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 $^{15}ND_3$ target

* scattered e^- and ejected neutron detected in coincidence

  custom n detector & HMS

* $Q^2 = 0.5\,GeV^2$ and $1.0\,GeV^2$

  $E_0 = 2.3\,GeV$ *and* $3.5\,GeV$

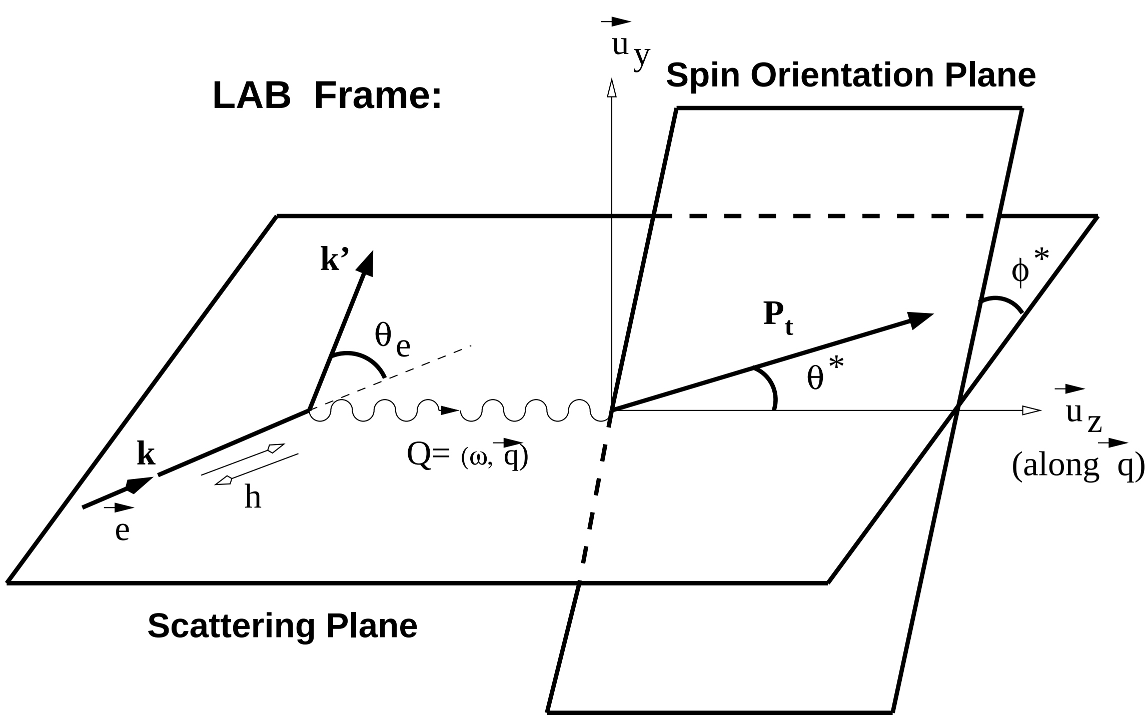
* extract G_E^n from cross section asymmetry

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)

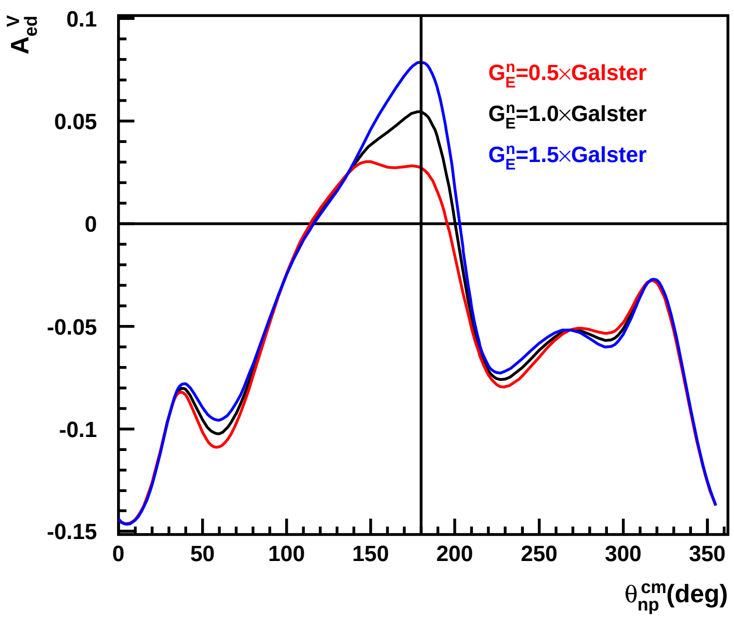
$$A_{ed}^V = \gamma_{nd} \times \frac{-2\sqrt{\tau(1+\tau)}\,\tan\frac{\theta_e}{2}\, G_E\, G_M}{{G_E}^2 + \tau[1+2(1+\tau)\tan^2\frac{\theta_e}{2}]\,{G_M}^2}$$

$$= \frac{\mathcal{E}_{ed}}{\mathcal{P}_{\text{beam}}\,\mathcal{P}_{\text{target}}} \times [\text{corrections}]$$

