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MEASUREMENTS OF THE A-DEPENDENCE OF DEEP-INELASTIC ELECTRON SCATTERING FROM NUCLEI*

R. G. Arnold, P. E. Bosted, C. C. Chang[a], J. Gomez, A. T. Katramatou,
G. G. Petratos, A. A. Rahbar, S. E. Rock, A. F. Sill, Z. M. Szalata
The American University, Washington, D. C. 20016
A. Bodek, N. Giokaris[b]
University of Rochester, Rochester, N.Y. 14627
D. J. Sherden
Stanford Linear Accelerator Center, Stanford, CA 94305
B. A. Mecking
Universitat Bonn, West Germany
R. M. Lombard
CEN Saclay, France

ABSTRACT

The deep inelastic electron scattering cross sections per nucleon σ_A for d, He, Be, C, Al, Ca, Fe, Ag, and Au were measured in the kinematic range $0.09 \leq x \leq 0.9$ and $2 \leq Q^2 \leq 15$ (GeV/c)^2 using electrons with energies ranging from 8 to 24.5 GeV. The ratio σ_A/σ_d is consistent with unity in the range $0.1 < x < 0.3$. For $0.3 < x < 0.8$, the ratio decreases logarithmically with atomic weight A, or linearly with average nuclear density. No Q^2 dependence in the ratio was observed over the kinematic range of the data.

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[a] Permanent Address: University of Maryland, College Park, Maryland 20742.
[b] Permanent Address: Fermilab, Batavia, Illinois 60510.

Significant differences in the inelastic structure functions of Fe, Al, and deuterium nuclei have recently been observed in muon[1] and electron[2] scattering experiments. This has been interpreted as a distortion of the quark momentum distributions in bound nucleons. To study the A-dependence of this effect, we have measured differential cross sections for the inelastic scattering of electrons from deuterium, He, Be, C, Al, Ca, Fe, Ag, and Au over a large kinematic range (x values between 0.09 and 0.9 and Q^2 values of 2, 5, 10, and 15 $(\mathrm{GeV/c})^2$). The Stanford Linear Accelerator Center (SLAC) provided electrons with incident energies (E) ranging from 8 to 24.5 GeV. The SLAC 8-GeV/c spectrometer was used at 23 kinematic settings to detect electrons with energies (E') from 3.1 to 8.4 GeV scattered at angles (θ) between 11° and 23°. A nitrogen-filled threshold Čerenkov counter and a 20 radiation length (r.l.) segmented lead glass shower counter were used to identify electrons whose trajectories were defined by ten planes of proportional wire chambers. The electron contributions from background processes such as π^0 decay and pair production were determined by reversing the spectrometer polarity and measuring the charge symmetric positron cross sections.

The target assembly consisted of a 15 cm long (2% r.l.) cylindrical target of recirculating liquid deuterium, a 25 cm long (2% r.l.) cylindrical target of recirculating pressurized (25 atm) helium, empty target cells, and >99.9% pure solid targets with natural isotopic abundances. The d and He targets were cooled to 21 °K. Data were usually[3] taken with 2% r.l. Be, C, and Fe in order to minimize radiative correction differences, with thicker (6% r.l.) Al, Ca, Fe, Ag, and Au targets being used to maintain reasonable counting rates. Both the 2% and 6% r.l. Fe targets were used at each setting to check radiative corrections. Various thicknesses of C, Al, Fe, and Au were used at selected settings as a further check. Measurements with the different targets were interspersed frequently to minimize systematic errors.

To monitor the d and He target densities, the SLAC 1.6-GeV/c spectrometer was used as a relative luminosity monitor for all data taking. Data at each kinematic setting were taken with at least two beam repetition rates. In addition, high statistics calibration data were taken at several beam intensities and repetition rates at each beam energy. The density changes were reproducible and well parametrized as a linear function of average beam current. By comparing the corrections (up to 1% for d and 7% for He) as determined by several different methods, we conclude that the uncertainties in the relative densities are less 0.5% for d and 1.4% for He.

The measured cross sections were radiatively corrected using the method of Mo and Tsai[4] in a manner similar to that described in Stein *et al.*[5] The Z-dependent correction for the nuclear Coulomb field was not applied, but has been calculated[6] to be less than 1.5% for Au over our kinematic range. The radiative correction factors were nearly identical for different targets having the same thickness (in r.l.), except for the d and He targets, where geometrical effects introduced differences of up to 3%. The radiatively corrected cross sections for targets of the same material but different radiation lengths were consistent within statistics.

The cross sections were adjusted to compensate for neutron excess, such that σ_A represents the cross section per nucleon of a hypothetical nucleus with an equal number (A/2) of protons and neutrons. Using the approximation $\sigma_n = \sigma_p(1-0.8x)$, corrections as large as 10% for Au were obtained at $x = 0.8$.

