The Neutron Detector for the Measurement of G_E^n at high Q^2 Experiment E02-013

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Overview

Technique: Exclusive quasi-elastic scattering $^3\overrightarrow{He}(\overrightarrow{e},e'n)$

Neutron Detector:

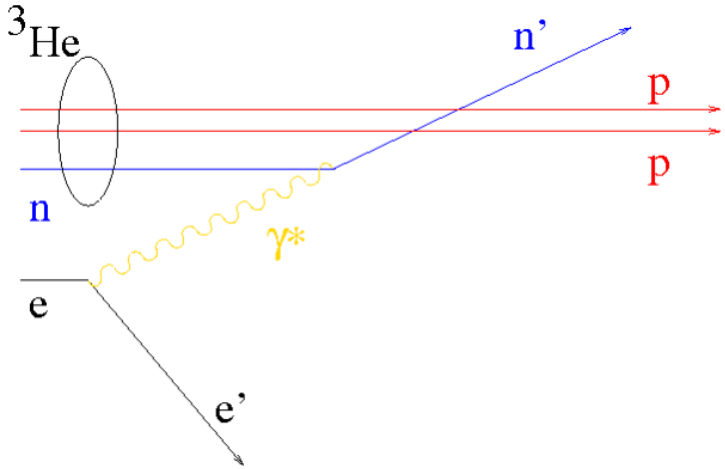
- Requirements
- Description
- Operation
- Performance
  - Rate
  - Momentum Resolution
  - Neutron Detection Efficiency

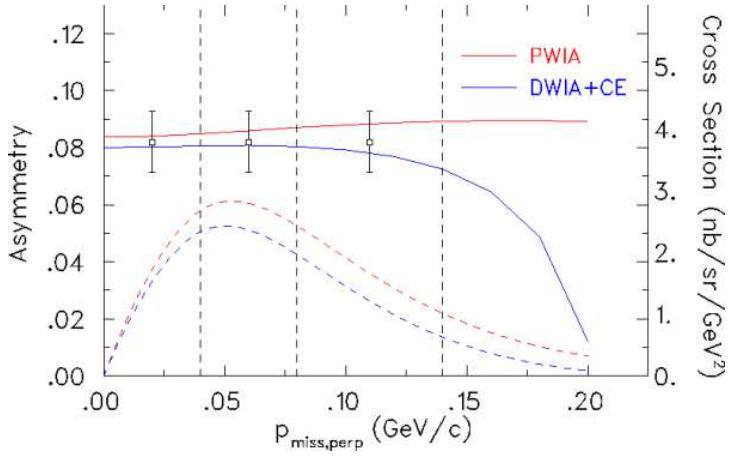
Events

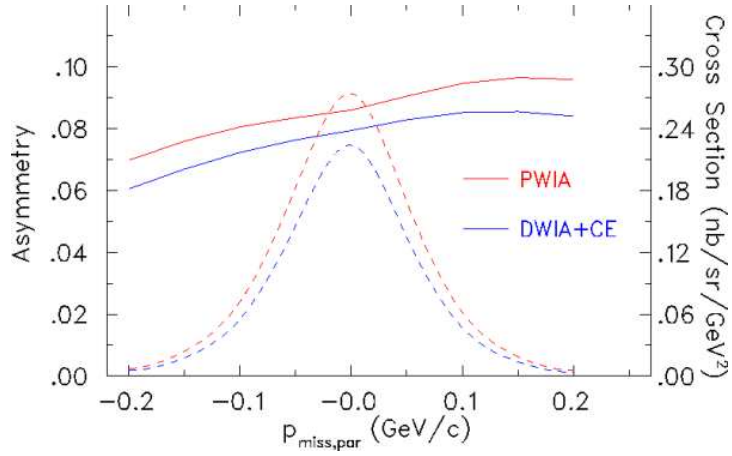
Summary

Technique: $\overrightarrow{^3He}(\vec{e}, e'n)$

- Selection of quasi-elastic events.
- FSI fairly well understood $p_m < p_{internal}$.





