^{16}O$(e,e'p)$

L. E. M. Andersson for the Jefferson Lab Hall A Collaboration
mattias.andersson@nuclear.lu.se
Department of Nuclear Physics, Lund University, Lund, Sweden
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LUND UNIVERSITY

E89-003

http://www.jlab.org/~fissum/e89003.html

The Jefferson Laboratory physics program in Hall A began in the spring of 1997 with a precision measurement of ^{16}O$(e,e'p)$ [1–5].

$|\vec{q}|$ = 1.000 GeV/c, ω = 0.445 GeV
Q^2 = 0.802 (GeV/c)^2, x_B = 0.960

- Data sets were obtained for the $1p$-shell, the $1s_{1/2}$ state, and the continuum, for

$$0 < E_{\rm miss} < 120\ {\rm MeV},$$
$$0 < p_{\rm miss} < 375\ {\rm MeV}/c.$$

- ^{1}H(e,e) and ^{1}H(e,ep) reactions were used to calibrate kinematics and monitor normalization.

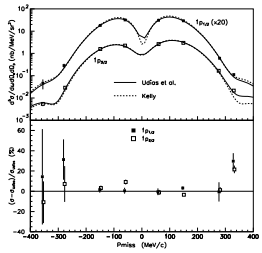

Figure 1: $p_{\rm miss}$-dependence of the measured cross sections for the $1p$-shell as compared to relativistic DWIA calculations for $E_{\rm beam}$ = 2.442 GeV. The solid line is the Udías *et al.* [6–8] calculation and the dashed line is the Kelly [9] calculation.

$$A_{LT} = \frac{[d^6\sigma_-]-[d^6\sigma_+]}{[d^6\sigma_-]+[d^6\sigma_+]}$$

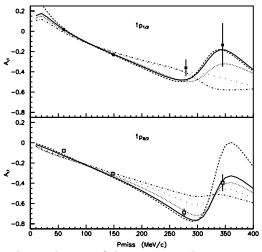

Figure 2: $p_{\rm miss}$-dependence of the measured A_{LT} asymmetry for the $1p$-shell as compared to relativistic DWIA calculations for $E_{\rm beam}$ = 2.442 GeV. The dashed line is from Kelly, while the other curves are from Udías *et al.* The densely dotted line includes only the bound-nucleon spinor distortion. The sparsely dotted line includes only the scattered-state spinor distortion. The dot-dashed line has no spinor distortion included.

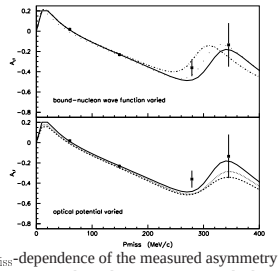

Figure 3: $p_{\rm miss}$-dependence of the measured asymmetry A_{LT} for the $1p_{1/2}$-state as compared to relativistic DWIA calculations [8] with different bound-state wave functions and optical potentials for $E_{\rm beam}$ = 2.442 GeV. The solid line in both panels are the same and correspond to the Udías *et al.* calculation shown in Fig. 2. For the three curves in the top panel, the EDAI-O [10] optical potential was used. The dot-dashed curve is for the NLSH-P [11] bound-nucleon wave function and the sparsely dotted line is for the HS [12] bound-nucleon wave function. For the three curves in the bottom panel, the NLSH bound-nucleon wave function was used. The dashed and dotted curves used the EDAD-1 and EDAD-2 [10] optical potentials, respectively.

Conclusions

From the fully relativistic theoretical analysis of Udías *et al.* [6–8], three major factors which determine the shape of the A_{LT} spectrum were identified:

1. the bound-nucleon and ejectile spinor distortion, which produced the observed diffractive structure;
2. the bound-nucleon wave function, which shifted the location of the diffractive structure as a function of $p_{\rm miss}$; and
3. the optical potential, which affected the amplitude of the diffractive structure.

More data were clearly needed at higher $p_{\rm miss}$ to allow the bound-nucleon wave function, optical potential, and spectroscopic factors to be determined independently.

E00-102

http://www.jlab.org/~fissum/e00102/e00102.html

In the Fall of 2001, a follow-up experiment [13] was performed in Hall A.

$|\vec{q}|$ = 1.066 GeV/c, ω = 0.494 GeV
Q^2 = 0.892 (GeV/c)^2, x_B = 0.962

- Data sets were obtained for the $1p$-shell, the $1s_{1/2}$ state, and the continuum, for

$$0 < E_{\rm miss} < 240\ {\rm MeV},$$
$$0 < p_{\rm miss} < 755\ {\rm MeV}/c.$$

- ^{1}H(e,e) and ^{1}H(e,ep) reactions were used to calibrate kinematics and monitor normalization.
- From these data, we intend to determine:
  1. the limits of validity of the single-particle model of valence proton knock-out;
  2. the effects of relativity and spinor distortion on valence proton knock-out; and
  3. the bound-state wave function and spectroscopic factors for valence proton knock-out.

