Coulomb Sum Rule Experiment Update

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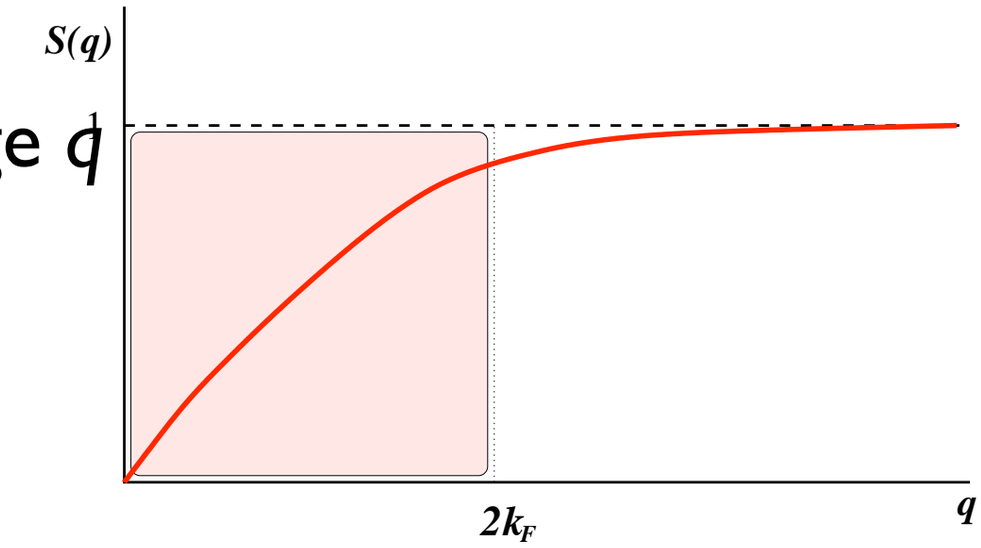
Hall-A Collaboration Meeting

In Short

- Measurement of response functions R_L and R_T from quasi-elastic electron scattering
- Integral of R_L = Coulomb Sum (S_L)
- Study Saturation/Quenching of Coulomb Sum on various nuclei: ^{4}He, ^{12}C, ^{56}Fe, ^{208}Pb
- Probing nucleons inside the nucleus

Coulomb Sum Rule in a Nutshell

- Coulomb Sum Rule
  - $S_L(q) \rightarrow 1$ at sufficiently large q
- Deviation from unity
  - at small q
    - Pauli blocking
    - NN long range correlations
  - at large $q(>>2k_F)$
    - Short range correlations
    - Nucleon properties in the nuclear medium



Experiment

- Beam: 16 energies from 0.4 to 4.0 GeV
- Scattering angles: 15°, 60°, 90°, 120°
- Targets: ^{4}He, ^{12}C, ^{56}Fe, ^{208}Pb
- Spectrometer momenta range from 4 GeV down to 100 MeV
- Covers q from 550 to 1000 MeV/c

