Measurement of A(Q) at low Q

by
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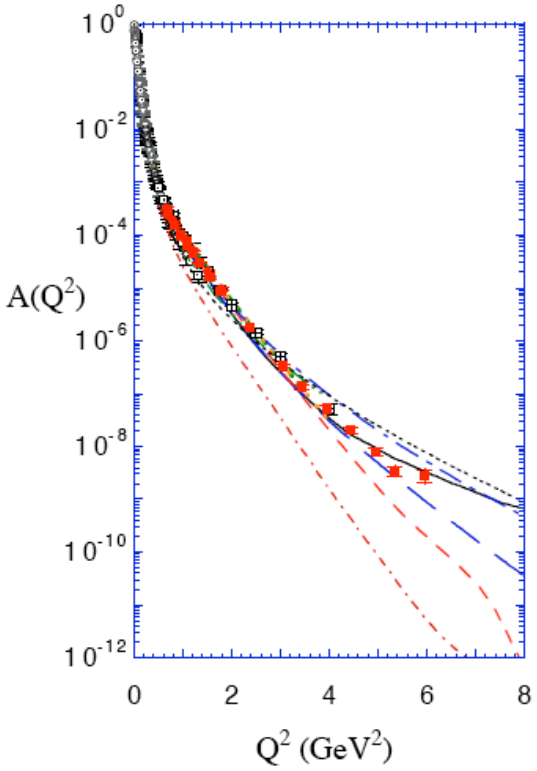
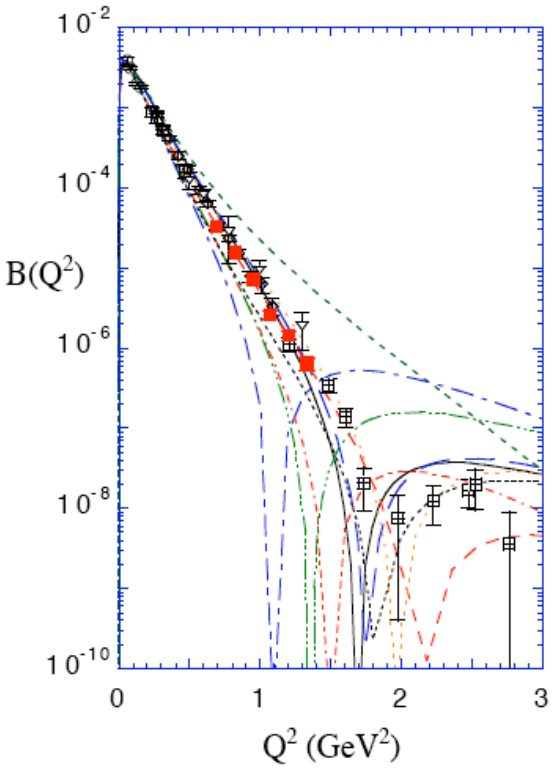
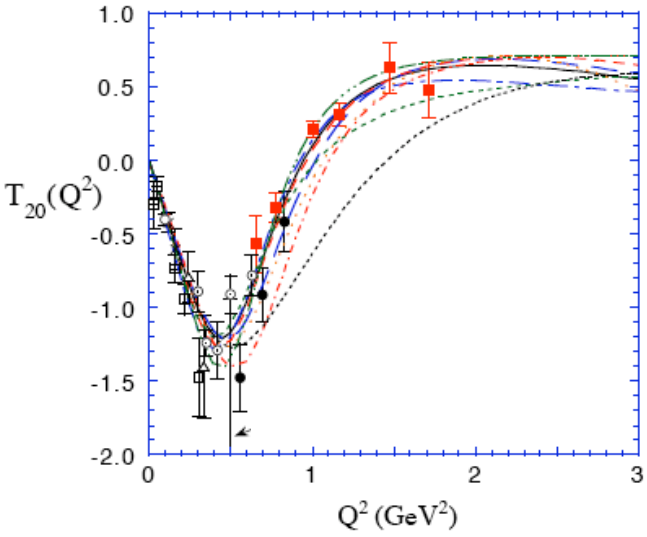
Analysis by Byungwuek Lee

