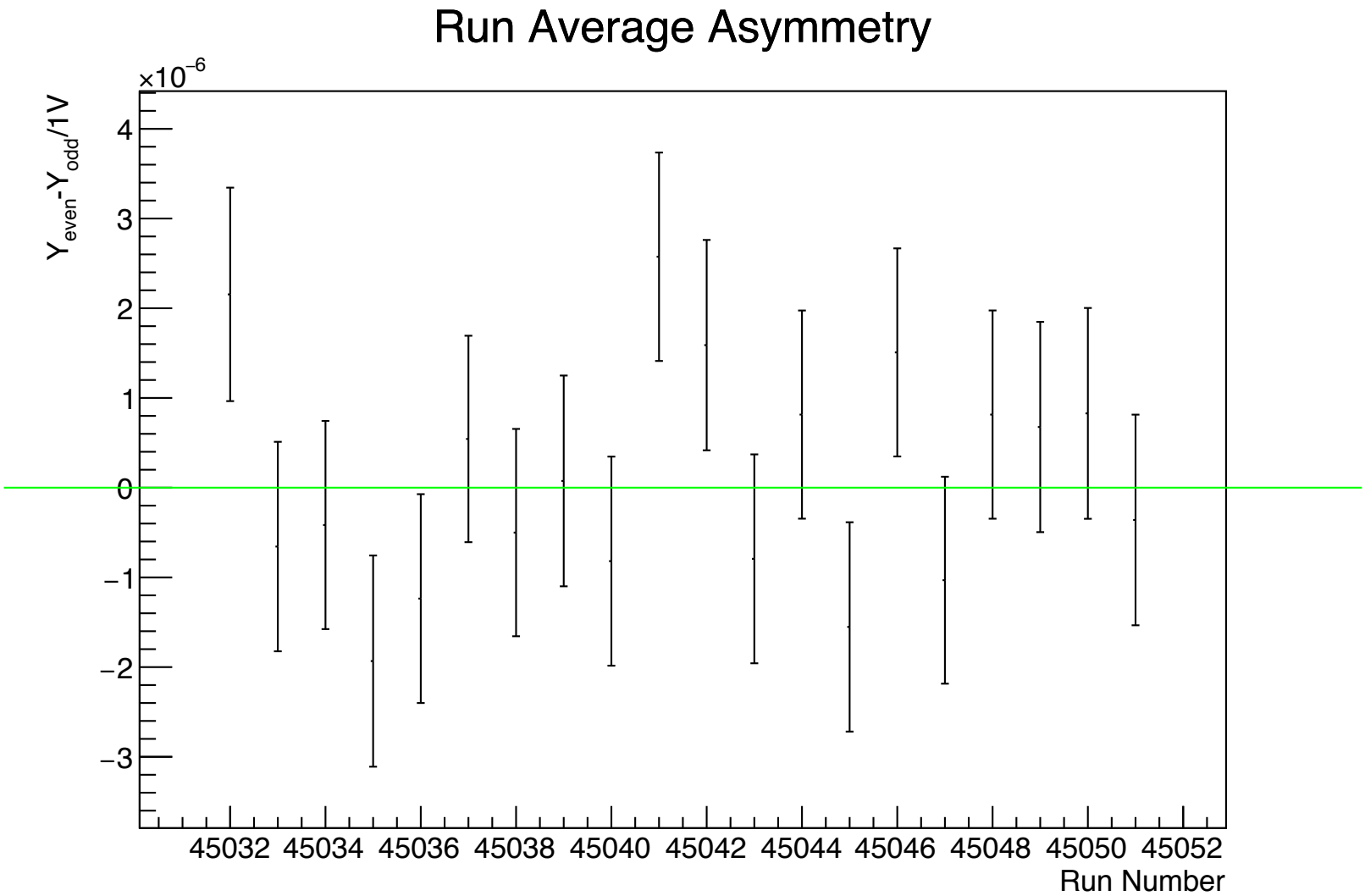
Note: The y-axis is the different for all plots.
Calculated for time bin range 5-44 inclusive, error bars are standard error from histogram RMS.

