

E93-026

G_E^n via $\vec{d}(\vec{e}, e'n)p$

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- * Overview
- * Setup
- * Analysis
- * Status & Results

Overview

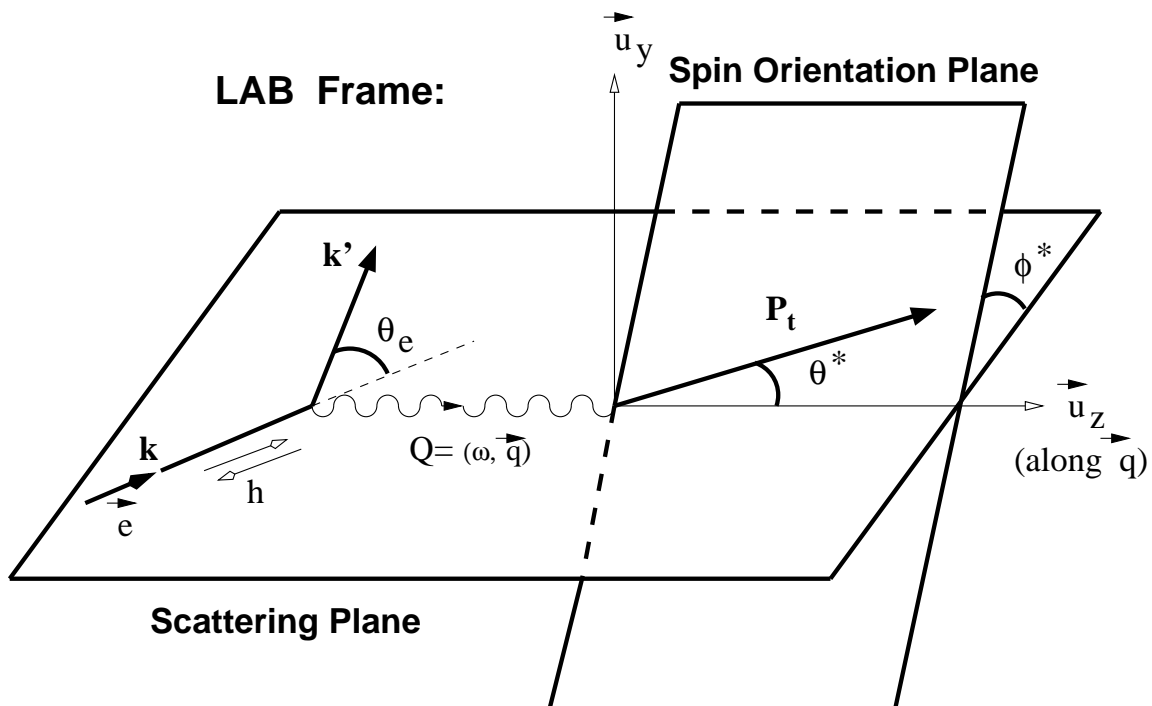
Jlab Experiment E93-026 ("Gen01"):

- * measured neutron charge form factor G_E^n
August – December 2001
- * *quasi-elastically* scattered polarized e^- beam off solid, polarized $^{15}\text{ND}_3$ target
- * scattered e^- and ejected neutron detected in coincidence
custom n detector & HMS
- * $Q^2 = 0.5 \text{ GeV}^2$ and 1.0 GeV^2
 $E_0 = 2.3 \text{ GeV}$ and 3.5 GeV
- * extract G_E^n from cross section asymmetry

From $\vec{d}(\vec{e}, e'n)p$ to G_E^n

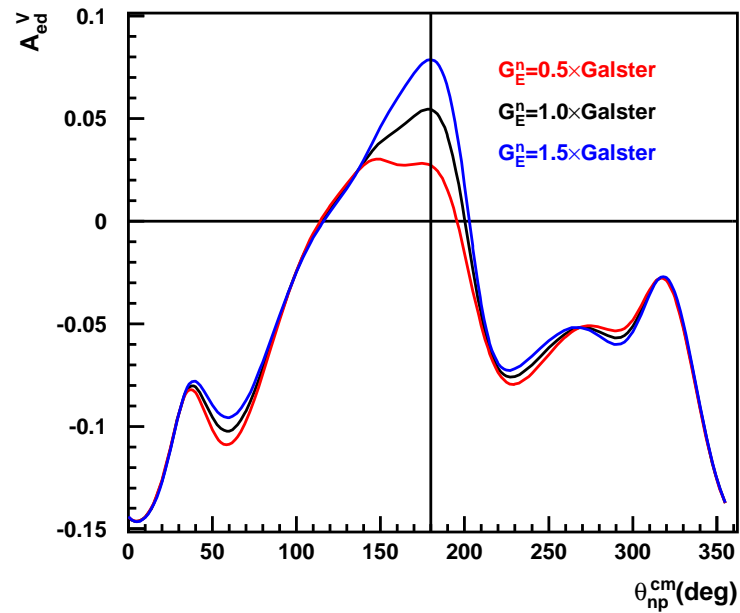
Extract G_E^n from cross section asymmetry
 (if $\mathcal{P}_{\text{target}} \perp \vec{q}$ and in scattering plane)

$$\begin{aligned}
 A_{ed}^V &= \gamma_{nd} \times \frac{-2 \sqrt{\tau(1+\tau)} \tan \frac{\theta_e}{2} G_E G_M}{G_E^2 + \tau [1 + 2(1+\tau) \tan^2 \frac{\theta_e}{2}] G_M^2} \\
 &= \frac{\mathcal{E}_{ed}}{\mathcal{P}_{\text{beam}} \mathcal{P}_{\text{target}}} \times [\text{corrections}]
 \end{aligned}$$

