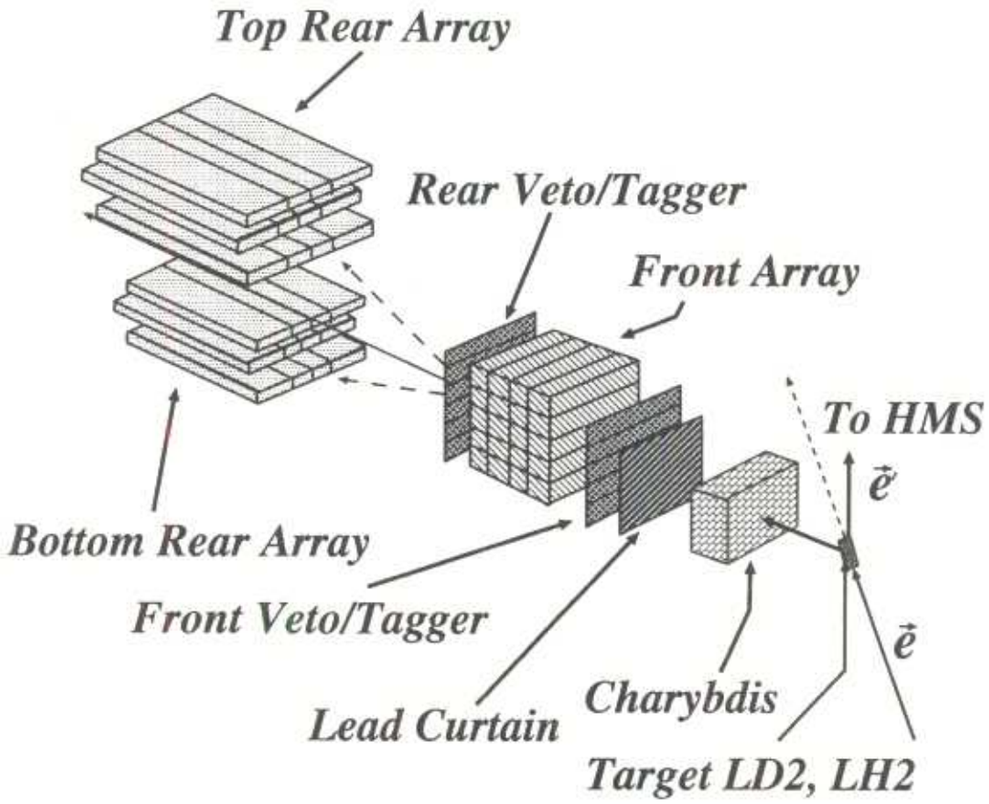
STATUS

OF THE E38-038 ANALYSIS

- Data Processing Procedures
- Results of the First-Pass Analysis
- Improvements in the Second Pass
- Corrections

A.Yu. Semenov

11 Jan 2002



In JLab E93-038 experiment, the ratio $g \equiv G_E^n/G_M^n$ is extracted by measuring the polarization of the recoil neutron after quasi-elastic scattering of a longitudinally polarized electron from an unpolarized deuteron target. The ratio of longitudinal and transverse components of the polarization can be obtained by measuring the ratio of asymmetries produced by recoil neutron in the second scattering in the NPOL after precession of the polarization vector on two different angles in the CHARYBDIS dipole magnet. In this technique, systematic uncertainties are small because the NPOL analyzing power and the electron beam polarization cancel in the ratio.