Deuteron Elastic Results





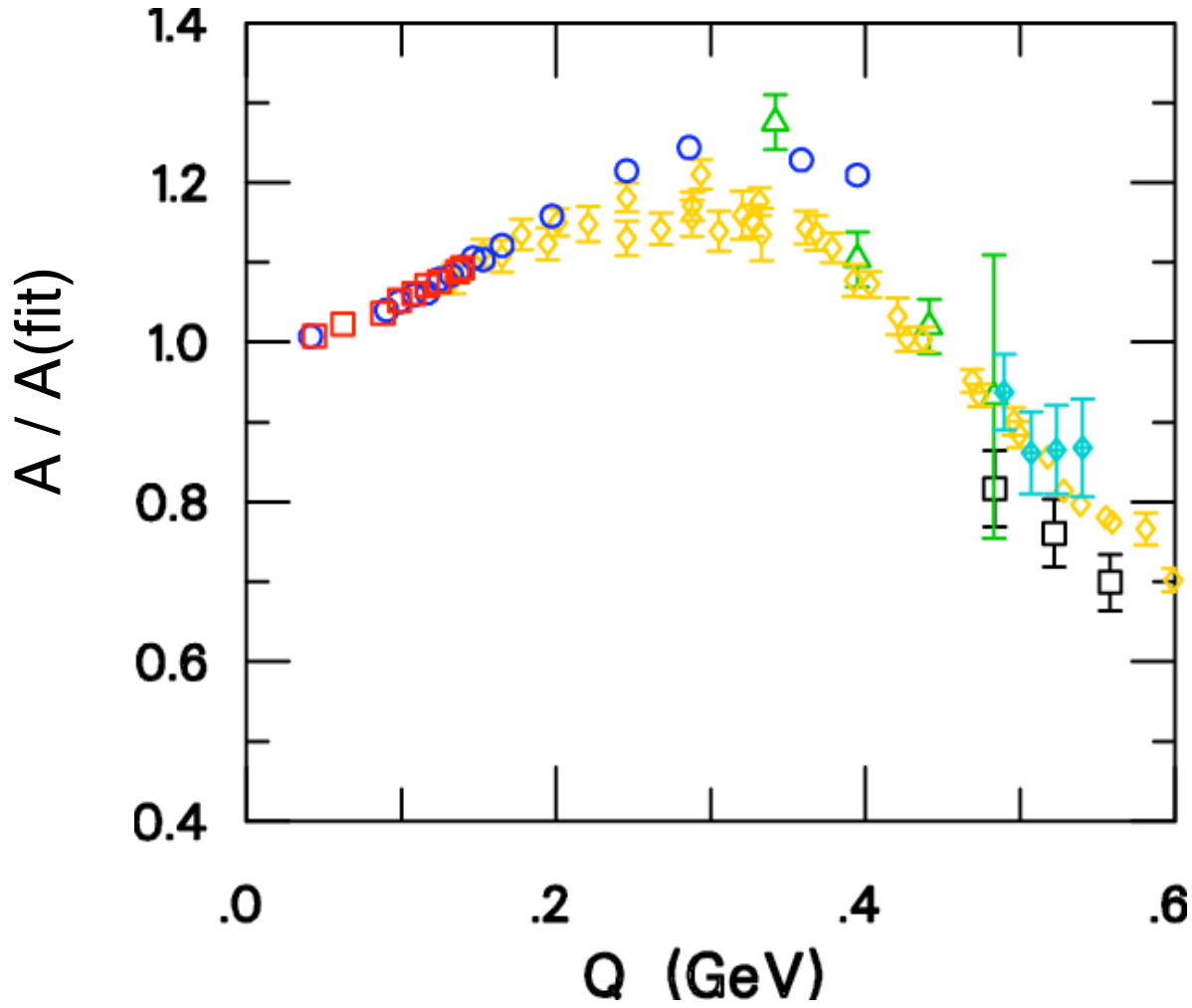


$$\frac{d\sigma}{d\Omega} = \sigma_M \frac{E'}{E} \left[A(Q) + B(Q) \tan^2(\theta/2) \right]$$