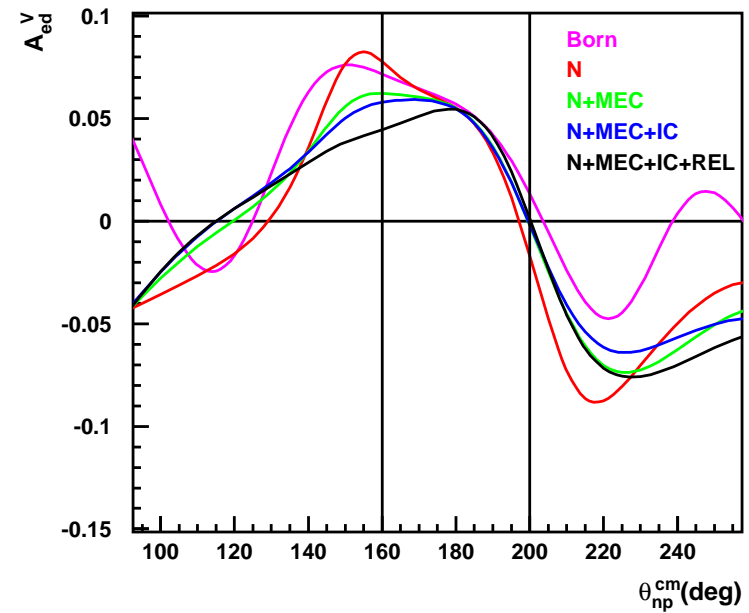


Benefits of this Approach

Maximize Sensitivity to G_E^n



Minimize Model Dependence

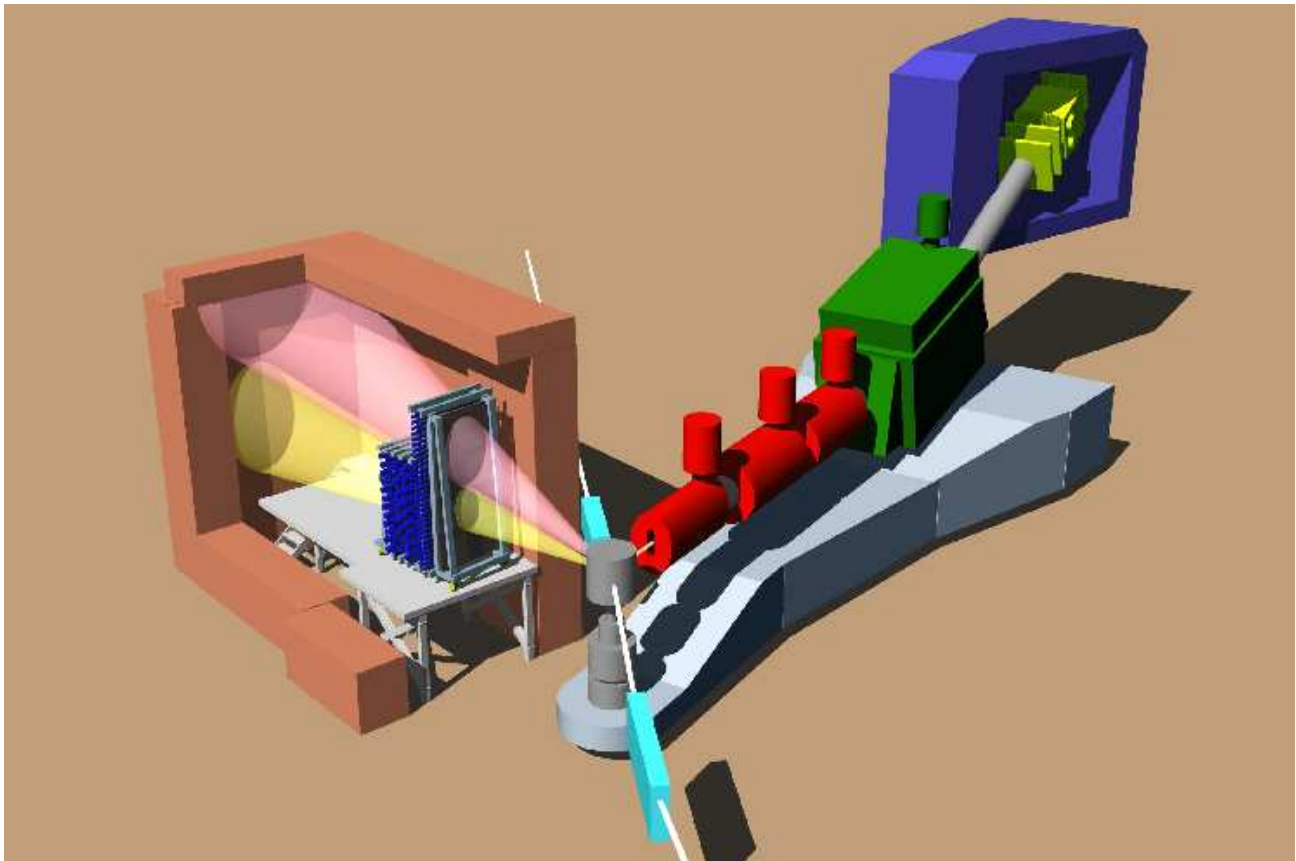


Gen01 Collaboration

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Vrije Universiteit of Amsterdam, Yerevan Physics Institute*

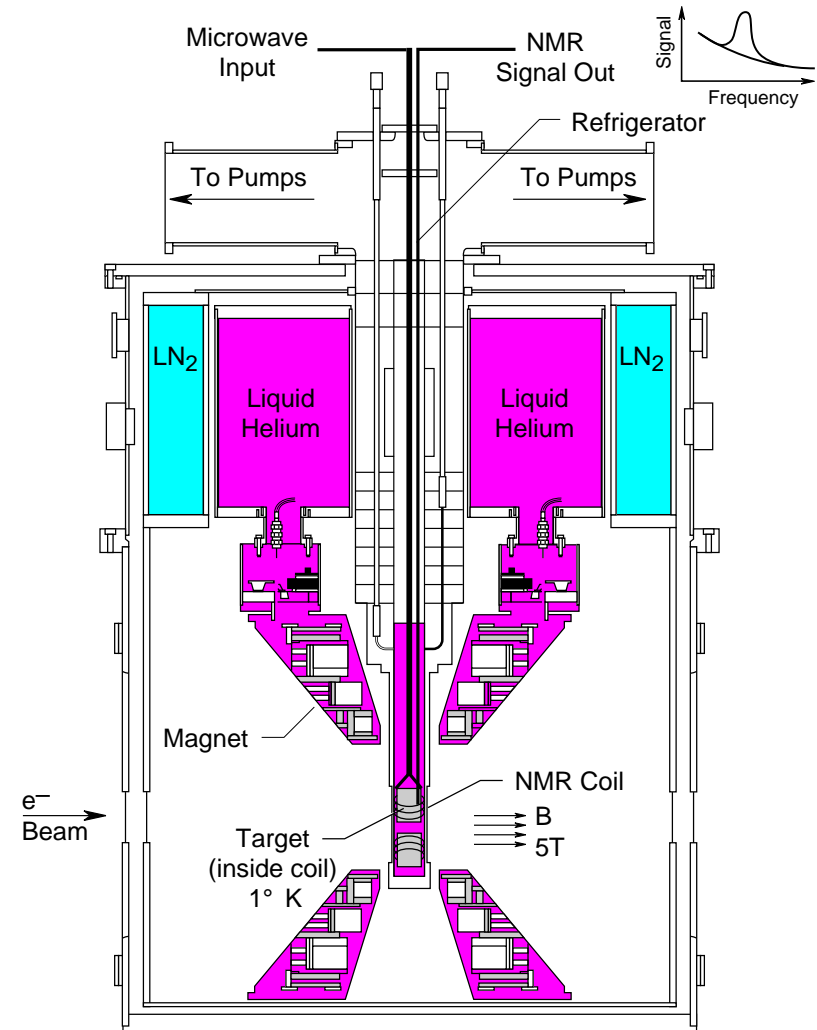
Experimental Setup



- * Moller polarimeter
- * High Momentum Spectrometer
- * polarized target
- * custom neutron detector
- * SEM beam position monitor
- * chicane magnets