Applied Cuts

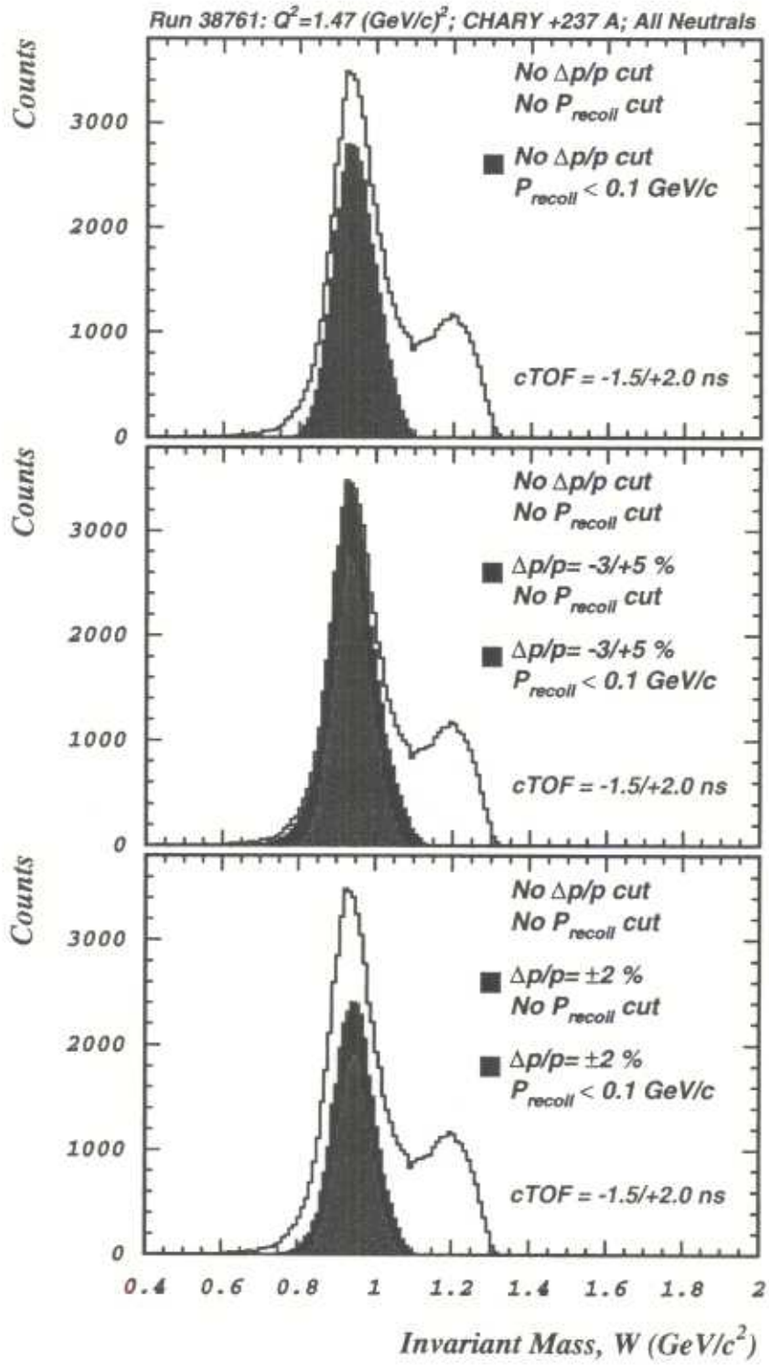
First-Level Cuts:

- **Position in the target:** $| Z_{TAR} | < 7.0\ cm$
- **Electron velocity in HMS:** $0.7 < \beta_{HMS} < 1.3$
- **HMS Cherenkov:** $N_{pe}^{CHER} > 2$
- **HMS Calorimeter:** $E_{SH} > 0.4$ (*or* 1.4, *or* 1.8)
- **Momentum in HMS:** $-3\,\% < \Delta P/P < 5\,\%$
- **PH threshold in the Front:** $Thr(FRONT) > 8\ MeVee$
- **PH threshold in the Rear:** $Thr(REAR) > 20\ MeVee$

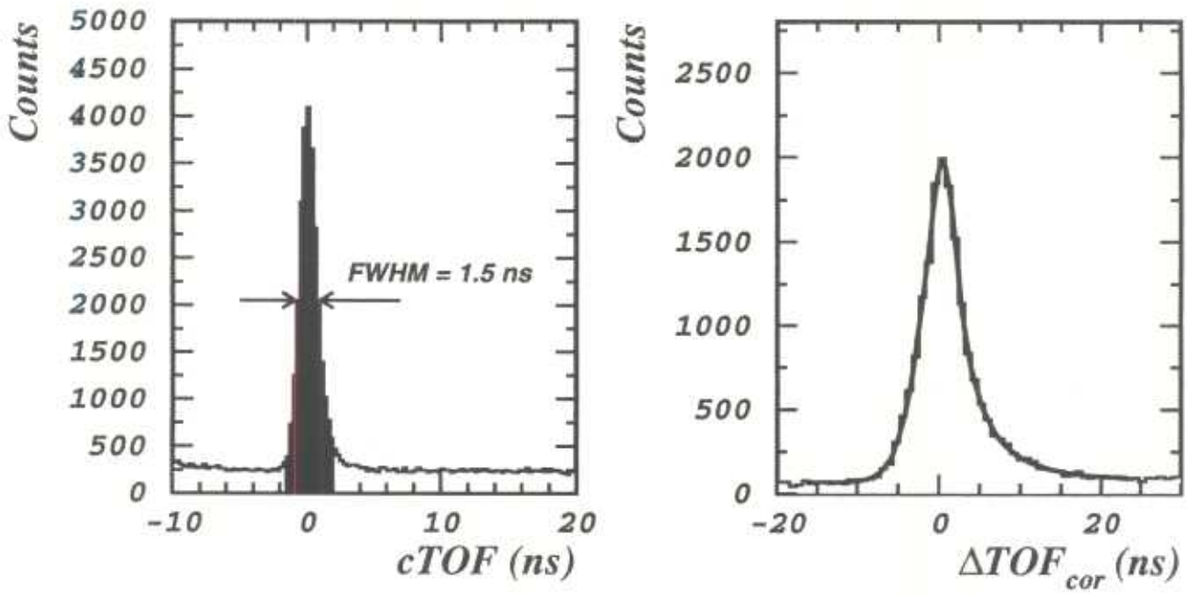
Cuts After Calibration and Event Sorting:

- **"Neutral particle in the Front"**
- **"No second scattering in the Front"**
- **Recoil momentum:** $P_{RECOIL} < 100\ MeV/c$
  (calculated from electron kinematics and hadron angle)
- **"No tracking errors in the polarimeter"**

Events Passed the Cuts: $\sim 5\,\%$



Each of these cuts alone supresses the pion production practically completely.