The deuterium cross sections extracted from the data are in excellent agreement ($\pm 2\%$) with a fit to previous data[7] in the same kinematic region. Systematic uncertainties (Δ) in the ratios σ_A/σ_d due to radiative corrections ($\pm 0.6\%$), spectrometer acceptance ($\pm 0.3\%$), electronics dead time ($\pm 0.3\%$), beam intensity monitoring ($\pm 0.1\%$), pion backgrounds ($\pm 0.5\%$), neutron excess (up to $\pm 0.7\%$), and pair-symmetric electron backgrounds (up to $\pm 0.5\%$ except $\pm 2\%$ at $x = 0.09$) were, when added in quadrature,

comparable to the uncertainties in the target thicknesses, estimated to be $\pm 1.2\%$ for deuterium and $\pm 0.5\%$ to $\pm 1.5\%$ for the other targets.

Within the quark-parton model, the variable $x = Q^2/2M_p\nu$ is related to the momenta of the quarks in a nucleon, where $Q^2 = 4EE'\sin^2(\theta/2)$, $\nu = E - E'$, and M_p is the proton mass. The structure functions W_1^A and W_2^A per nucleon are related to the differential cross section per nucleon by

$$\sigma_A = \sigma_M \left[W_2^A(x, Q^2) + 2W_1^A(x, Q^2) \tan^2(\theta/2) \right]$$

where $\sigma_M = 4\alpha^2 E'^2 \cos^2(\theta/2)/Q^4$. The ratio $W_2^A/W_1^A = (1+R)/(1+Q^2/4M_p^2x^2)$ is determined by $R = \sigma_L/\sigma_T$, the ratio of the cross sections for absorption of longitudinal and transverse virtual photons. To study the possible A-dependence of R, measurements were made at $Q^2 = 5$ (GeV/c)^2 and $x = 0.3$, 0.5, and 0.7 using two different angles θ for each x value. The resulting x-averaged values for R are 0.112 ± 0.048 for d, 0.127 ± 0.174 for He, 0.195 ± 0.112 for Al, 0.299 ± 0.079 for Fe, and 0.382 ± 0.197 for Au. The errors are statistical only. The results are consistent with the average value for deuterium ($R = 0.24 \pm 0.1$) from previous measurements[8] in our kinematic region, but do not exclude an increase with A that would significantly change the extracted structure functions. Therefore we do not make the assumption that $W_2^A/W_2^d = \sigma_A/\sigma_d$ in this paper.

Figure 1(a) shows our data for the ratio σ_{Fe}/σ_d (taken at Q^2 values of 2, 5, 10 and 15 (GeV/c)^2), along with data from higher energy muon experiments[1,9]. While our data alone show no significant Q^2 dependence, comparison with the higher Q^2 muon data[1] ($\Delta \approx \pm 6\%$) indicate a Q^2 dependence for $x < 0.3$ consistent in direction with that expected from nuclear shadowing.

Because we see no significant Q^2 dependence in our data, Figs. 1(b-i) show Q^2-averaged ratios for each target in finer x bins than in Fig. 1(a). Also shown are

data from Stein *et al.*[5] for Be ($\Delta = \pm 3.2\%$), Al ($\Delta = \pm 3.2\%$), Cu ($\Delta = \pm 4.2\%$), and Au ($\Delta = \pm 10\%$) and from Bodek *et al.*[2] for Al ($\Delta = \pm 2.3\%$) and Fe ($\Delta = \pm 1.1\%$). Systematic differences between our results and the earlier data are within quoted systematic errors. The data for all the targets display a similar trend. The deviation from unity is largest for x near 0.6 and is larger for the heavier elements. Except for $x > 0.8$, the trend of the data is opposite to that expected from Fermi motion effects.[10,2]

Figure 2 shows Q^2-averaged ratios σ_A/σ_d as a function of atomic weight A for two selected values of x. The data may be equally well described by two-parameter fits of the form $\sigma_A/\sigma_d = c\,\mathrm{A}^{\alpha}$ or $\sigma_A/\sigma_d = a\,[1 + b\rho(\mathrm{A})]$, where ρ(A) is the average nuclear density[11]. Values of α and b from fits to our data are shown in Fig. 3. The systematic uncertainties in the target thicknesses were included in the fits, resulting in χ^2 per degree of freedom of ≈ 1.2 for either type of fit.

The data do not directly correlate with binding energy per nucleon, which peaks around Fe, since the observed ratios continue to decrease for A above Fe. The anomalous binding energies and nuclear densities for d and He make them of particular interest. For $x > 0.4$, where $|\alpha|$ and $|b|$ are large, the x-averaged ratio σ_A/σ_d for d (He) differs from the power fit by $1.3 \pm 0.3\%$ ($-1.9 \pm 0.4\%$), and from the nuclear density fit by $0.3 \pm 0.3\%$ ($2.0 \pm 0.4\%$). These differences are only slightly greater than the systematic uncertainties in the d and He normalizations.

Theoretical mechanisms[12] for the distortions of structure functions of bound nucleons include ideas such as multi-quark bags, a larger confining radius for bound nucleon bags, delta resonances in nuclei, and an enhancement of the abundance of pions or quark-antiquark pairs in large nuclei. Our data on the atomic weight dependence of nuclear cross sections will provide a test for such models.