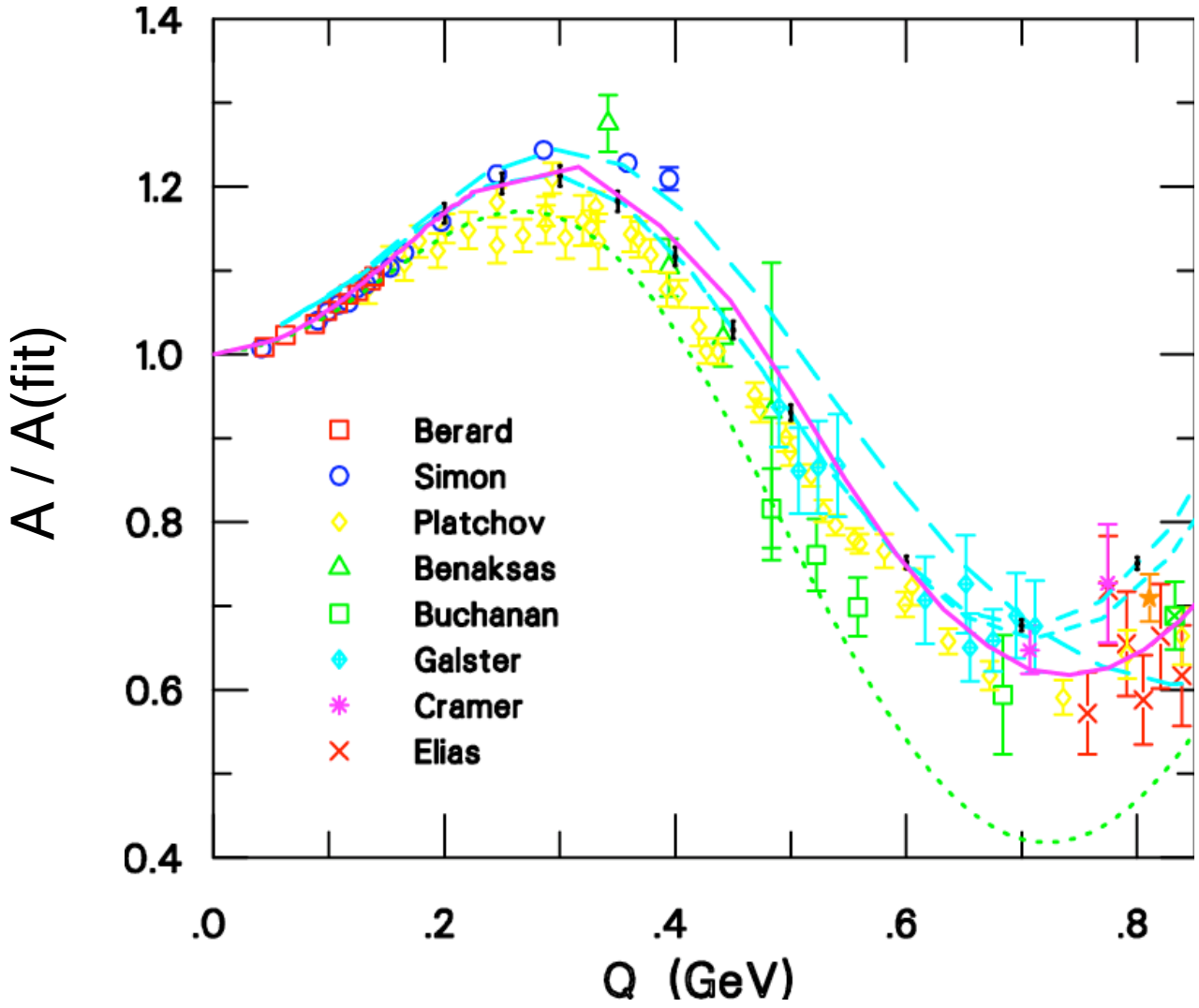
$$A(Q) = G_C^2(Q) + \frac{8}{9}\eta^2 G_Q^2(Q) + \frac{2}{3}\eta G_M^2(Q),$$

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

The Problem



Hall A Proposal E05-004



Overview of Theory

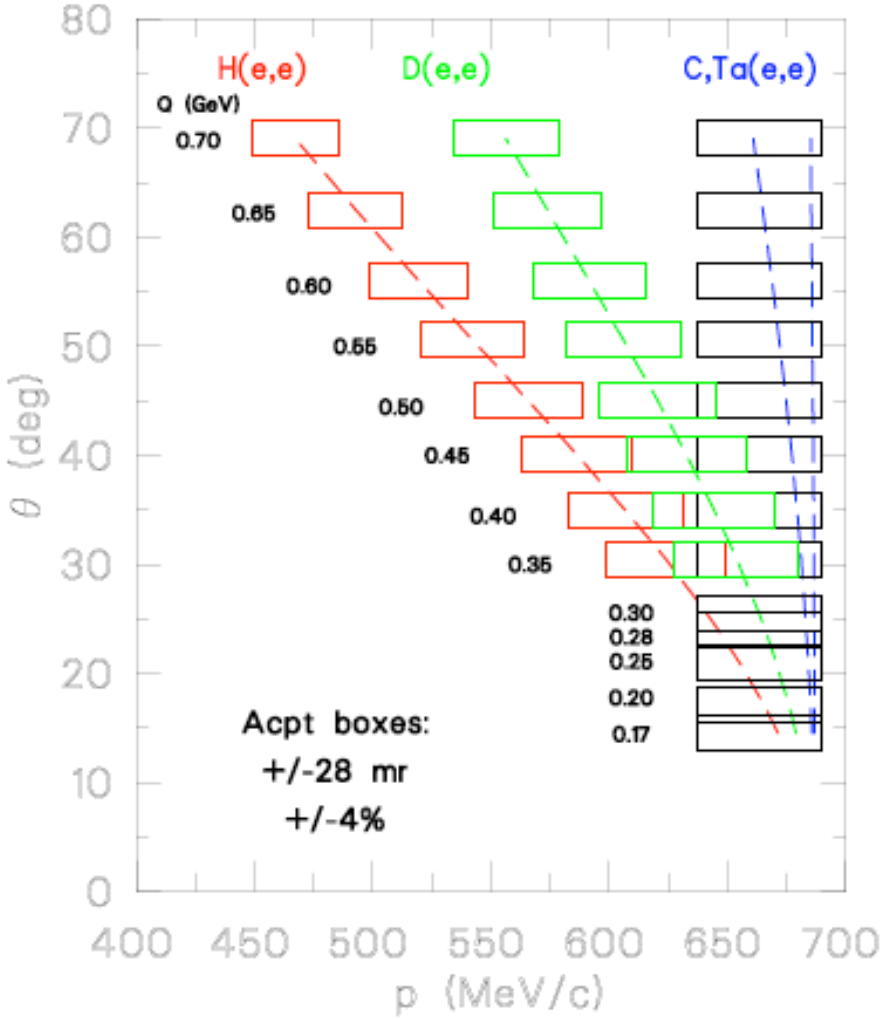
Relativistic Calculations which describe B(Q) and T20