Tuesday 10 - Panel Plot - identical y-axis ranges



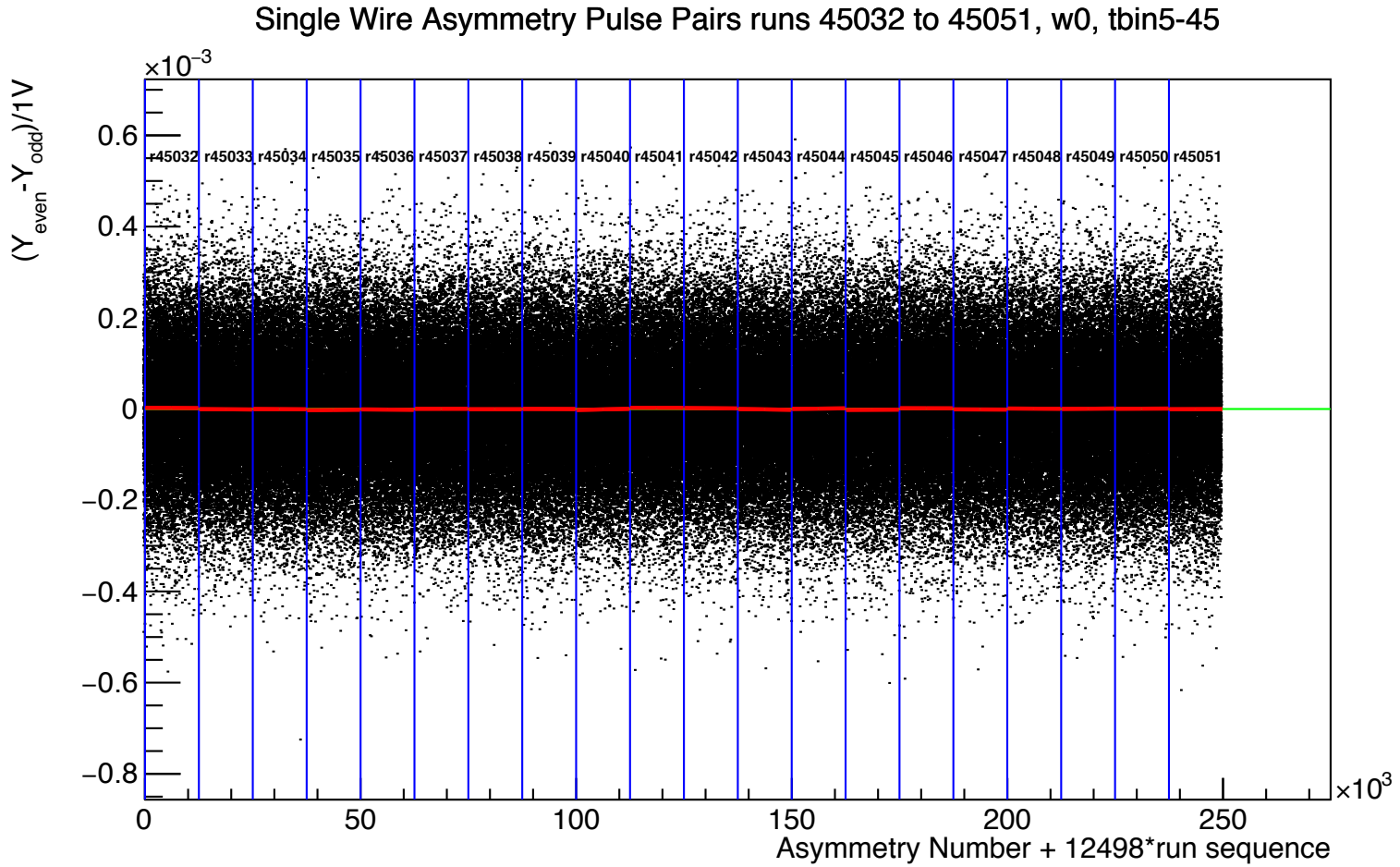
Note: The y-axis is the **same** for all plots.
Calculated for time bin range 5-44 inclusive.

Tuesday 10 - Wire 0 - Run Averages



The run average and standard error of the instrumental asymmetry calculated for time bins 5-44.

