

DEVELOPMENT OF A TWO-DIMENSIONAL EVENT DISPLAY FOR TRACKING MODE OF Q_{WEAK}

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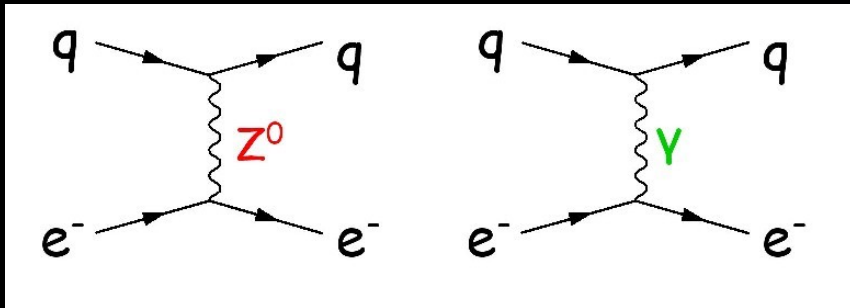
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Newport News, VA

PROJECT GOALS

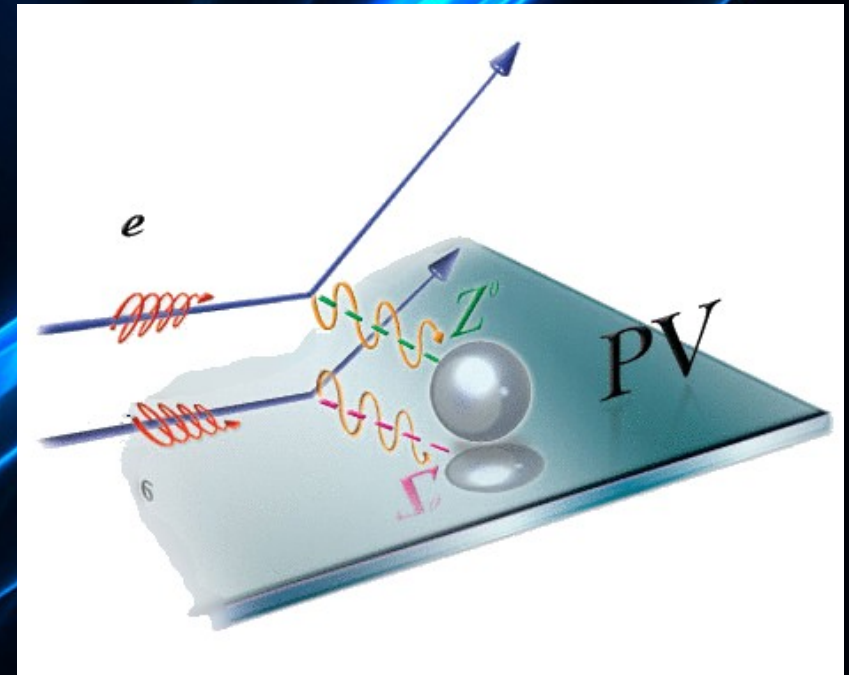
- Assist with Q_{weak} Collaboration at Jefferson Lab Hall C
- Combine data from tracking subsystems into one program
- Develop analyzable orthographic projections of events with scaled geometry
- Provide real time “at a glance” tracking analysis
- Provide a tool for tracking hardware diagnostics
- Create a user-friendly and appealing interface
- Integrate into the Q_{weak} Data Analysis GUI

Q_{WEAK} OVERVIEW

- Conduct very precise study to challenge the Standard Model
- Measure sensitivity of parity violation to weak interaction
- Measure weak charge of proton Q_W^P with $\sim 4\%$ total error
- Determine weak mixing angle $\sin^2\theta_W$ to $\sim 0.3\%$