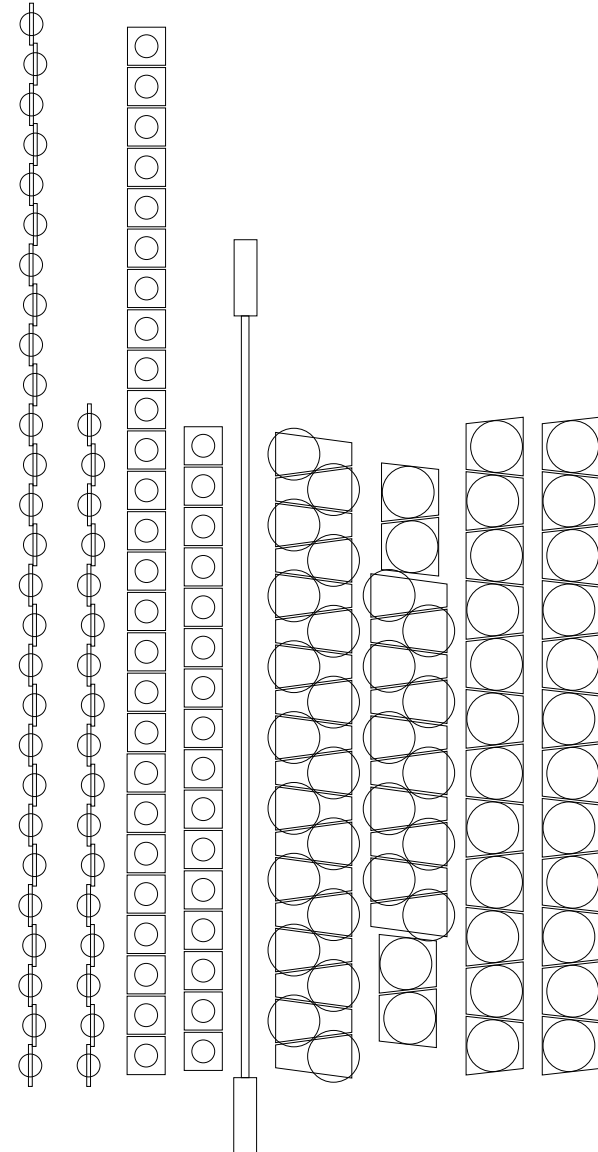
Target

- * frozen ND_3
- * ^4He evaporation refrigerator
- * $5T$ polarizing field
- * dynamic nuclear polarization driven by microwaves
- * remotely movable insert



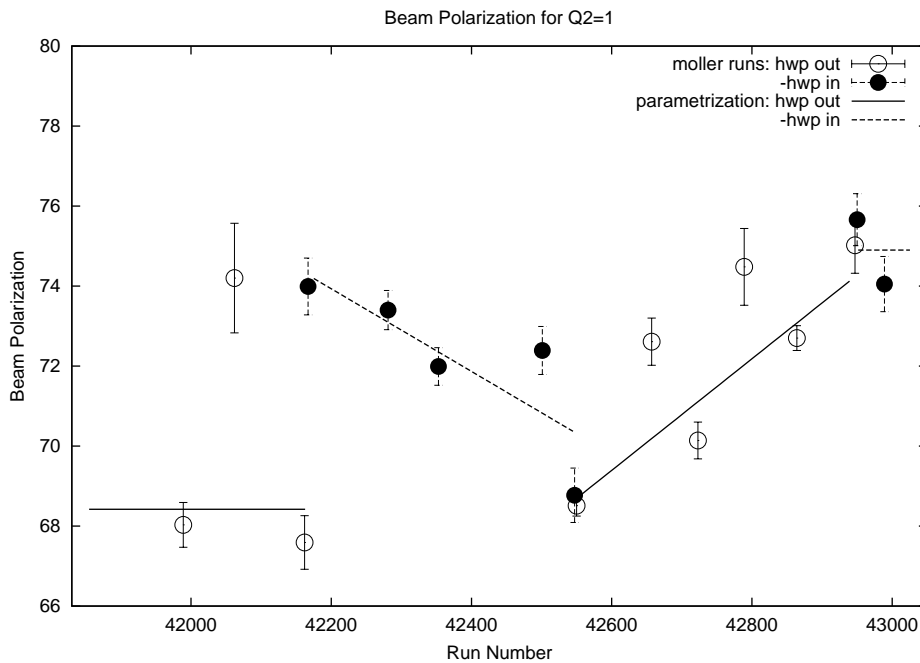
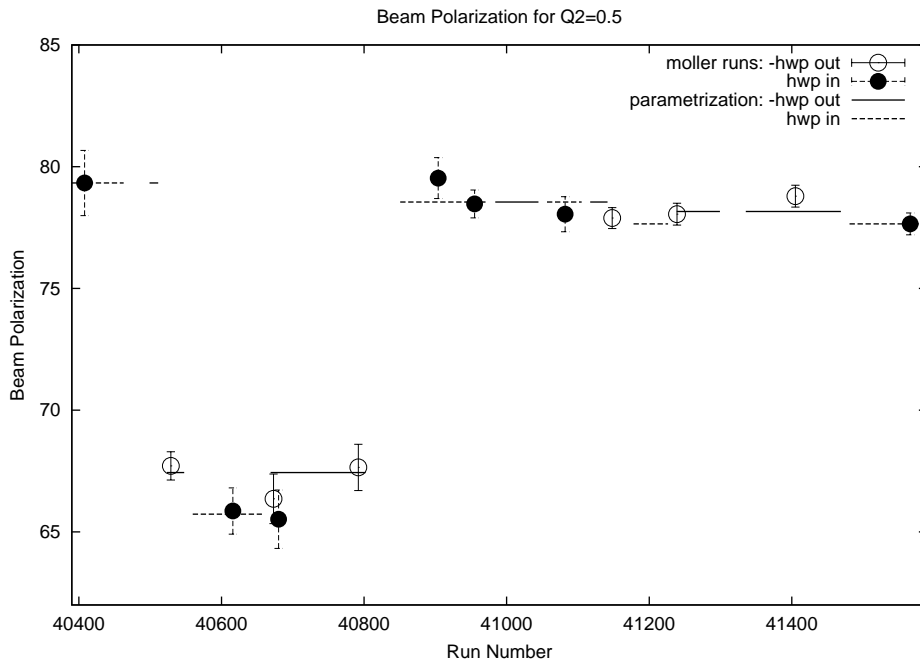
Neutron Detector

- * segmented scintillator
high rate: $\sim 100kHz$
- * 2 proton VETO layers,
6 conversion layers
142 elements total
- * vertically extended for
symmetric p^+ acceptance
- * phototubes at both ends
horizontal position
2 vertical elements for calibration
- * provides 3 space coords,
time and energy

