Status report for E04-005

$A(Q)$ at low Q in eD

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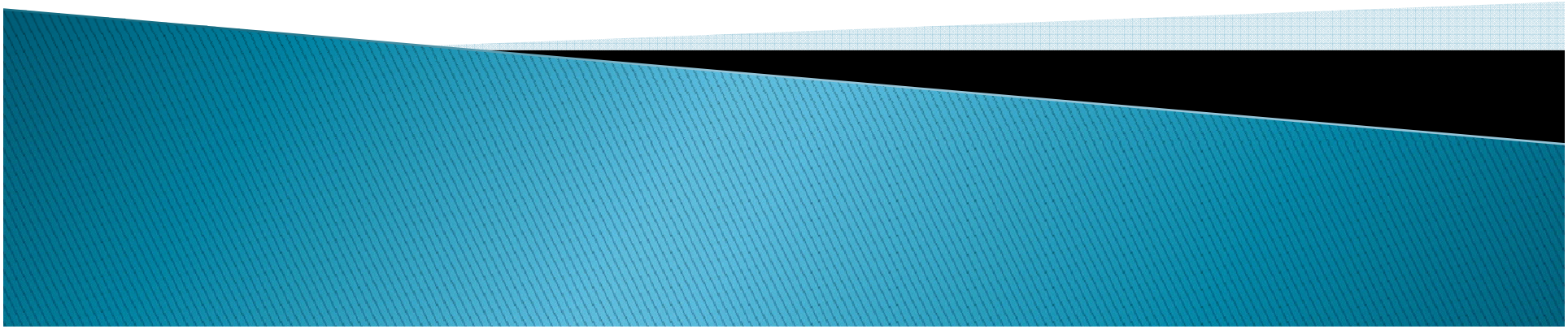

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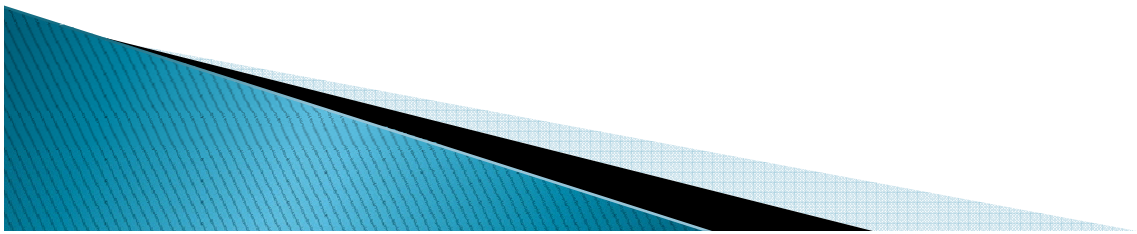


Overview

- Review
  - Purpose of the experiment
  - World's data and theories
- Experiment kinematics
- Analysis of the carbon data
- Additional experiment on Feb. 2007
- Summary

Reviews

Experiment Goal:

We investigate e-D elastic scattering in the Q range from 0.1 GeV to 0.7 GeV to get acurate A(Q) to <<1% statistical and ~ 2-3% systematic absolute precision.

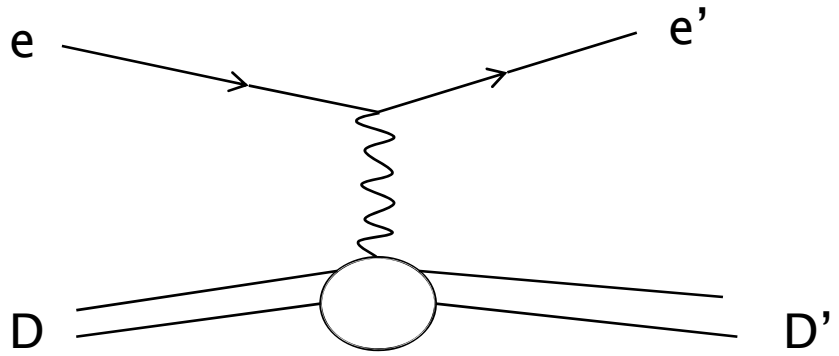
We will improve the results of Mainz and Saclay data that have 10% discrepancy in the Q ~0.2 – 0.4 GeV.

