# Collaboration Meeting: Analysis

Jonathan Miller

Preliminary Results

# Discussion

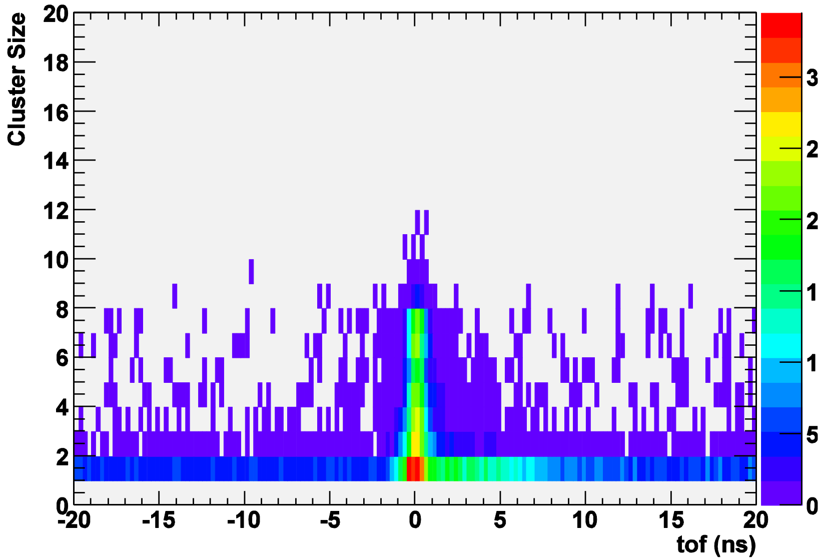
- Clustering
- Single Quasi-Elastic
- Kinematic 4
  - Event Selection
  - Proton to Neutron Conversion
  - Results
- Kinematic 3 – in Progress

# Clustering

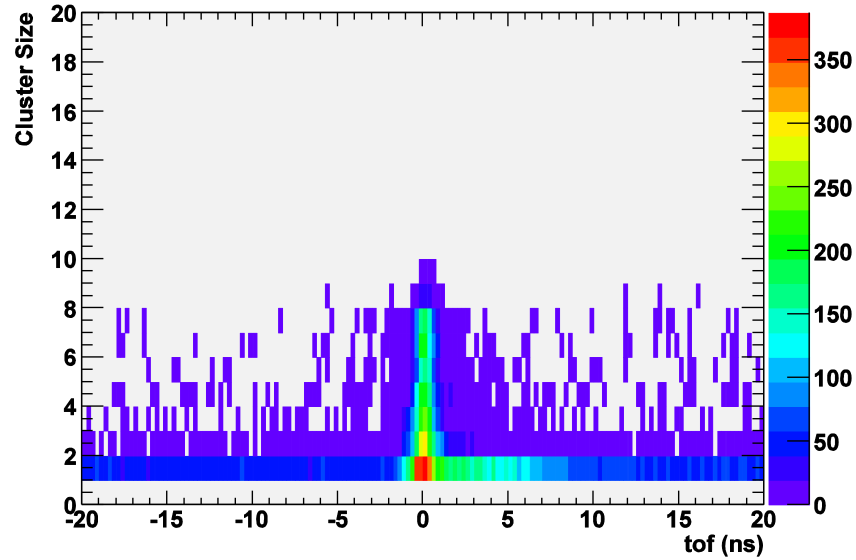
- Current Mechanism:
  - Selects neighboring bars (within 1) in X and Z
  - Selects hits within 10 ns (corrected time)
- Proposed Mechanism:
  - Selects neighboring bars within 2 in X and Z
  - Selects hits with time of flight calculated relative to Big Bite of within 2 ns

# Clustering

**Within 2 bars**




**Within 1 bar**




Adding the second bar into the cluster narrows the peak in time and decreases the tail. This is also uses horizontal position for selection but only uses time for depth. Both these clusters are done with 2 ns TOF selection rather than 10 ns corrected time selection.