People

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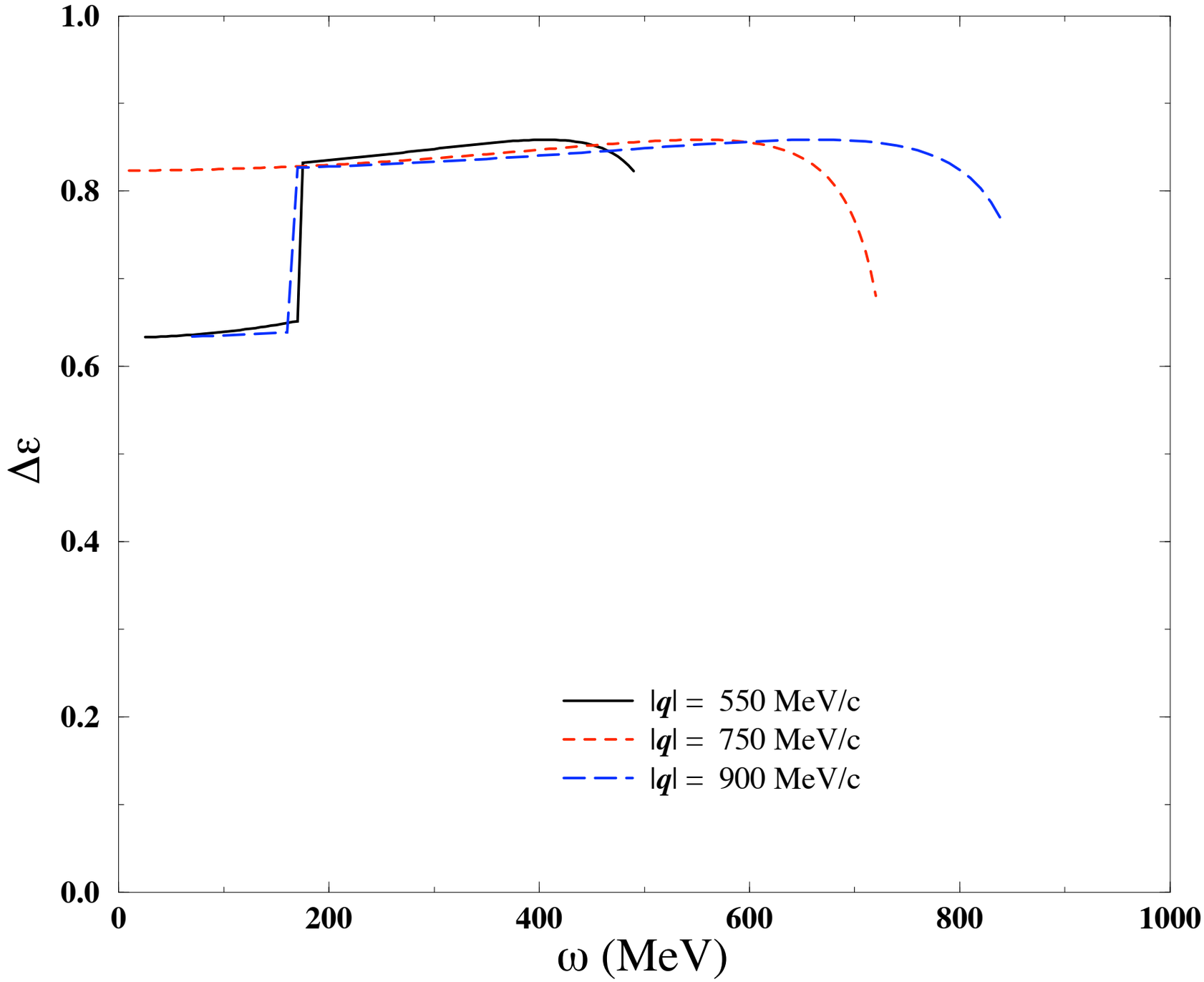
and

Hall-A Collaboration

What's New?

- Comfortable high values of q
  - From 550 MeV/c to 1000 MeV/c
  - High enough for clean observation of CSR
  - Previously unexplored region
- Comprehensive single experiment
  - Largest lever arm
  - Measurement at 4 angles
- Better control of background with NaI detector

Lever arm for Rosenbluth Separation



Detector Setup

- L-HRS
  - S1/S2/VDC
  - Gas Cerenkov
  - NaI Detector
  - Pion Rejector
- R-HRS
  - S1/S2/VDC
  - Gas Cerenkov
  - Preshower/Shower