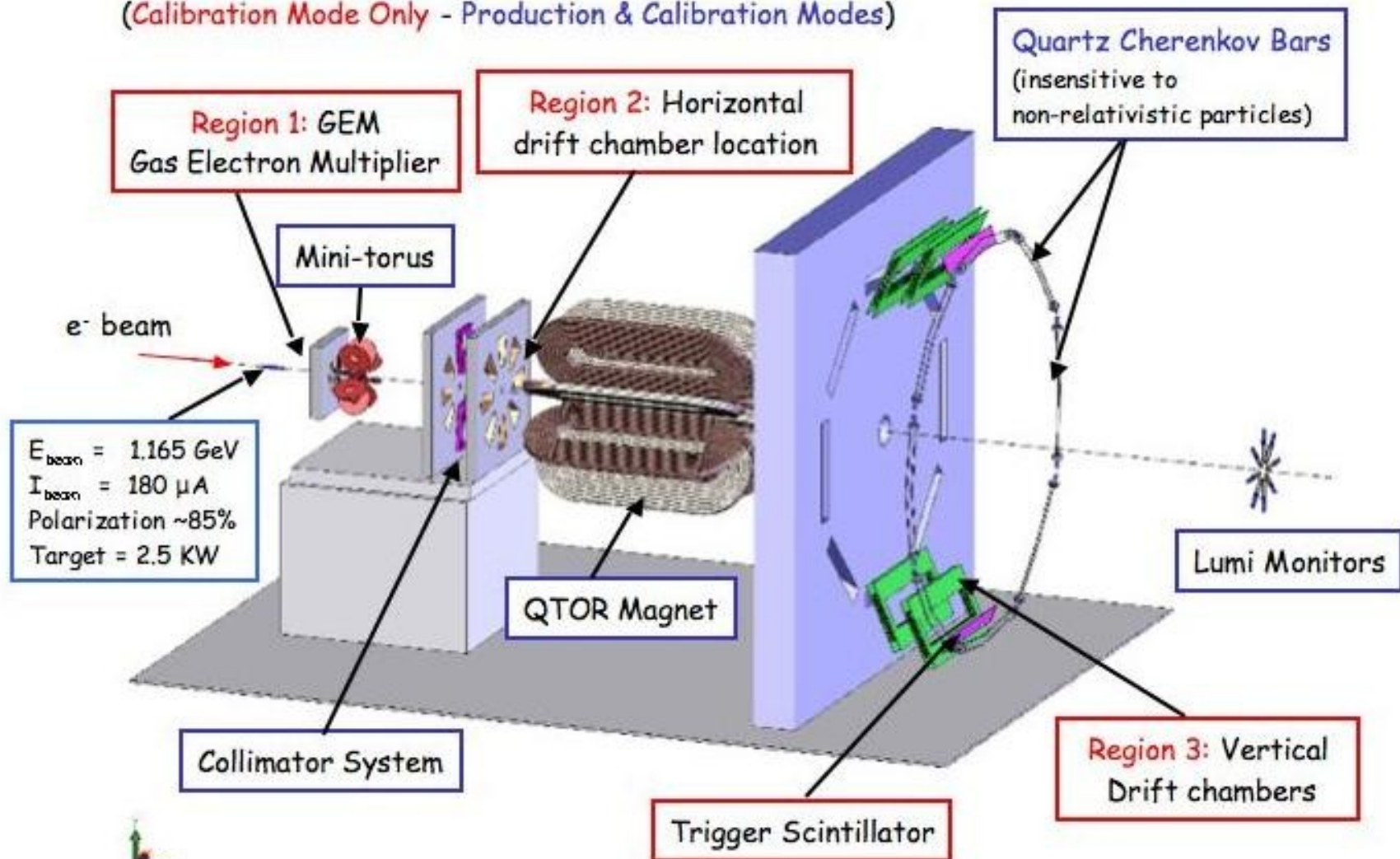
$$Q_W^P = 1 - 4\sin^2\theta_W$$



TRACKING SYSTEMS

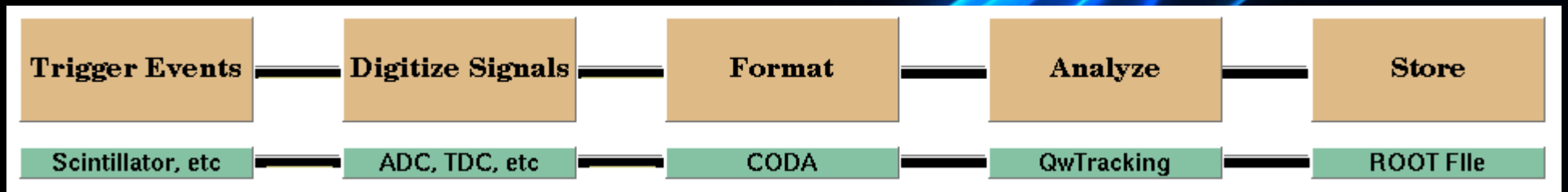
The Qweak Apparatus

(Calibration Mode Only - Production & Calibration Modes)



