New Low Q^2 Elastic Scattering Measurements

presented

by

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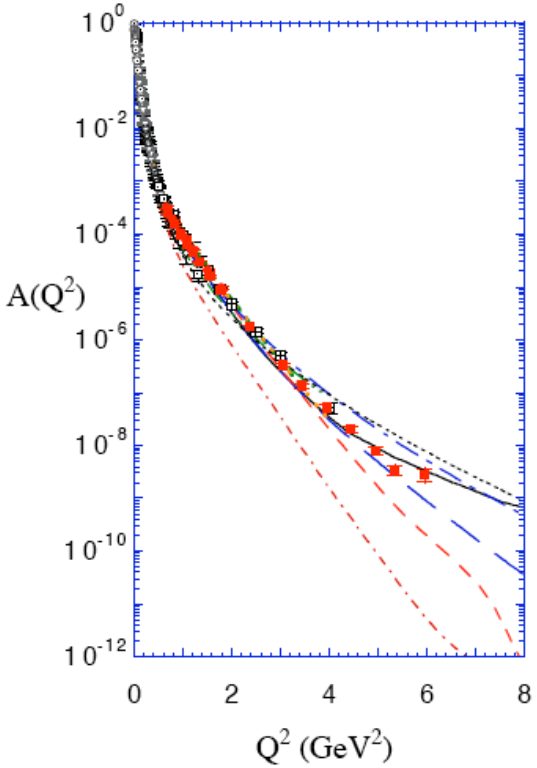
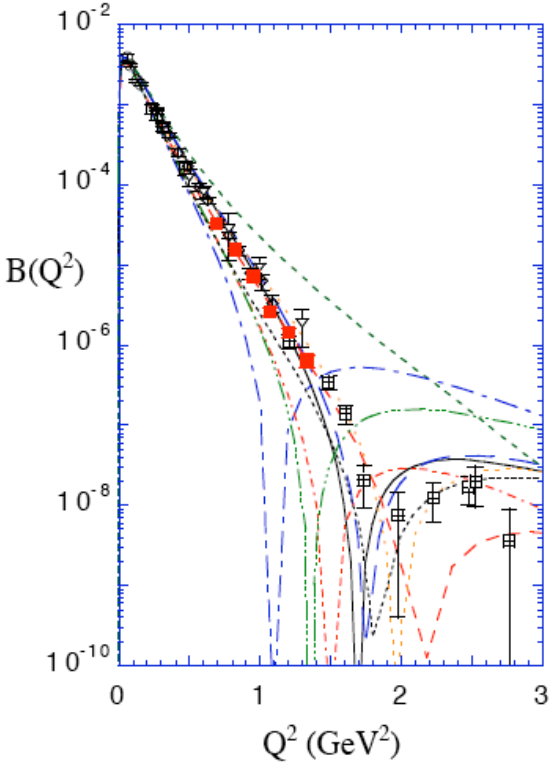
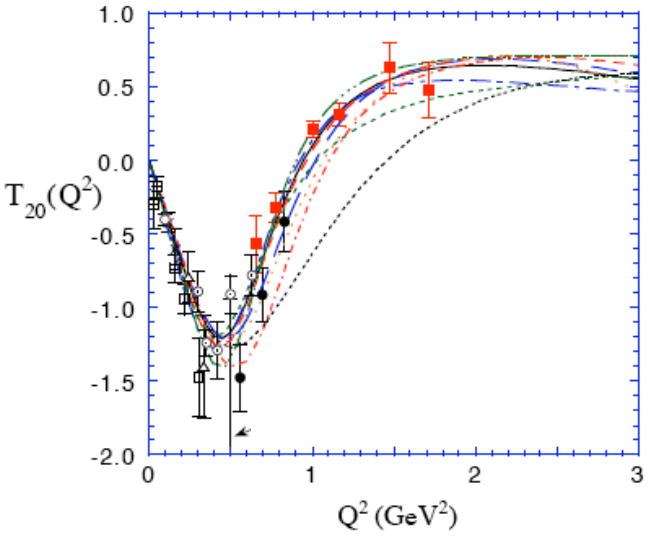
for the Hall A LEDEX Collaboration

(Ph.D. Students: B.W. Lee, G. Ron, & J. Glister)

Deuteron Elastic Results







$$\frac{d\sigma}{d\Omega} = \sigma_M \frac{E'}{E} \left[A(Q) + B(Q) \tan^2(\theta/2) \right]$$

