Measurements of Deuteron $A(Q^2)$

- What is $A(Q^2)$
- Why measure again?
- What was done.
- First look at data
- “To be done”

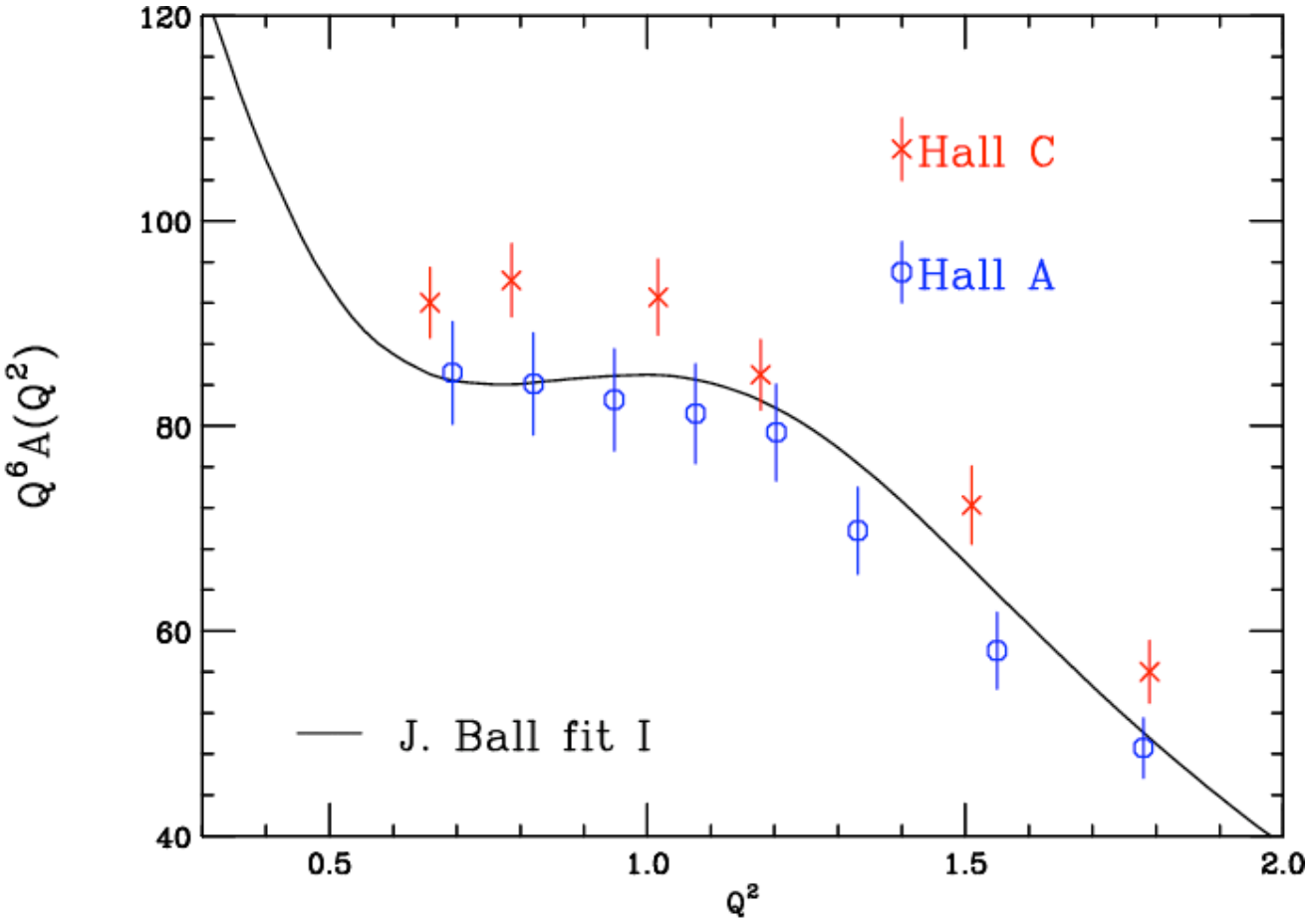
What is $A(Q^2)$?

- Deuteron has 3 elastic form factors (FF) (electric, magnetic, quadrupole).
- $A(Q^2)$ is a combination of all three.
- $\sigma = \sigma_m [A(Q^2) \cos^2(\theta/2) + B(Q^2) \sin^2(\theta/2)$
- $B(Q^2)$ is magnetic FF: small compared to $A(Q^2)$, and suppressed forward angles
- At small Q^2, $A(Q^2)$ proportional to $(Gep + Gen)^2$, so related to nucleon FFs.
- Most easily measured nuclear FF.

Why measure again?