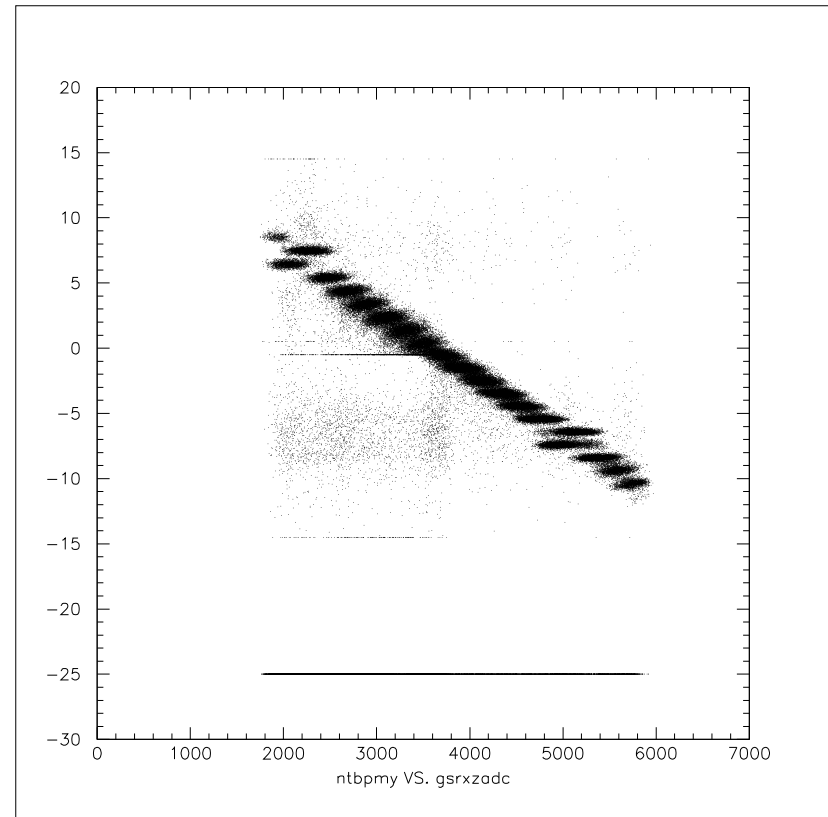
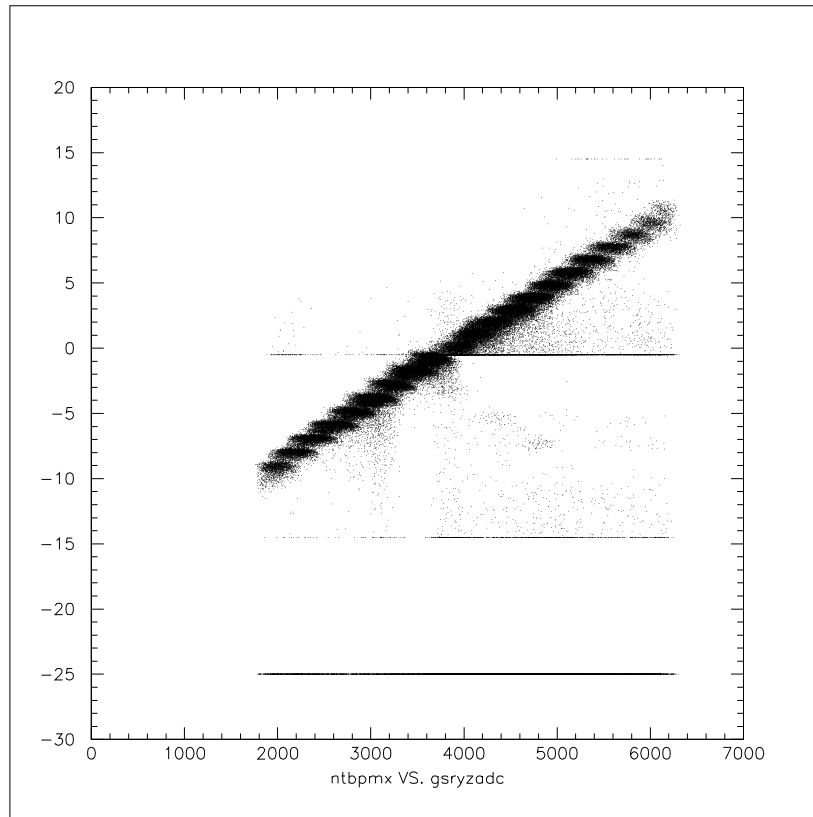


Beam Polarization

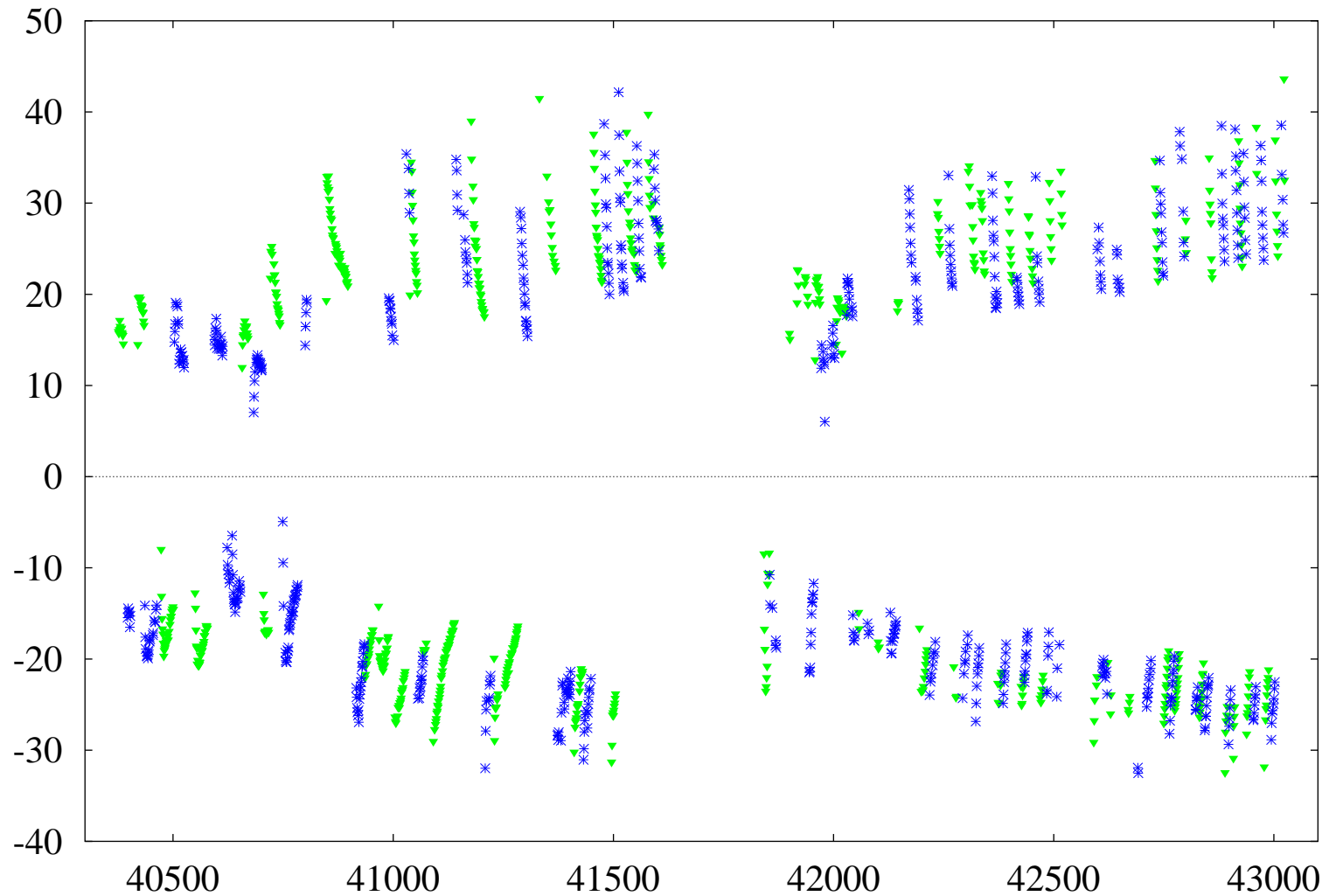
$Q^2 = 0.5 \text{ GeV}^2$ effective average = 78.2%