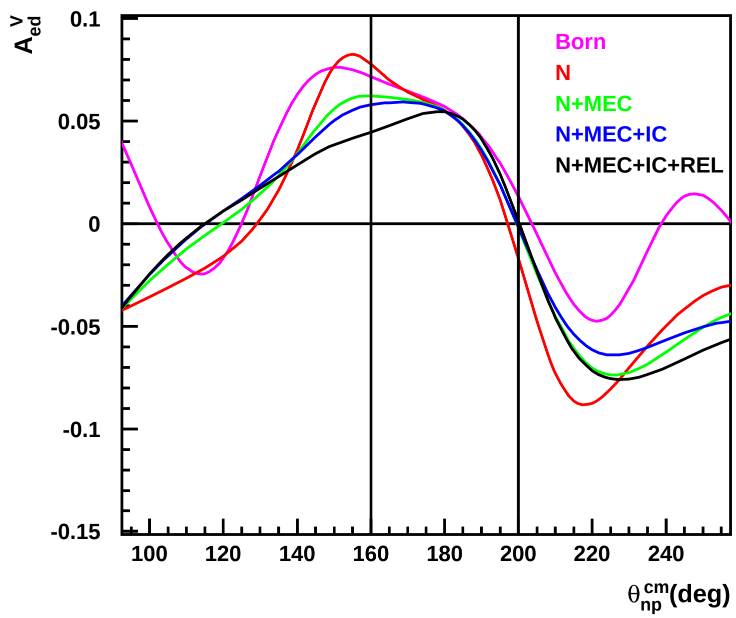


Benefits of this Approach

Maximize Sensitivity to G_E^n



Minimize Model Dependence



Gen01 Collaboration

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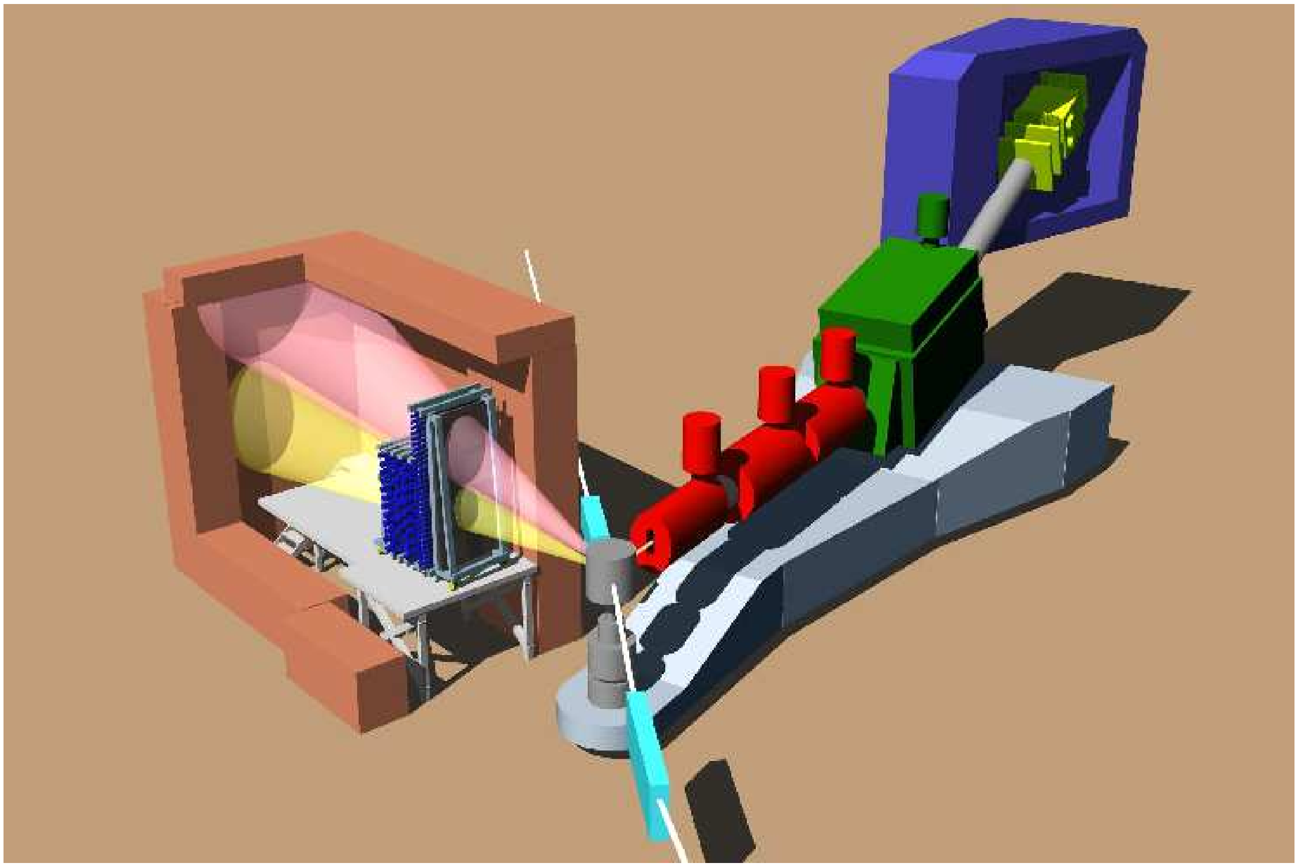
Ohio University, Southern University at New Orleans,
Tel Aviv University, University of Basel,
University of Maryland at College Park, University of Virginia,
Virginia Polytechnic Institute & State University,
Vrije Universiteit of Amsterdam, Yerevan Physics Institute

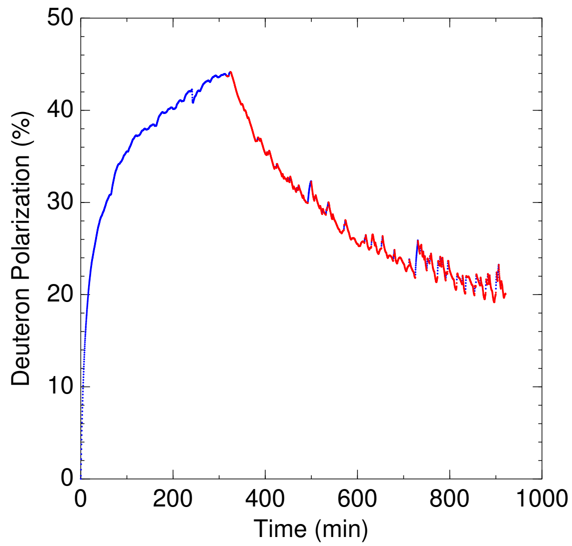
Experimental Setup

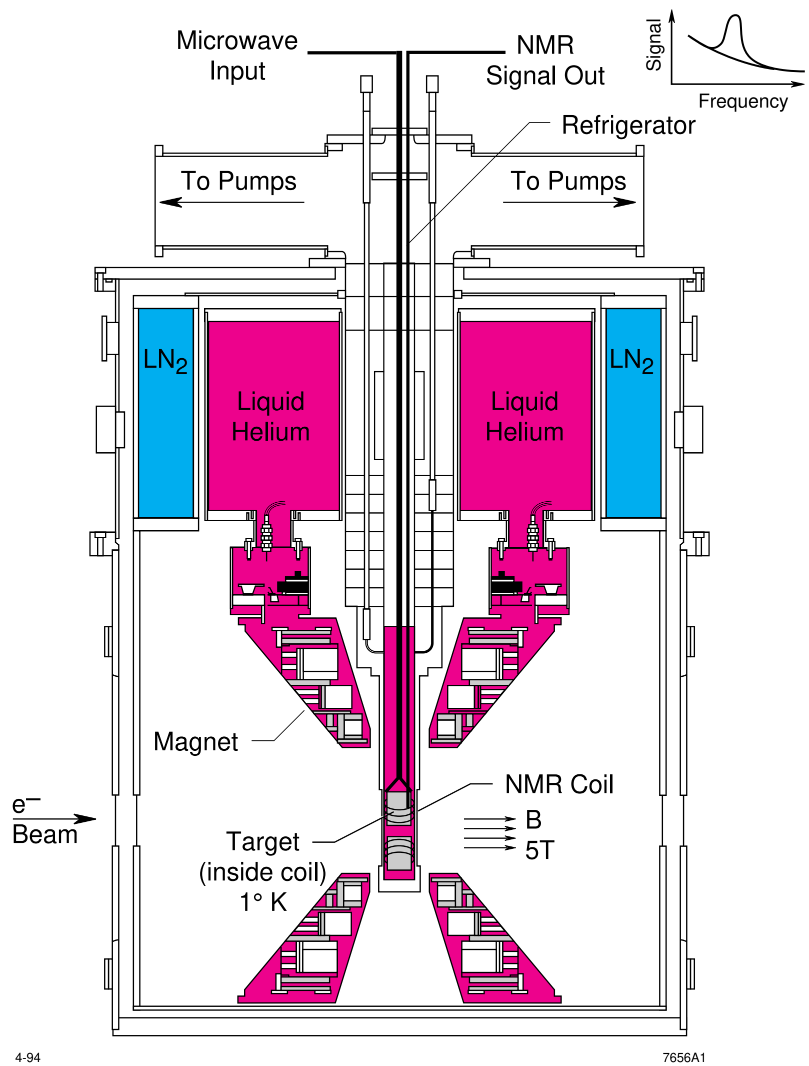


* Moller polarimeter
* High Momentum Spectrometer
* polarized target
* custom neutron detector
* SEM beam position monitor
* chicane magnets