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APPENDIX

This appendix to SLAC-PUB-3257 contains tables of cross section ratios σ_A/σ_d for He, Be, C, Al, Ca, Fe, Ag, and Au. Table I shows Q^2-averaged ratios in fixed x bins. The quantities have been formed by first dividing the events at each spectrometer setting among the fixed x bins. The ratios to deuterium in each x bin at each kinematic setting were then averaged over all kinematic settings to form the Q^2-averaged ratios shown in the table. No correction for Fermi motion has been made, but a correction for unequal numbers of neutrons and protons has been applied (see main text). The errors shown are statistical only, and include the errors for deuterium. The data correspond directly to those shown in Figs. 1(b-i).

Table II is the same as Table I except that the data were put into ξ bins, where $\xi = 2x/[1+\sqrt{(1+4M_p^2x^2/Q^2)}]$ is the Nachtmann variable.

Table III shows the ratios σ_A/σ_d at the value of x, ξ, Q^2 and ϵ at the center of the spectrometer acceptance for each kinematic setting, as well as the Q^2-averaged ratios for each x value. The degree of longitudinal polarization of the virtual photons ϵ is defined by

$$\epsilon = [1+2(1+Q^2/4M_p^2x^2)\tan^2(\theta/2)]^{-1}$$

The ratios shown are the average over the spectrometer acceptance ($\Delta E'/E' = \pm 5\%$, $\Delta\theta = \pm 8$ mr). No correction for Fermi motion has been applied, but the ratios have been adjusted for unequal numbers of neutrons and protons (see text). The errors are statistical only, and include the errors for deuterium. The values for Fe correspond to those in Fig. 1(a).

Table I

Q^2-averaged ratios σ_A/σ_d for He, Be, C, Al, Ca, Fe, Ag, and Au versus x.

x	He	Be	C	Al	Ca	Fe	Ag	Au
0.080	...	...	...	...	...	0.984 ± 0.025	...	...
0.100	...	...	...	...	...	0.984 ± 0.035	...	...
0.123	0.997 ± 0.018	1.009 ± 0.016	...	1.012 ± 0.017	...	1.013 ± 0.015	...	0.990 ± 0.020
0.148	1.066 ± 0.040	1.056 ± 0.038	...	1.023 ± 0.037	...	1.013 ± 0.022	...	1.030 ± 0.044
0.205	0.978 ± 0.014	0.991 ± 0.013	1.022 ± 0.021	0.989 ± 0.013	0.976 ± 0.021	1.003 ± 0.012	0.997 ± 0.023	0.978 ± 0.015
0.235	0.993 ± 0.016	0.996 ± 0.015	0.992 ± 0.024	0.978 ± 0.015	0.939 ± 0.023	0.990 ± 0.014	0.966 ± 0.026	0.971 ± 0.018
0.268	1.013 ± 0.020	0.993 ± 0.019	1.047 ± 0.032	0.998 ± 0.019	1.014 ± 0.031	0.999 ± 0.017	0.993 ± 0.032	0.987 ± 0.022
0.303	1.003 ± 0.012	0.998 ± 0.011	0.999 ± 0.017	0.994 ± 0.011	0.992 ± 0.017	0.989 ± 0.009	1.011 ± 0.019	0.981 ± 0.013
0.340	0.991 ± 0.027	0.993 ± 0.026	0.934 ± 0.053	0.981 ± 0.025	0.935 ± 0.057	0.941 ± 0.023	0.965 ± 0.063	0.969 ± 0.030
0.380	0.973 ± 0.012	0.966 ± 0.010	0.977 ± 0.019	0.970 ± 0.010	0.960 ± 0.018	0.949 ± 0.009	0.985 ± 0.020	0.928 ± 0.012
0.420	0.956 ± 0.013	0.951 ± 0.011	0.965 ± 0.022	0.955 ± 0.012	0.935 ± 0.021	0.935 ± 0.011	0.944 ± 0.024	0.926 ± 0.014
0.460	0.971 ± 0.013	0.994 ± 0.014	0.960 ± 0.022	0.951 ± 0.014	0.957 ± 0.022	0.939 ± 0.011	0.939 ± 0.023	0.932 ± 0.014
0.500	0.959 ± 0.011	0.953 ± 0.012	0.931 ± 0.018	0.934 ± 0.012	0.902 ± 0.017	0.904 ± 0.008	0.909 ± 0.019	0.893 ± 0.011
0.540	0.947 ± 0.012	0.947 ± 0.013	0.945 ± 0.017	0.918 ± 0.013	0.890 ± 0.016	0.915 ± 0.011	0.903 ± 0.018	0.884 ± 0.014
0.580	0.937 ± 0.012	0.938 ± 0.012	0.918 ± 0.014	0.909 ± 0.012	0.907 ± 0.015	0.884 ± 0.010	0.889 ± 0.016	0.855 ± 0.014
0.620	0.921 ± 0.012	0.908 ± 0.012	0.889 ± 0.014	0.864 ± 0.012	0.856 ± 0.014	0.851 ± 0.011	0.833 ± 0.015	0.805 ± 0.014
0.660	0.934 ± 0.017	0.938 ± 0.016	0.925 ± 0.019	0.893 ± 0.015	0.867 ± 0.018	0.881 ± 0.012	0.851 ± 0.019	0.817 ± 0.017
0.700	0.953 ± 0.022	0.916 ± 0.018	0.852 ± 0.023	0.871 ± 0.017	0.851 ± 0.023	0.838 ± 0.013	0.843 ± 0.025	0.812 ± 0.020
0.740	0.971 ± 0.025	0.932 ± 0.022	0.889 ± 0.033	0.919 ± 0.021	0.861 ± 0.031	0.874 ± 0.017	0.904 ± 0.035	0.827 ± 0.023
0.780	0.920 ± 0.030	0.921 ± 0.027	0.968 ± 0.058	0.942 ± 0.028	0.956 ± 0.056	0.924 ± 0.026	0.945 ± 0.061	0.870 ± 0.031
0.820	0.984 ± 0.050	0.978 ± 0.046	...	0.945 ± 0.046	...	0.983 ± 0.045	...	0.903 ± 0.051
0.860	0.973 ± 0.083	1.145 ± 0.088	...	1.283 ± 0.096	...	1.061 ± 0.079	...	1.116 ± 0.101