Tuesday 10 - Wire 0 - Run Points



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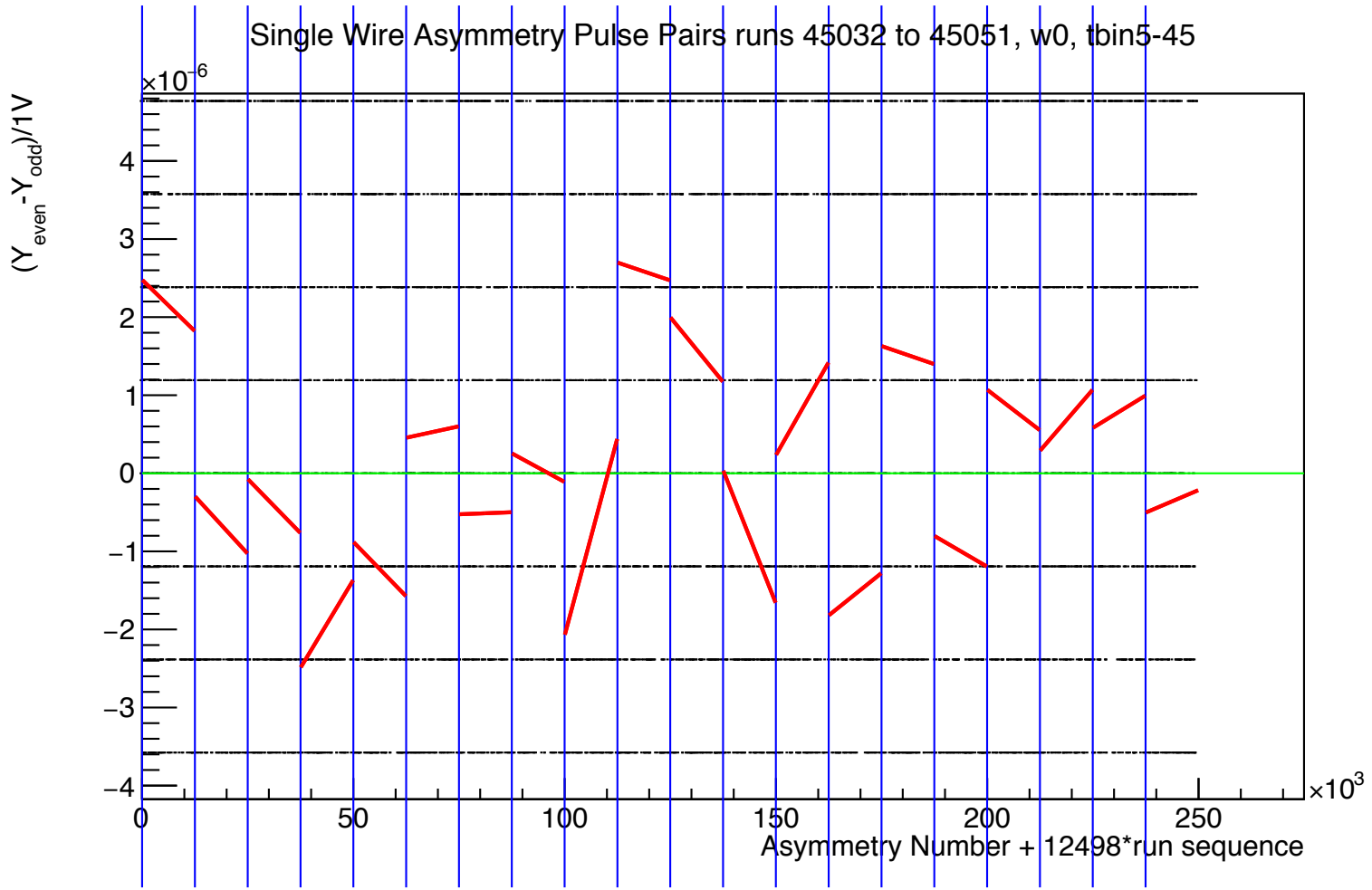
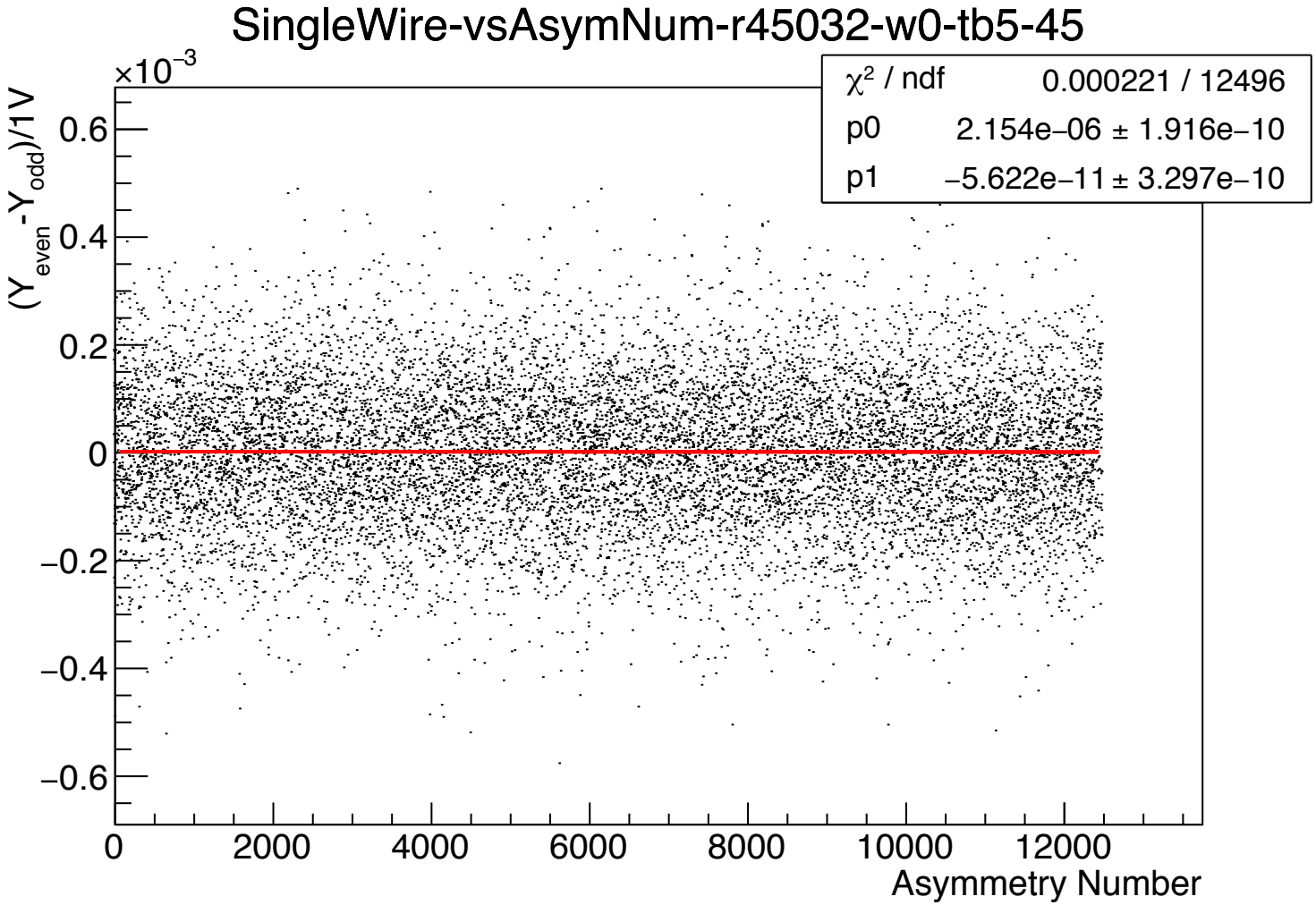
Tuesday 10 - Wire 0 - Run Points - Zoomed