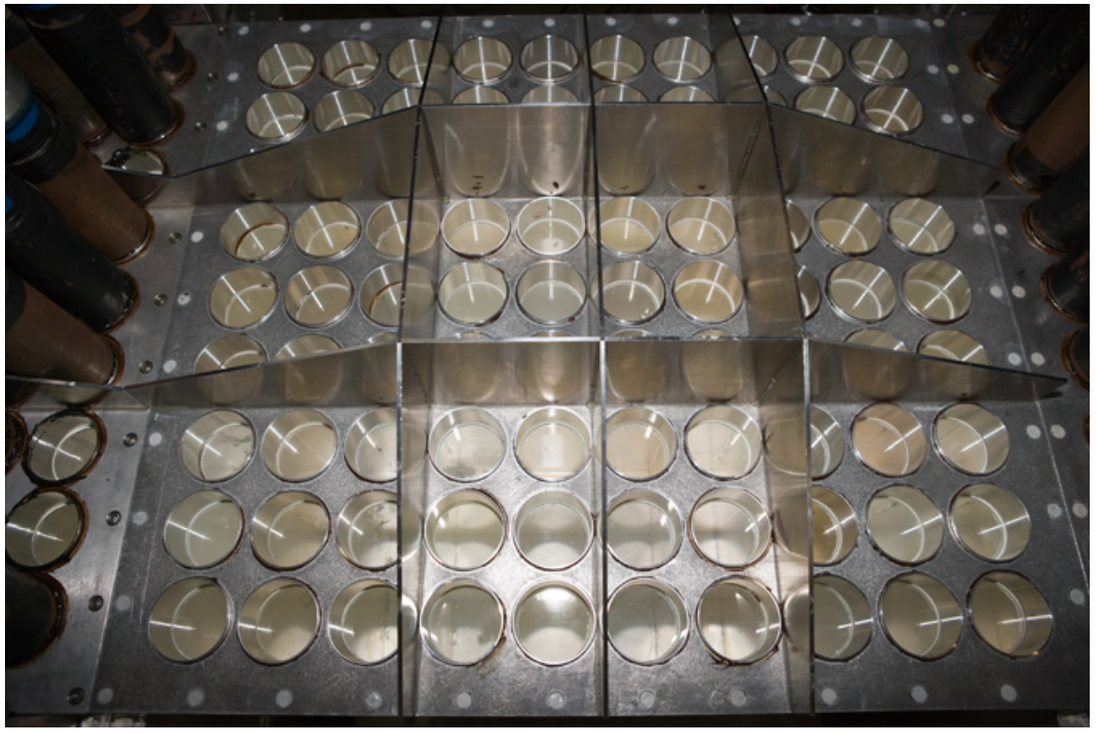
NaI Detector

- Electrons reflected inside the spectrometer
  - Source of background at low energy backward angle
- Reduction of the background
  - Careful geometry cut at the focal plane
  - Independent energy measurement of the electrons using NaI detector