Target

- frozen ND_3
- ^{4}He 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

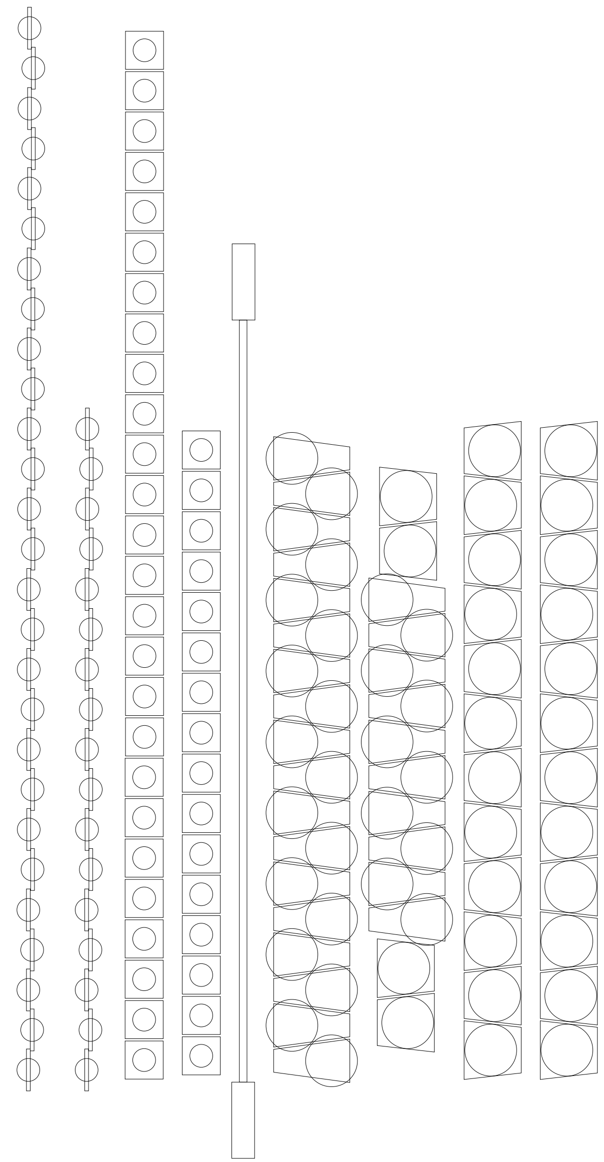
* vertically extended for
  symmetric p^+ acceptance

* phototubes at both ends

  horizontal position

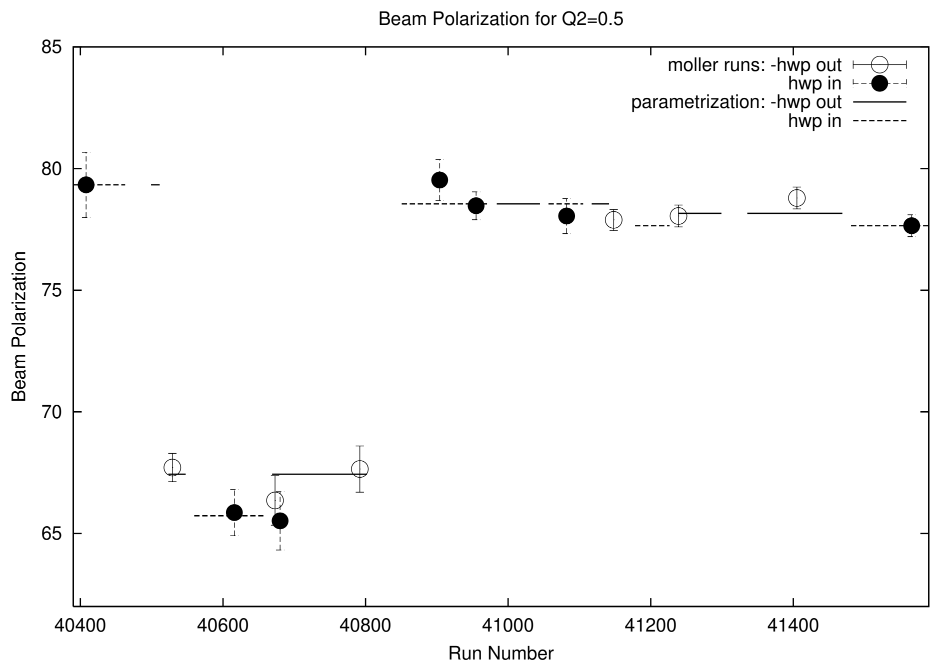
  2 vertical elements for calibration

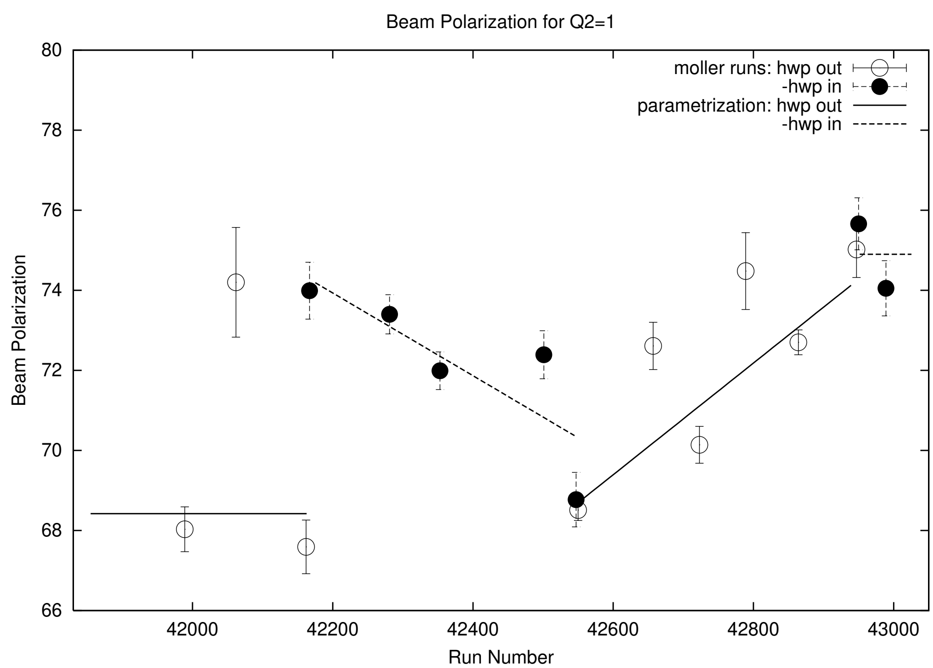
* provides 3 space coords,
  time and energy