Table II

Q^2-averaged ratios σ_A/σ_d for He, Be, C, Al, Ca, Fe, Ag, and Au versus ξ.

ξ	He	Be	C	Al	Ca	Fe	Ag	Au
0.080	...	...	...	...	...	0.984 ± 0.024	...	...
0.100	...	...	...	...	...	0.985 ± 0.037	...	...
0.123	0.996 ± 0.017	1.007 ± 0.016	...	1.016 ± 0.017	...	1.014 ± 0.014	...	0.991 ± 0.019
0.148	1.087 ± 0.046	1.078 ± 0.043	...	1.000 ± 0.042	...	1.011 ± 0.023	...	1.034 ± 0.049
0.205	0.986 ± 0.013	0.999 ± 0.012	1.023 ± 0.020	0.995 ± 0.012	0.972 ± 0.019	1.005 ± 0.011	0.999 ± 0.021	0.986 ± 0.014
0.235	0.984 ± 0.019	0.981 ± 0.017	0.985 ± 0.026	0.960 ± 0.017	0.941 ± 0.025	0.982 ± 0.016	0.956 ± 0.028	0.954 ± 0.020
0.268	1.004 ± 0.015	1.004 ± 0.015	1.049 ± 0.028	0.989 ± 0.015	1.020 ± 0.028	0.990 ± 0.013	1.014 ± 0.030	0.990 ± 0.018
0.303	1.003 ± 0.013	0.986 ± 0.012	0.988 ± 0.018	0.999 ± 0.012	0.983 ± 0.017	0.988 ± 0.010	0.999 ± 0.019	0.971 ± 0.014
0.340	1.023 ± 0.021	0.992 ± 0.019	0.978 ± 0.048	0.985 ± 0.019	0.997 ± 0.048	0.968 ± 0.017	1.004 ± 0.053	0.936 ± 0.021
0.380	0.959 ± 0.011	0.955 ± 0.009	0.973 ± 0.017	0.960 ± 0.009	0.954 ± 0.016	0.937 ± 0.008	0.971 ± 0.018	0.928 ± 0.011
0.420	0.957 ± 0.014	0.976 ± 0.013	0.983 ± 0.026	0.963 ± 0.013	0.947 ± 0.025	0.945 ± 0.011	0.954 ± 0.028	0.933 ± 0.014
0.460	0.959 ± 0.011	0.964 ± 0.012	0.933 ± 0.017	0.937 ± 0.012	0.923 ± 0.017	0.918 ± 0.008	0.921 ± 0.018	0.914 ± 0.011
0.500	0.947 ± 0.011	0.947 ± 0.013	0.940 ± 0.017	0.912 ± 0.012	0.886 ± 0.016	0.898 ± 0.009	0.880 ± 0.018	0.868 ± 0.012
0.540	0.951 ± 0.012	0.951 ± 0.013	0.932 ± 0.014	0.921 ± 0.013	0.909 ± 0.014	0.899 ± 0.011	0.905 ± 0.015	0.872 ± 0.015
0.580	0.936 ± 0.011	0.916 ± 0.011	0.900 ± 0.013	0.886 ± 0.011	0.877 ± 0.013	0.867 ± 0.009	0.850 ± 0.014	0.814 ± 0.012
0.620	0.929 ± 0.015	0.922 ± 0.013	0.913 ± 0.016	0.885 ± 0.013	0.853 ± 0.015	0.864 ± 0.011	0.842 ± 0.016	0.802 ± 0.015
0.660	0.941 ± 0.021	0.896 ± 0.017	0.836 ± 0.023	0.872 ± 0.017	0.850 ± 0.022	0.838 ± 0.013	0.844 ± 0.024	0.817 ± 0.019
0.700	0.951 ± 0.025	0.940 ± 0.022	0.934 ± 0.040	0.903 ± 0.022	0.925 ± 0.039	0.888 ± 0.019	0.889 ± 0.041	0.812 ± 0.024
0.740	0.931 ± 0.032	0.911 ± 0.029	1.102 ± 0.130	0.946 ± 0.029	0.939 ± 0.114	0.920 ± 0.027	1.093 ± 0.139	0.872 ± 0.032
0.780	1.002 ± 0.049	0.985 ± 0.044	...	0.953 ± 0.044	...	0.971 ± 0.043	...	0.902 ± 0.049
0.820	0.876 ± 0.088	1.132 ± 0.099	...	1.339 ± 0.114	...	1.128 ± 0.094	...	1.141 ± 0.116