DAQ SYSTEMS

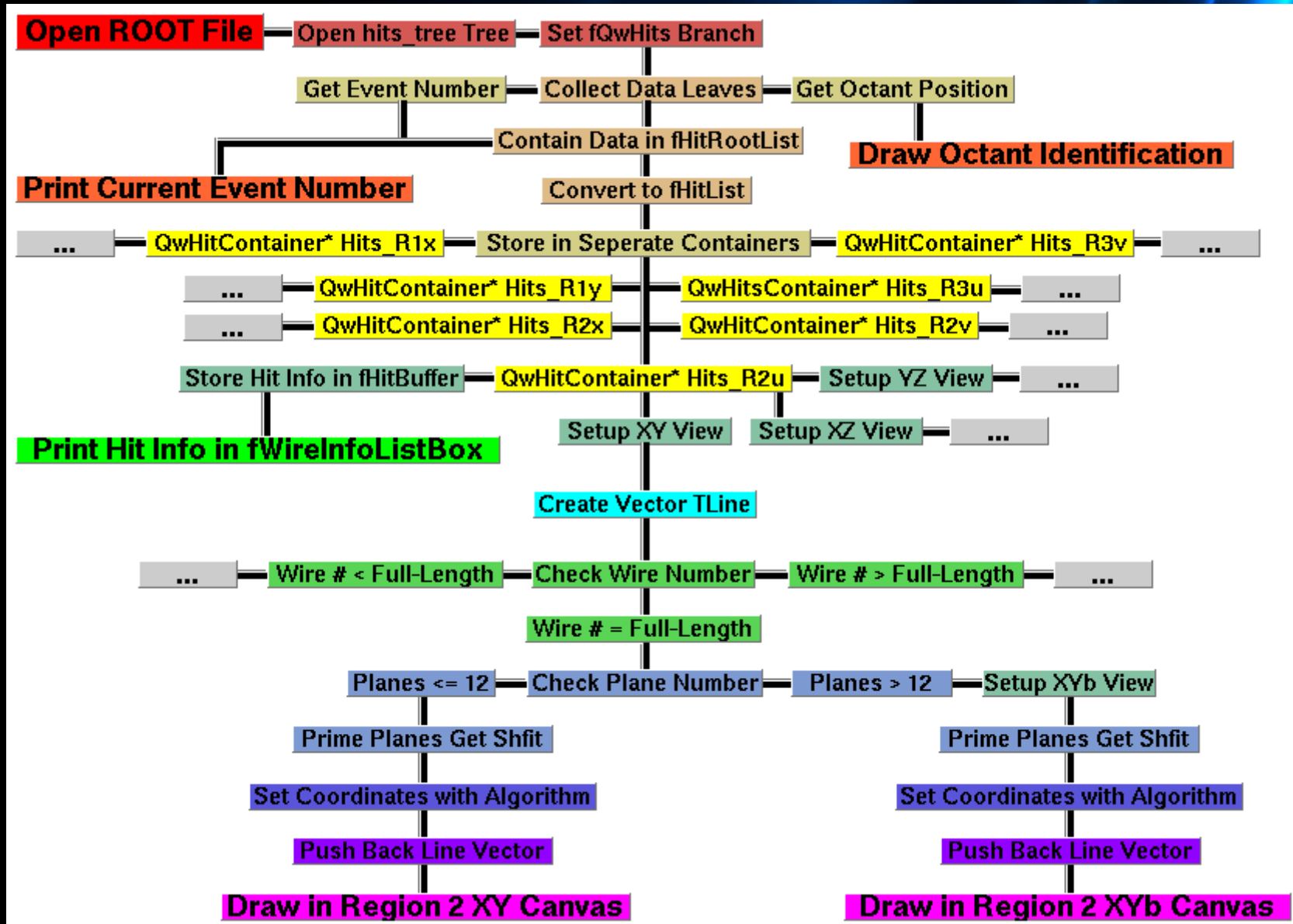
- **CEBAF Online Data Acquisition (CODA)**
 - Standardize and transport events
 - Minimalize commercial software dependance
 - Provide specialized support for some JLab detector systems
- **QwTracking Analyzer**
 - Process run files from CODA into readable events



DEVELOPMENT METHODS

- **Communication between collaborators**
 - Individual needs
 - Hardware specifications
- **ROOT library in C++**
 - Analyze large amounts of data in short time
 - Specific classes for accelerator physics
- **Geant4 Monte Carlo simulations**
 - Realistic event data package
 - Contains inconsistencies

PROGRAMMING LOGIC



DISPLAY FEATURES

– Event Boxes

- Event Counter
- Wire Hit Information
- Octant Identification

– Region Boxes

- Orthographic projections in scaled geometry

– Goto Event

- Number entry and button skip to a desired event

– Region Tabs

- Move between region views quickly

– Previous/Next Event

- Move to preceding/proceeding event number



Qweak 2D Single Event Display

THE GEORGE
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Event Counter

Current Event

6

12

Goto Event

Wire Hit Information

```

Region 1: Trace 186, Plane 2
Region 1: Trace 187, Plane 2
Region 1: Trace 188, Plane 2
Region 1: Trace 189, Plane 2
Region 1: Trace 190, Plane 2
Region 2: Wire 13, Plane 1   Drift Distance: 0.421449
Region 2: Wire 13, Plane 2   Drift Distance: 0.452449
Region 2: Wire 12, Plane 3   Drift Distance: 0.092919
Region 2: Wire 14, Plane 4   Drift Distance: 0.316955
Region 2: Wire 13, Plane 5   Drift Distance: 0.163089
Region 2: Wire 13, Plane 6   Drift Distance: 0.473118
  