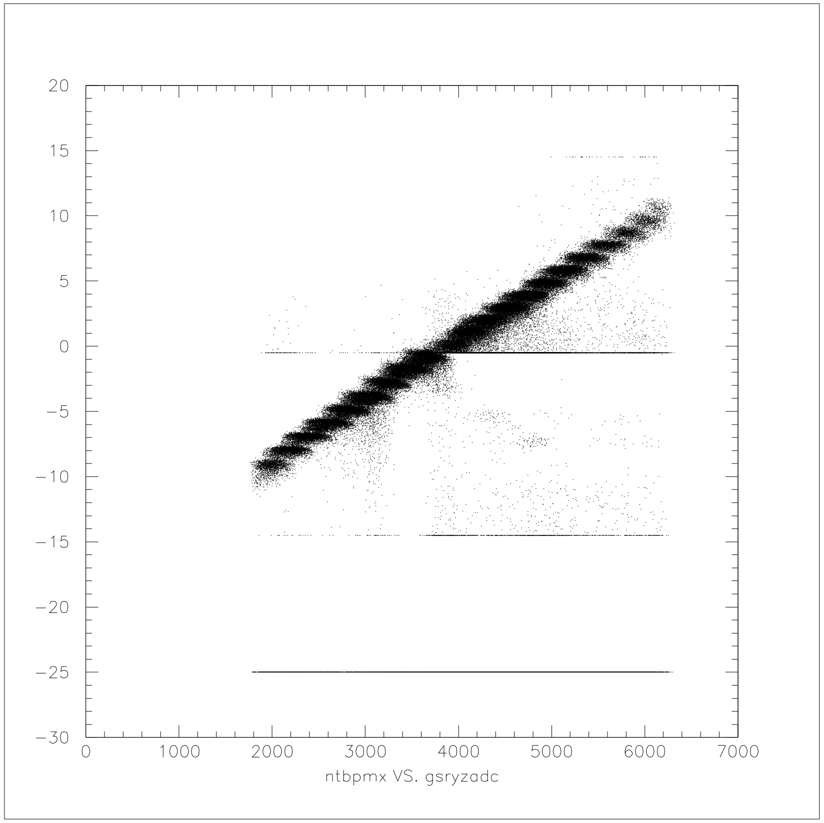
Beam Polarization

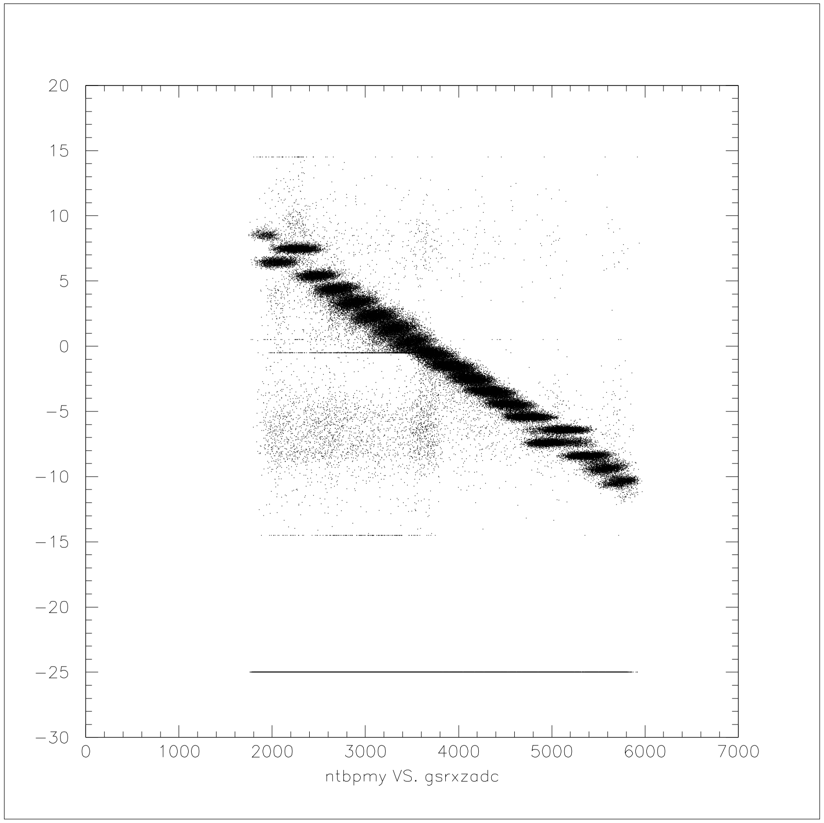
$Q^2 = 0.5\ GeV^2$ effective average = 78.2%