Background:

Deuteron is the simplest nucleus.

By exploring e-D elastic scattering cross-section, we explore structure functions of Deuteron that is a key-issue in understanding Nucleon-Nucleon interaction.

In one photon exchange (elastic scattering),



$$\frac{d\sigma}{d\Omega} = \left.\frac{d\sigma}{d\Omega}\right|_{NS} [A(Q) + B(Q) \tan^2(\theta/2)] = \left.\frac{d\sigma}{d\Omega}\right|_{NS} S_d(Q, \theta)$$

Where $\left.\frac{d\sigma}{d\Omega}\right|_{NS}$ is non-structure cross-section,

$$A(Q) = G_C^2(Q) + \frac{8}{9}\eta^2 G_Q^2(Q) + \frac{2}{3}\eta G_M^2(Q), \quad B(Q) = \frac{4}{3}\eta(1+\eta)G_M^2(Q), \quad \eta = Q^2/4m_d^2$$

- At low energy transfers that we are considering, B(Q) contributes $< 1\%$

World's experiments

In the region Q ~ 0.2 – 0.4, it is problematic.
There are ~10 % discrepancies between the Saclay and Mainz data

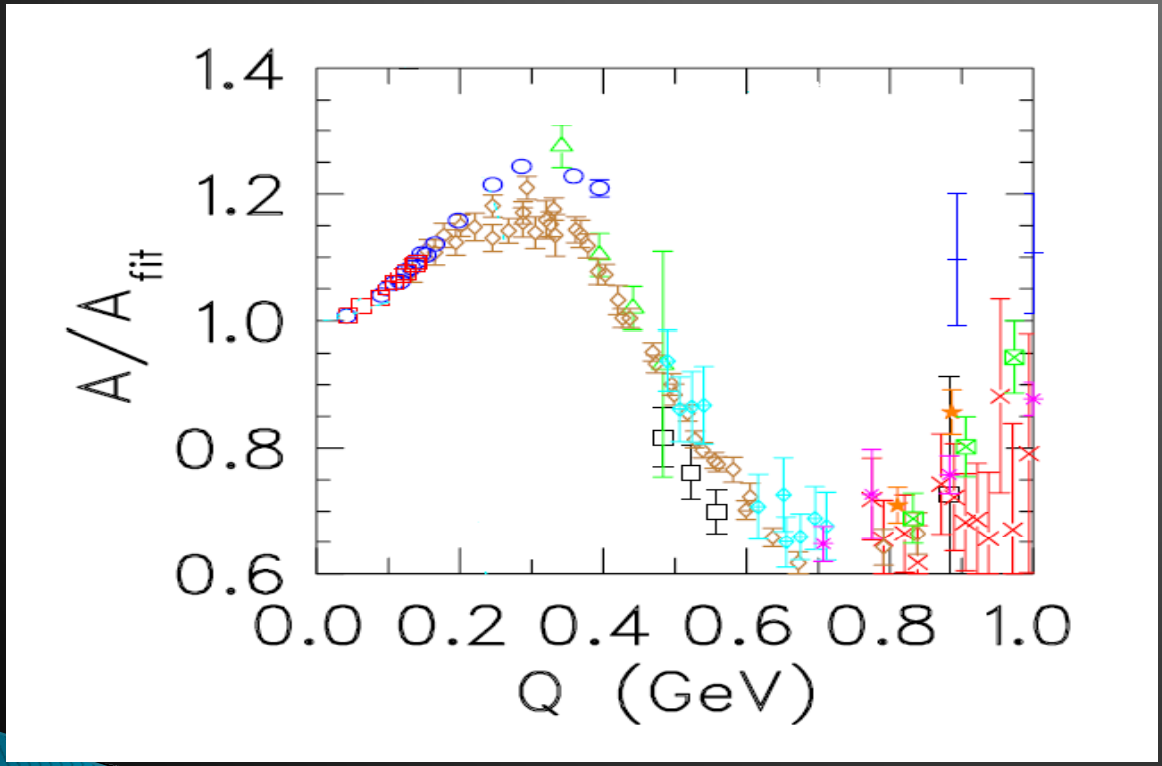


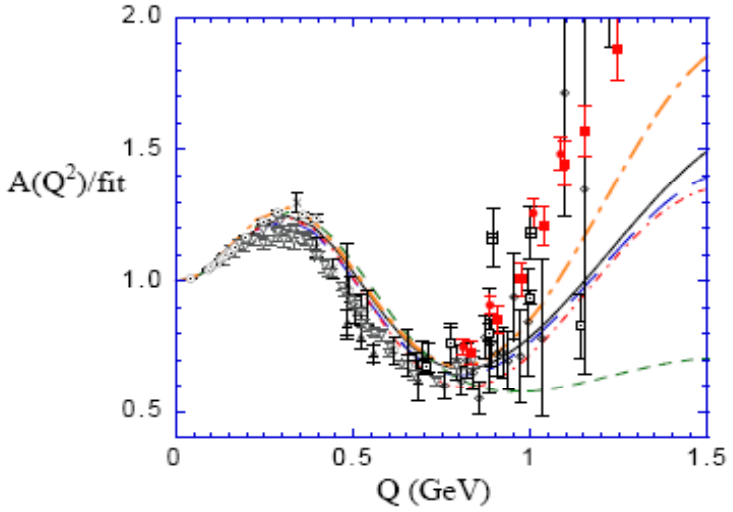
TABLE I: Some measurements of A.

Experiment	Q (GeV)	Symbol	# of points	Year and Reference
Monterey	0.04 - 0.14	□	9	1973 [15]
Mainz	0.04 - 0.39	○	16	1981 [9]
Saclay ALS	0.13 - 0.84	◇	43	1990 [10]
Orsay	0.34 - 0.48	△	4	1966 [16]
Stanford	0.48 - 0.88	□	5	1965 [17]
DESY	0.49 - 0.71	◇	10	1971 [18]
CEA	0.76 - 1.15	×	18	1969 [19]
JLab Hall C	0.81 - 1.34	⋆	6	1999 [4]
JLab Hall A	0.83 - 2.44	□	16	1999 [3]
SLAC E101	0.89 - 2.00	+	8	1975 [20]

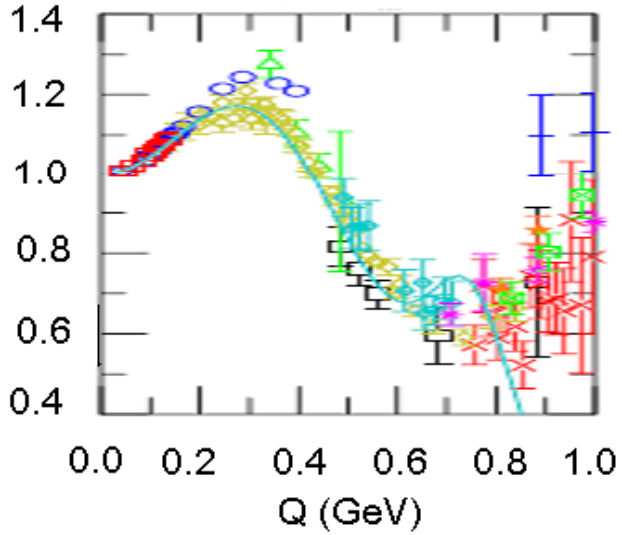
Theories

- Pionless EFT is only applicable upto Q ~ $2m_\pi$
- χ–pt mactches well with Saclay data.
- Conventional nonrelastivistic calculations lie between the Saclay and Mainz data