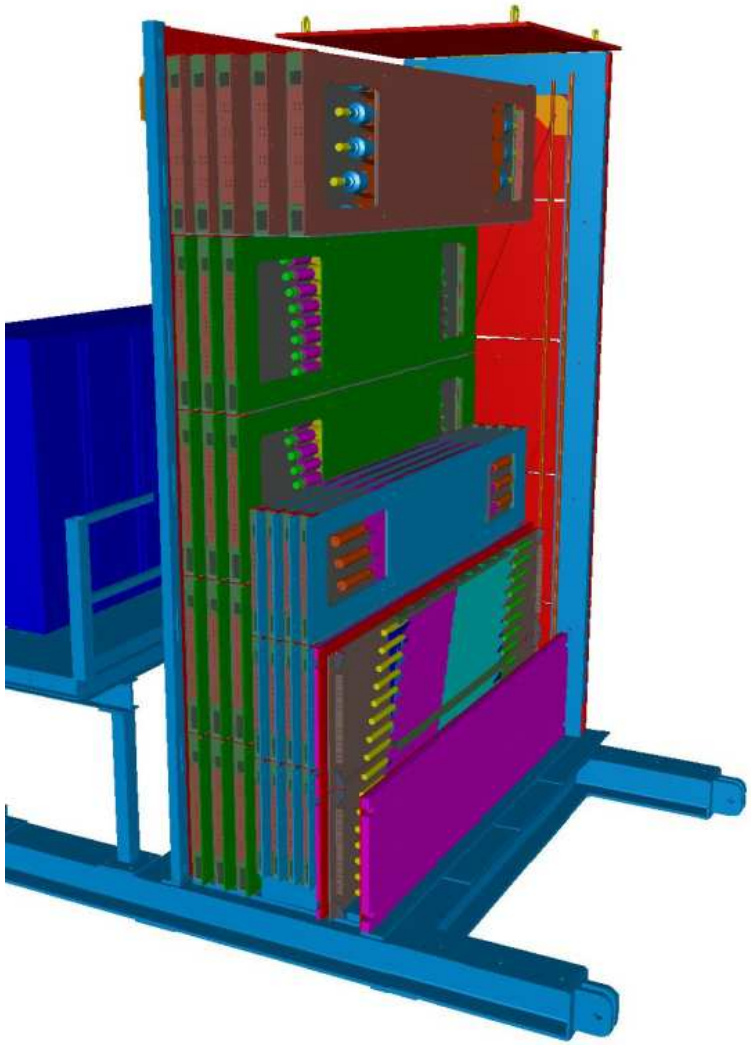


Neutron Detector: Requirements

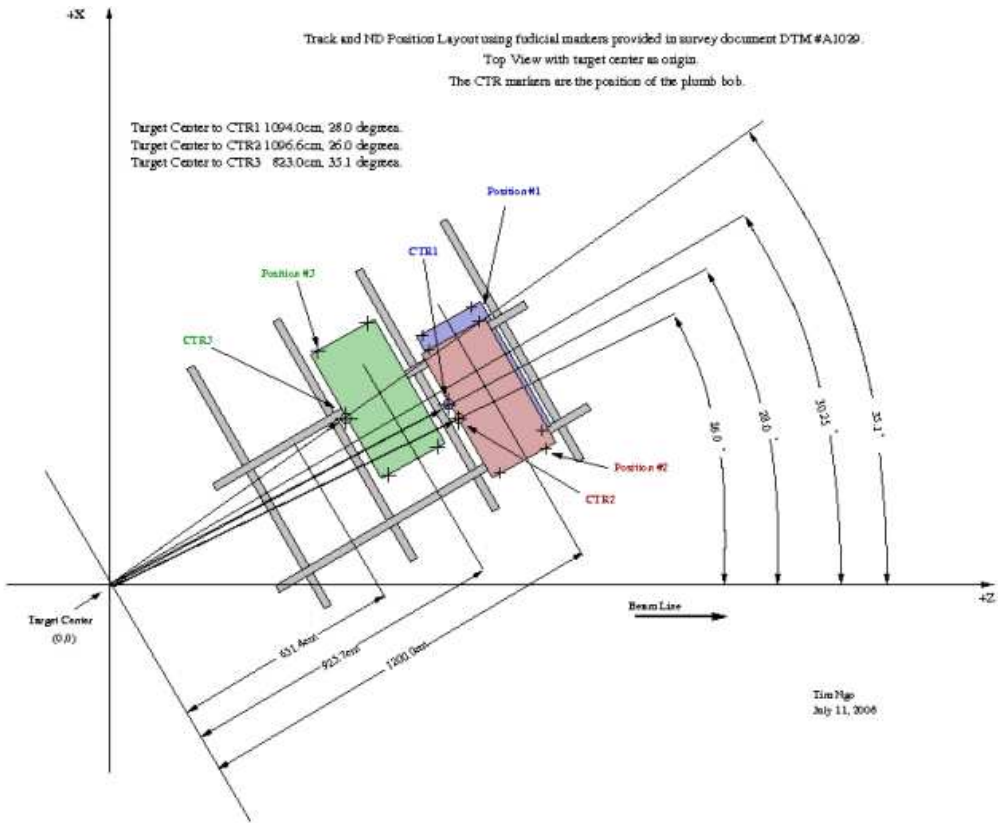
- Large
  - match's BigBite's Acceptance of up to $p_{mperp} = 150 MeV/c$
  - High Rate MegaHertz
- Momentum Resolution <250 MeV/c
  - Time Resolution <500 ps
  - Distance 12m
  - Neutron Momentum 2.58 GeV/c
- Transverse Missing Momentum <30 MeV/c
- Exclusivity Neutrons
  - Veto
  - Shielding