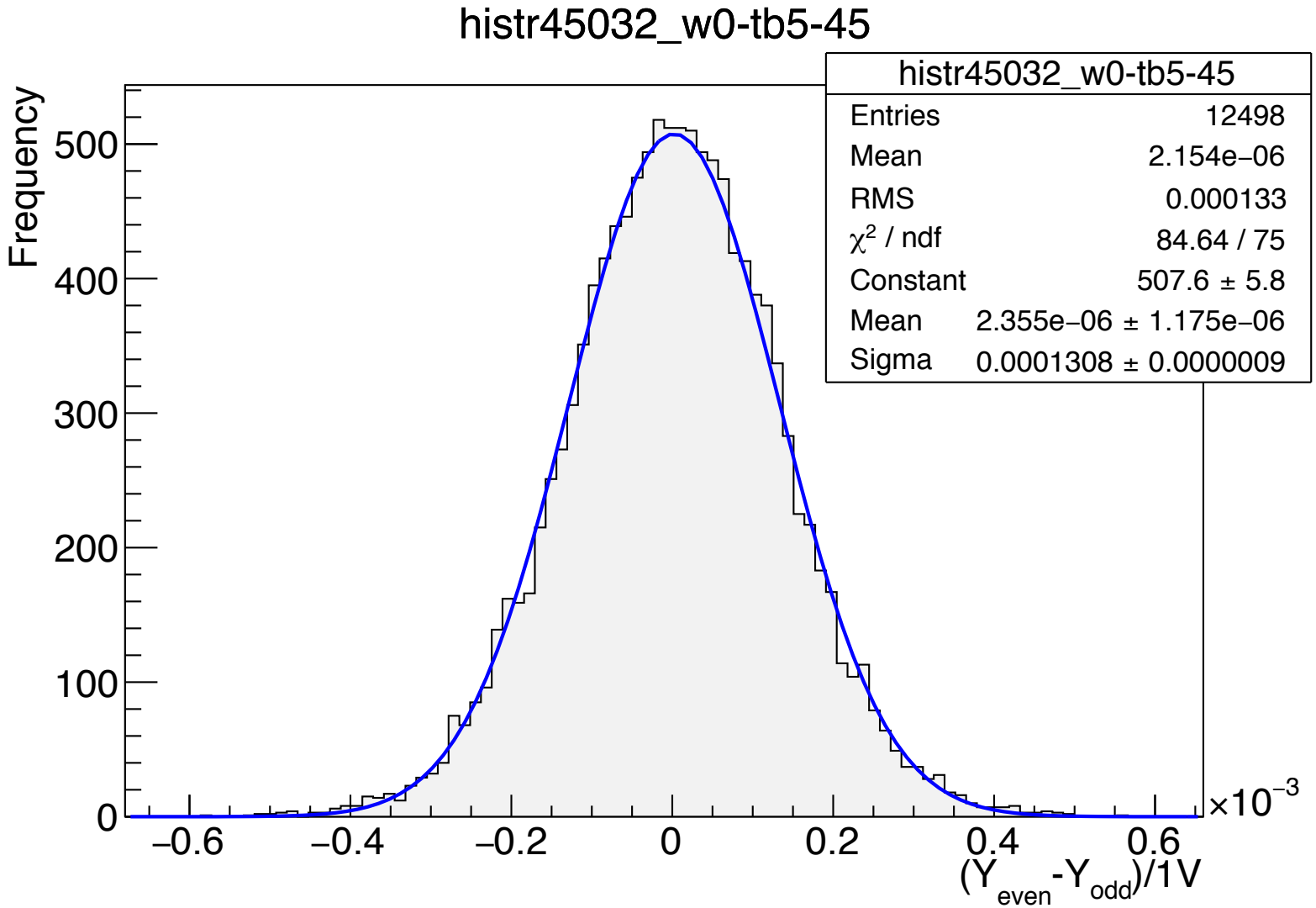
This is the same plot as the previous slide, but zoomed in to show the fit lines.

Tuesday 10 - Run 45032 - Wire 0



This plot shows the instrumental asymmetries and fitting parameters for one of the runs in the previous two plots.

Tuesday 10 - Run 45032 - Wire 0



This is a histogram of the instrumental asymmetries calculated for one run that was graphed on the previous slide.

Conclusions

- Three Tuesday Runs show low noise without the diamond structures
- 2-4 wires on the Tuesday runs have larger asymmetries than the other wires
- Noise may be limited to the mid and late summer maintenance periods.
- No particular structure is visible in the time bin averaged asymmetry.

Future Work:

- Finish examining all summer runs for asymmetry
- Look at un-averaged asymmetry for each time bin over a run
- Look at beam on dropped pulses, especially random dropped pulses, to see if asymmetry is present with the beam on.