Nonrelativistic theories



χ–pt



Our goal : identify sign of relativistic corrections

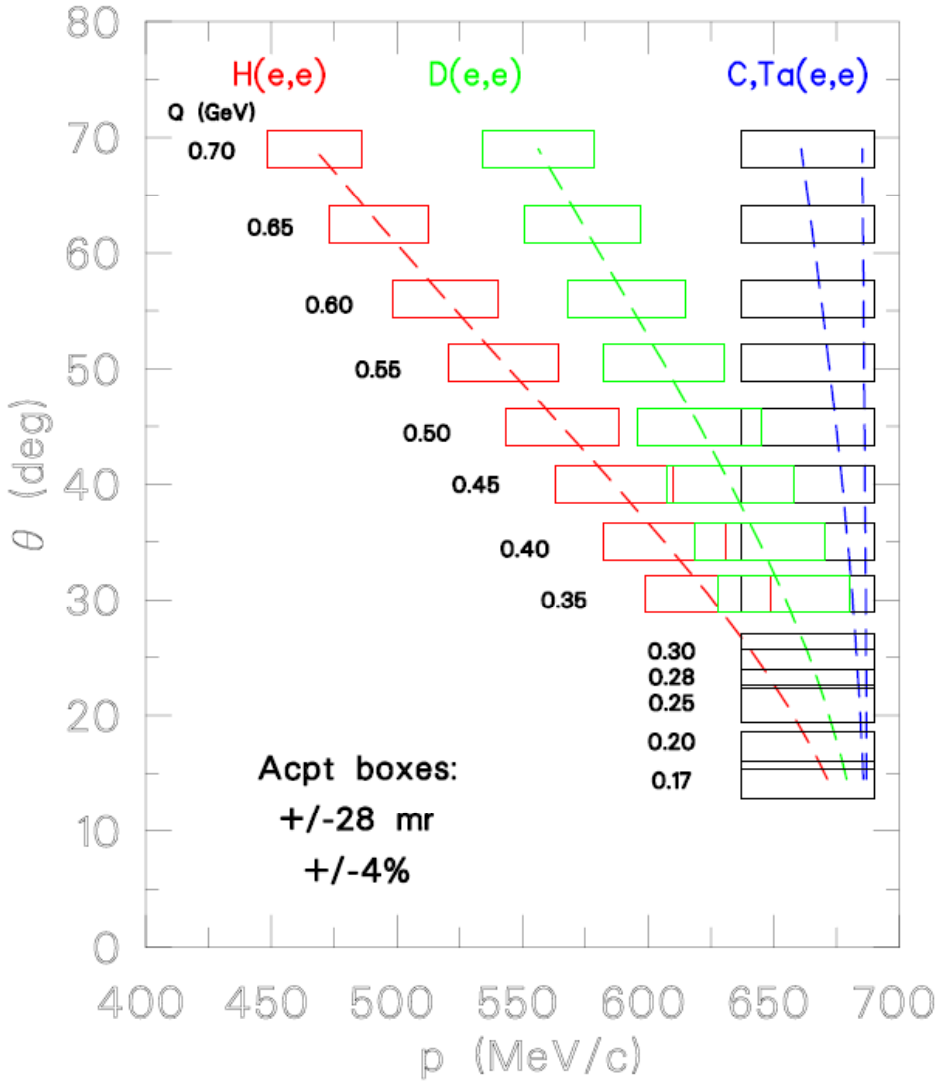
Kinematics

Q range
: 0.100 GeV ~ 0.700 GeV

We used two energy
: 680 MeV and 360 MeV

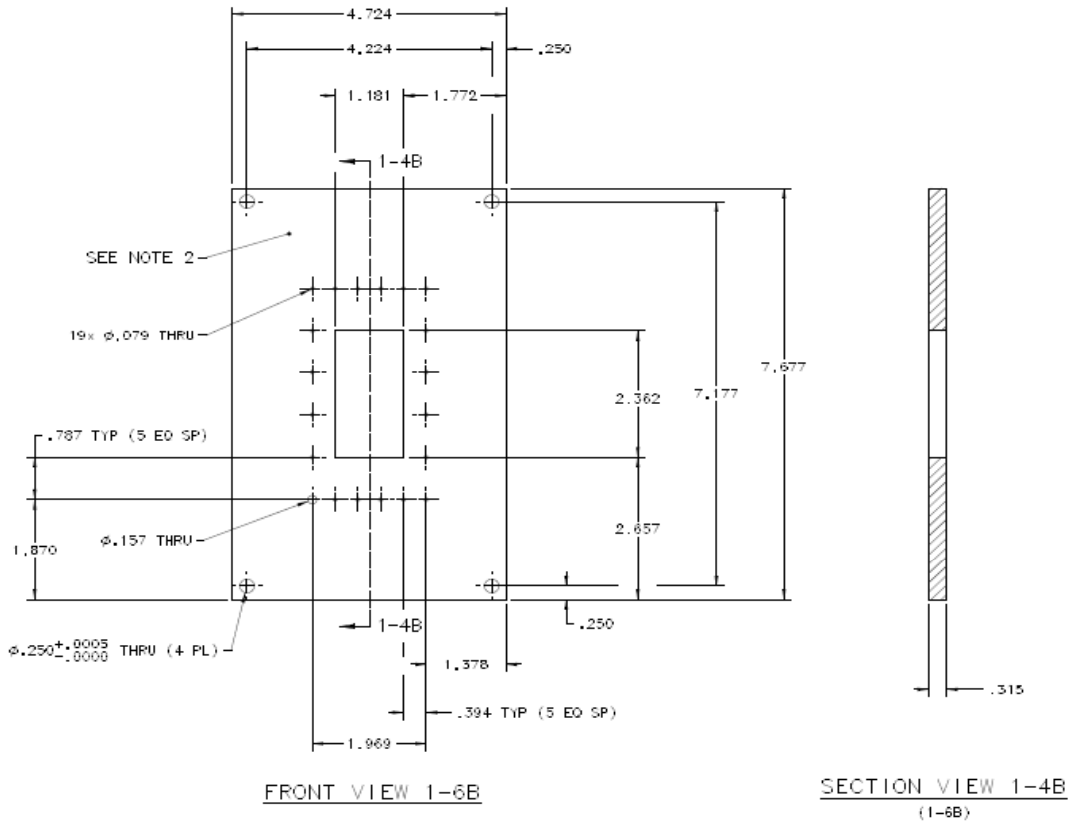
Targets
: D, H, C, and Ta

To check our cross-section systematics, we will get the cross-section of carbon and hydrogen also.