Non-Relativistic

Chiral Perturbation Theory

Kinematics

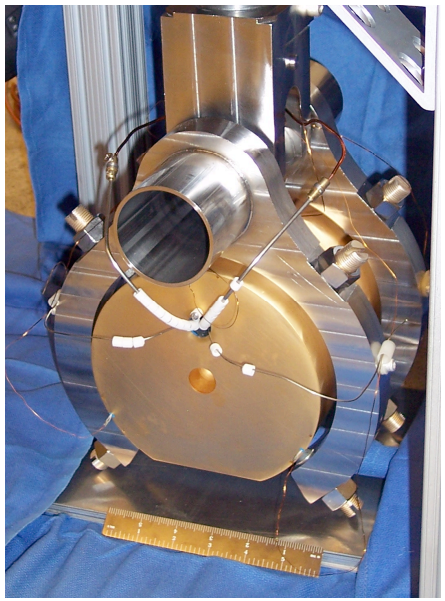
- Shown for 687 MeV Beam
- Also Took 362 MeV Data
- HRS Need Special Settings Below 400 MeV/c
- 2 - 3 % Absolute
- 0.5 - 1 % Relative
- Check Results Against World Carbon Cross Sections



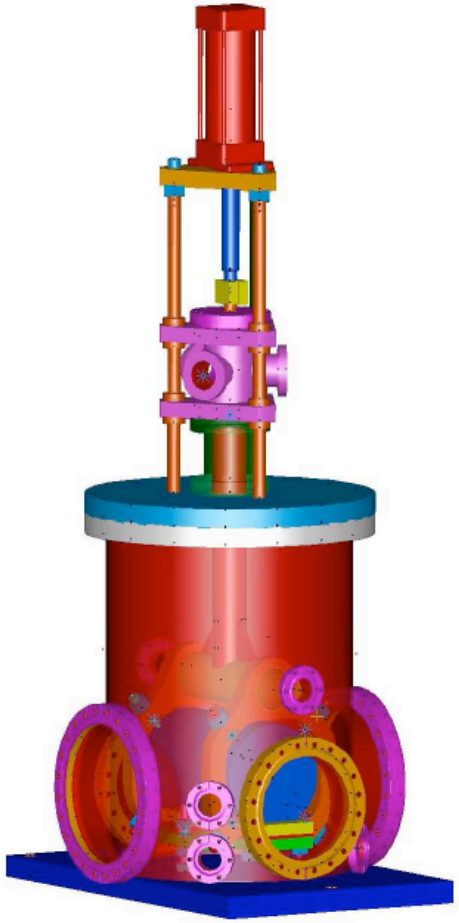
Systematic Errors