Table III

Ratios σ_A/σ_d for He, Be, C, Al, Ca, Fe, Ag, and Au as a function of Q^2.

x	ξ	Q^2	ϵ	He	Be	C	Al	Ca	Fe	Ag	Au
0.089	0.089	2.0	0.390	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	...	...	0.978 ± 0.019	...	...
Average				0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	...	...	0.978 ± 0.019	...	...
0.130	0.129	2.0	0.573	1.018 ± 0.015	1.023 ± 0.014	0.000 ± 0.000	1.017 ± 0.014	...	1.011 ± 0.013	...	1.003 ± 0.017
0.130	0.130	5.0	0.418	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	...	...	1.009 ± 0.022	...	...
Average				1.018 ± 0.015	1.023 ± 0.014	0.000 ± 0.000	1.017 ± 0.014	...	1.011 ± 0.011	...	1.003 ± 0.017
0.220	0.215	2.0	0.783	1.009 ± 0.013	0.997 ± 0.012	0.000 ± 0.000	1.000 ± 0.012	...	1.009 ± 0.011	...	0.990 ± 0.015
0.220	0.218	5.0	0.537	0.974 ± 0.014	0.990 ± 0.013	1.006 ± 0.014	0.975 ± 0.013	0.959 ± 0.014	0.979 ± 0.012	0.977 ± 0.015	0.959 ± 0.016
Average				0.992 ± 0.010	0.994 ± 0.009	1.006 ± 0.014	0.989 ± 0.009	0.959 ± 0.014	0.995 ± 0.008	0.977 ± 0.015	0.976 ± 0.011
0.300	0.289	2.0	0.826	1.018 ± 0.012	1.006 ± 0.012	0.000 ± 0.000	0.995 ± 0.012	...	0.998 ± 0.011	...	0.973 ± 0.014
0.300	0.295	5.0	0.472	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	...	...	0.966 ± 0.023	...	...
0.300	0.295	5.0	0.686	0.989 ± 0.014	0.990 ± 0.012	1.005 ± 0.013	0.995 ± 0.012	0.990 ± 0.013	0.998 ± 0.012	0.998 ± 0.014	0.984 ± 0.015
0.300	0.298	10.0	0.498	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	...	...	0.923 ± 0.020	...	...
Average				1.006 ± 0.009	0.998 ± 0.009	1.005 ± 0.013	0.995 ± 0.009	0.990 ± 0.013	0.986 ± 0.007	0.998 ± 0.014	0.978 ± 0.010
0.400	0.375	2.0	0.901	0.985 ± 0.013	0.968 ± 0.012	0.000 ± 0.000	0.974 ± 0.012	...	0.956 ± 0.011	...	0.953 ± 0.014
0.400	0.389	5.0	0.721	0.962 ± 0.019	0.960 ± 0.012	0.967 ± 0.013	0.971 ± 0.012	0.950 ± 0.013	0.950 ± 0.011	0.964 ± 0.014	0.920 ± 0.014
0.400	0.395	10.0	0.635	0.966 ± 0.015	0.956 ± 0.012	0.000 ± 0.000	0.956 ± 0.013	...	0.925 ± 0.011	...	0.922 ± 0.015
Average				0.974 ± 0.009	0.961 ± 0.007	0.967 ± 0.013	0.967 ± 0.007	0.950 ± 0.013	0.944 ± 0.006	0.964 ± 0.014	0.932 ± 0.008
0.500	0.454	2.0	0.933	0.952 ± 0.013	0.971 ± 0.012	0.000 ± 0.000	0.940 ± 0.012	...	0.925 ± 0.011	...	0.914 ± 0.014
0.500	0.480	5.0	0.709	0.963 ± 0.013	0.000 ± 0.000	0.000 ± 0.000	...	...	0.906 ± 0.010	...	0.899 ± 0.013
0.500	0.480	5.0	0.827	0.970 ± 0.016	0.978 ± 0.012	0.945 ± 0.012	0.931 ± 0.011	0.920 ± 0.011	0.928 ± 0.010	0.916 ± 0.013	0.926 ± 0.013
0.500	0.489	10.0	0.643	0.953 ± 0.019	0.937 ± 0.016	0.000 ± 0.000	0.930 ± 0.016	...	0.893 ± 0.015	...	0.850 ± 0.018
Average				0.959 ± 0.007	0.967 ± 0.007	0.945 ± 0.012	0.934 ± 0.007	0.920 ± 0.011	0.916 ± 0.006	0.916 ± 0.013	0.903 ± 0.007
0.600	0.566	5.0	0.879	0.946 ± 0.010	0.941 ± 0.010	0.918 ± 0.011	0.904 ± 0.010	0.896 ± 0.010	0.892 ± 0.009	0.885 ± 0.012	0.844 ± 0.012
0.600	0.582	10.0	0.761	0.939 ± 0.015	0.920 ± 0.012	0.907 ± 0.012	0.886 ± 0.012	0.867 ± 0.013	0.856 ± 0.010	0.851 ± 0.013	0.820 ± 0.014
0.600	0.588	14.9	0.627	0.939 ± 0.018	0.901 ± 0.014	0.000 ± 0.000	0.911 ± 0.015	...	0.867 ± 0.012	...	0.839 ± 0.019
Average				0.943 ± 0.008	0.925 ± 0.007	0.913 ± 0.008	0.900 ± 0.007	0.884 ± 0.008	0.875 ± 0.006	0.870 ± 0.009	0.835 ± 0.008
0.700	0.648	5.0	0.767	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	...	...	0.854 ± 0.013	...	...
0.700	0.648	5.0	0.909	0.943 ± 0.018	0.928 ± 0.011	0.901 ± 0.011	0.893 ± 0.010	0.869 ± 0.011	0.870 ± 0.009	0.871 ± 0.012	0.826 ± 0.012
0.700	0.672	10.0	0.763	0.948 ± 0.021	0.927 ± 0.017	0.000 ± 0.000	0.885 ± 0.016	...	0.874 ± 0.015	...	0.831 ± 0.018
Average				0.945 ± 0.014	0.927 ± 0.009	0.901 ± 0.011	0.891 ± 0.009	0.869 ± 0.011	0.866 ± 0.007	0.871 ± 0.012	0.827 ± 0.010
0.800	0.759	10.0	0.820	0.949 ± 0.019	0.960 ± 0.016	0.000 ± 0.000	0.957 ± 0.016	...	0.936 ± 0.015	...	0.880 ± 0.019
Average				0.949 ± 0.019	0.960 ± 0.016	0.000 ± 0.000	0.957 ± 0.016	...	0.936 ± 0.015	...	0.880 ± 0.019