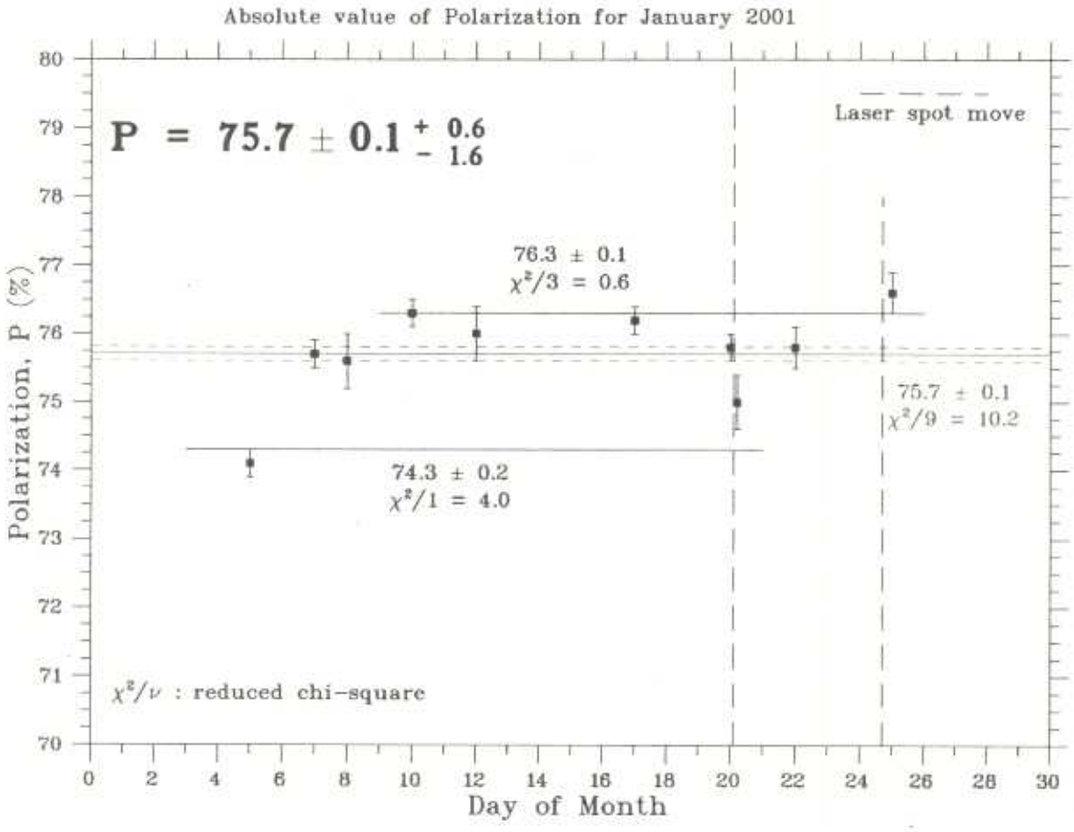
Left panel: calibrated and corrected HMS-NPOL coincidence time-of-flight (cTOF).
Right panel: calibrated and corrected TOF between a neutron event in the front array of the polarimeter and an event in the rear array (ΔTOF) for the peak region in cTOF. The ΔTOF spectrum can be subdivided into four spectra – two for each beam helicity state (L and R) with scattered to the upper (U) array or to the bottom (D) array. The fitting procedure gives the yields in the peak region for these spectra, and cross ratio r and the asymmetry ξ are calculated:

$$r = [(N_{RU} N_{LD})/(N_{LU} N_{RD})]^{1/2}$$

$$\xi = (r-1)/(r+1)$$

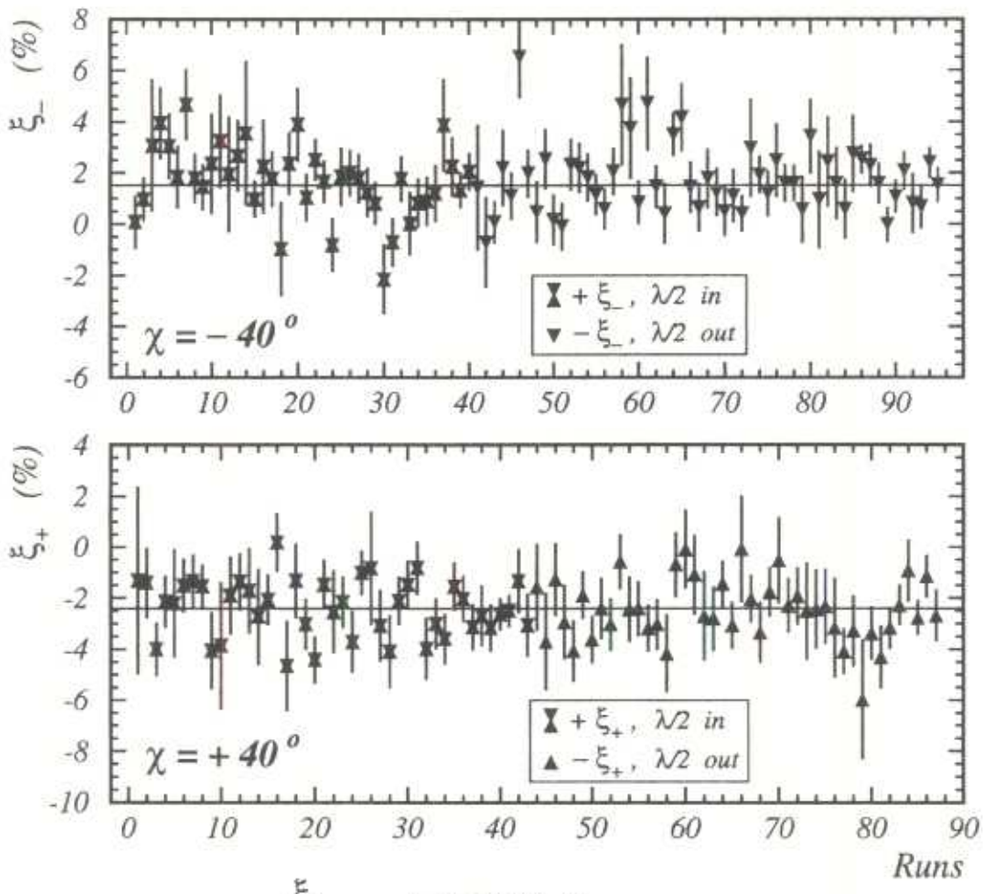
Beam charge asymmetry and NPOL geometrical asymmetry cancel in the cross ratio.

Correction on Beam Polarization



To combine asymmetry measurements for a paticular Q^2 point, "clusters" of polarization measurements were identified, the mean beam polarization for each "cluster" was calculated, and the asymmetries measured around the cluster were normalized on the "nominal" polarization value of 80%.

Report: B. Plaster and R. Madey, *The Contribution of the Uncertainty in the Beam Polarization to the Systematic Uncertainty in* G_E^n/G_M^n.