Description

- Active frontal area of 11.25 m^2.
- Mounted on rails, so that the 83 ton detector could be set at:
  - 6 m, 9 m, and 12 m from target
  - between 25.4 degrees and 35.2 degrees from the beamline.
- Two veto planes of 48 detectors.
- Seven neutron detector planes of between 26 and 45 detectors.
- Includes 4 marker bars for position calibration..



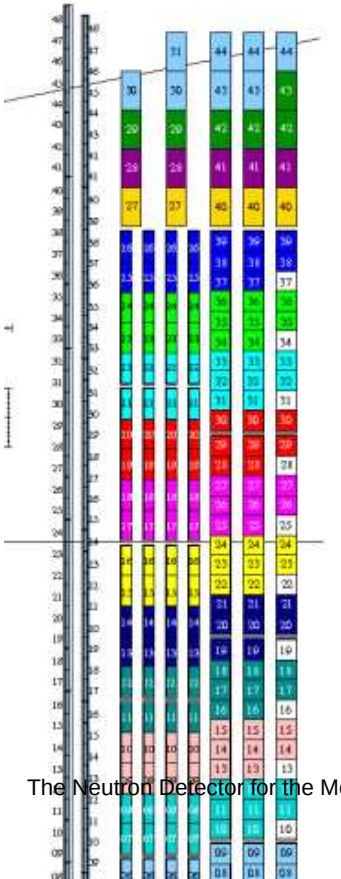
Description



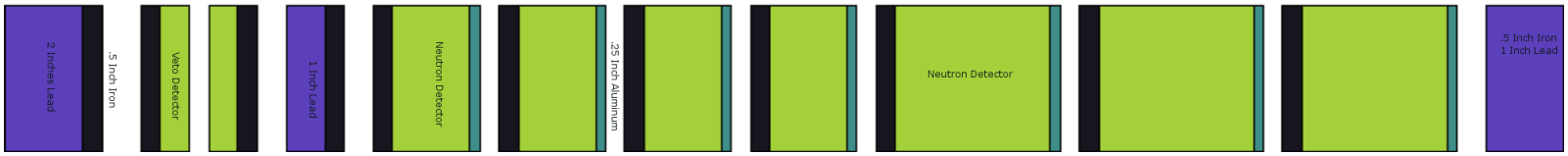
Beam Energy	Q^2	Neutron Momentum	Flight Path
1.519 GeV	2.46 GeV	1.2 GeV/c	9 m
3.290 GeV	4.23 GeV	2.6 GeV/c	12 m
2.638 GeV	3.58 GeV	2.1 GeV/c	9 m
2.079 GeV	3.02 GeV	1.6 GeV/c	9 m