FIGURE CAPTIONS

1. (a) σ_{Fe}/σ_d as a function of x for various values of Q^2, as well as higher energy muon data from Refs. 1 and 9. (b)-(i) σ_A/σ_d averaged over Q^2 as a function of x for various nuclei, as well as electron data from Refs. 2 and 5. The errors shown are statistical only.
2. Q^2-averaged ratios σ_A/σ_d versus A at fixed x. (a) $x = 0.3$, (b) $x = 0.62$. The solid line is a fit of the form $\sigma_A/\sigma_d = c\,\mathrm{A}^{\alpha}$. The errors shown are statistical only.
3. Values as a function of x of parameters in fits to Q^2-averaged ratios σ_A/σ_d. (a) nuclear density fit and (b) power law fit.

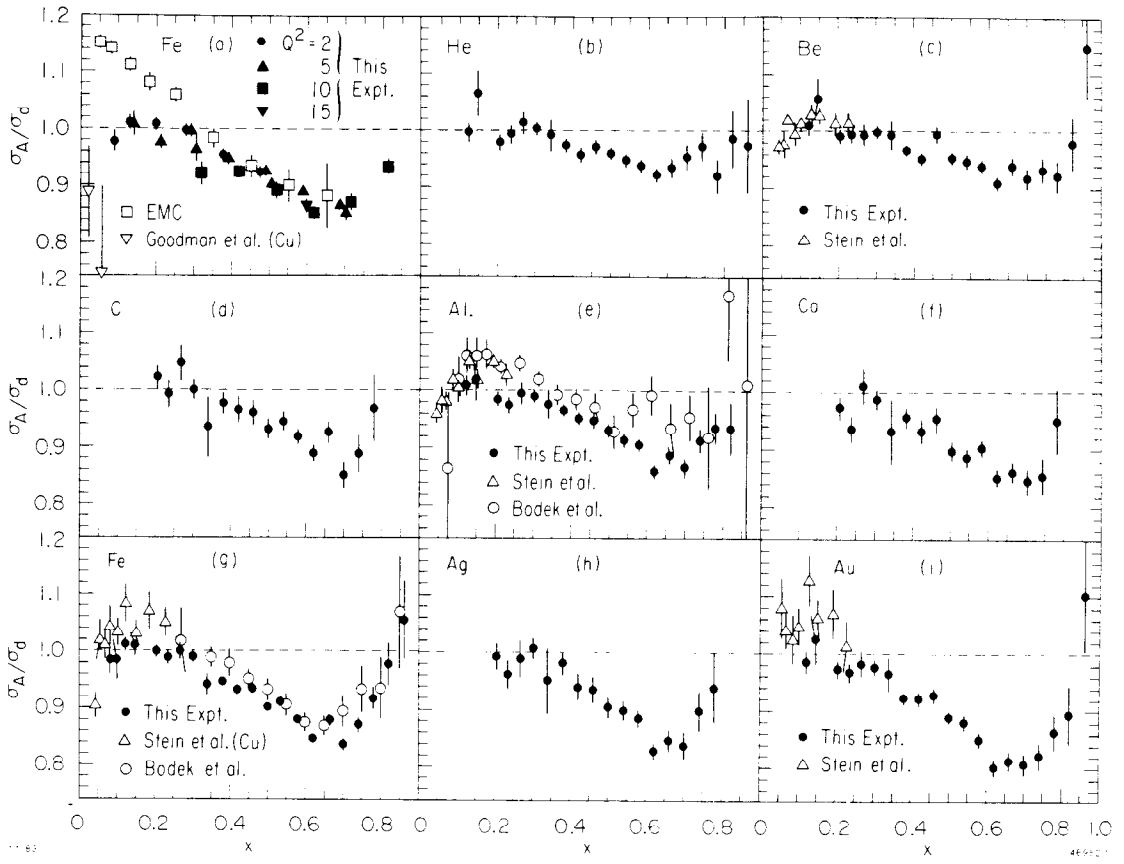
Fe (a)
Q^2 = 2
5
10
15
This Expt.
EMC
Goodman et al. (Cu)
He (b)
Be (c)
This Expt.
Stein et al.
C (d)
Al. (e)
This Expt.
Stein et al.
Bodek et al.
Ca (f)
Fe (g)
This Expt.
Stein et al. (Cu)
Bodek et al.
Ag (h)
Au (i)
This Expt.
Stein et al.
σ_A/σ_d
x
0
0.2
0.4
0.6
0.8
1.0
0.8
0.9
1.0
1.1
1.2