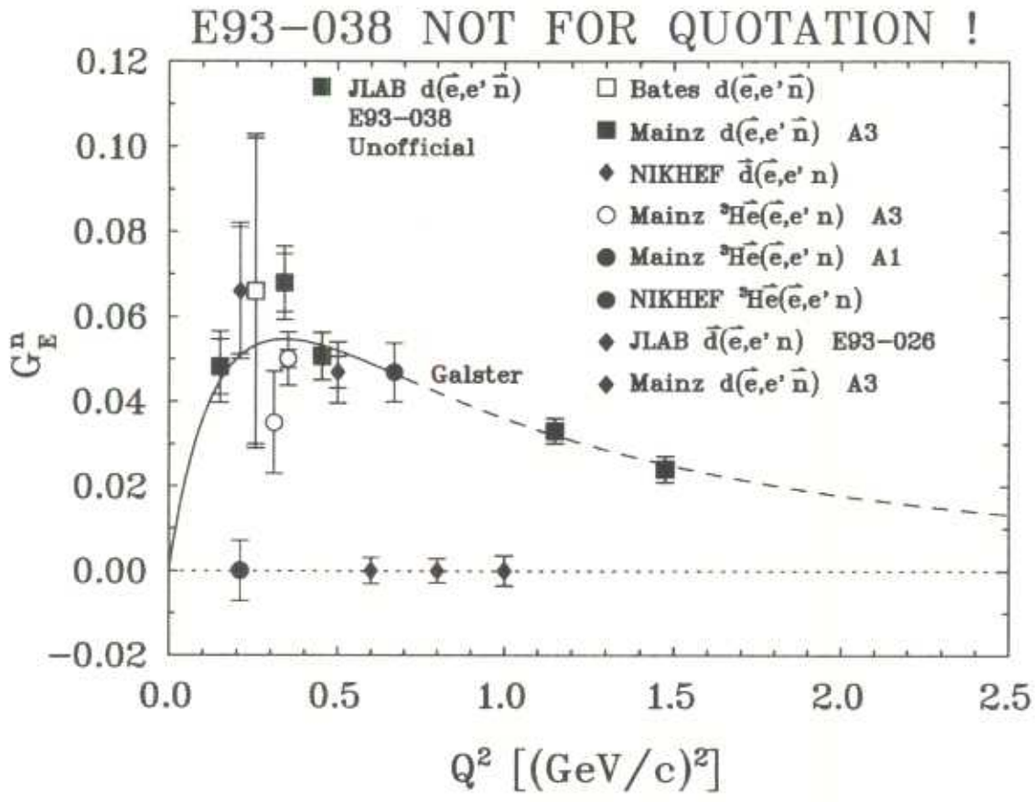


$$\eta = \frac{\xi_-}{\xi_+} = \frac{1.51 \pm 0.11\ \%}{-2.42 \pm 0.12\ \%} = -0.624 \pm 0.055$$

$$\eta_{Galster} = -0.634$$

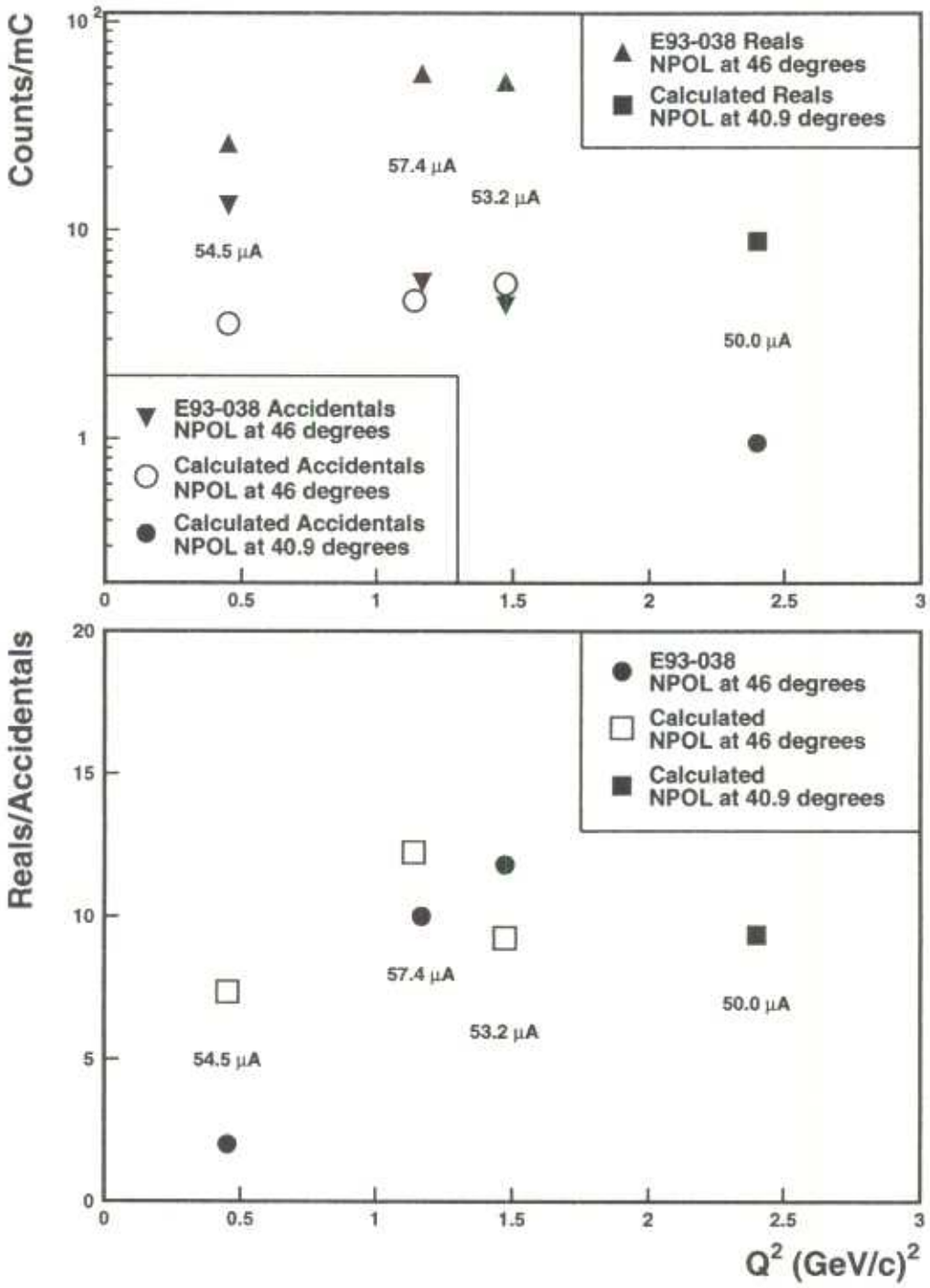
$\chi = 0^o, \pm 90^o$: $g = -K\,\eta$, where $\eta = \left(\frac{\xi_{0^o}}{\xi_{90^o}}\right)$