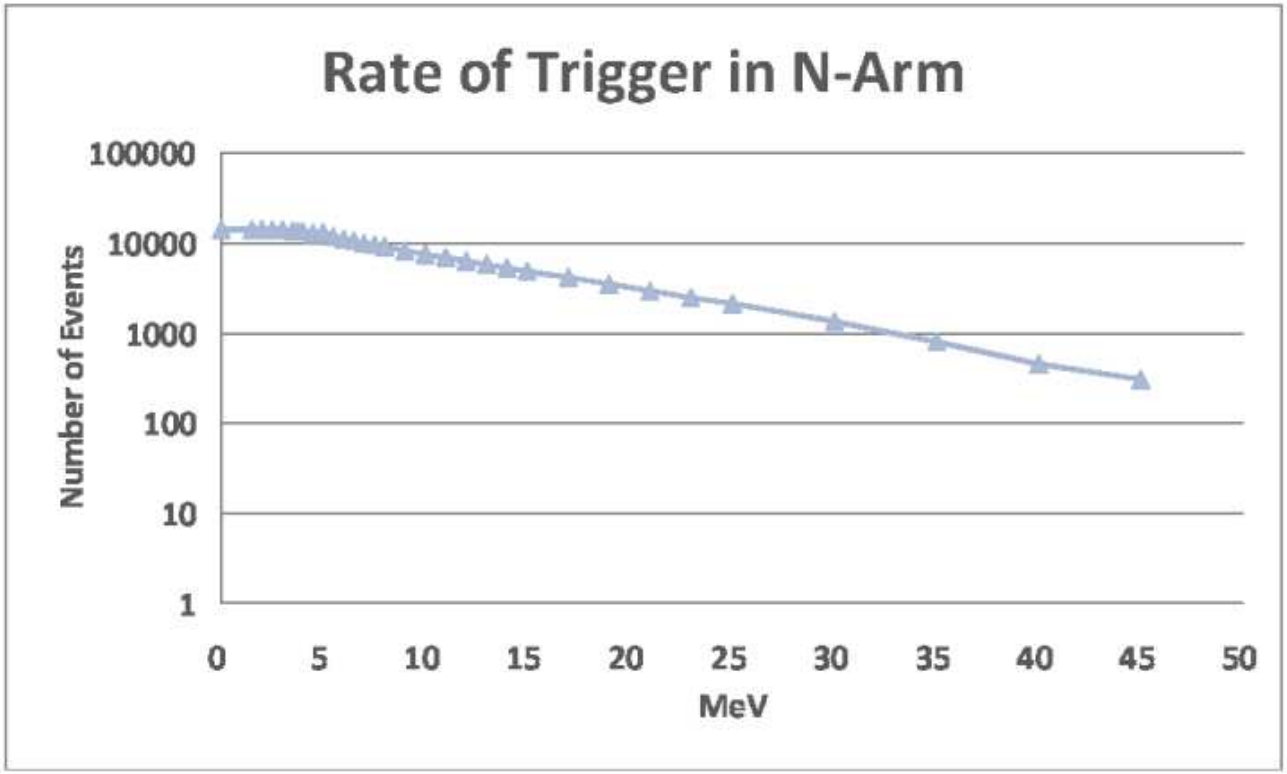
Operation

- Trigger
  - For every two neighboring sets of detectors (Shown here denoted by color), there is one sum channel.
  - An OR of all these sum channels, for both sides is then used to set the Neutron Trigger.
- Multi-hit pipeline TDCs with 120 ps resolution