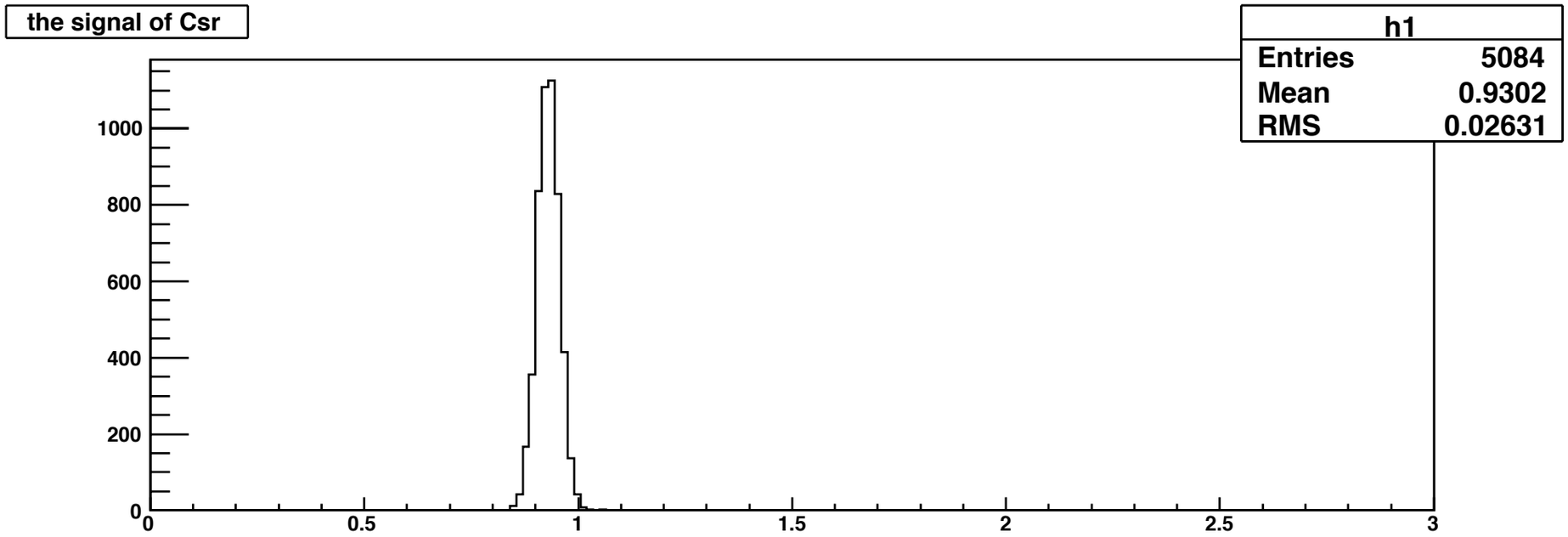
NaI Detector

- NaI Crystal borrowed from BNL
- About 400 crystals of 2.5”x2.5”x12”
- Refurbished at JLab: polishing, assembly in new boxes, sealing
- Final product: 3 boxes of 90 crystals (9x10 arrangement) each
- Covers whole focal plane of L-HRS