Fig. 1

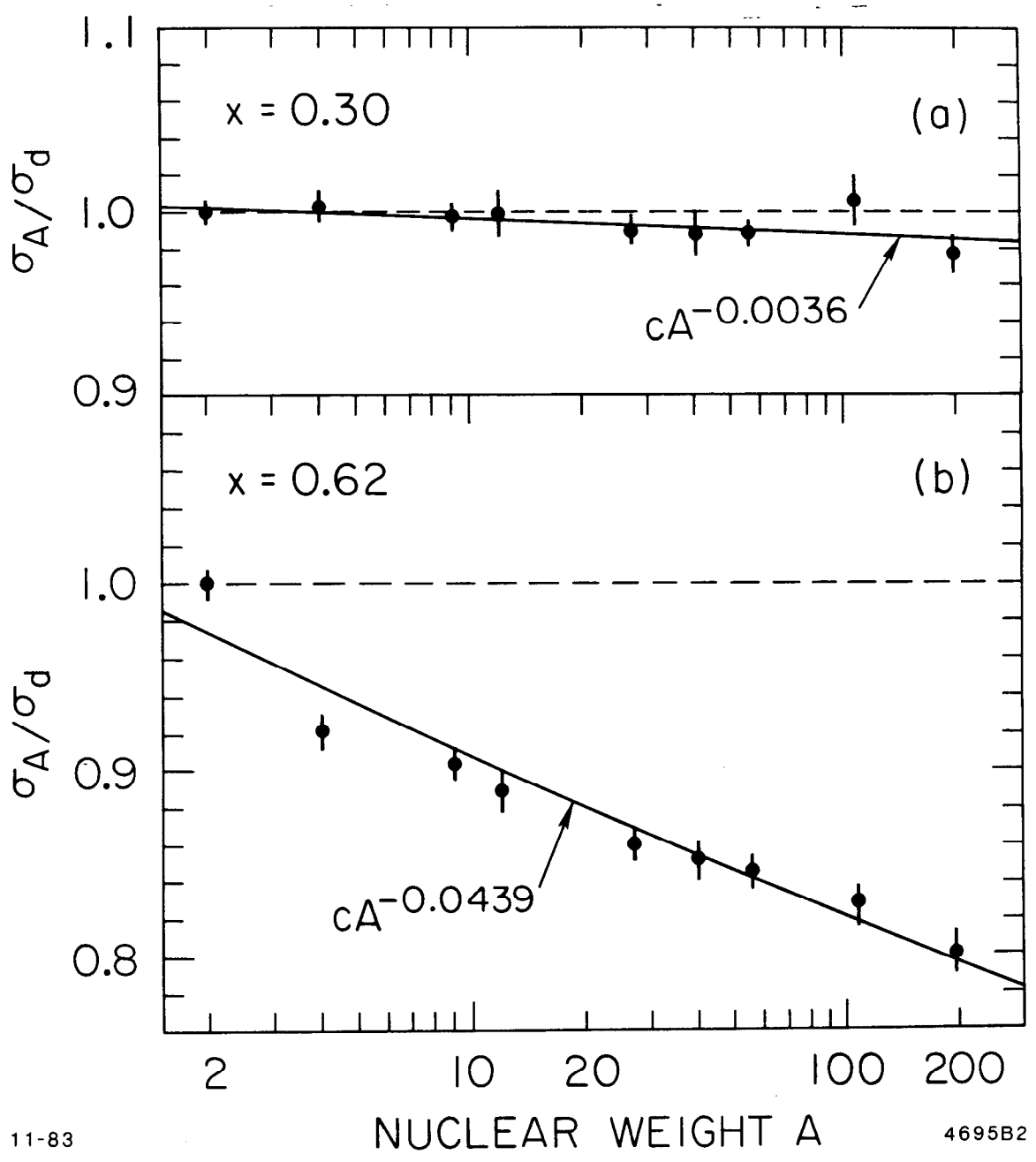
1.1
1.0
0.9
x = 0.30
(a)
σ_A/σ_d
$cA^{-0.0036}$
x = 0.62
(b)
1.0
0.9
0.8
σ_A/σ_d
$cA^{-0.0439}$
2
10
20
100
200
NUCLEAR WEIGHT A
11-83
4695B2