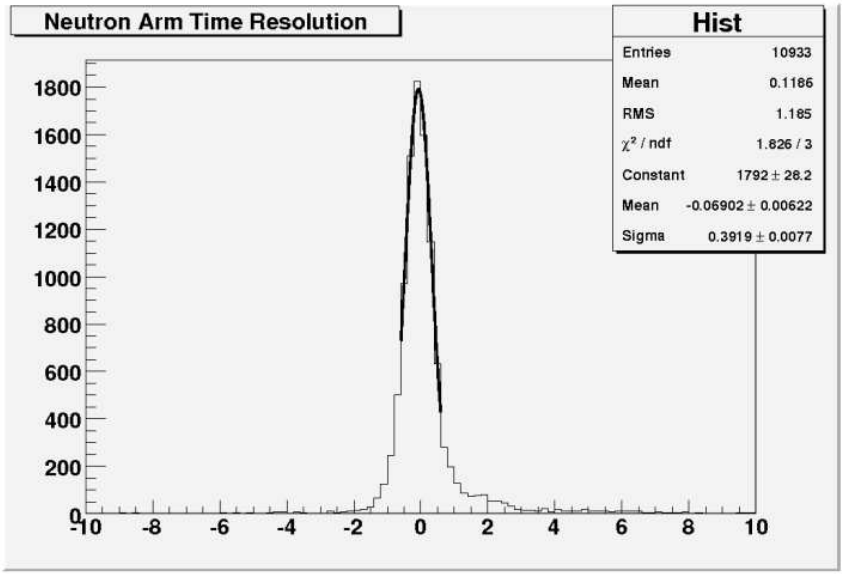
Neutron Detector: Rate





Momentum Resolution

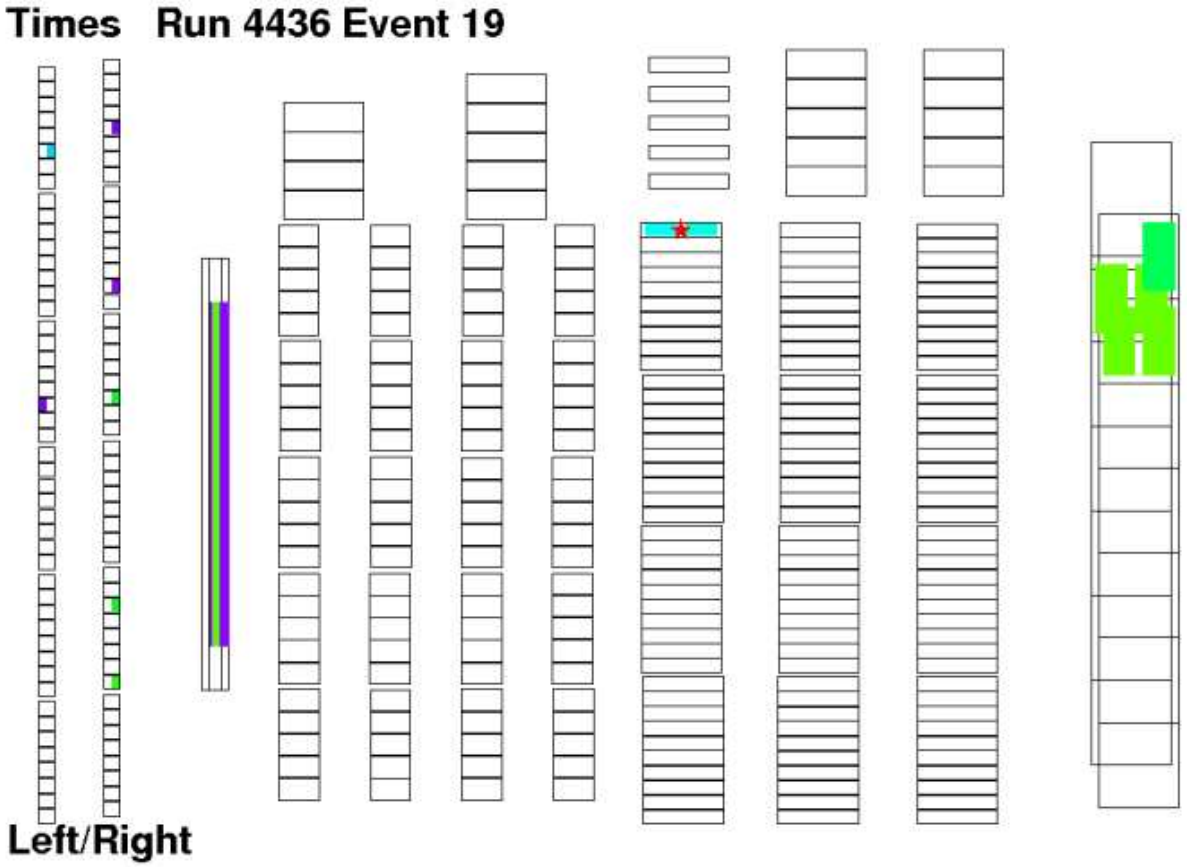
- Match of 200 detectors.
- Elastic $(\overrightarrow{e}, e'p)$ resolution (for a single plane) of 390 ps.
- Single Plane Elastic Momentum Resolution $\frac{\delta p}{p} = \frac{\delta t}{t}\gamma^2$ of $\delta p = 73$ MeV/c.



Efficiency

- Veto Measured the total Veto efficiency to be 81.5
- Neutron Bars
  - Monte Carlo gives an efficiency of 35-39
  - Study of $H(\overrightarrow{e}, \pi^+ n)$ in progress.

Events



Summary

- The Neutron Arm matched BigBite's acceptance with an active area of 11.25 m^2
- The Neutron Arm has a momentum resolution of 73 MeV/c.
- The Veto Efficiency was 81.5
- I would like to thank the Neutron Team, in particular Rob Feuerbach.