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 %

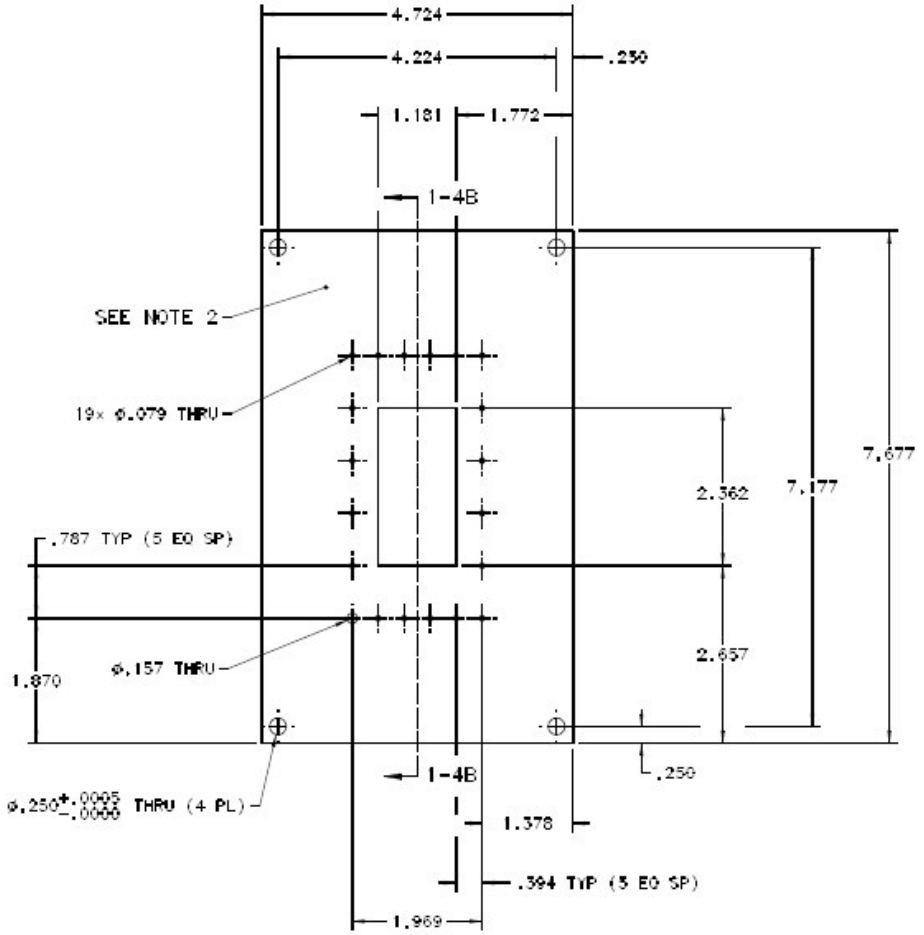
The “Silver” Beam Calorimeter



- 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



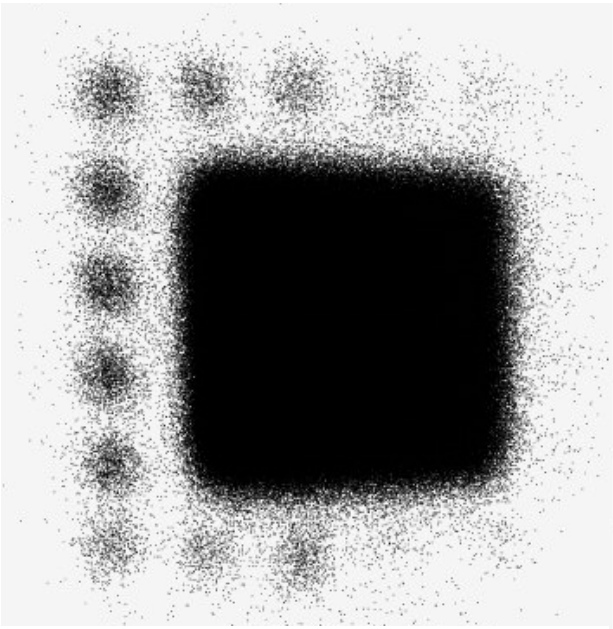
Sieve Collimator Combo



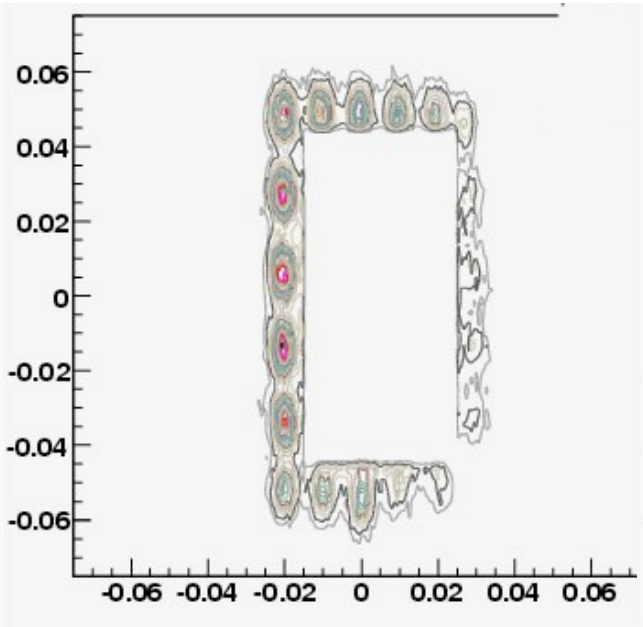
FRONT VIEW 1-6B