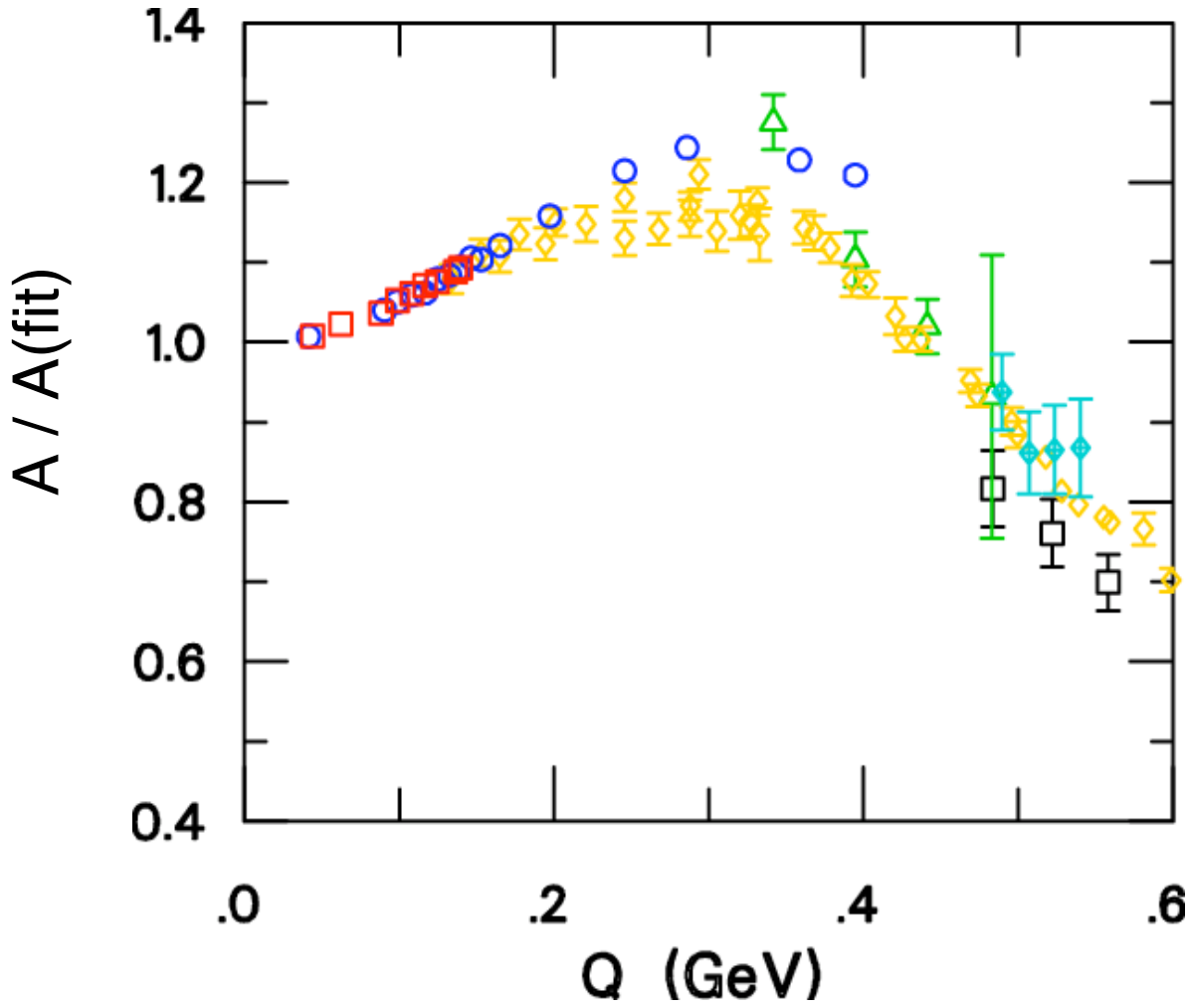
$$A(Q) = G_C^2(Q) + \frac{8}{9}\eta^2 G_Q^2(Q) + \frac{2}{3}\eta G_M^2(Q),$$