Rastered Beam Position — SEM vs ADC

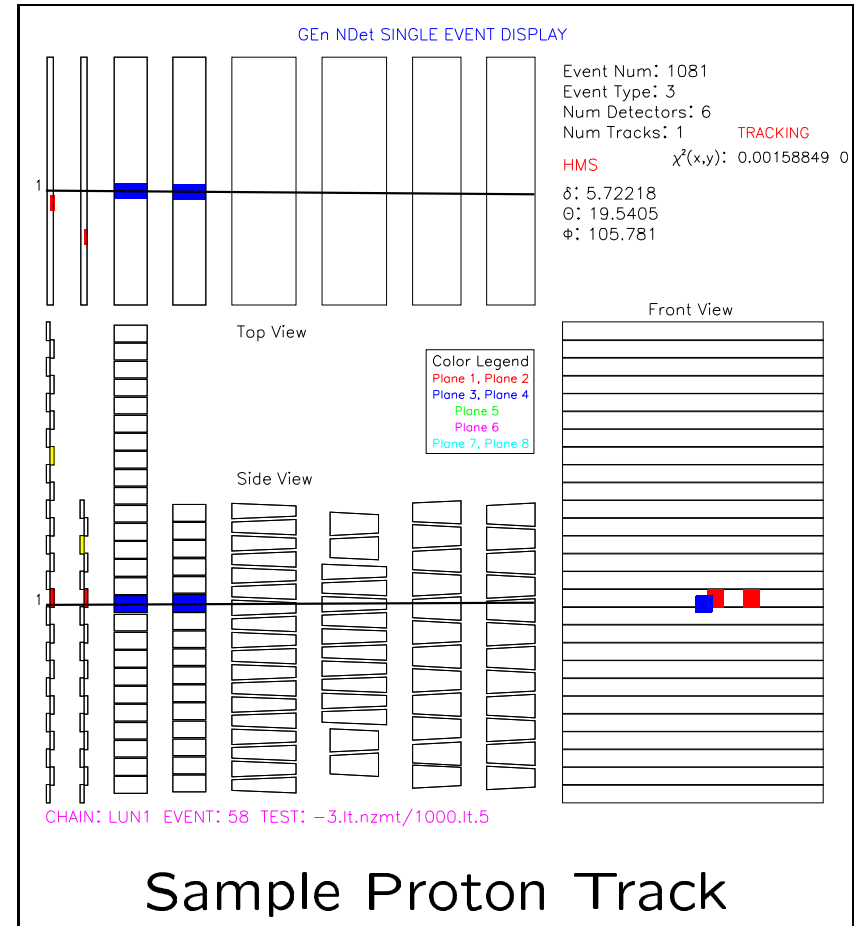
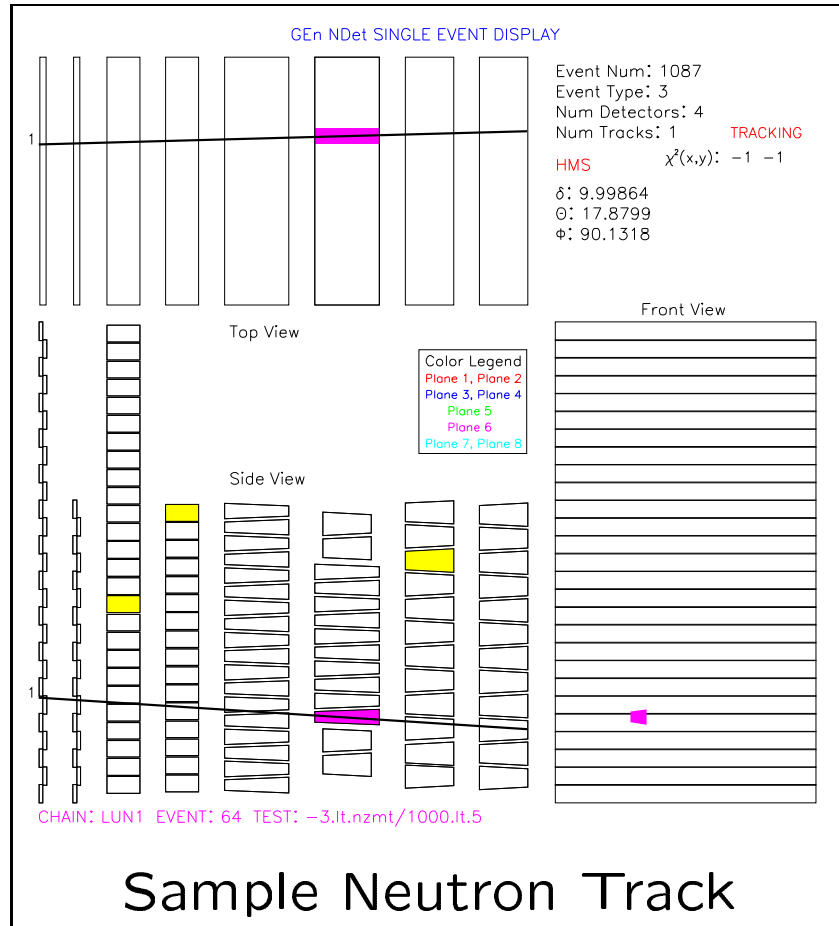


Target Polarization



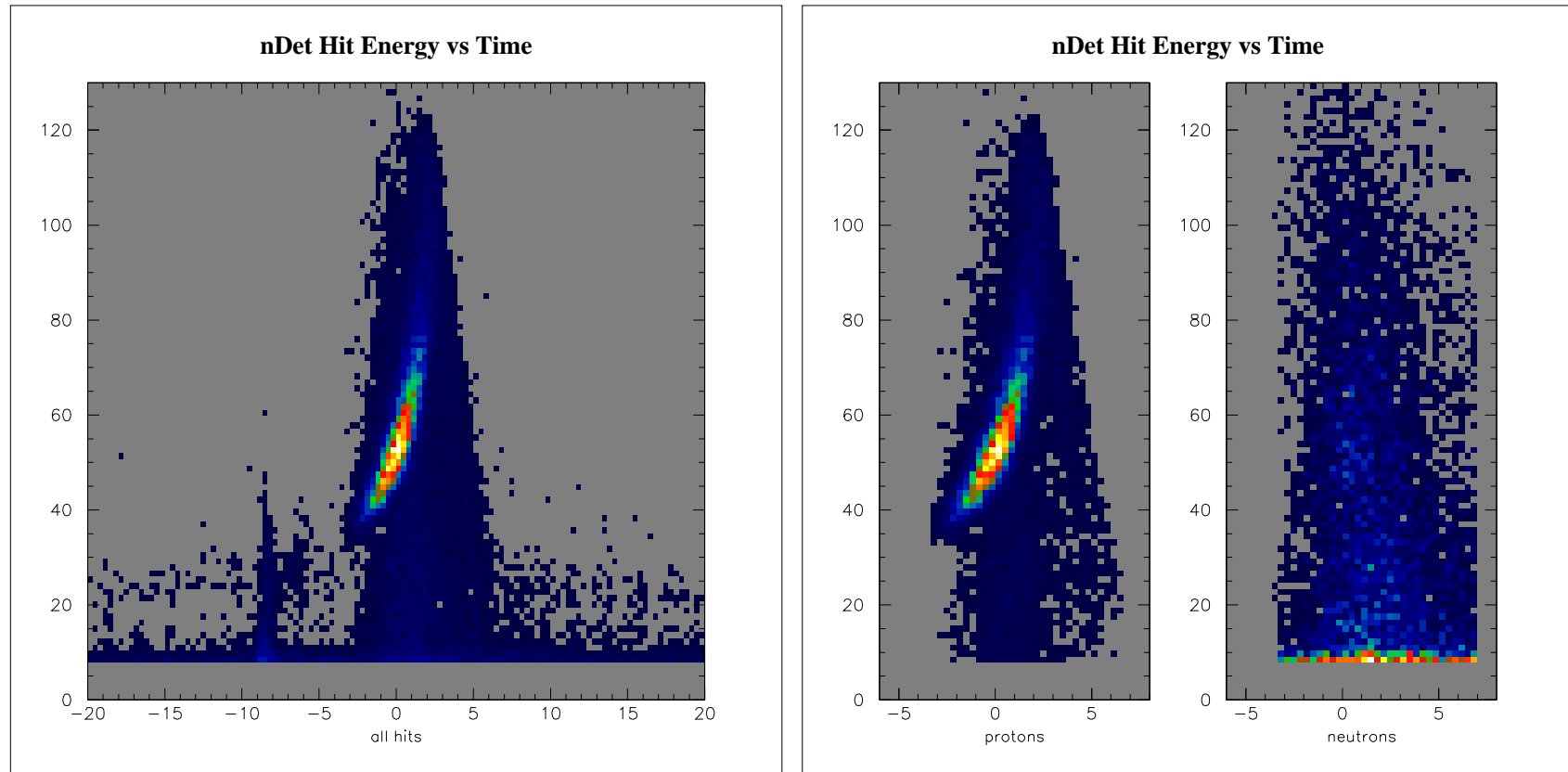
$Q^2 = 0.5 \text{ GeV}^2$ effective average = 24.4%