- In region $0.6<Q^2<1.7$ GeV^2, Hall A and Hall C measurements do not agree.
- Hall C was "byproduct" of T20 experiment. Used e-d coincidences with specialized spectrometers
- Hall A was early use of HRS's. Also coincidence experiment. Focused on high Q^2 where rates low, need coincidences to reduce background.
- Both systematic limited (not statistics)

Why measure again?



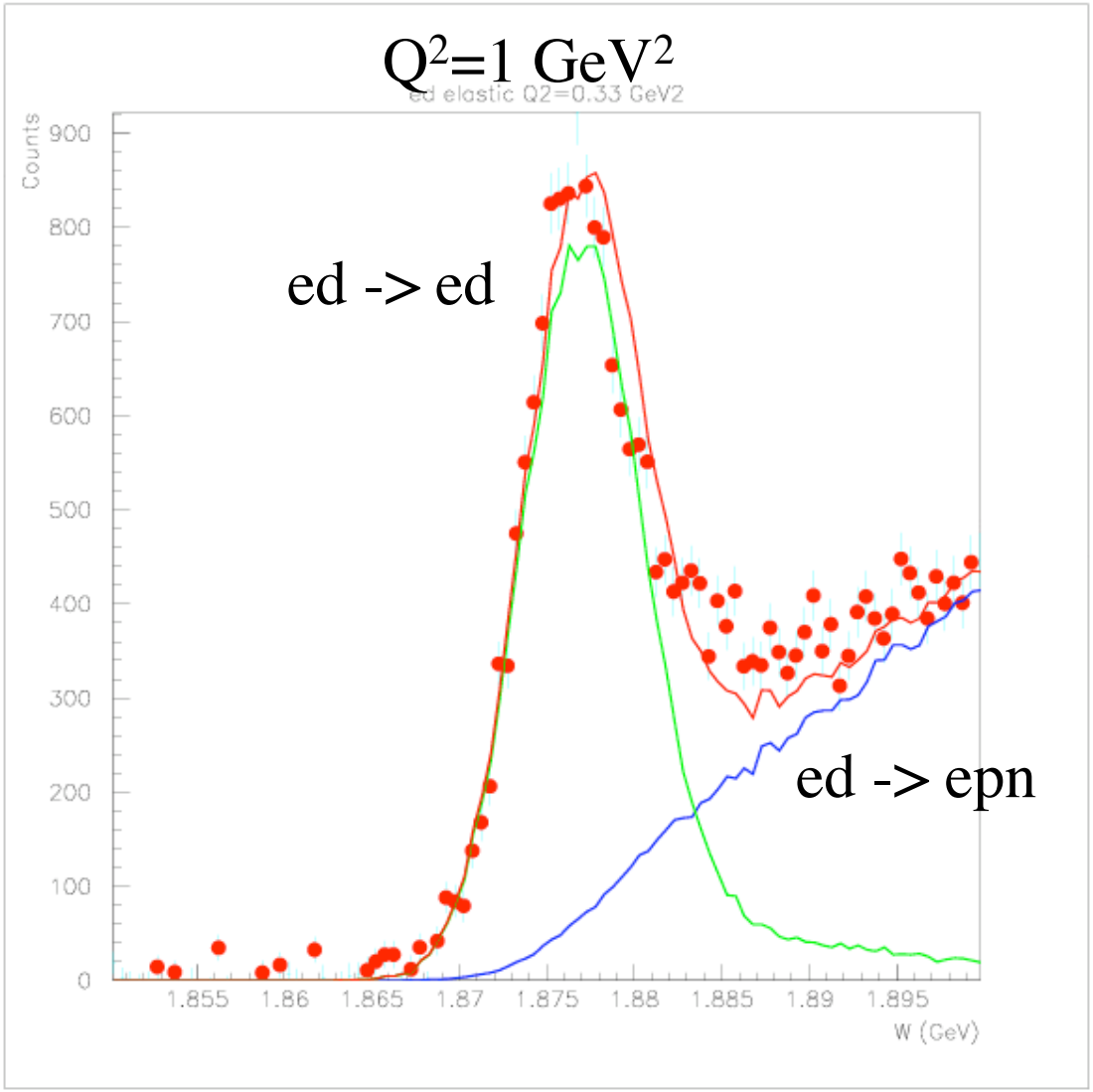
What was done

- Measured ed elastic using electrons only (no coincidence). Used HMS.
- (First tried measuring deuterons only,but too much background).
- Ran in June 2004 (dedicated run of about one day) and January 2005 (part of Rd experiment needed for energy/angle calibrations, so almost “for free”).