$$B(Q) = \frac{4}{3}\eta(1+\eta) G_M^2(Q),$$

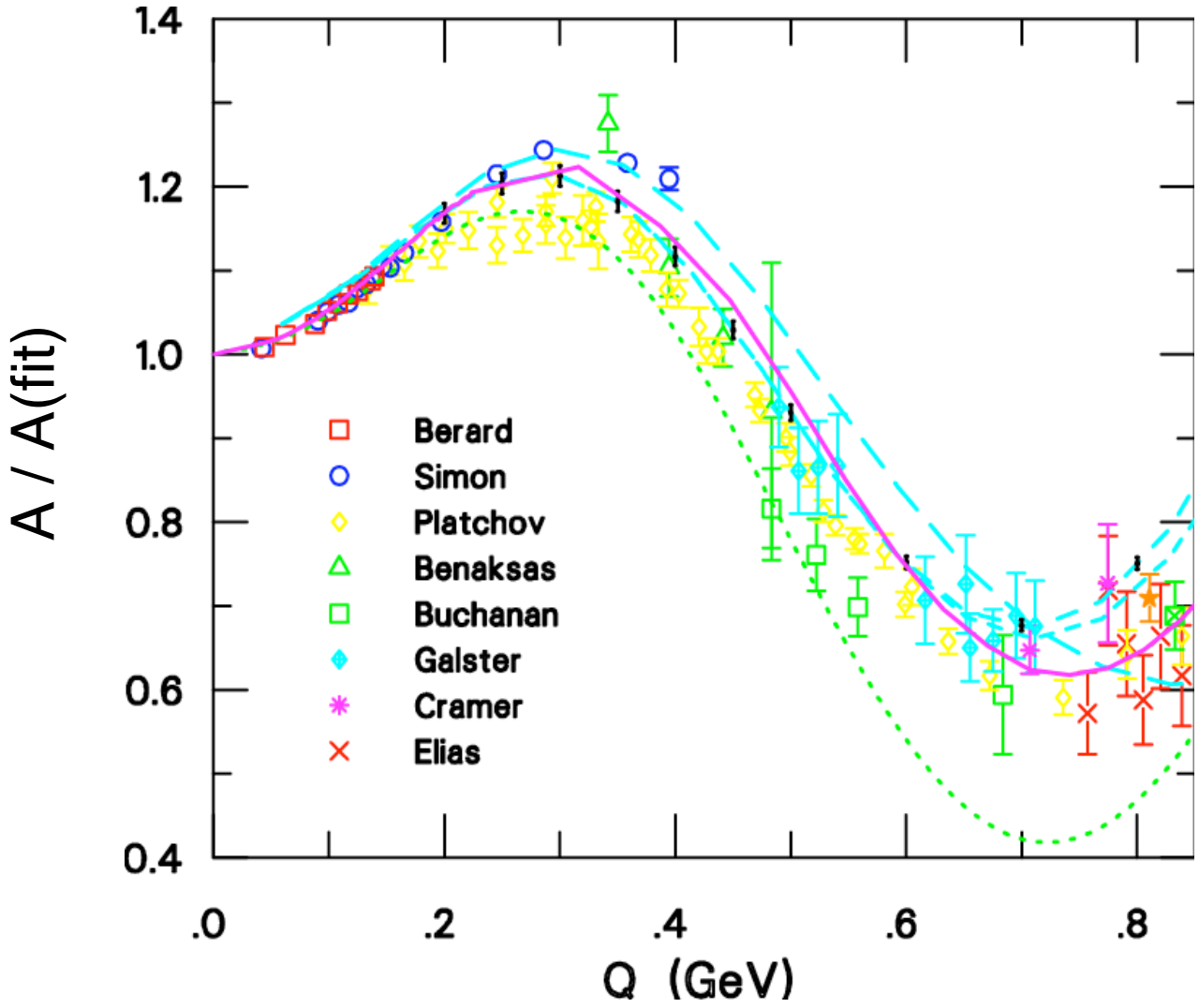
Jefferson Lab

JSA

The Problem



Hall A Proposal E05-004



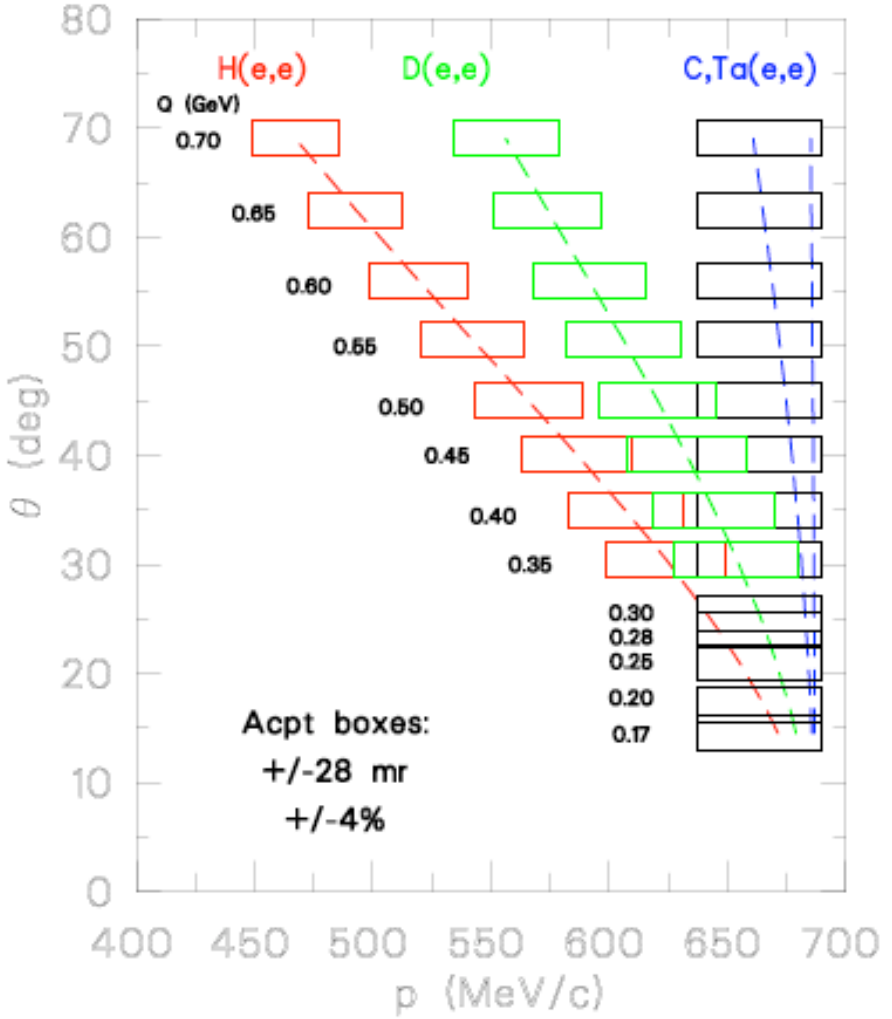
Relativistic Calculations which describe B(Q) and T20