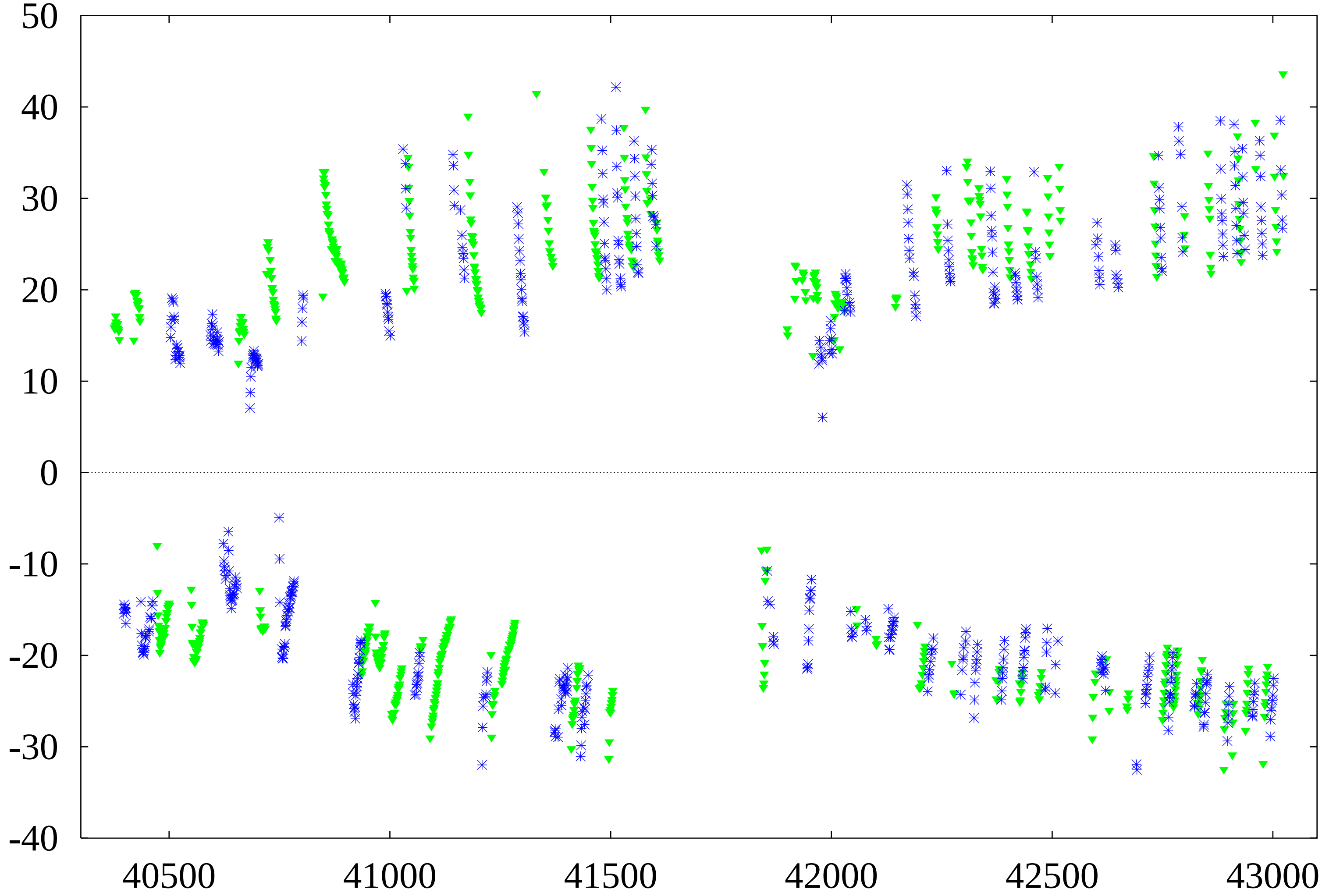


Rastered Beam Position — SEM vs ADC



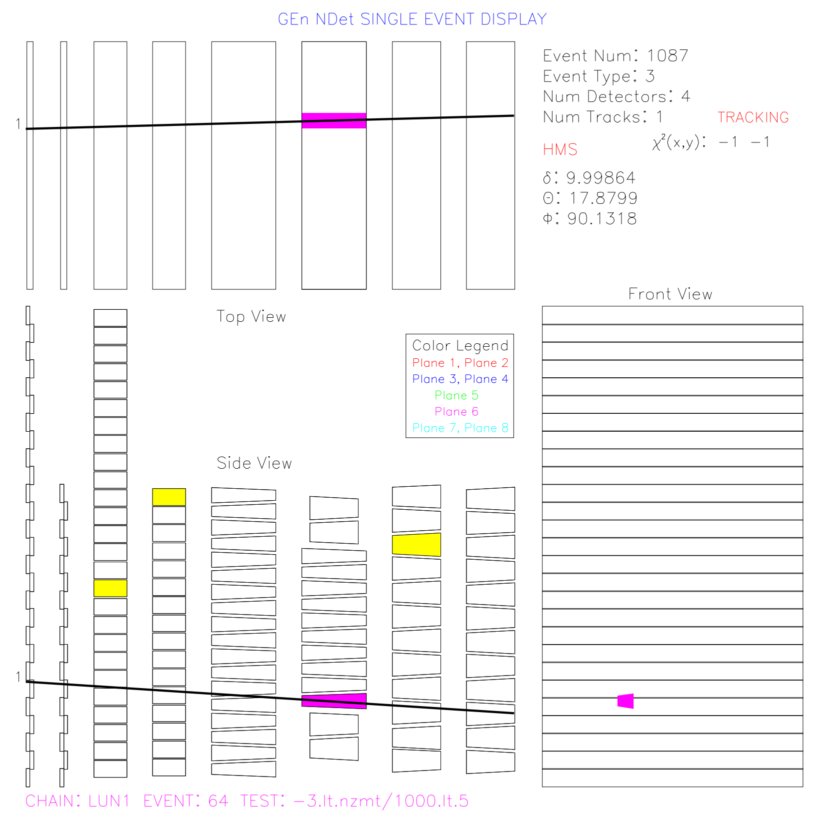


Target Polarization

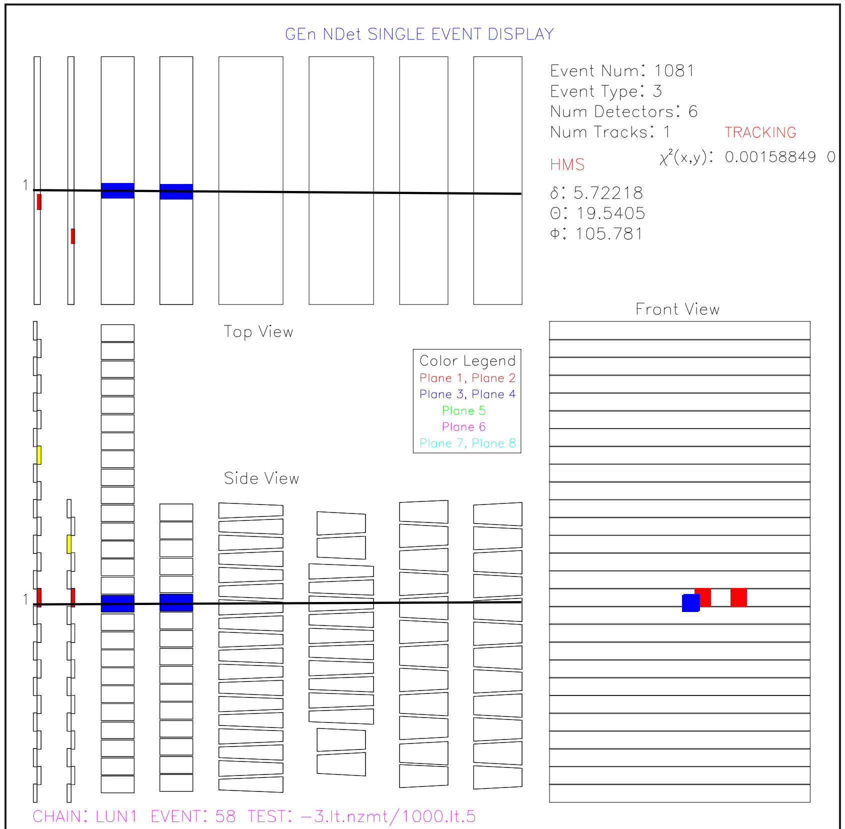


$Q^2 = 0.5\ GeV^2$ effective average = 24.4%

Neutron Detector — Single Event Display



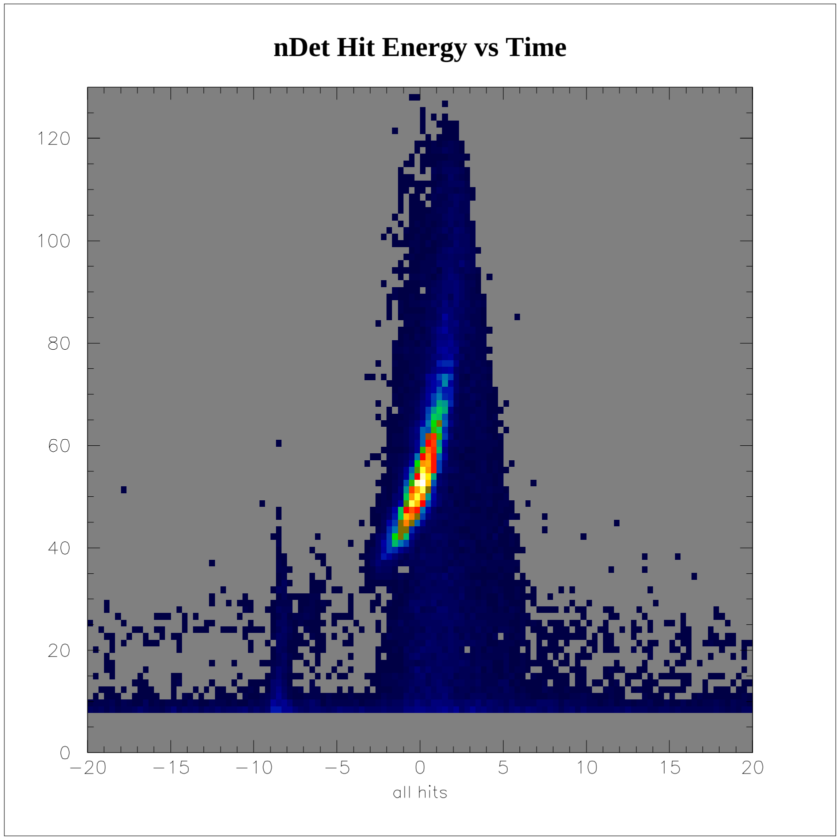
Sample Neutron Track

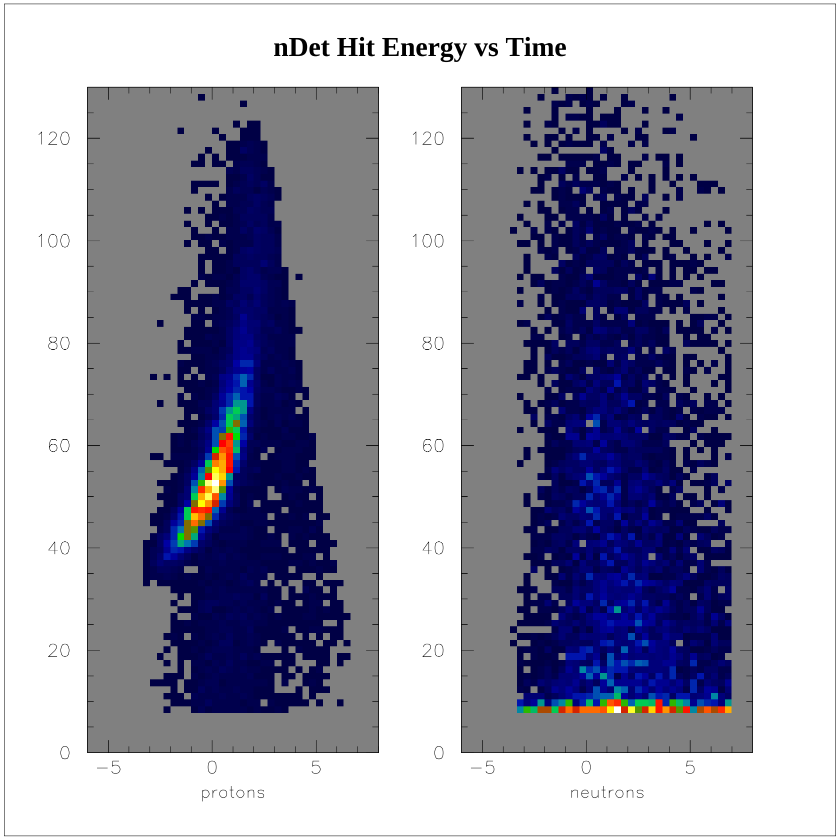


Sample Proton Track