$\chi = \pm 40^o$: $g = K\,tan(\chi)\left(\frac{\eta+1}{\eta+1}\right)$, where $\eta = \left(\frac{\xi_{-40^o}}{\xi_{+40^o}}\right)$



Data Summary

Q^2 (GeV/c^2)	χ (deg)	Q (C)	cTrig.
0.45	$-40^o/+40^o$	48.7	218.7 M
1.13	$0^o/\pm 90^o$	42.3	511.6 M
1.17	$-40^o/+40^o$	16.3	63.8 M
1.47	$0^o/\pm 90^o$	35.1	393.0 M
1.47	$-40^o/+40^o$	41.5	217.4 M



Reals-to-accidentals ratio from the experiment is consistent with the (GEANT/GCALOR + MONQEE) calculations.

Estimated Systematic Uncertainties in $\Delta g/g$ [%]

Source	Q^2 [(GeV/c)^2]				
	0.45[1]	1.17[1]	1.13[2]	1.47[1]	1.47[2]
Beam Polarization	1.4	0.8	0.4	1.7	0.3
False Asymmetry/Dilution	in progress				
Positioning/Traceback	0.2	0.3	0.3	0.4	0.4
Precession Angle	2.1	1.4	0.3	2.4	0.3

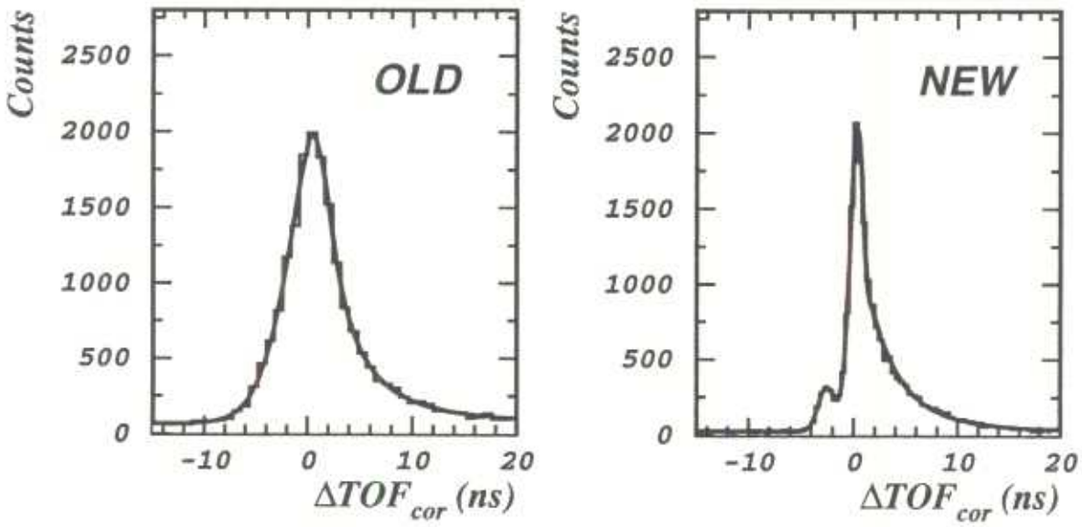
1. $\chi = \pm 40^\circ$ precession.
2. $\chi = 0^\circ,\ \pm 90^\circ$ precession.

Reports:

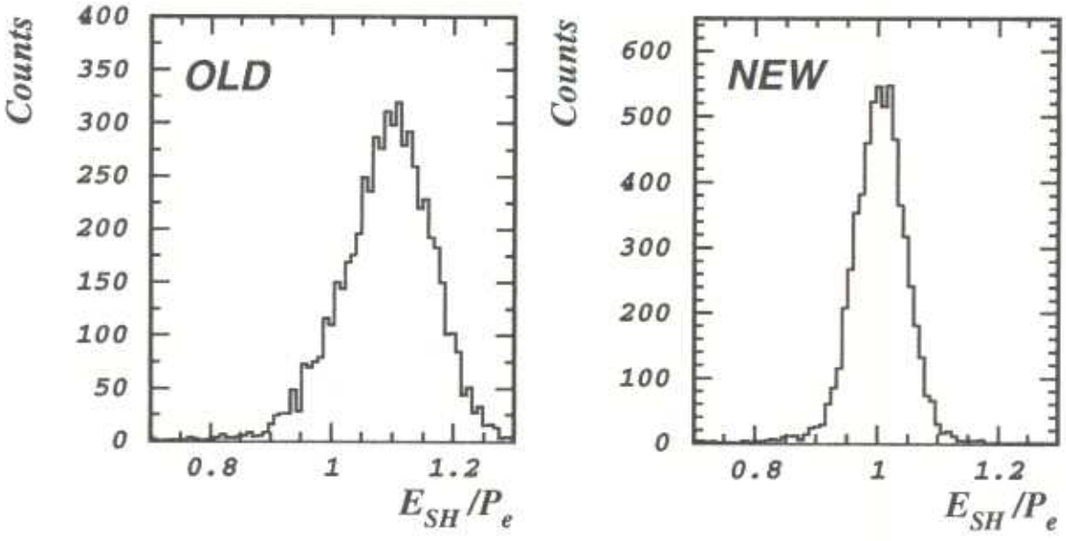
- B. Plaster and R. Madey, *The Contribution of the Uncertainty in the Beam Polarization to the Systematic Uncertainty in* G_E^n/G_M^n.
- B. Plaster, R. Madey, and A. Aghalaryan, *The Contribution of the Traceback and Positioning Uncertainty to the Systematic Uncertainty in* G_E^n/G_M^n.
- More reports expected.