Installation of NaI detector



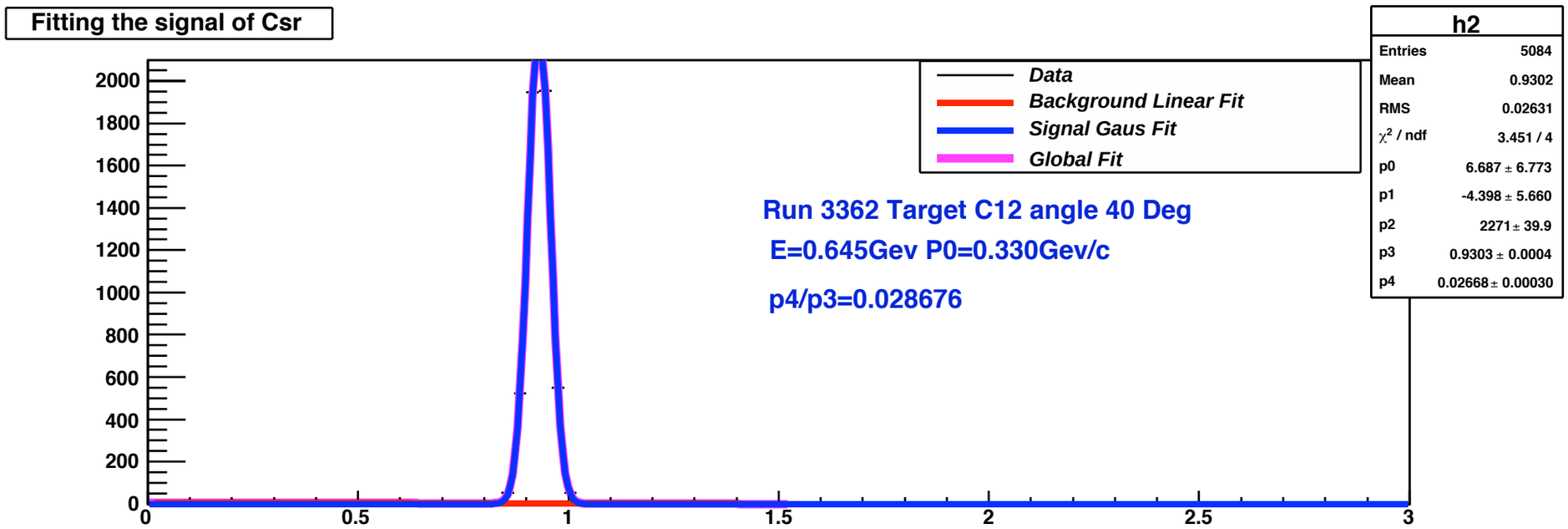
Performance



~3% at 0.3 GeV

or

~5% at 0.1 GeV



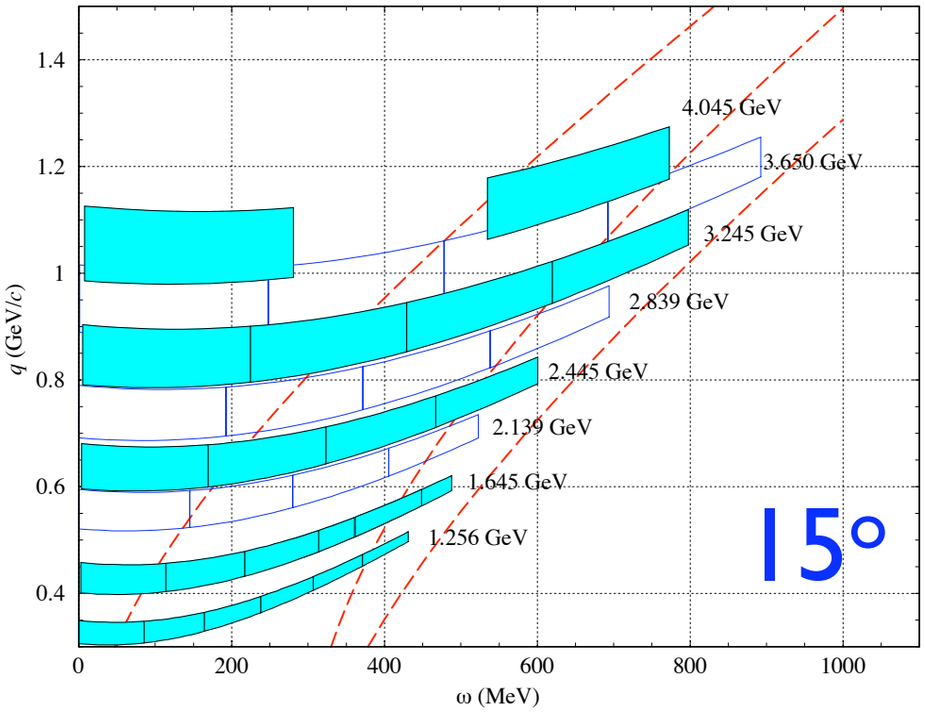
Spectrometers

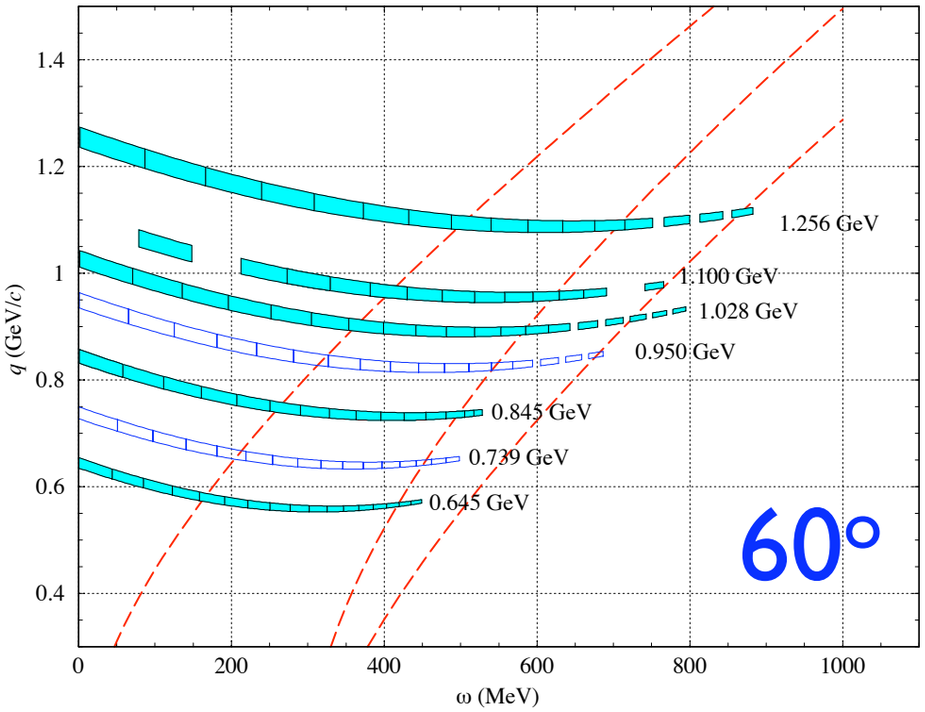
- Momentum setting down to 100 MeV/c
  - Below ~400 MeV/c, field regulation using Hall probe (NMR no longer works)
    - New automatic script working well
    - Momentum change takes only 5 minutes on L-HRS (about 30 to 1 hour for R-HRS)
- Data for optics and acceptance studies taken at low momentum settings.