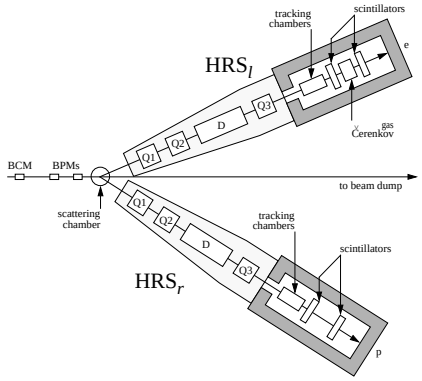

Figure 4: The Hall A spectrometers. The electron beam passed through a beam current monitor and beam position monitors before striking a waterfall target located in the scattering chamber. Scattered electrons were detected in the HRS$_l$, while knocked-out protons were detected in the HRS$_r$. Non-interacting electrons were dumped.

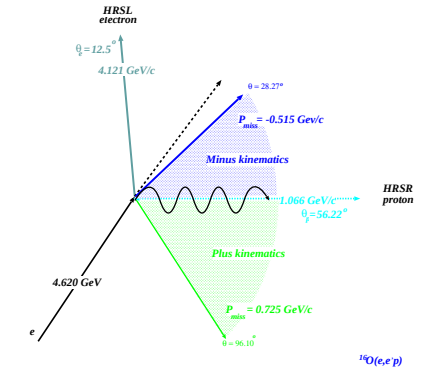

Figure 5: The experiment kinematics. The HRS$_l$ was fixed at 12.5° throughout the experiment, dramatically simplifying the normalizations and calibrations. The HRS$_r$ rotated about the central pivot. Figure courtesy W. Hinton.

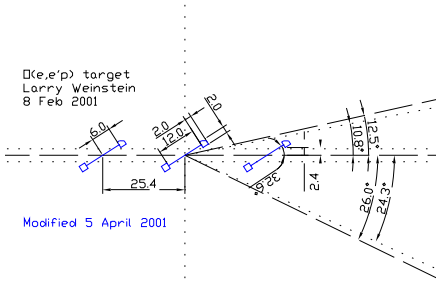

Figure 6: The waterfall target [14,15] from above (dimensions in mm). Each waterfall was 125 mg/cm^2 thick. The three-film configuration reduced both the energy loss and the background associated with the target.

E00-102 (continued)

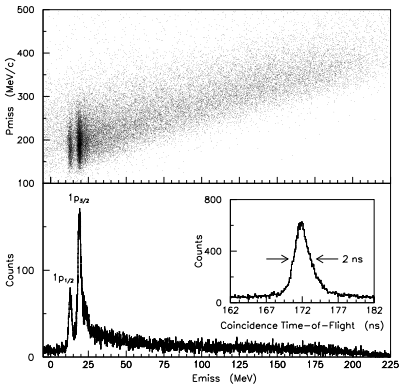

Figure 7: Online yield spectra obtained at $\theta_{pq} = +9.4°$ ($p_{\rm miss} = +175$ MeV). Some timing corrections have been performed. The top panel shows a scatter plot of $p_{\rm miss}$ versus $E_{\rm miss}$. The dark vertical bands project into the peaks located at 12.1 and 18.3 MeV in the bottom panel, corresponding to protons from the $1p_{1/2}$ and $1p_{3/2}$ states of ^{16}O, respectively. The insert shows the corresponding coincidence time-of-flight peak with a FWHM of 2ns.

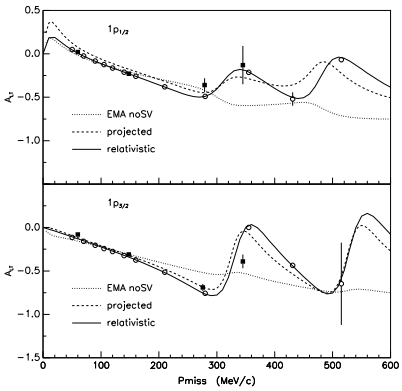

Figure 8: Projected A_{LT} data in comparison to the calculations of Udías *et al.* The open circles represent the anticipated data from E00-102. They have been normalized to the fully relativistic calculation. A 3% systematic uncertainty has been added in quadrature to the anticipated statistical uncertainties to yield the error bars associated with these points. The solid squares are the E89-003 data obtained in slightly different kinematics.

The analysis is underway. At this point:

1. the optimization of the detector databases is 90% completed;
2. the determination of the spectrometer optics databases is underway; and
3. a MySQL database containing all of the experiment setup and normalization information has been constructed.

References

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