Neutron Detector — Single Event Display



majority of protons in upper half of detector

Neutron Detector — Particle Detection



only hit times and VETO matches were considered

Data Analysis

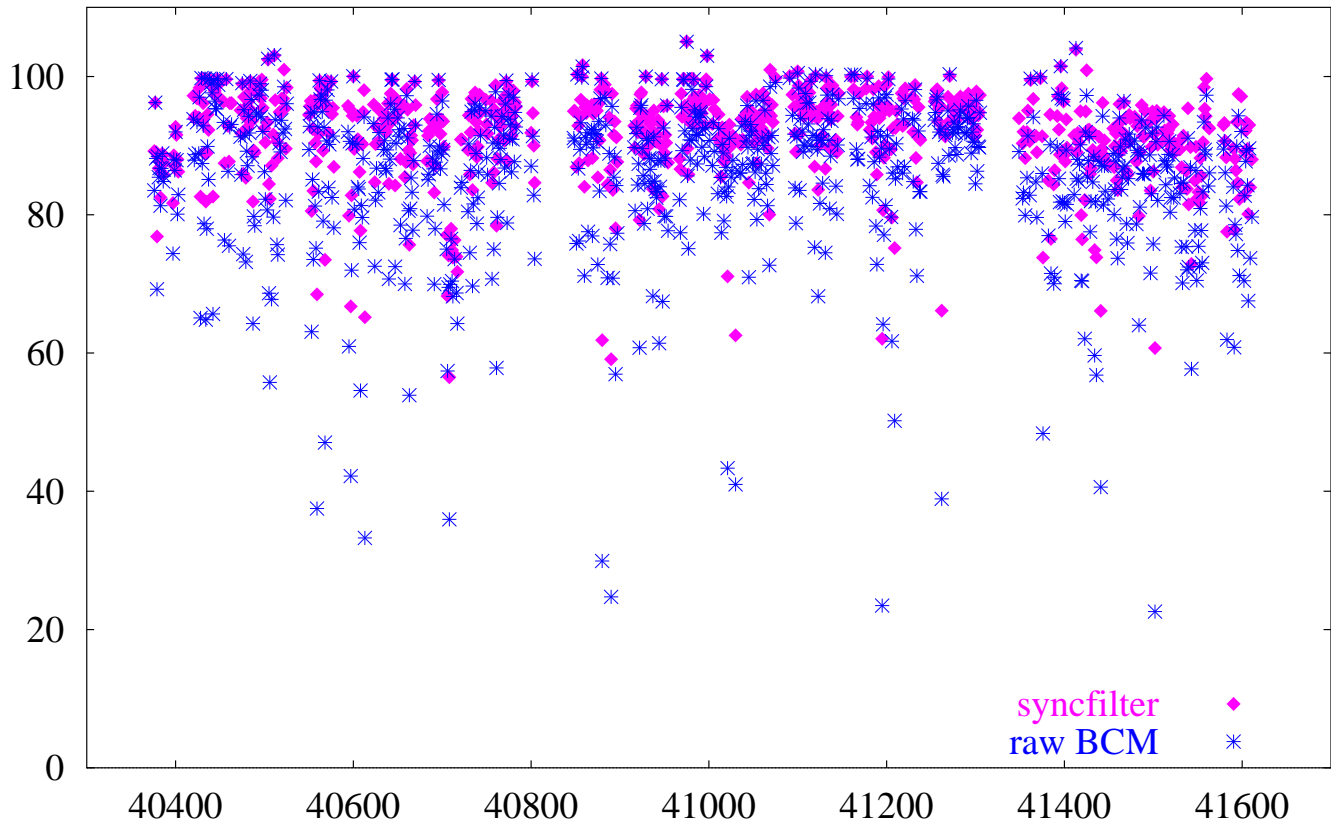
- * based on standard Hall C replay engine, customized for large beam offset (raster), target field & neutron detector
“syncfilter” pipeline
- * highly automated batch replay
“BatchMan” daemon & GUI
- * quick & easy cut studies on full data set
“Butchering” of Ntuples on batch farm

syncfilter

filter between data file and replay engine

- * detects & fixes/flags data problems
- * low current flag into data stream
 - non-zero BCM minimum*
- * correlates data and charge, time
 - *eliminates DAQ, helicity dead time*
 - *determines actual beam charge asymmetry*

BCM2 Beam Current -- syncfilter Impact



Analysis Management with *BatchMan*

The screenshot shows the BatchMan web interface. At the top, there are buttons for 'All Entries', 'Add Entries', 'Select All', and 'Clear All'. The current date and time are 'Wed Mar 20 18:11:35 EST 2002'. There are also buttons for '?', 'Params', and 'Exit'.