Fig. 2

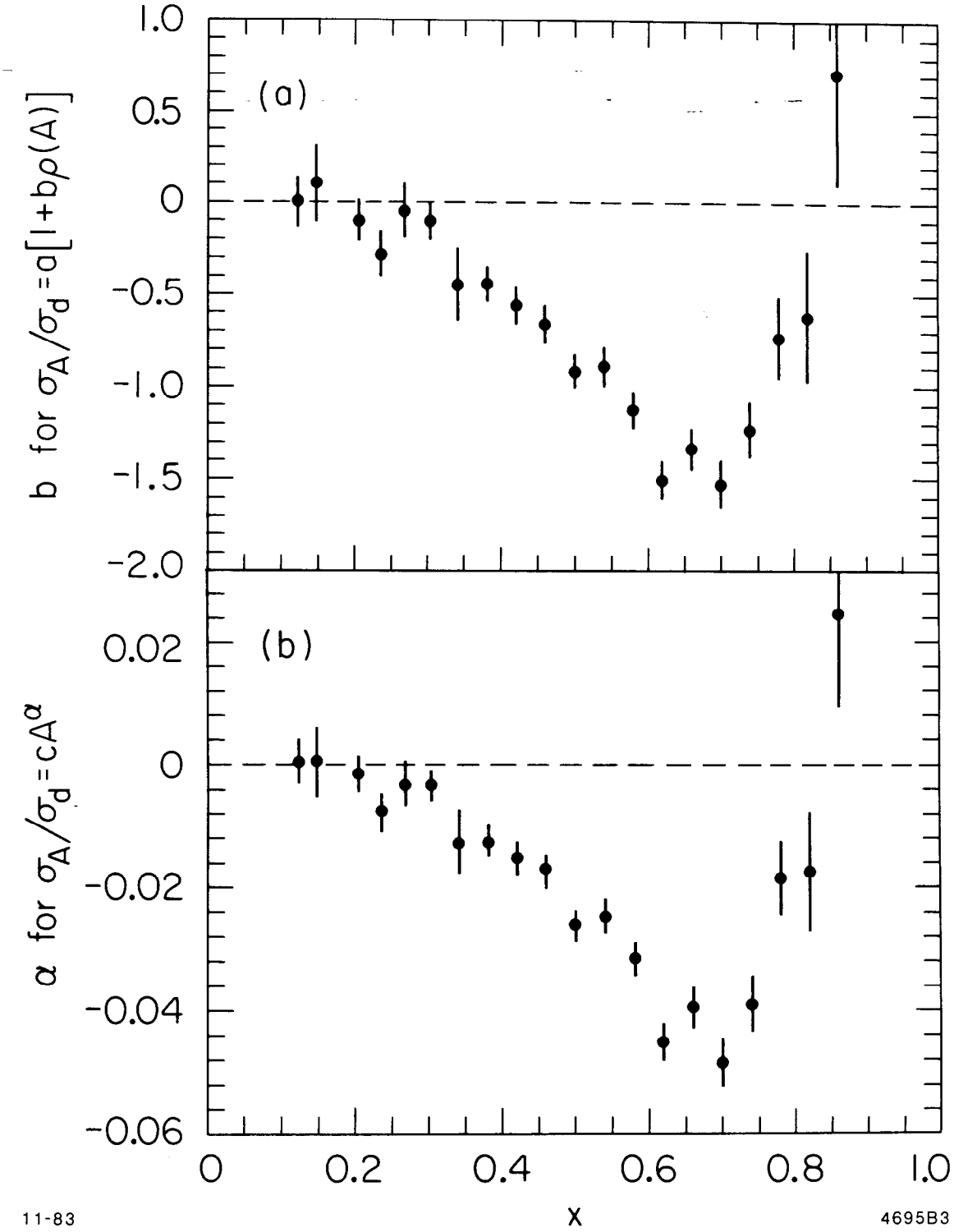
(a)
(b)
b for $\sigma_A/\sigma_d = a[1+b\rho(A)]$
α for $\sigma_A/\sigma_d = cA^{\alpha}$
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
0.02
0
-0.02
-0.04
-0.06
0
0.2
0.4
0.6
0.8
1.0
X
11-83
4695B3

Fig. 3