Non-Relativistic

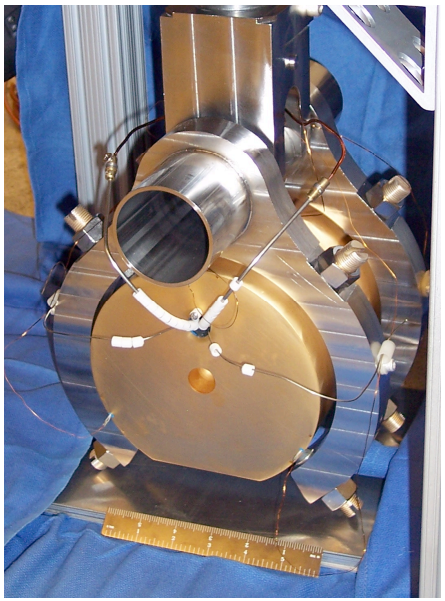
Chiral Perturbation Theory

Precision Cross Sections

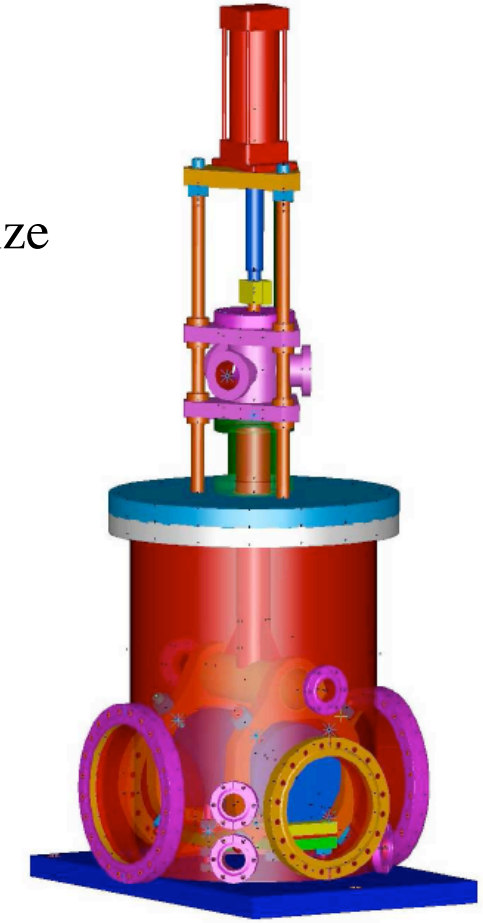
- Kinematics Shown for 687 MeV Beam
- Also Took 362 MeV Data
- HRS Need Special Settings Below 400 MeV/c
- 2 - 3 % Absolute
- 0.5 - 1 % Relative
- Check Results Against World Carbon Cross Sections