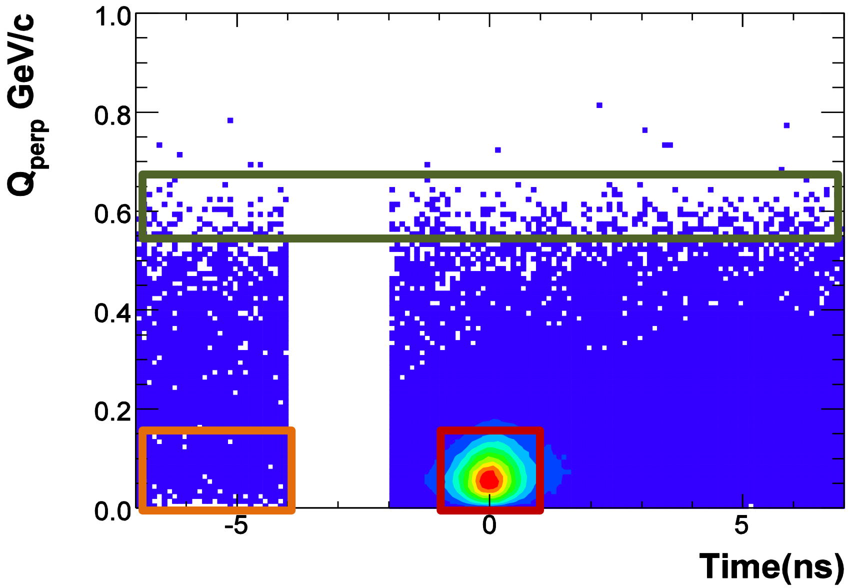
# Single Quasi-elastic Analysis

- In standard analysis, due to quasi-elastic events being observed as hadrons within the neutron layers, and causing hits within the veto layers, the charge of an accidental hit can not be determined near the quasi-elastic hit.
- If multiple clusters are observed from the same quasi-elastic event (which is quite common using current clustering), then either all clusters are charged or all are uncharged.
  - This is accounted for in neutron to proton conversion analysis.

# Alternate Background Analysis Technique – Mechanism

Here is the formula for the total number of hadron hits in regions A and B. The label *back* refers to background accidentals while *QE* refers to quasi-elastic hits. Here the | means with at least one other hit of the type of event referred to in the region.

$$N_{full}^{A+B} = N_{back}^{A} + N_{QE}^{A} + N_{QE}^{A}|_{back} + N_{back}^{A}|_{back} + N_{back}^{B}|_{back} + N_{QE}^{B}|_{back} + N_{QE}^{A}|_{QE} + N_{back}^{A}|_{QE} + N_{back}^{B} + N_{back}^{B}|_{QE}$$




Once the regions are properly scaled, the proper number of accidental quasi-elastic events can be determined. Since only a single event can be in region *A* or *B*, we are left with:

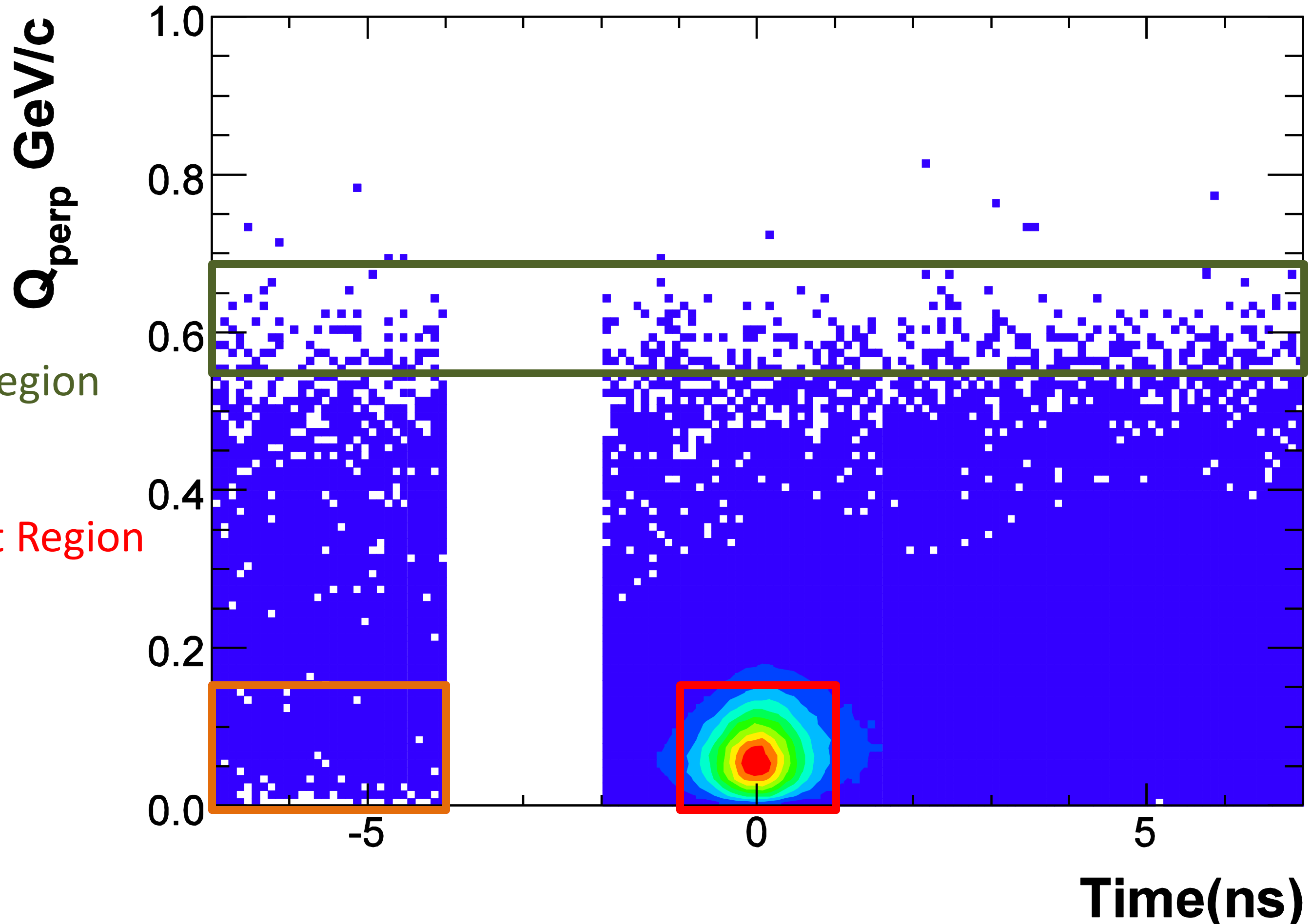
$$N_{SQE}^{B} = N_{back}^{B}$$

$$N_{SQE}^{A} = N_{back}^{A} + N_{QE}^{A}$$

# Alternate Background Analysis Technique – Region Selection

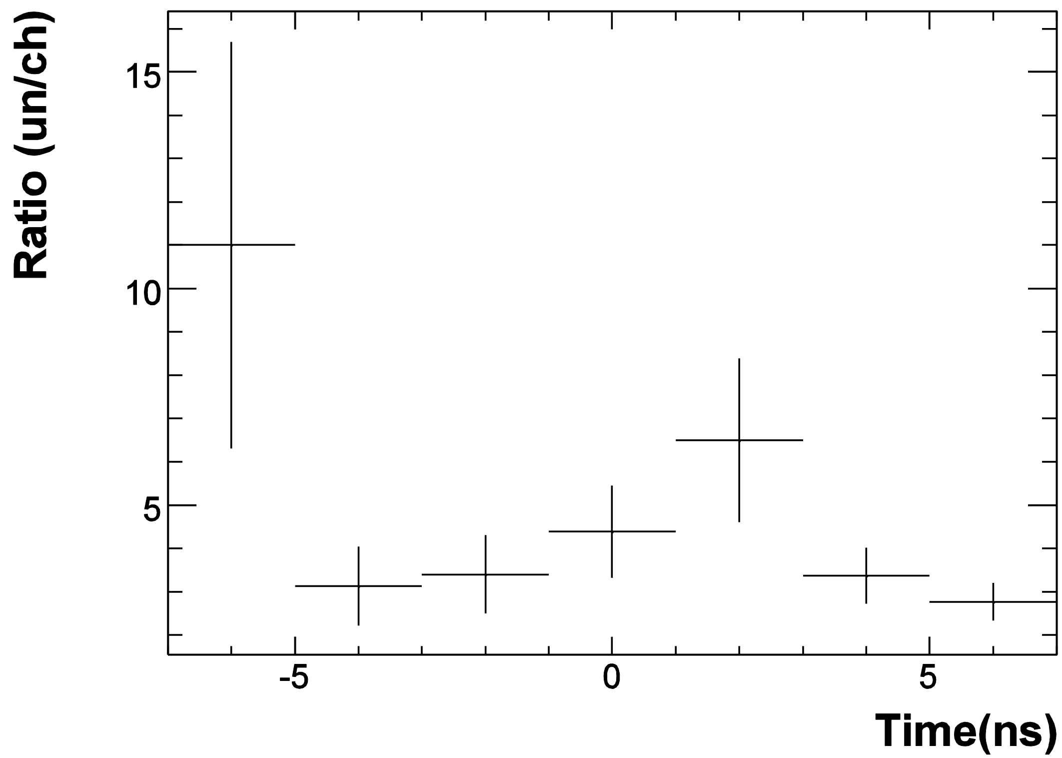
•Distant Region
•Region A

•Single Hit Region
•Region B




**The Single Hit Region must be the sum of Region A and B.**

# Alternate Background Analysis Technique - Ratio




Looking far in $q_{perp}$ is the same as looking in a distant part of the neutron detector. The quasielastic hit should not change the charge of this 'distant' accidental.

# Event Selection

- Pre-shower Channels > 450
- | Vertex | < 0.16
- | BB_fid_X + 0.02 | < 0.53
- | W – 1.0 | < 0.6
- | P_e – 0.9 | < 0.9

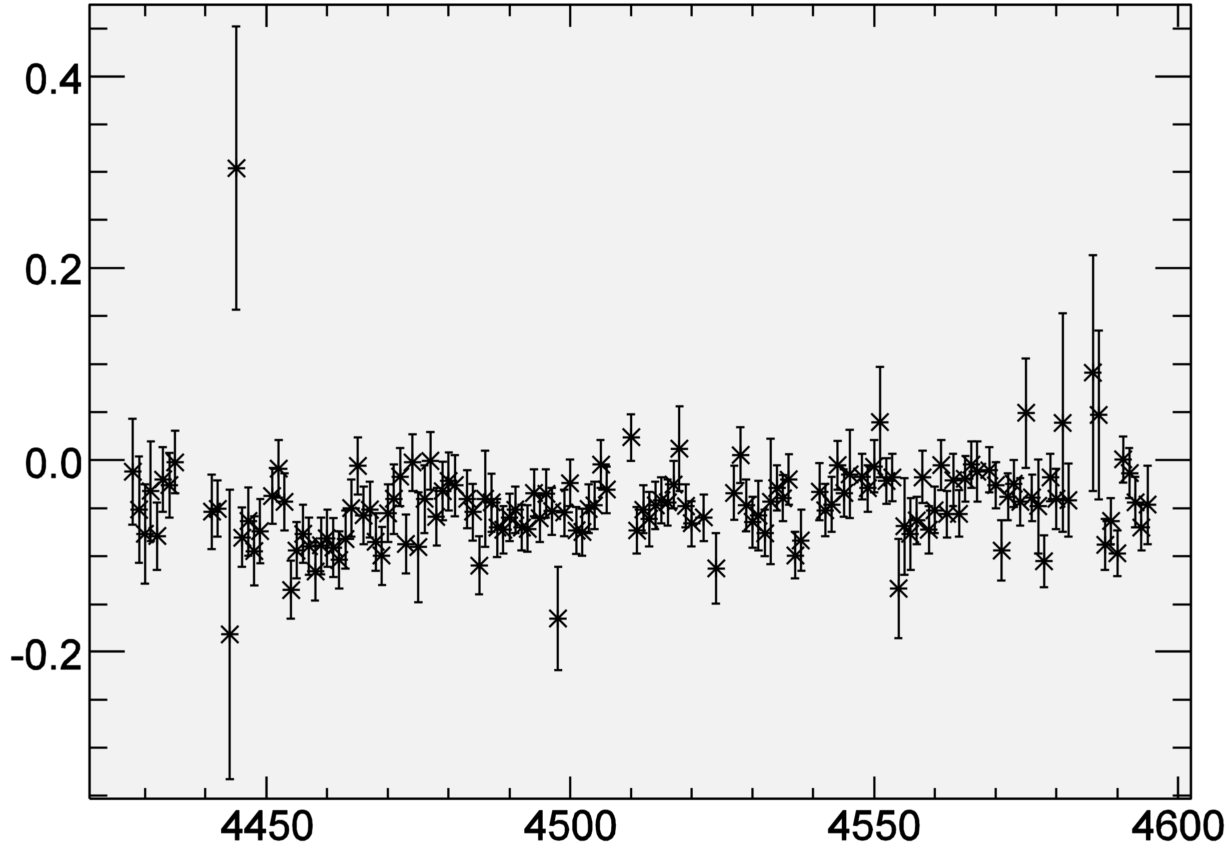
I used the values of 0.947 for the neutral N2 dilution and 0.964 for the charged N2 dilution.