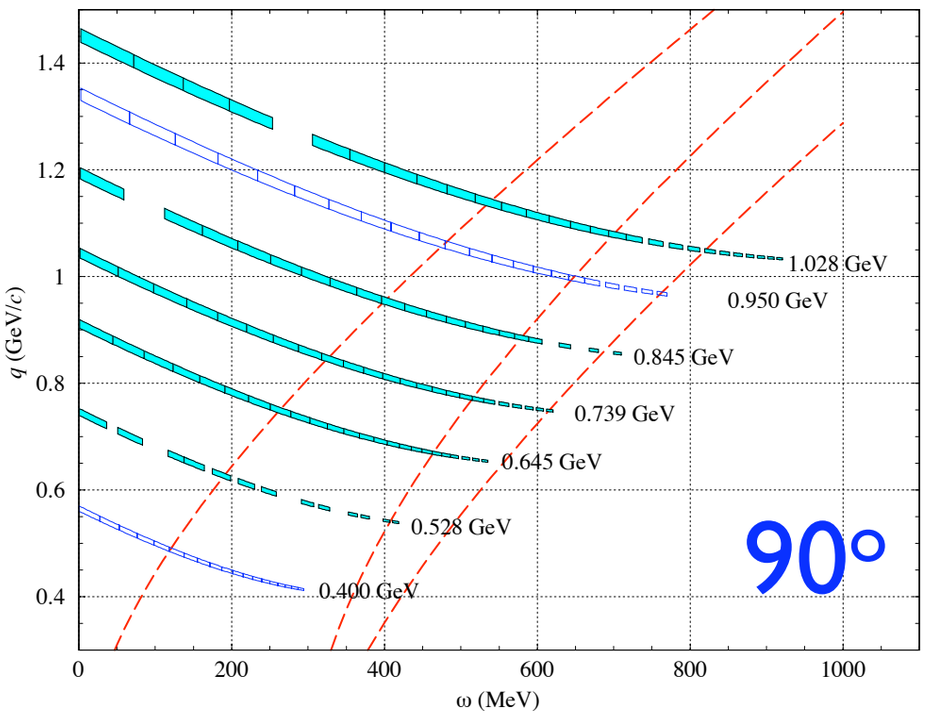
Beam

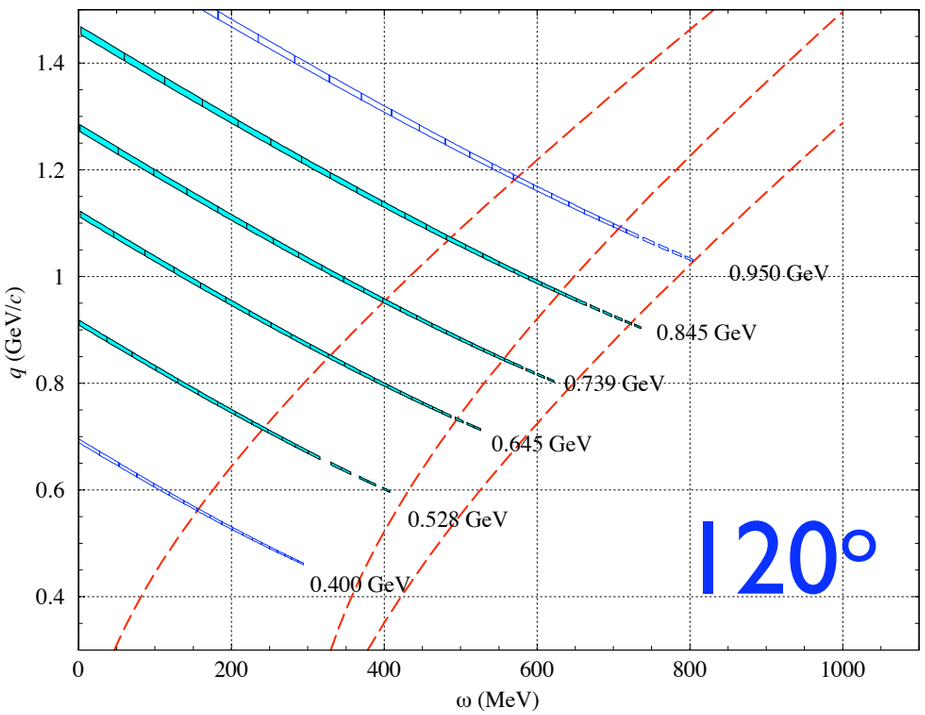
- In general, very stable beam throughout the experiment with current up to 80uA
- ARC energy measurement failed at 645 MeV (another trial scheduled at 739 MeV)
- Will use ^{12}C elastic peak positions at various angles for energy calibration
- Tuning through the Compton chicane helps to improve the beam quality