Small collimator

We use ~2 msr small collimator for precise solid angle determination for all runs. With this collimator, we could get pretty clean online results.

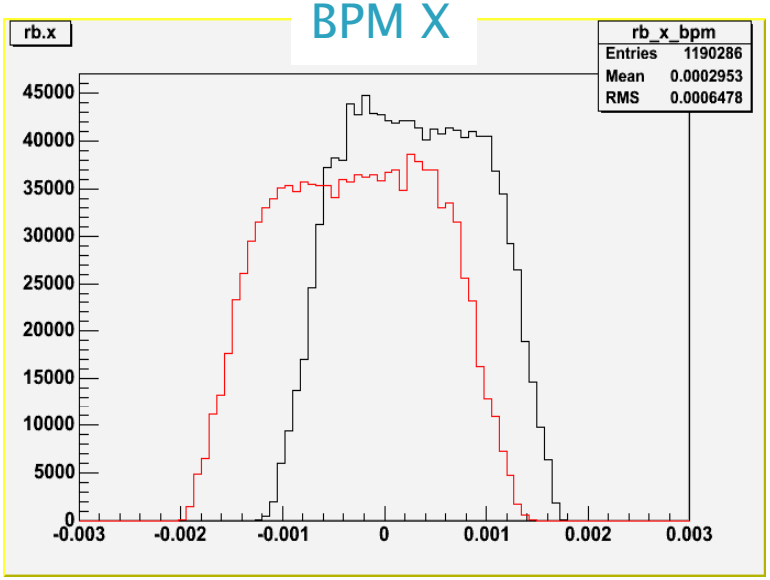


Carbon Analysis

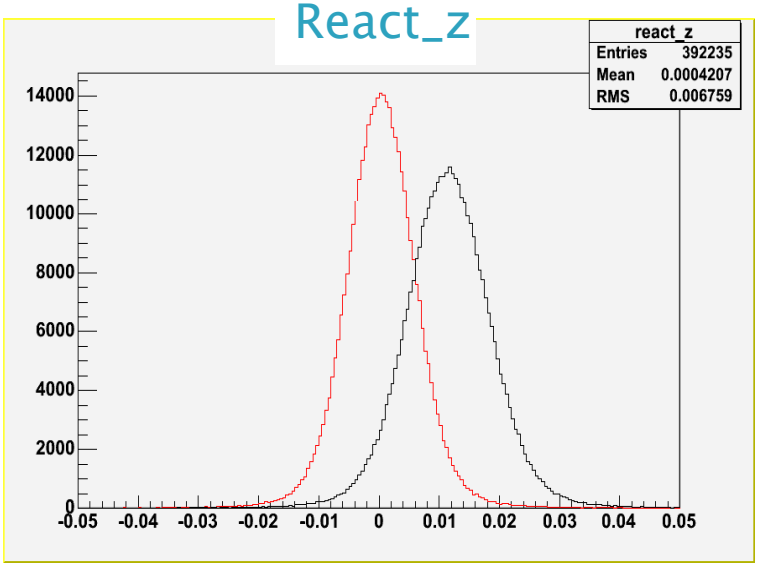
Because carbon form factor is already very well known and simple, carbon is chosen as the first step analysis.