What was done

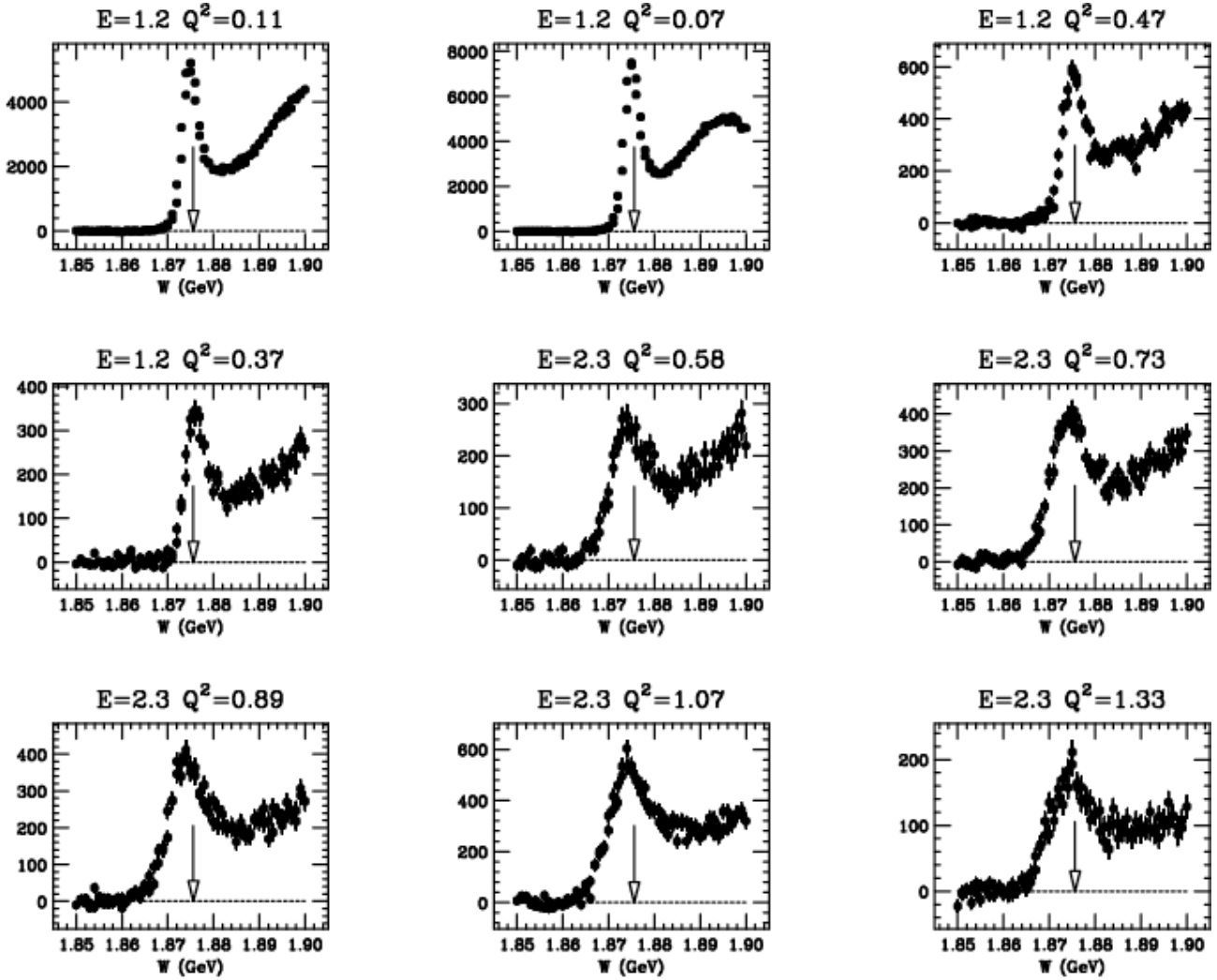
- June 04: measured Q^2=0.33, 0.55, 0.85, and 1.0 GeV^2 using E=2.04 GeV. (Q^2=1.25 in SOS, might be useful: not sure).
- January 05: measured Q^2=0.10, 0.38, 0.57, 0.70 using E=1.2 GeV, and Q^2=0.52, 0.72, 0.89, 1.02, and 1.25 using E=2.4 GeV.
- Systematics better in 1/05: also have ep and eC elastic peaks for energy/angle calibration, plus two E for check on $B(Q^2)$
- Usually 10K counts in ed elastic peak

A typical W spectrum



- Endcap subtracted (big!)
- ed->ed from simplified SIMC and normalized to data by eye
- ed-> epn from J.M. Laget with resolution smearing and normalized to data

W spectra from Jan 05



To be done

- Energy/angle calibration (use ep, ed, and even eC elastic peak positions).
- Detector efficiency, BCM calibration, target boiling, spectrometer aceptance…
- Treatment of ed->epn. Compare J.M Laget model, Arenhoevel model, and simple polynomial fits.
- Matching of resolutions data/SIMC
- Iteration on radiative corrections.
- Most of work being done by Vipuli Dharmawardane. More help welcome.