Improvements in the Second Pass

- Improved TOF calibration and events sorting



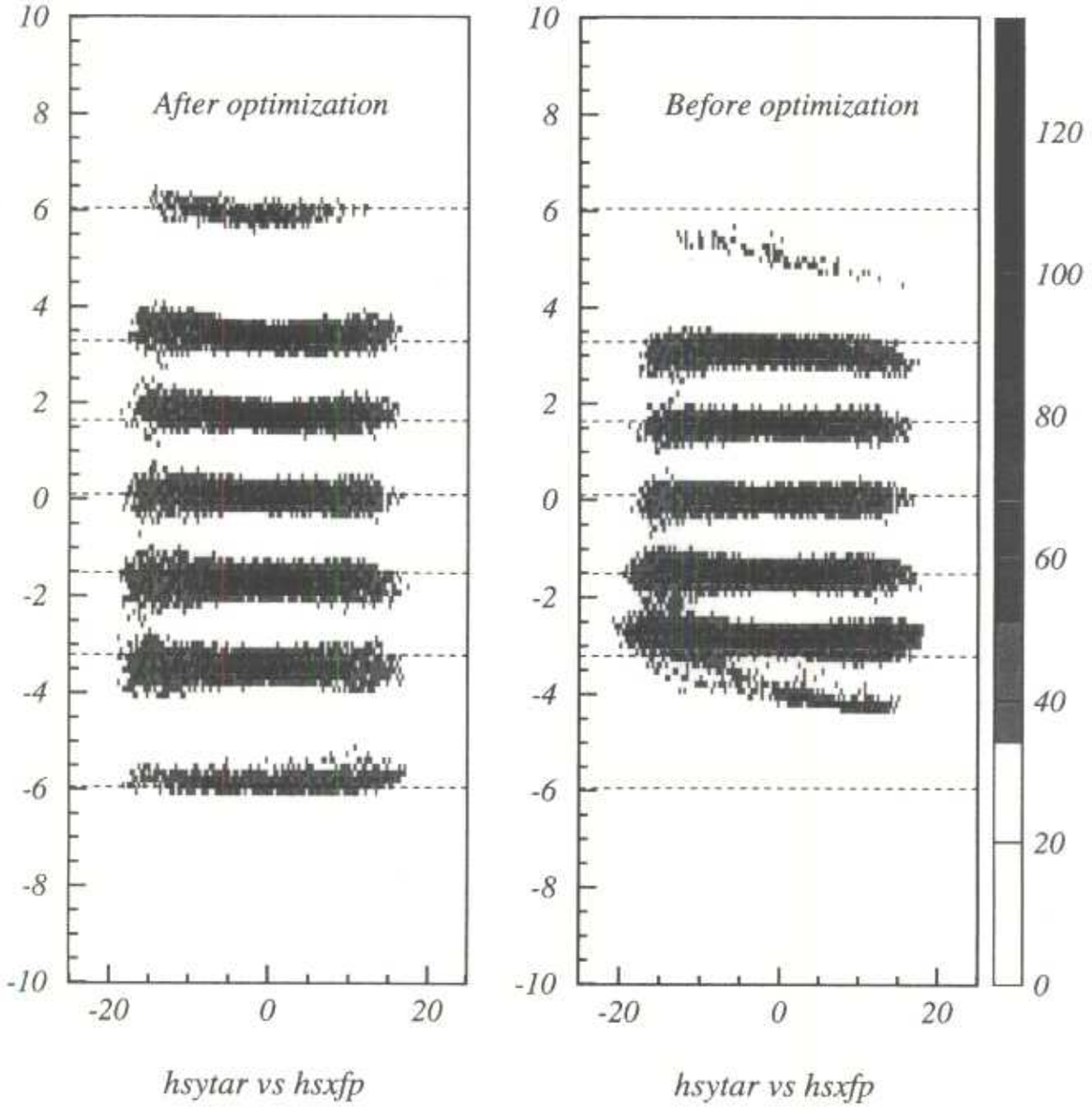
- New calibration for HMS calorimeter



- New HMS matrix elements
- "Direct" cut on invariant mass W

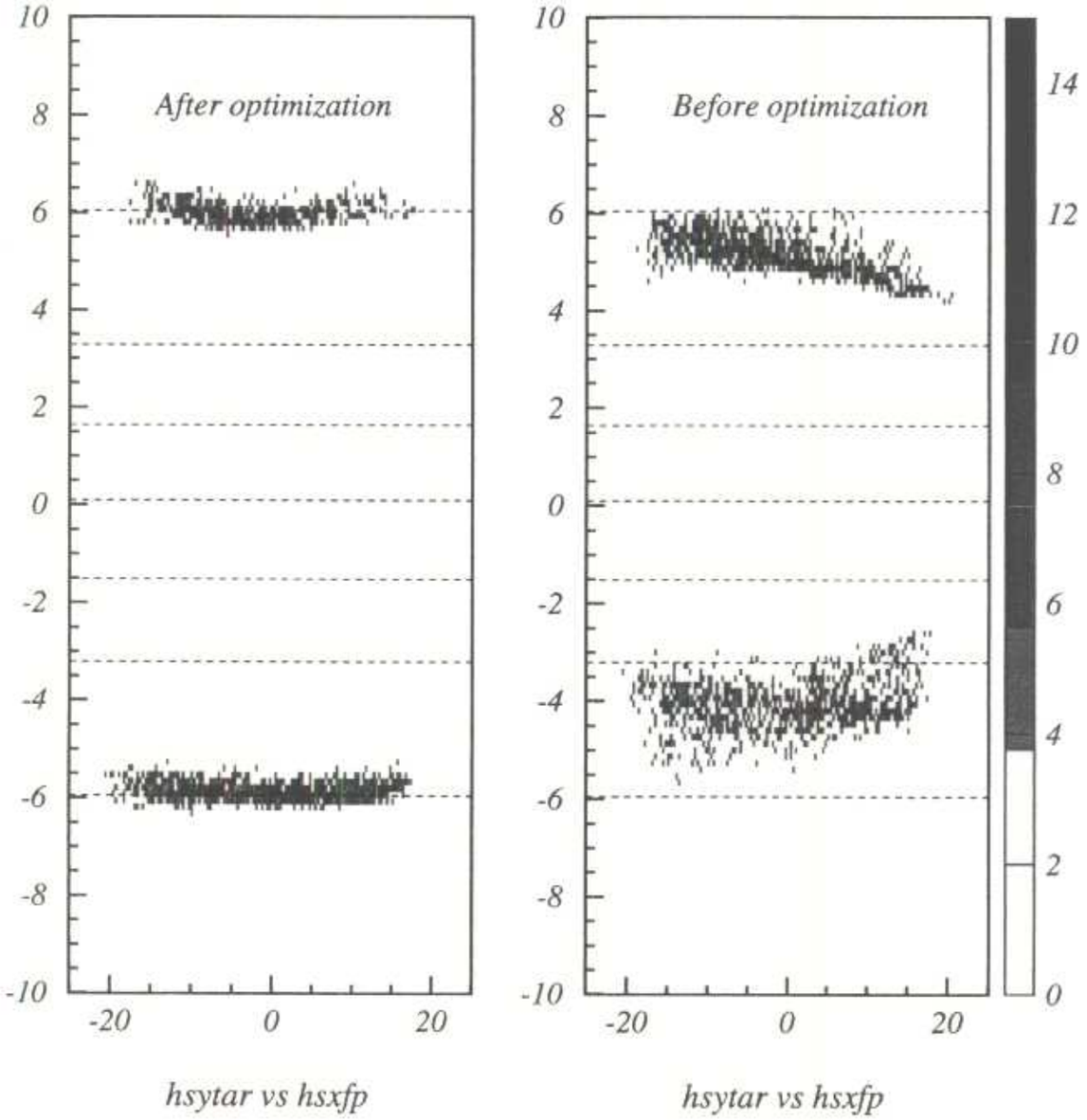
$Q^2 = 0.447\ (GeV/c)^2$; $E = 0.884\ GeV$; $P_{HMS} = 0.643\ GeV/c$; HMS Angle 52.66^o

Optic Run 39191 .



$Q^2 = 0.447\ (GeV/c)^2$; $E = 0.884\ GeV$; $P_{HMS} = 0.643\ GeV/c$; HMS Angle 52.66^o

Dummy Run 39138 .



Corrections

- False-asymmetry analysis
  (in progress)
- Acceptance averaging / FSI correction
  (GENGEN: event generator by J.J. Kelly)
- Radiative Corrections
  (A. Afanasiev et al.)