- Raster calibration and HRS mispointing correction is done.

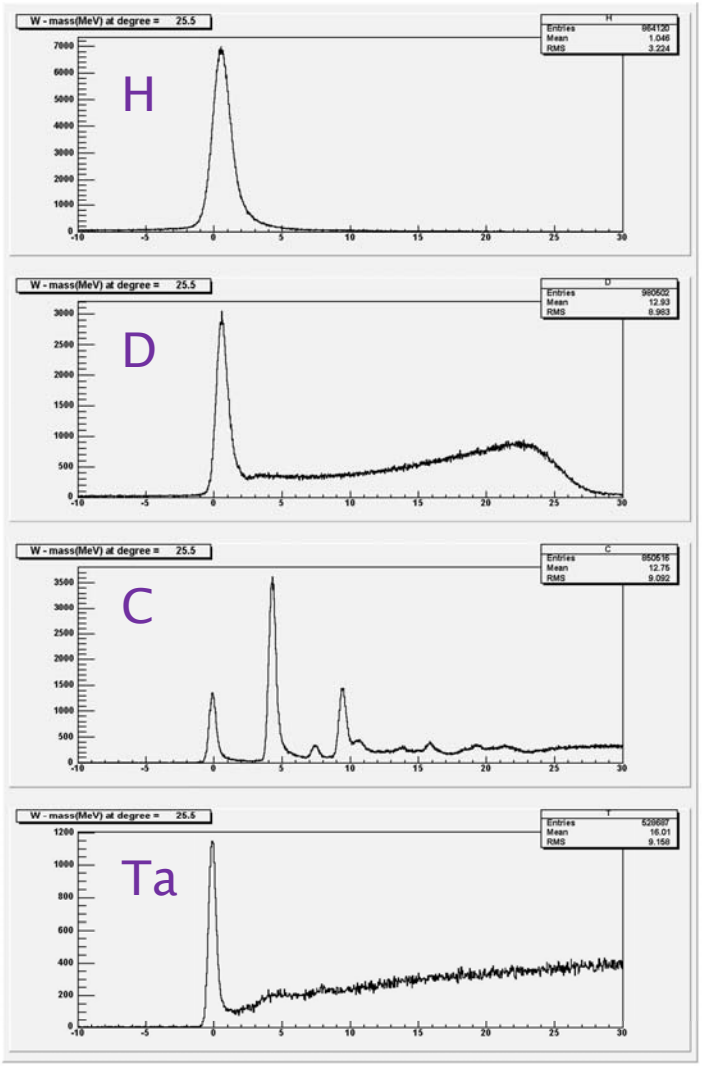
BPM X



React_z



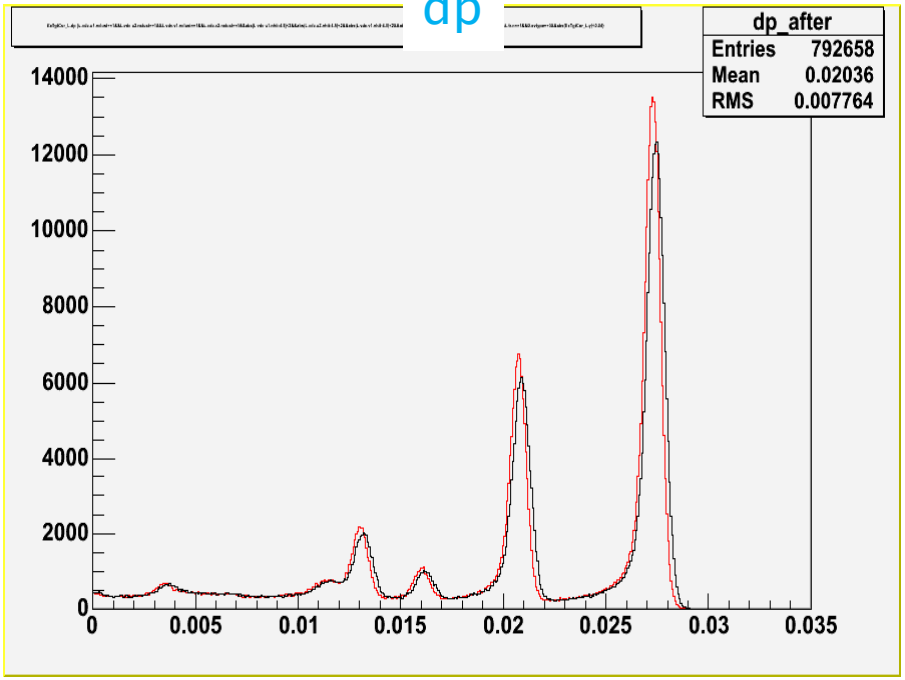
Online data



online

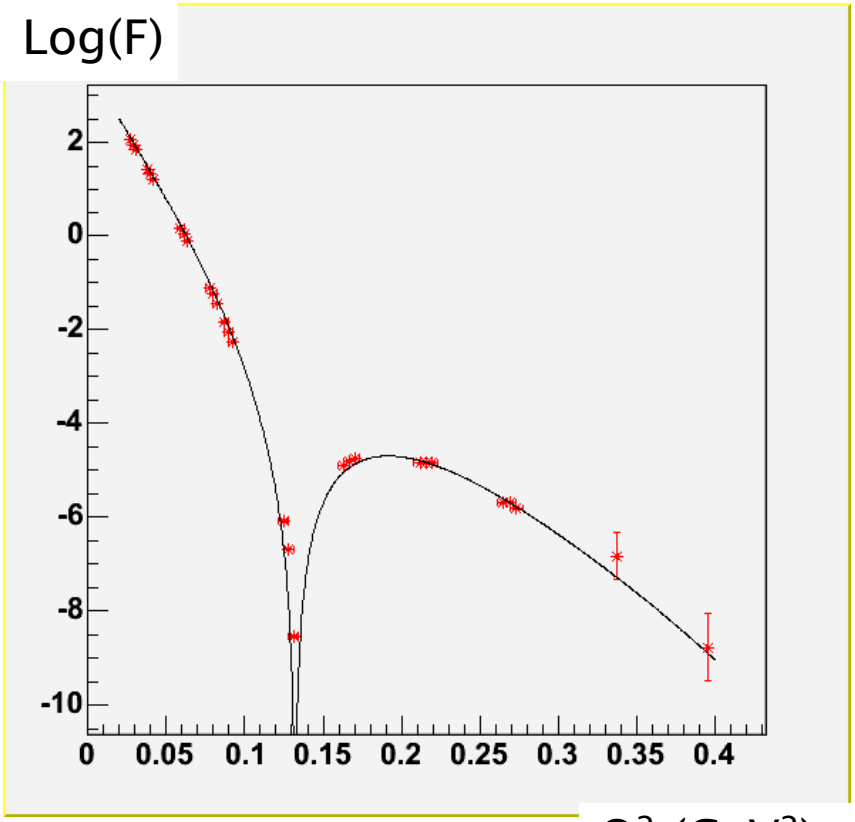
calibrated C

dp



Preliminary

Carbon Form Factor



* data

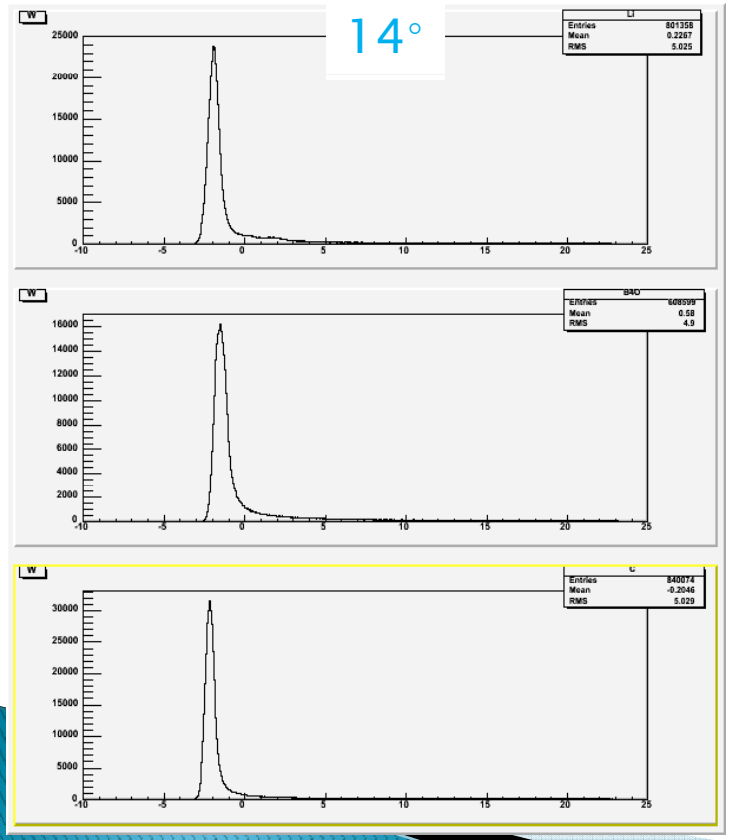