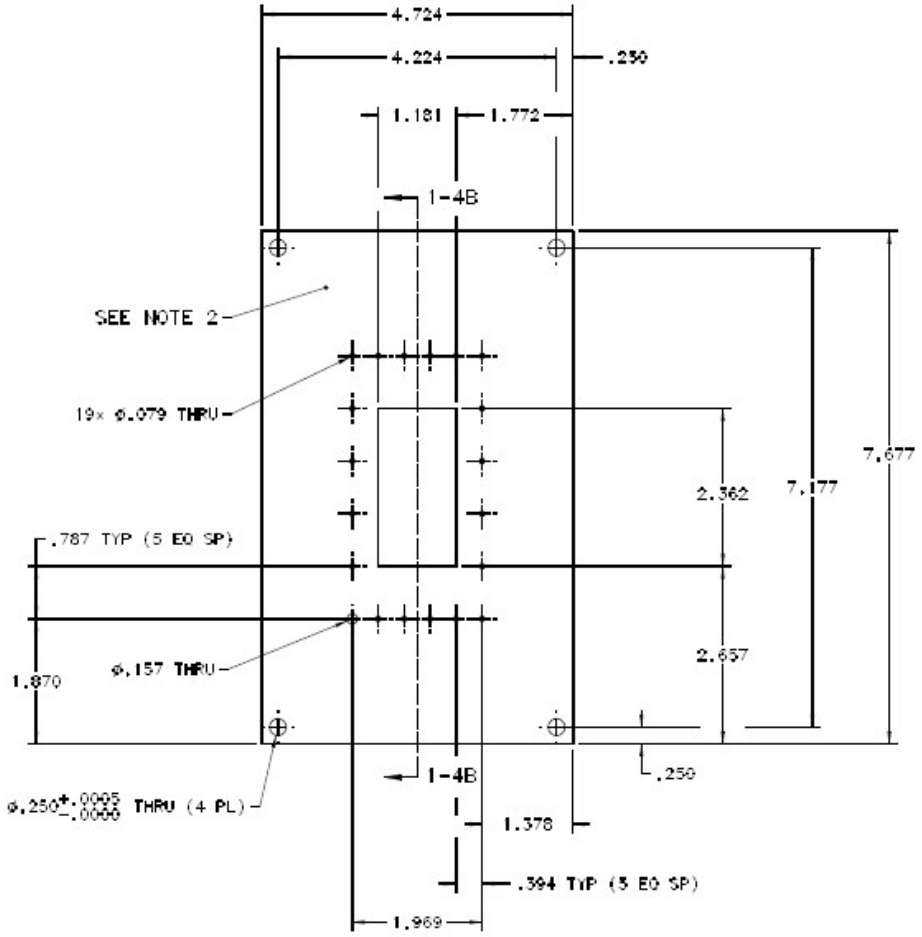
The “Silver” Beam Calorimeter



- Hall A Beam Current Monitors Not Calibrated At Low Current
- Built of Tungsten & Copper To Minimize Shower Losses
- Data Being Analyzed
- 0.5% Absolute Calibration
- 0.1% Relative Calibration



External Sieve Collimator Combo



FRONT VIEW 1-6B

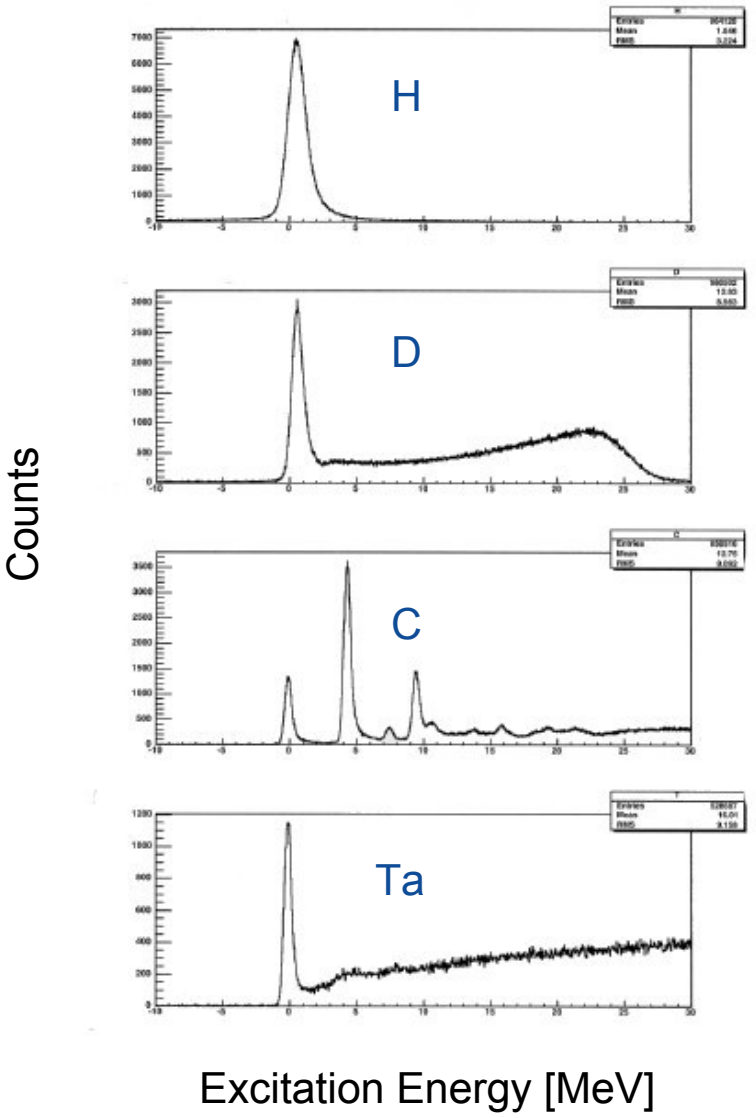
SECTION VIEW 1-4B
(1-6B)