```

Octant Identification



Region 1--GEM | Region 2--HDC (1-4) | Region 2--HDC (5-8) | Region 3--VDC | Region 3--TS

Front View (Normal to Tilt Angle)



Lela (1) Vader (2) Han (3) Yoda (4)

Top View (Oriented to Tilt Angle)



Lela (1) Vader (2) Han (3) Yoda (4)

Side View (Rotated to Tilt Angle)



Lela (1) Vader (2) Han (3) Yoda (4)

Previous Event

Next Event

X

Y

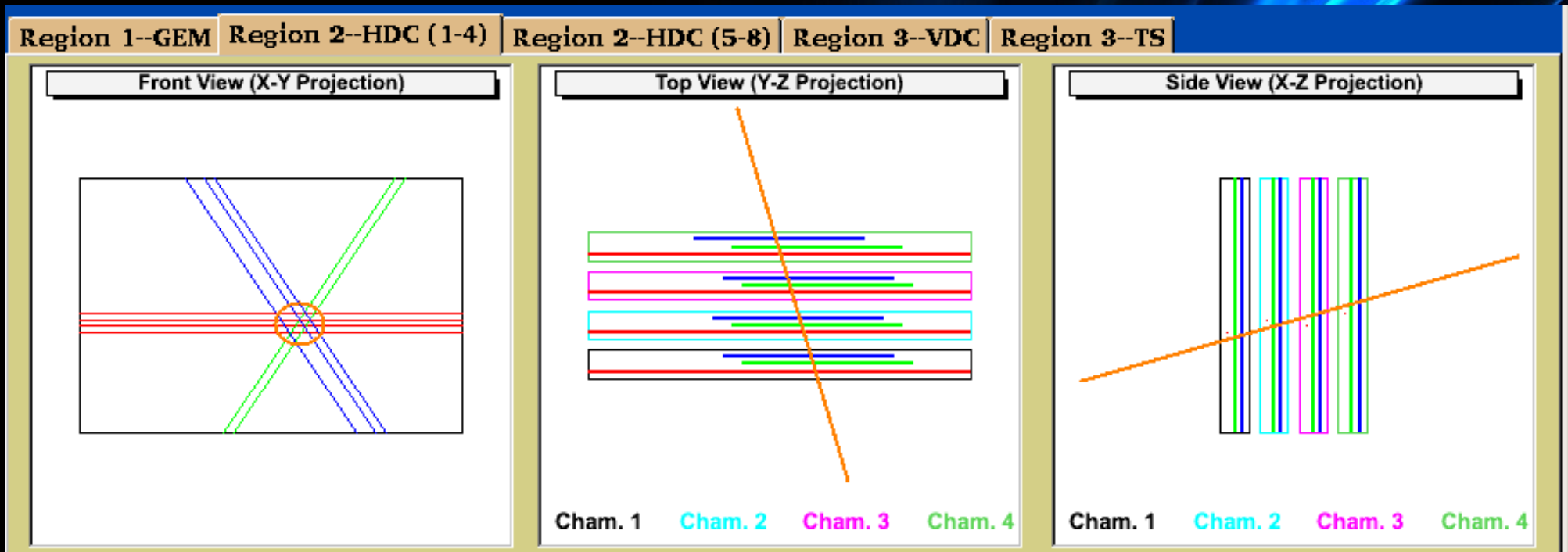
U

V

Exit

EVENT DISPLAY ANALYSIS

- Hit patterns used to interpolate tracks
- Simple methods described in tutorial
 - Hand drawn fit lines:



FURTHER DEVELOPMENT

- Some minor bugs still exist**
- No X trace data for GEM's from simulation**
- Simulated data does not always provide precise data**
- Octant identification data**
- Trigger scintillator data**
- Automated interpolation of hit patterns**
- Continuation of project by Martin McHugh (GWU)**

CONCLUSIONS

- Successful reconstruction of hit patterns with many useful control features
- May also be used as diagnostic tool for tracking hardware
- Room for further development
- Compliments a 3D event display (Juan Carlos Cornejo, William and Mary)
- Valuable subsystem in the Q_{weak} Data Analysis GUI

ACKNOWLEDGEMENTS

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- **Members of the Q_{weak} Collaboration** (research/development)
- **Marcus Hendricks** (original GUI design)
- **Ramesh Subedi** (technical support)
- **Wouter Deconick** (software development)
- **National Science Foundation** (fellowship)

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The background features several bright blue, glowing streaks that originate from the top right and fan out towards the bottom left, creating a sense of motion and energy. The streaks vary in thickness and intensity, with some appearing as sharp lines and others as softer, more diffuse bands of light. The overall color palette is dominated by deep blues and bright cyan, set against a solid black background.

QUESTIONS?