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

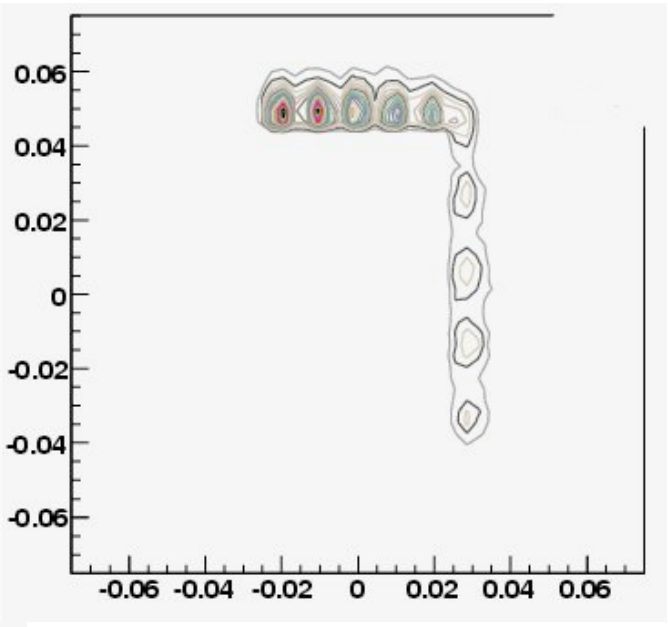
Reconstructed Images



Raw Elastic Data



Cutting Central Region

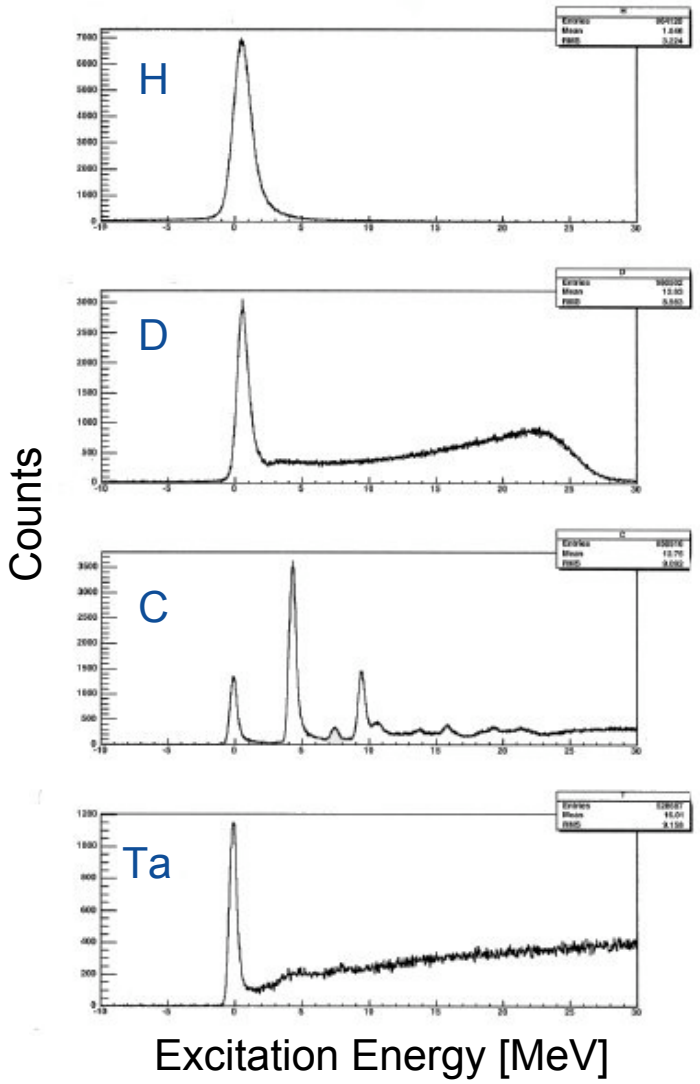


Cutting Small Angle Holes

Using Multiple Targets And Selecting Events With Pass Through One Sieve Hole, One Can Determine The Scattering Angle and Beam Energy