Systematic Errors

systematic	uncertainty	$\frac{\delta\sigma_d}{\sigma_d}_{abs}$	$\frac{\delta(Y_{ed}/Y_{ep})}{Y_{ed}/Y_{ep}}$	$\frac{\delta A(Q)}{A(Q)}$
Beam energy	0.02 %	0.1 %	-	-
Scattered electron energy	0.04 %	0.1 %	-	-
Scattered electron angle	0.3 mr	0.5 %	0.1 %	0.7 %
Beam charge Q	0.5 %	0.5 %	0.1 %	0.1 %
Target areal density	0.2 %	0.2 %	0.3 %	0.1 %
Target boiling	0.1 %	0.1 %	0.1 %	0.1 %
Solid angle $\Delta\Omega$	1.0 %	1.0 %	0.1 %	0.3 %
Radiative correction	1.0 %	1.0 %	0.1 %	0.1 %
$\epsilon_{detector}$	0.5 %	0.5 %	0.1 %	0.1 %
$\epsilon_{trigger}$	0.1 %	0.1 %	-	-
ϵ_{DAQ}	0.1 %	0.1 %	-	-
$\epsilon_{reconstruction}$	0.5 %	0.5 %	0.2 %	0.2 %
Total		1.8 %	0.4 %	0.8 %