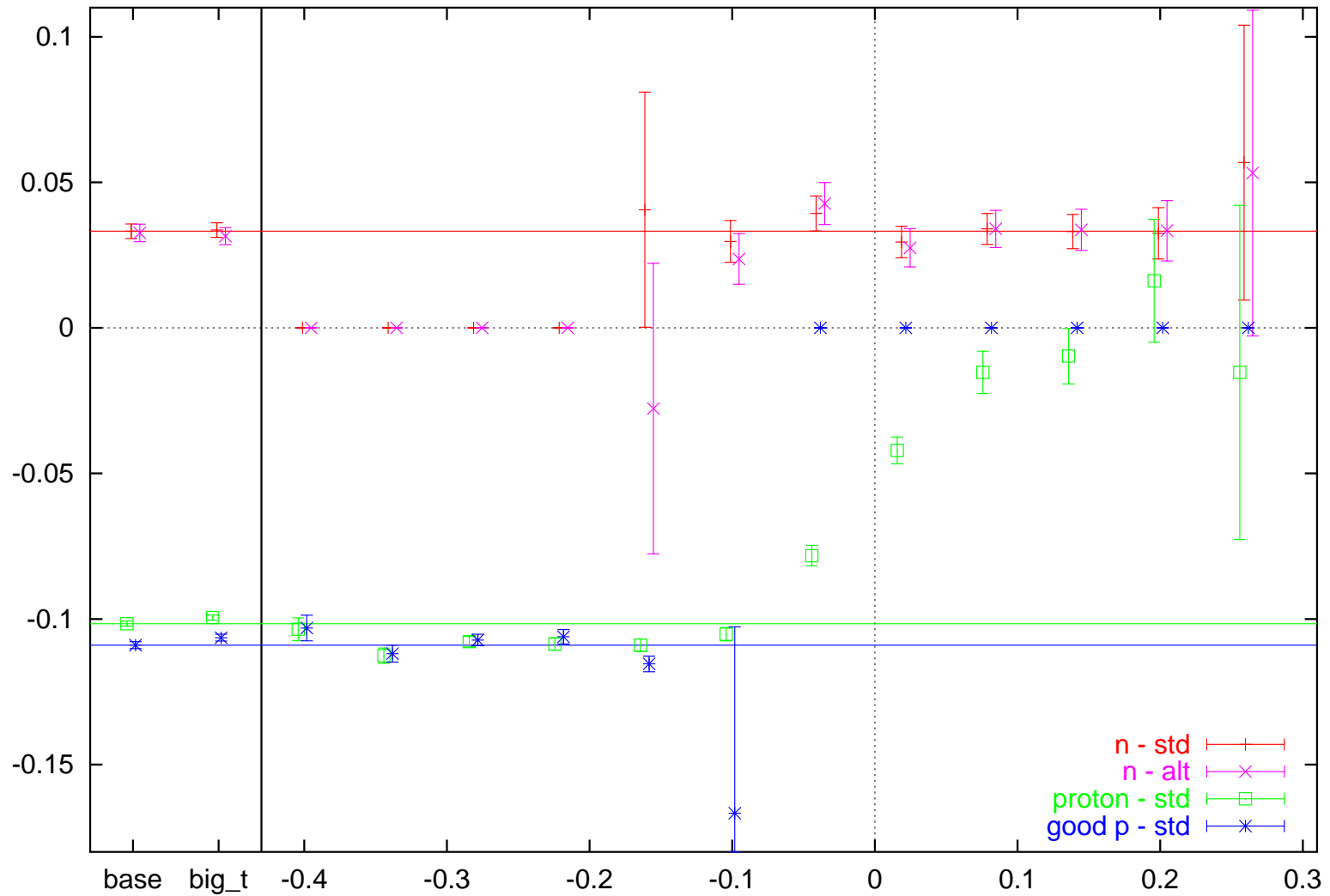
<input type="checkbox"/>	41530	unstaged	4 Files Total				
<input type="checkbox"/>	40925	staging...	2 Files Total	1 Files Staged			0
<input type="checkbox"/>	41549	queued	1 Files Total	Job n/a	Mon Mar 18 19:55:14 EST 2002		46 hours
<input type="checkbox"/>	40868	running	2 Files Total	Job 843423	Mon Mar 18 19:54:38 EST 2002		46 hours
<input type="checkbox"/>	40869	Incomplete.	2 Files Total		Ran up to seg 0	19:54:38 EST 2002 to Mon Mar 18 19:54:38 EST 2002	0 minutes
<input type="checkbox"/>	41524	Completed.	1 Files Total	Job n/a	Mon Mar 18 17:04:48 EST 2002	Mon Mar 18 18:58:17 EST 2002	113 minutes
<input type="checkbox"/>	41559	Unknown!	???	Job 843203	Wed Mar 20 14:35:00 EST 2002	Queue State: RUN	3 hours
<input type="checkbox"/>							
<input type="checkbox"/>							
<input type="checkbox"/>							

At the bottom, there are navigation buttons: '<', '<<<', '<< Previous 10', 'Entries 1 - 7 of 7', 'Next 10 >>>', '>>>', and '>|'.

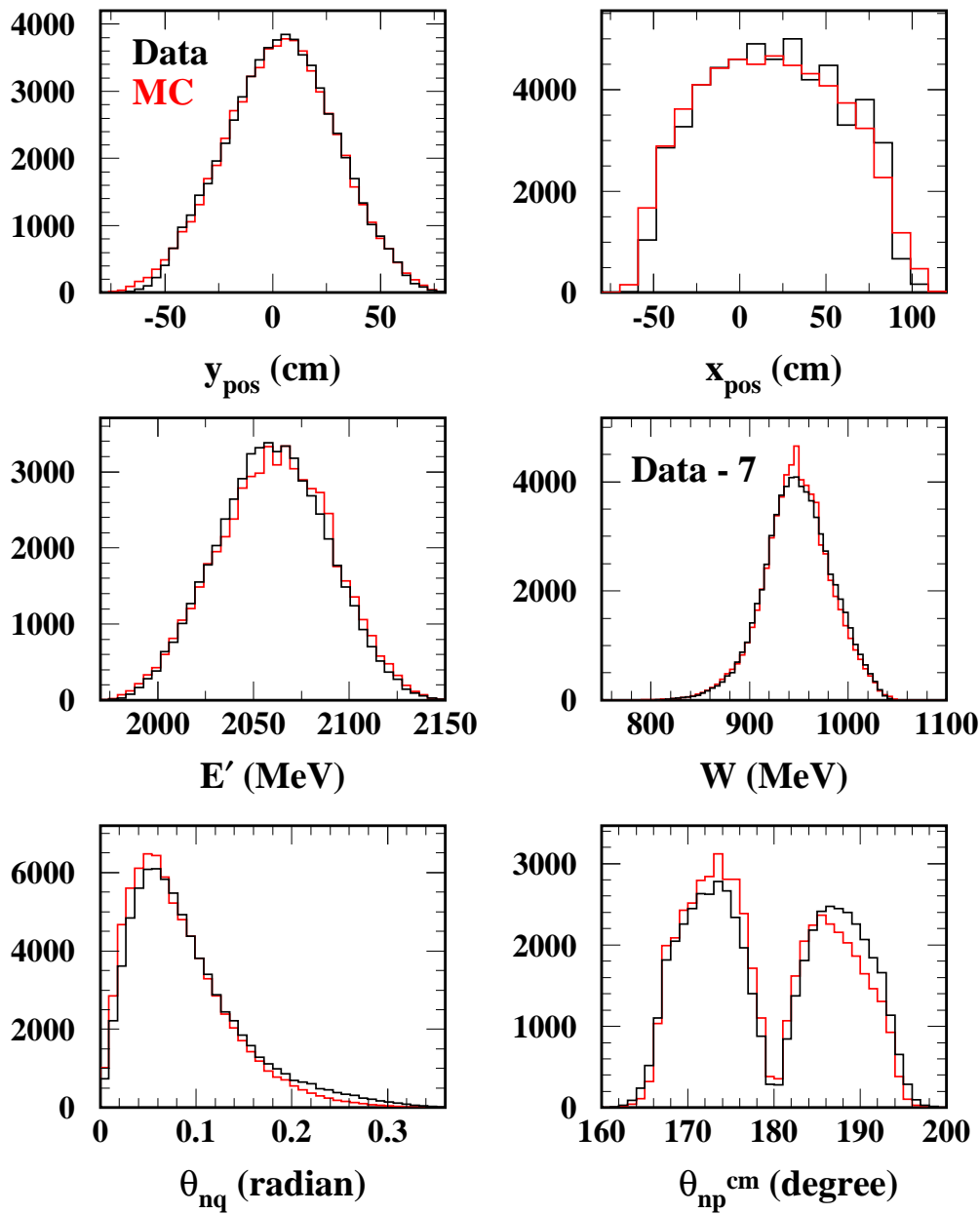
- * stages raw files, submits analysis job, verifies completion
- * tracks progress, maintains HTML formatted status file
- * handles multi-segment input files