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

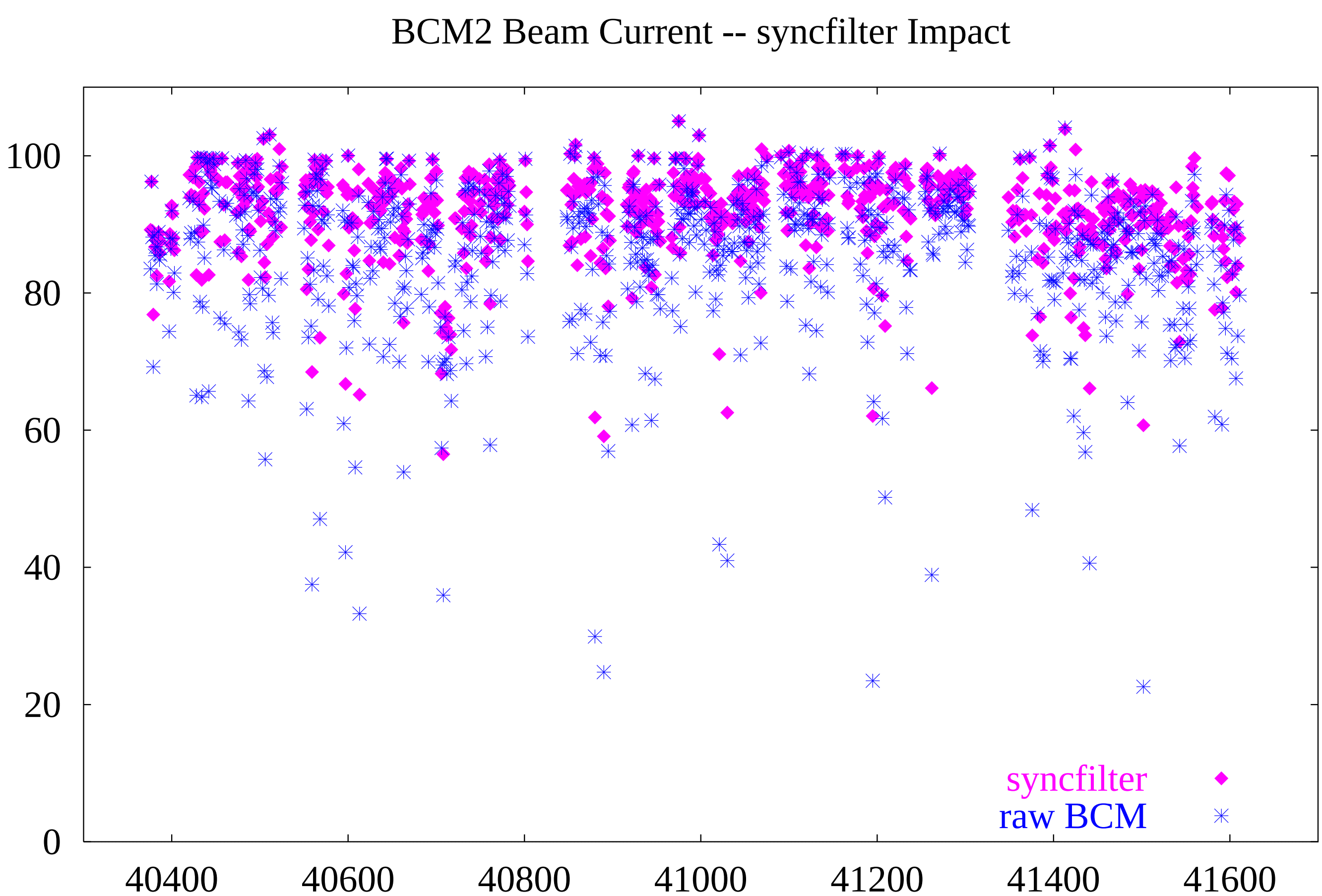
filter between data file and replay engine

- $*$ detects & fixes/flags data problems
- $*$ low current flag into data stream

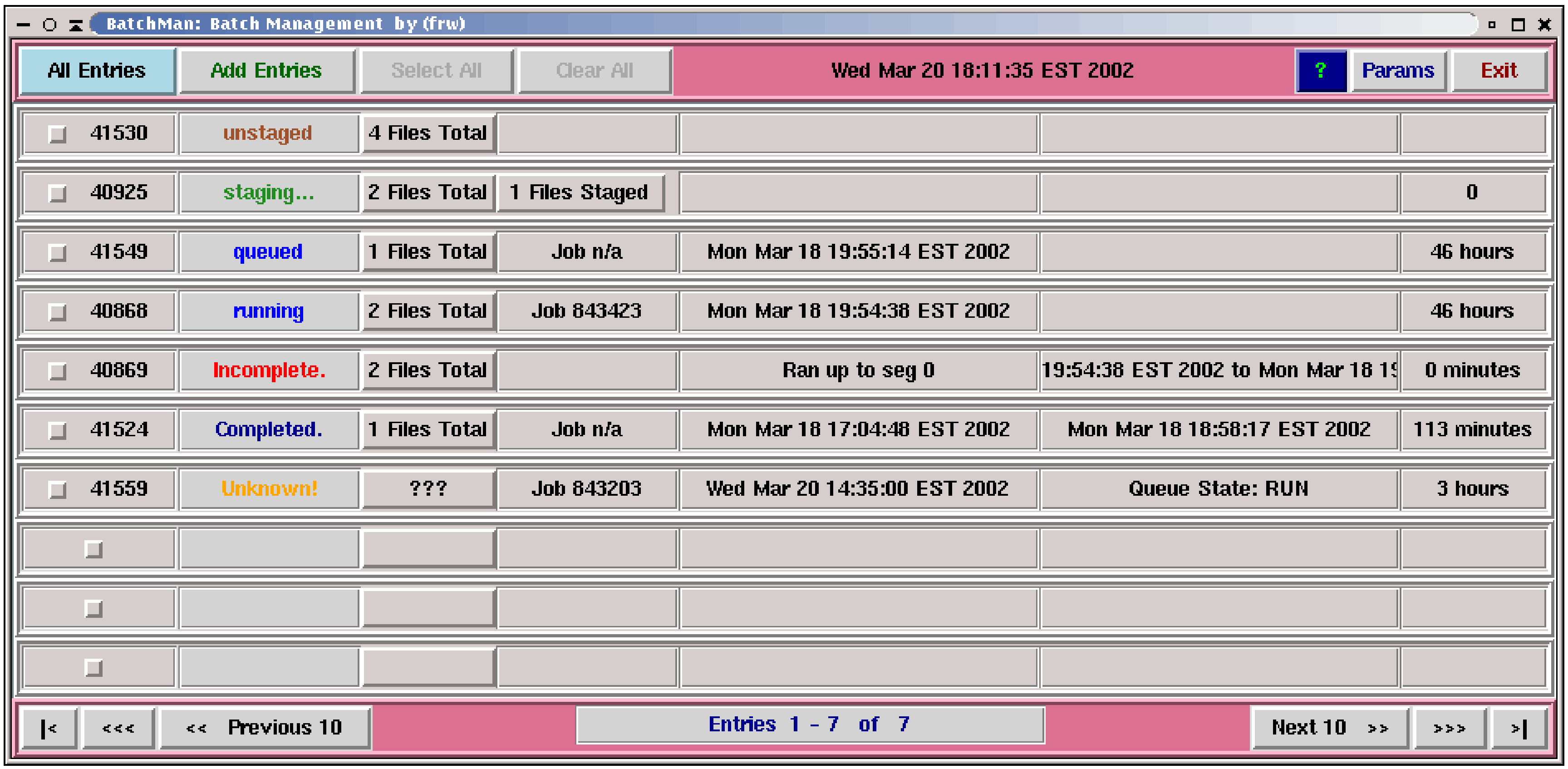
  non-zero BCM *minimum*

- $*$ correlates data and charge, time

  - *eliminates* DAQ, *helicity dead time*
  - *determines* actual *beam charge asymmetry*