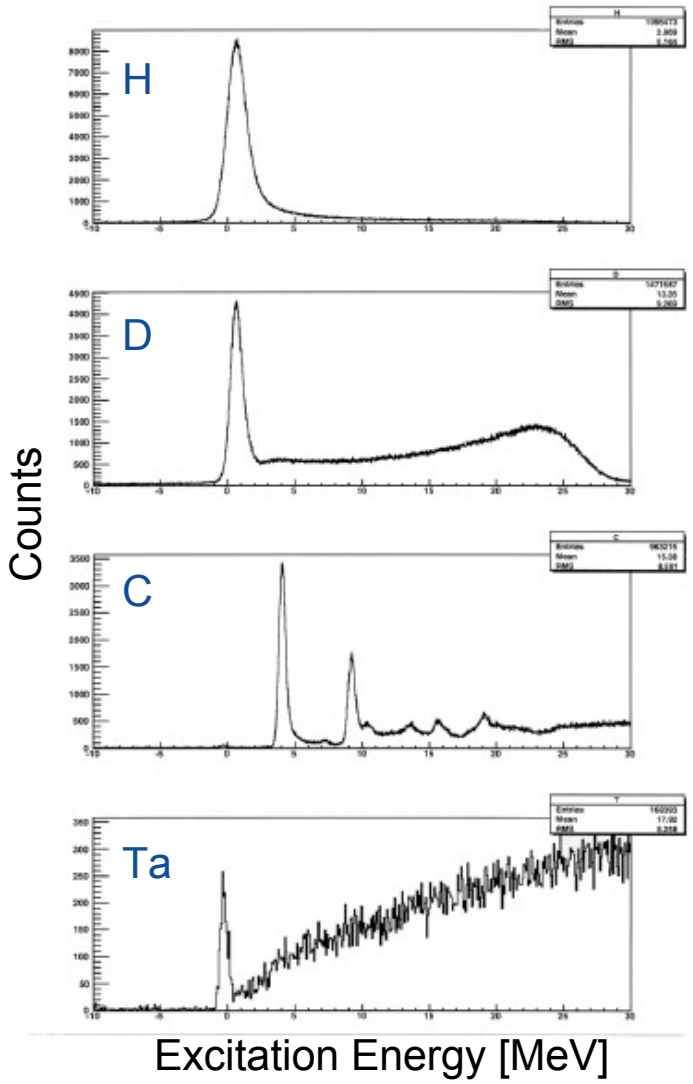
Online Spectra

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



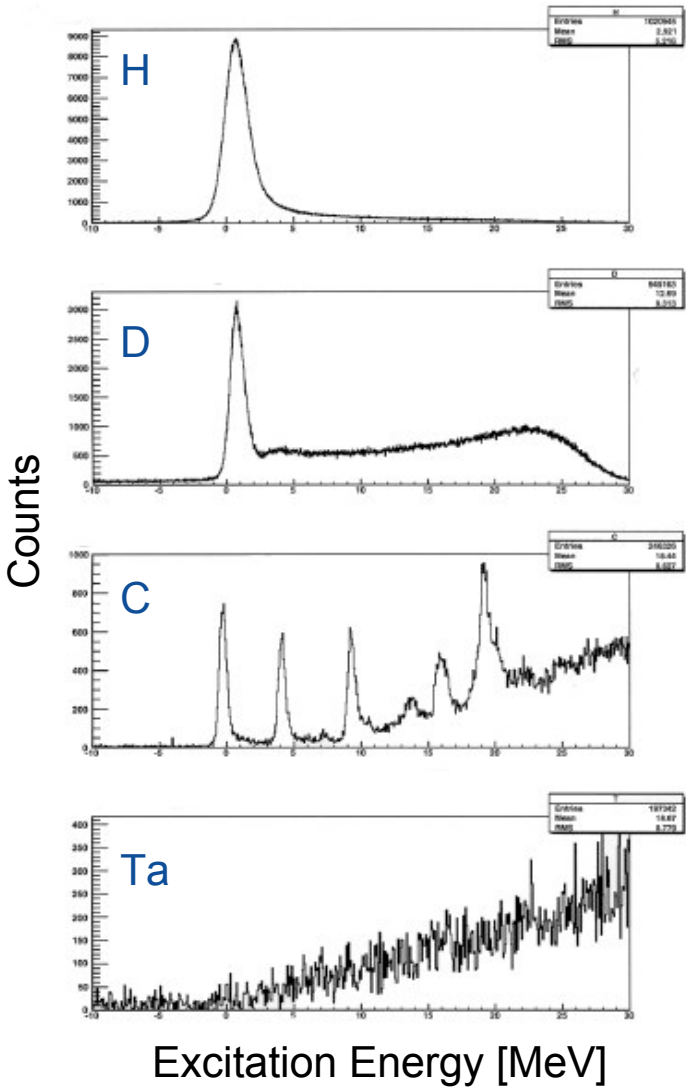
Online Spectra

- Energy = 687 MeV
- Angle = 30.5 Degrees
- Q = 0.35 GeV



Online Spectra

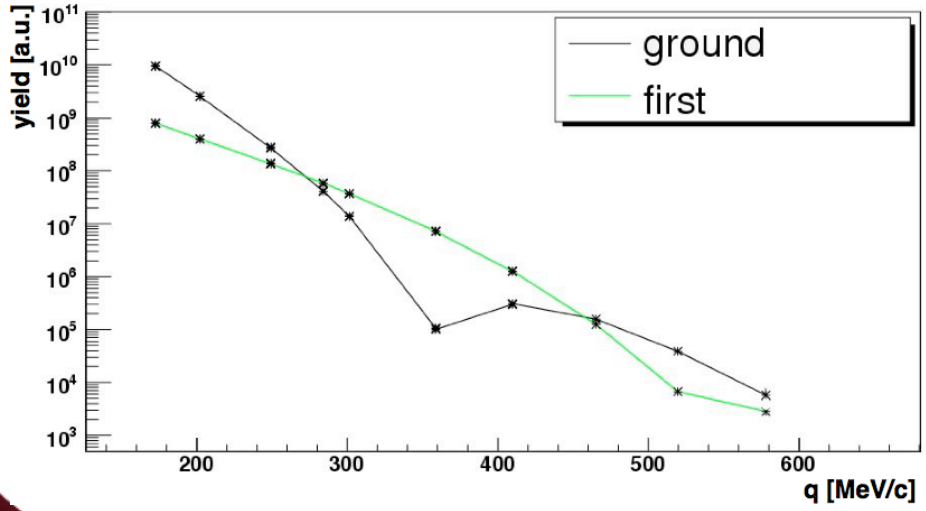
- Energy = 687 MeV
- Angle = 40 Degrees
- Q = 0.45 GeV

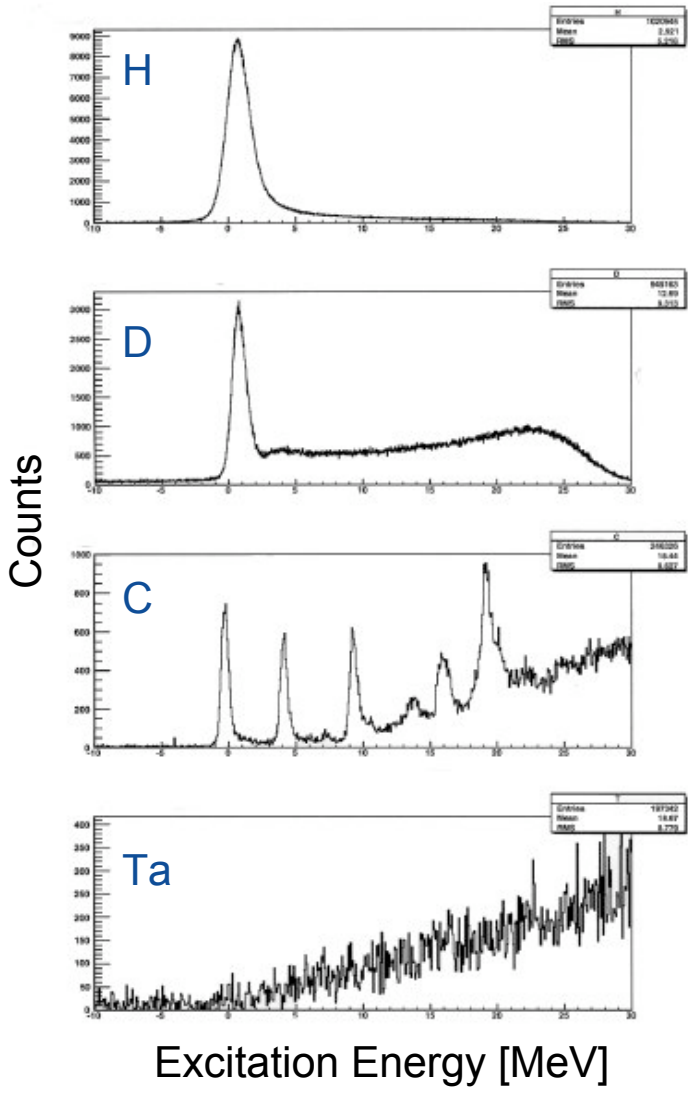


Online Spectra

- Energy = 687 MeV
- Angle = 40 Degrees
- Q = 0.45 GeV

Online Carbon Elastic





Jefferson Lab

Summary and Outlook

- New Elastic Data On H, D, C, Ta
- Q Range from 0.2 to 0.8 GeV
- Results Can Be Checked Against Carbon Data
- Resolve Issue With A(Q) at Low Q
- Ph.D. Student Working On Analysis

Thanks to the JLab Accelerator for the Low Energy Beam
(the first time CEBAF split first pass beam to two halls)

Test Measurement Scheduled

- Starting Feb. 9th Short Test Measurement Scheduled
- New Elastic Data On $^{10}B_4C$, ^{7}Li, C, Ta
- Q Range from 0.2 to 0.8 GeV
- Almost Entire Range of Q Done With Single Momentum Setting