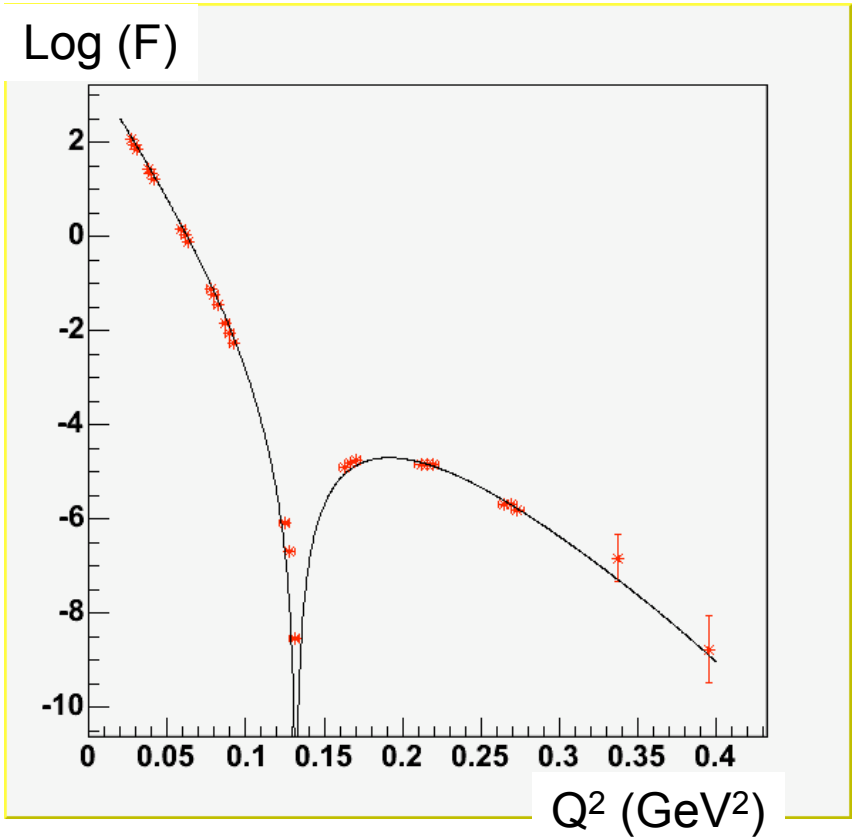
Example Online Spectra

- Energy = 687 MeV
- Angle = 25.5 Degrees
- Q = 0.3 GeV



Precision Cross Sections

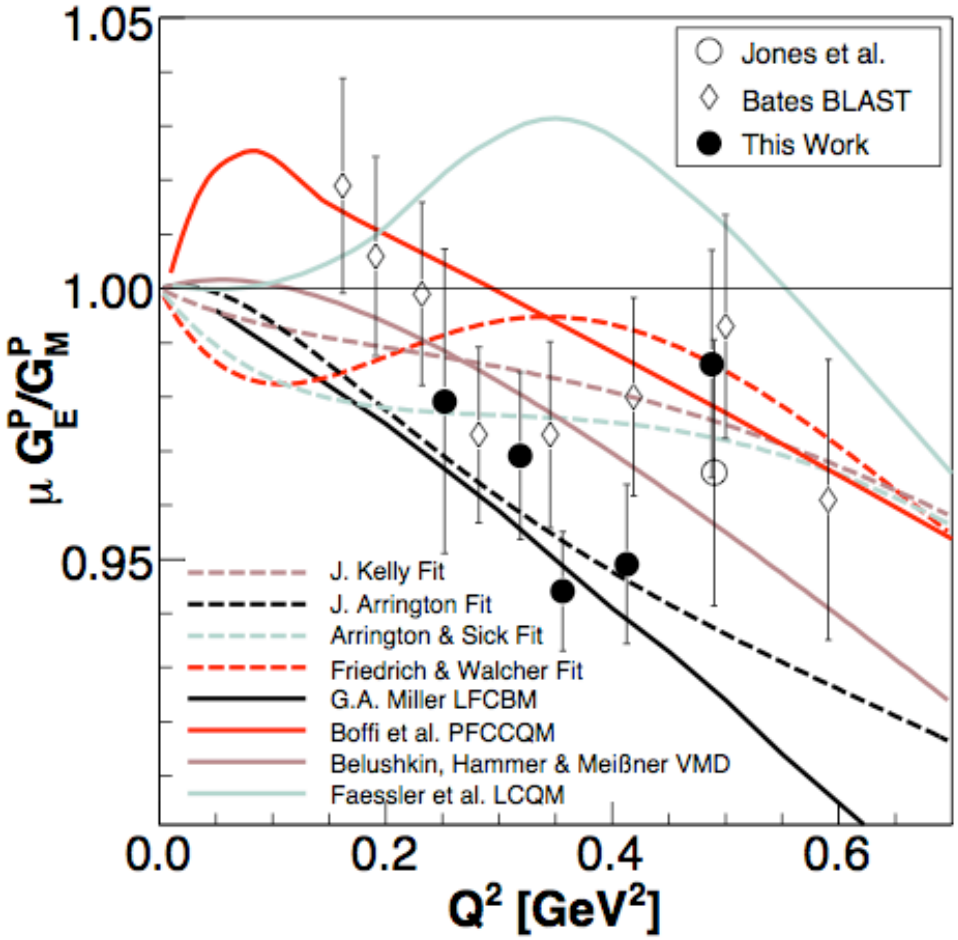
- Carbon Cross Section Extremely Well Known
  - E.A.J.M. Offermann et al., Phys. Rev. C 44 (1991)
- Low Q^2 Dominated Systematic Uncertainties