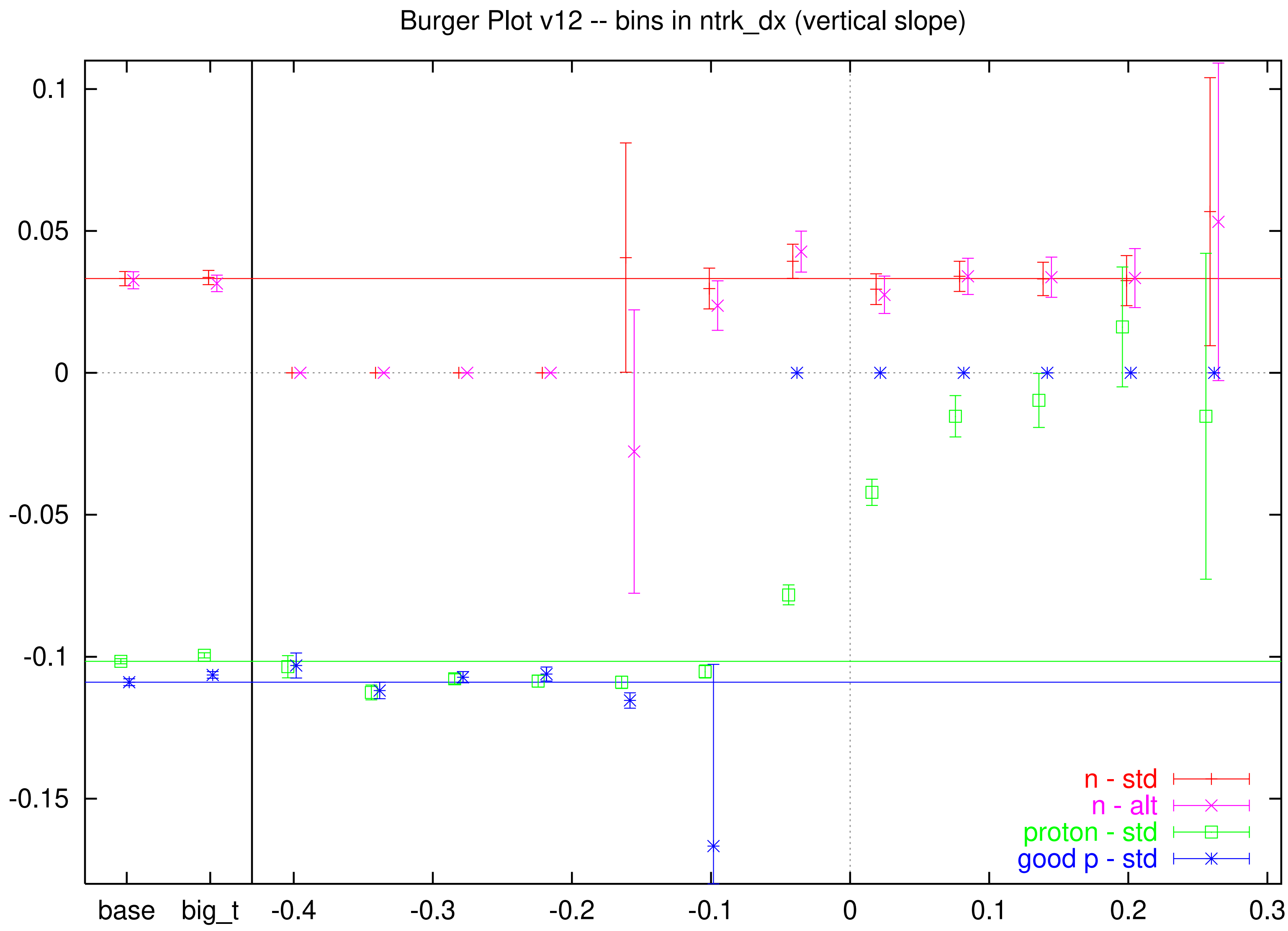


Analysis Management with *BatchMan*

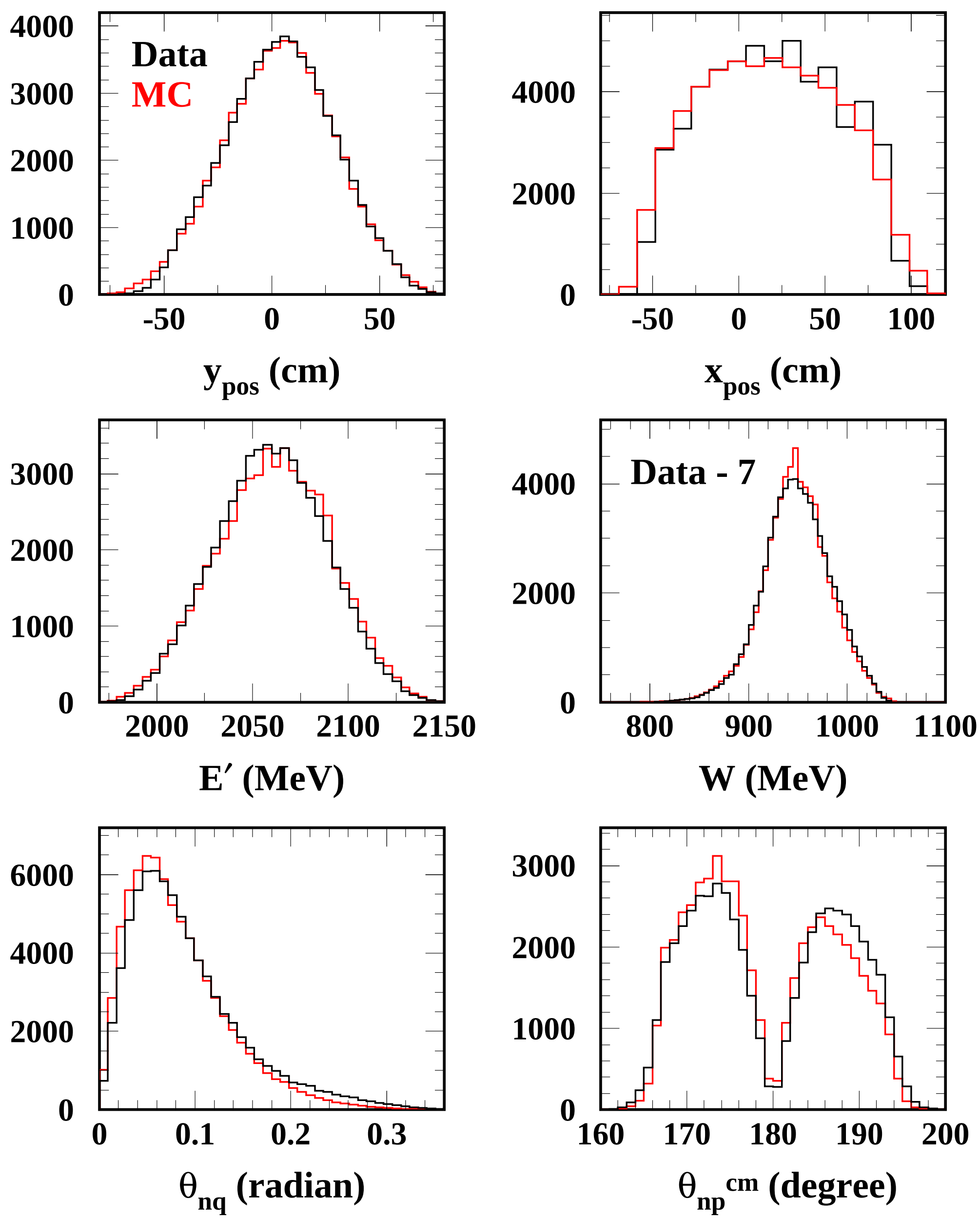


* stages raw files, submits analysis job, verifies completion
* tracks progress, maintains HTML formatted status file
* handles multi-segment input files