Data taken so far

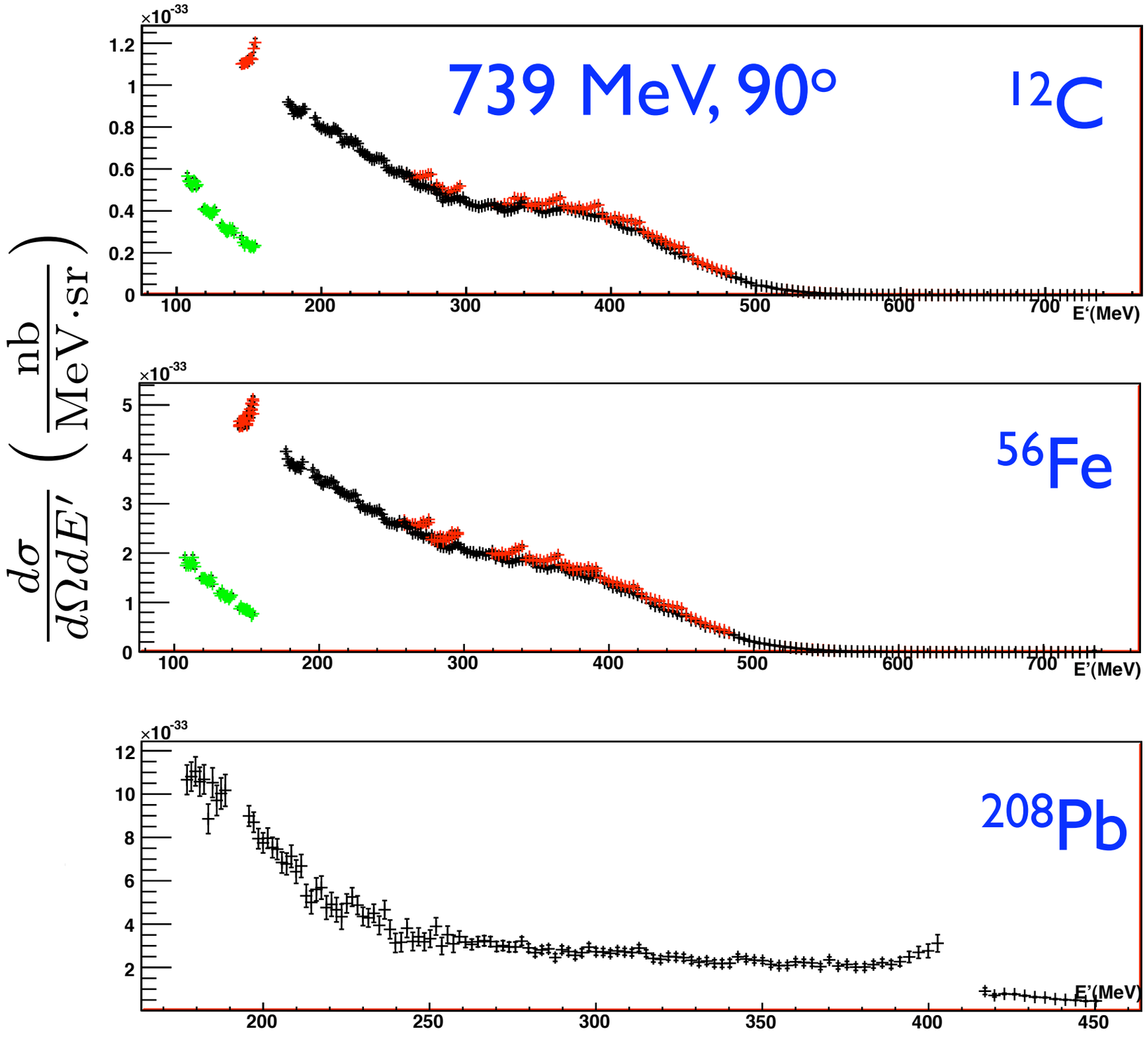




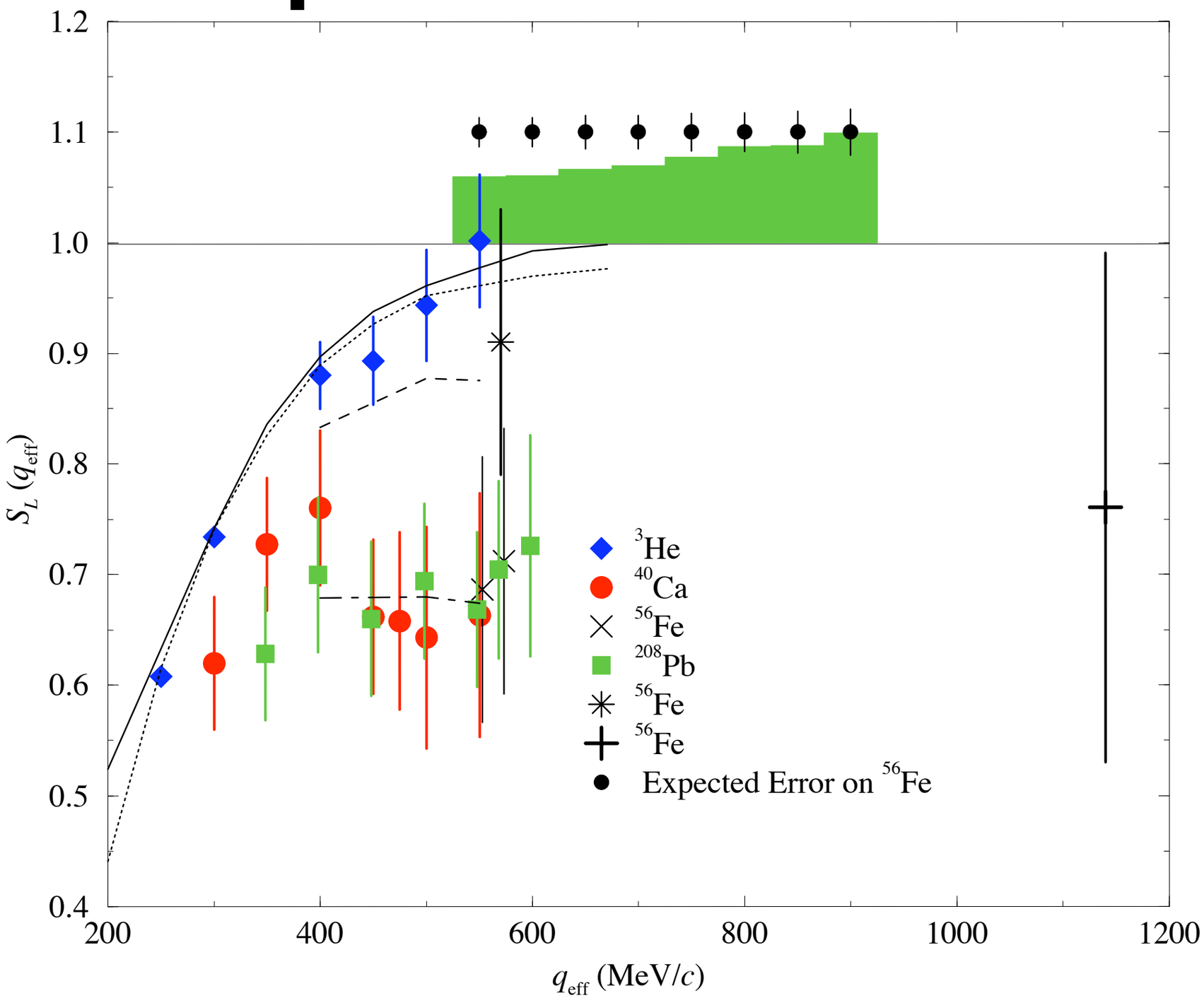




First look at the data



Expected Error



Summary

- Experiment in smooth progress
  - to be completed by Jan. 2008
- A few new features
  - High enough momentum transfer, previously unexplored.
  - Comprehensive single experiment
  - Independent energy measurement for background reduction
- First look at the data seems reasonable
- Hope to answer the question on the CSR