———— Fourier Bessel series of carbon form factor

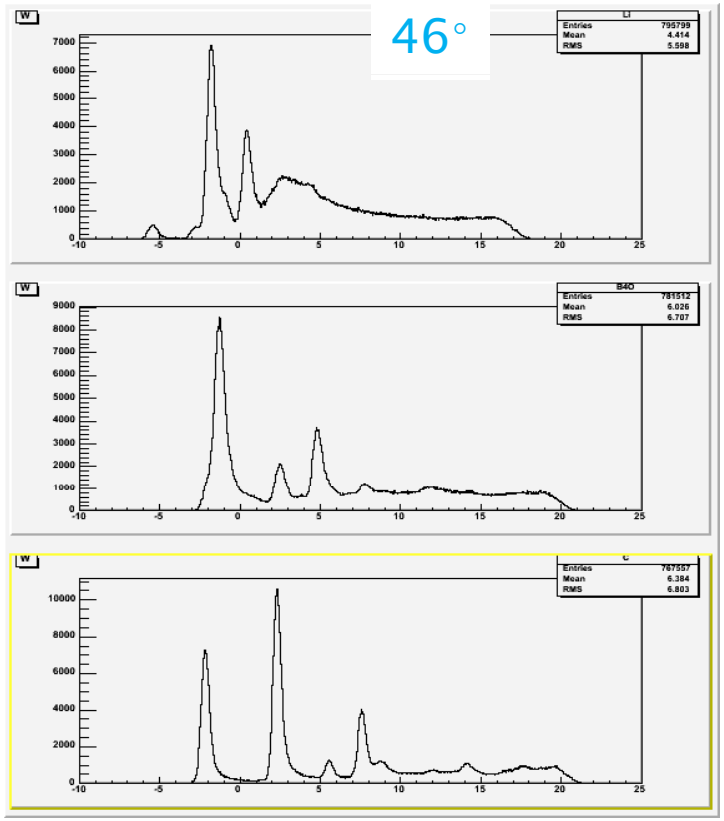
-E.A.J.M. Offermann et al., Phys. Rev. C 44 (1991)

Feb. 2007 additional runs

We had additional data of Li, B_4C, C and Ta in Feburary.

Goal : Getting improved radii of Li and B isotope ~ 0.01 – 0.02 fm





Summary

- Raster calibration and HRS mispointing correction is finished
- Rough carbon form-factor is derived.
  But still some factors need to be adjusted.

Next step

- Hydrogen data need the same procedure as carbon data for the calibration.
- At large angles, there are many background events to be removed.
- Analysis of the deuteron data and obtaining A(Q)