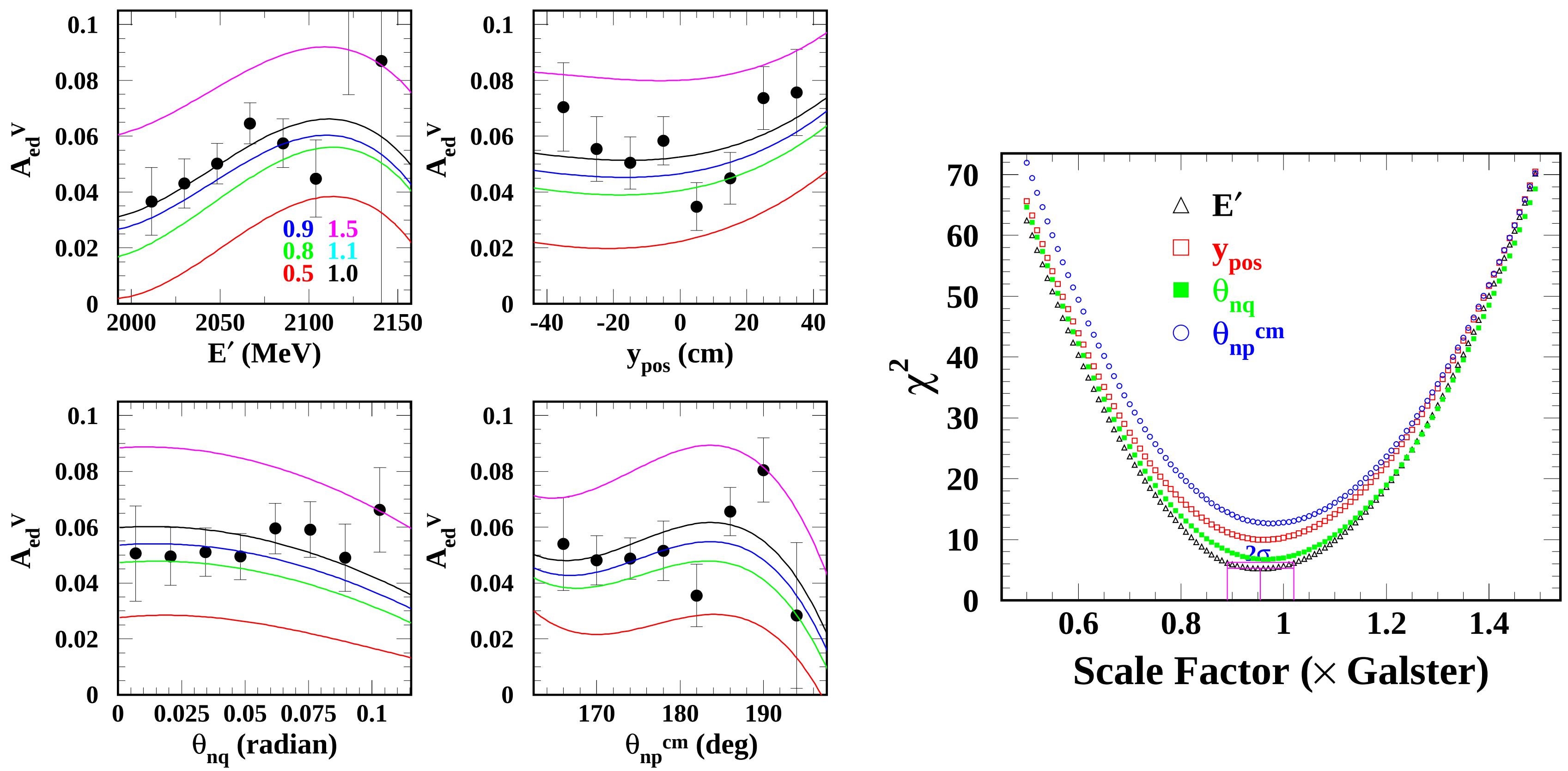
Data Butchering



A_{ed}^V — Data and MC Comparison

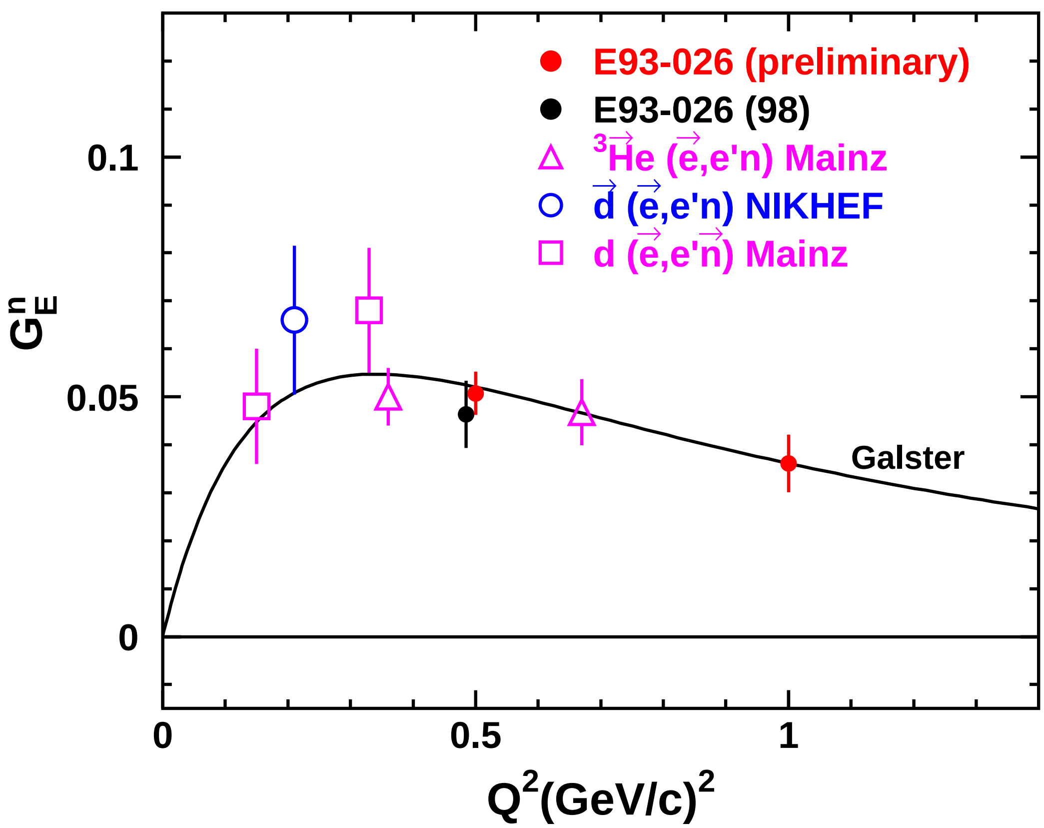


Extracting G_E^n



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

$Q^2 = 0.5\ GeV^2$

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

$Q^2 = 1.0\ GeV^2$

- analysis in progress
- results by late spring