New Polarization Transfer Result

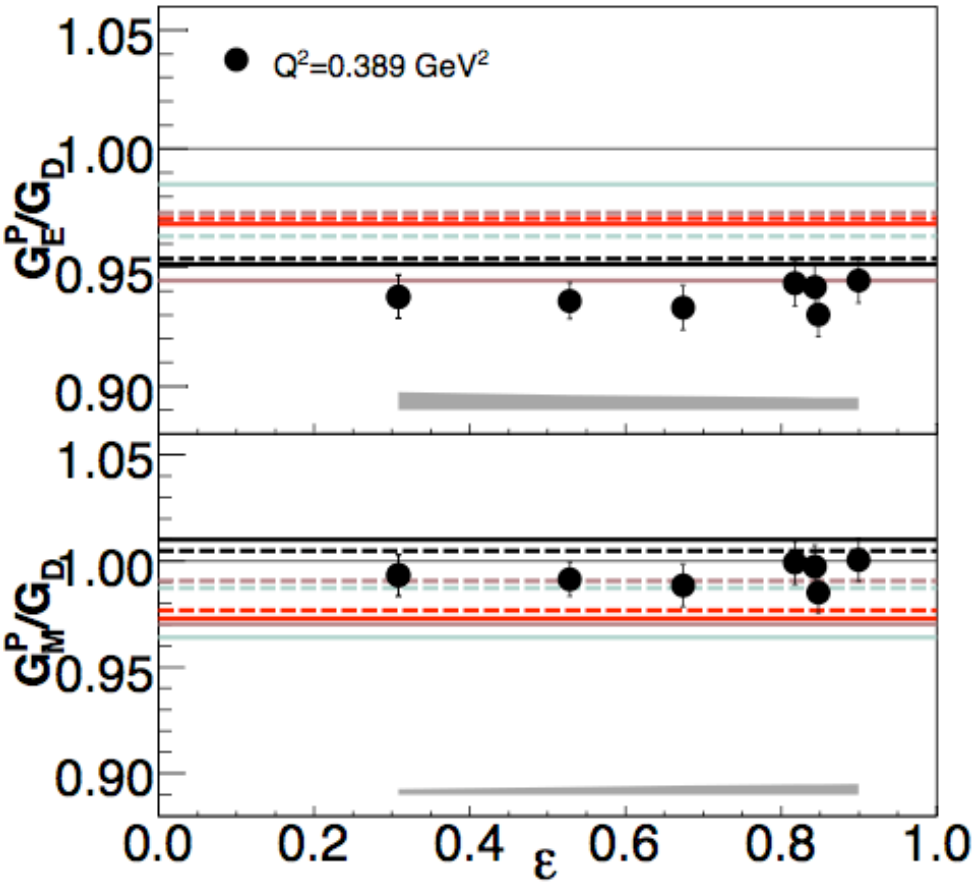
Phys. Rev. Lett. 99 (2007) 202002

- Parasitic to G0
- 40% Polarized Beam
- Approx. 12 hours/point



Asymmetry & Cross Section Combined

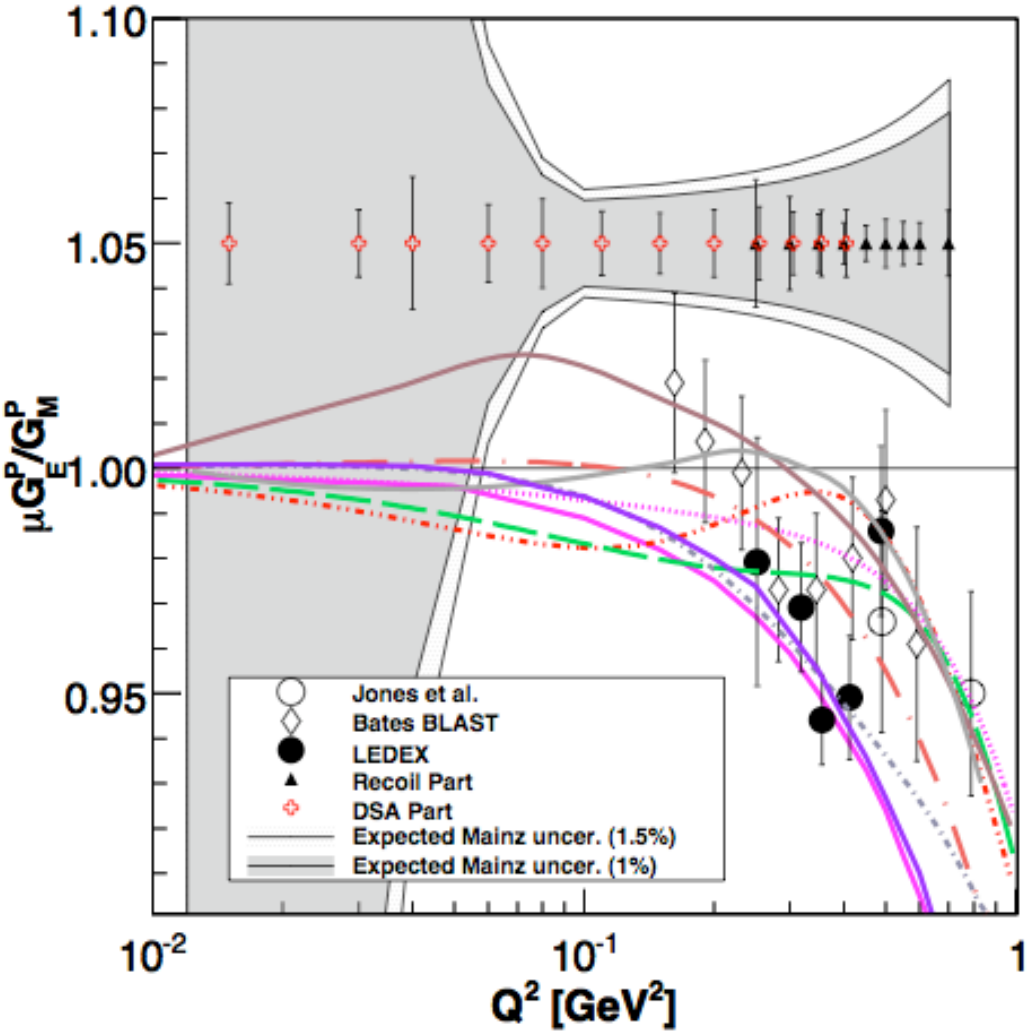
Cross Section from C. Berger *et al*., Phys. Lett. **B35** (1971) 87.



Deviation in Ratio is due to Electric Form Factor

Proposed Experiment PR07-008

(Ron Gilman's Talk Tomorrow)



Conclusions & Outlook

- February 2007 Took Even More Low Energy Elastic Data (360 MeV)
  - ^{6}Li, $^{10}B_4{}^{12}C$, ^{12}C, Ta
  - Many Thank To Dave Meekins (JLab) For The Li Target!
- Many New Low Q^2 Elastic Results Coming
  - Mainz Cross Section Measurements
  - Hall A Cross Sections Measurements
  - Conditionally Approved Polarization Transfer Running in Hall A
  - Added Even Lower Q^2 Being Proposed
- Once ^{12}C and H Elastic Analysis Is Complete, We Will Analyze The Deuterium Data Extract Our New A(Q) Result