# Kinematic 4 cuts

| Veto Cuts | |
|---|---|
| X position | \|X _C – X_V + const \| < 0.3 |
| Y position | Y_C < -0.177 & Y_V < 0 or Y_C > -0.72 & Y_V > 0 |
| Time | \| T_C – T_V + const \| < 10 |
| Amplitude | Amp > 200 |

| Neutron | Cuts |
|---|---|
| Invariant Mass | \| w – 0.925 \| < 0.225 |
| Y region | \| Y + 0.25 \| < 0.9 |
| Q_perp | Q_perp < 0.15 |
| Time | \| t \| < 1 |
| Missing Mass | M < 2 |
| X region | \| X - 0.2 \| < 1.8 |
| SQE | \| t \| < 1 & \| t + 5.5 \| < 1 and Q_perp < 0.15 |

# Raw Asymmetry per Run




| | | | | |
|---|---|---|---|---|
| 4444 | 4445 | 4510 | 4498 | 4587 |
| 4551 | 4554 | 4575 | 4581 | 4586 |

# Kinematic 4 Results – Preliminary

| 1 | Value | Statistical | Systematic |
|---|---|---|---|
| Raw Count | 176525 | | |
| Raw Asymmetry | -0.04810 | 0.0024 | |
| Physical Asymmetry | -0.2588 | 0.0253 | 0.0157 |
| Q2 | 1.716 | | |
| Lambda | -0.2119 | 0.0310 | 0.0167 |
| Gmn | -0.1662 | | 0.0033 |
| Gen | 0.0352 | 0.0051 | 0.0029 |
| Targets (H2/He/N2) | 0.0597 +- 0.0001 | 0.141 +- 0.001 | 0.225 +- 0.0007 |
| Background Dilut | 0.9821 | 0.0206 | 0.0002 |
| Proton Dilution | 0.5975 | | 0.0082 |
| Target Polarization | 0.4856 | | 0.20 |
| Proton Asymmetry | -0.00098 | | 0.00018 |
| Background Asymm | -0.0001 | | 0.0210 |

# Kinematic 3 cuts

| **Veto Cuts** | |
|---|---|
| X position | $\lvert X\_C - X\_V + \text{const} \rvert < 0.3$ |
| Y position | $Y\_C < -0.177$ & $Y\_V < 0$ or $Y\_C > -0.72$ & $Y\_V > 0$ |
| Time | $\lvert T\_C - T\_V + \text{const} \rvert < 10$ |
| Amplitude | Amp > 200 |

| **Neutron** | **Cuts** |
|---|---|
| Invariant Mass | $\lvert w - 0.85 \rvert < 0.2$ |
| Y region | $\lvert Y + 0.25 \rvert < 0.9$ |
| Q_perp | $Q\_perp < 0.25$ |
| Time | $\lvert t \rvert < 1$ |
| Missing Mass | $M < 2$ |
| X region | $\lvert X - 0.2 \rvert < 1.8$ |
| SQE | $\lvert t \rvert < 1$ & $\lvert t + 5.5 \rvert < 1$ and $Q\_perp < 0.25$ |

# Kinematic 3 Results

- In Progress