Data Butchering

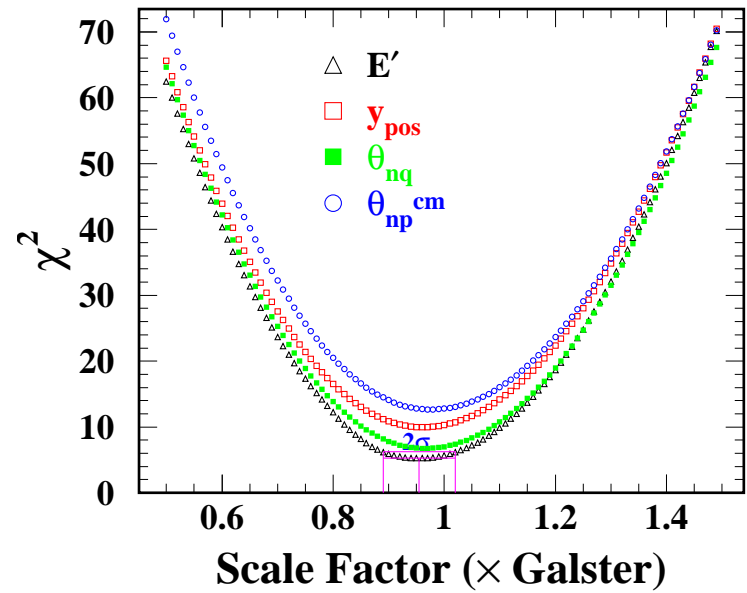
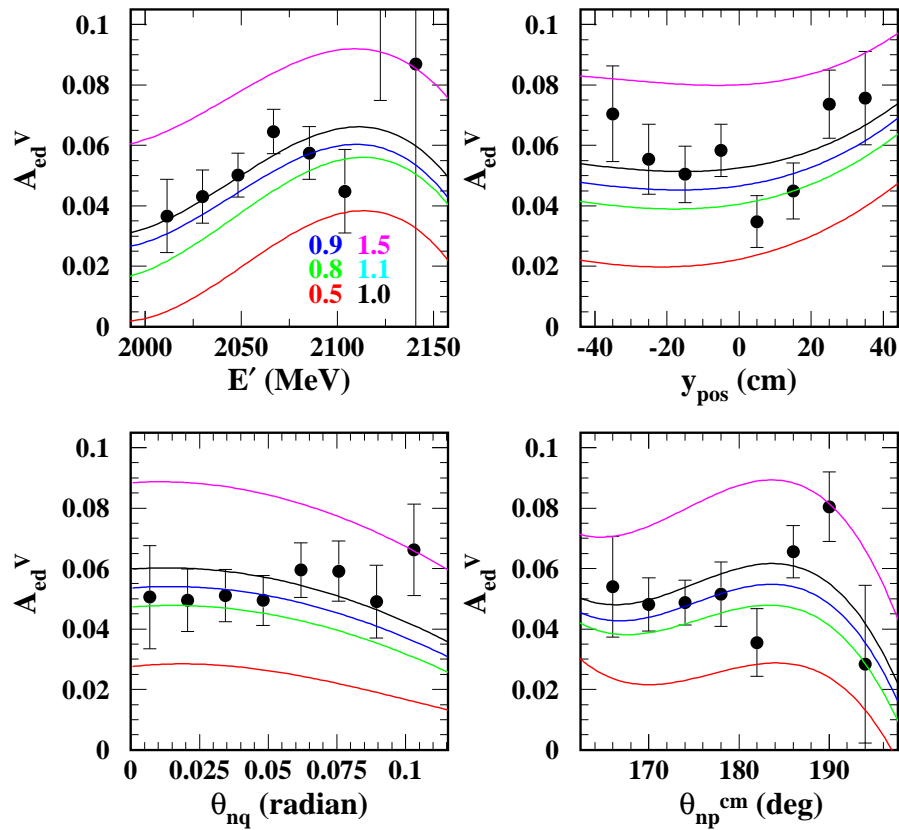
Burger Plot v12 -- bins in ntrk_dx (vertical slope)



A_{ed}^V — Data and MC Comparison

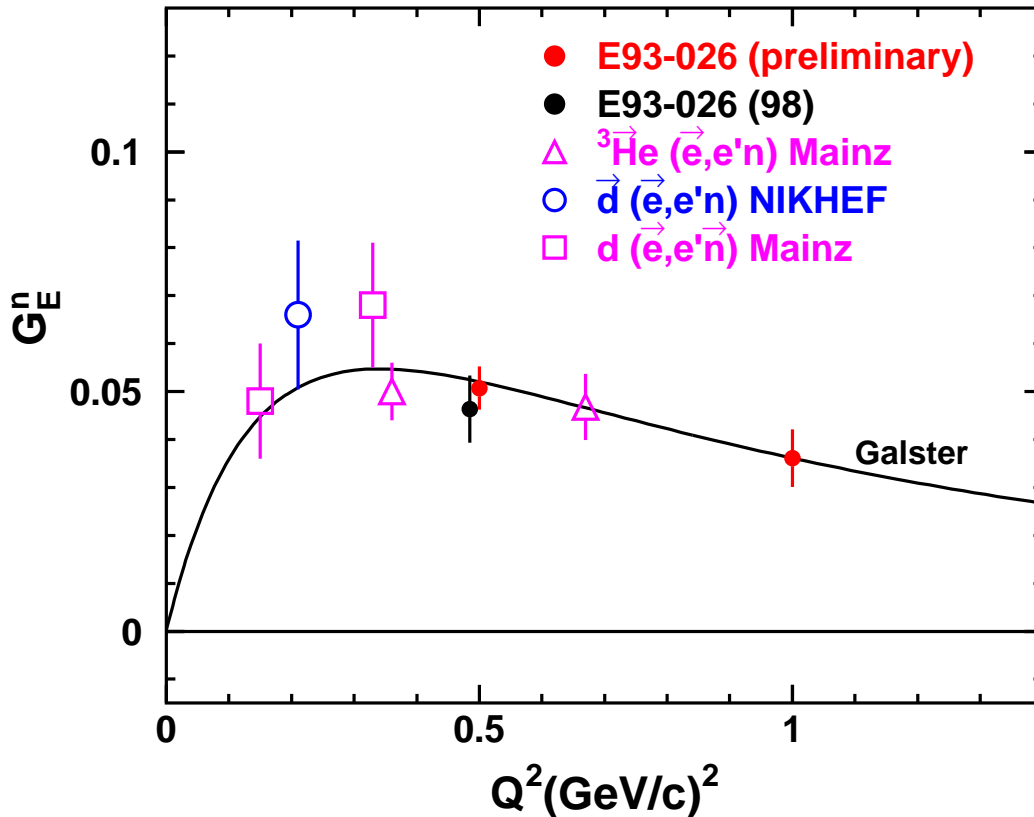


Extracting G_E^n



Results

preliminary



Systematic Errors (incl.)

Target Polarization	3-5 %
Dilution Factor	3 %
Cut Dependence	2 %
Kinematics	2 %
G_M^n	1.7 %
Beam Polarization	1-3 %
Other	1 %
Sum	6-8 %

Outlook

$$Q^2 = 0.5 \text{ GeV}^2$$

- * analysis done
- * final error values
- * G_E^n extraction fit

$$Q^2 = 1.0 \text{ GeV}^2$$

- * analysis in progress
- * results by late spring