Parallel & Plenary Sessions

Workshop On Physics Opportunities with 12-GeV Electrons

Jefferson Lab Jan 13-15, 2000

HADRONS IN THE NUCLEAR MEDIUM

Parallel Session I	**Thursday, January 13, 1.30 pm**	**L102/104**
1.30 - 2.00	Deuteron and Helium Form Factor Measurements at Large Momentum Transfers	Makis Petratos
2.00 - 2.20	Possibilities of Studying Nuclear Effects for g_1 Using a Polarized ^{7}Li Target	Oscar Rondon
2.20 - 2.50	Expectations at x > 1 in Electron—Nucleus Scattering with a 12 GeV CEBAF	Donal Day
2.50	Coffee	
3.05 - 3.40	Where to Look for Color Transparency at 12 GeV	Misak Sargsian
3.40 - 4.10	Coherent Production at High Energies with CLAS	Stepan Stepanyan
4.10 - 4.40	Prospects of CT eD -> epn Experiments at Higher Energies	Keith Griffioen
4.40 - 5.00	Deep Inelastic Scattering with a Tag	Rolf Ent

Parallel Session II	**Friday, January 14, 1.30 pm**	**L102/104**
1.30 - 2.00	Pseudo-Scalar Meson Productions from Nuclear Targets at Higher Energies	Haiyan Gao
2.00 - 2.40	Looking for Exotic Components of Nuclei	Carl Carlson
2.40 - 3.20	Probing the Quark-Gluon Structure of the Short-Range Correlations in Nuclei	Mark Strikman
3.20	Coffee	
3.40 - 4.10	Knockout of \Delta's and N*'s from the Nucleus	Larry Weinstein
4.10 - 4.40	Looking for Nucleon—Nucleon Correlations at x = 2	Jan Ryckebusch

VALENCE QUARK STRUCTURE

Parallel Session I	**Friday, January 14, 08.30 am**	**Auditorium**
08.30 - 09.15	Polarized Structure Functions	Xiangdong Ji
09.15 - 10.00	Polarized Structure Functions Measurements with 12-GeV Electrons	Jian Ping Chen
10.00	Coffee	
10.20 - 10.50	g2 Results from SLAC	Keith Griffioen
10.50 - 11.20	Model Calculations of the g2 Structure Function	Xiaotong Song
11.20 - 12.00	Discussion	

Parallel Session II	**Friday, January 14, 1.30 pm**	**A110**
1.30 - 2.15	Valence Quarks at Large x	Wally Melnitchouk
2.15 - 3.00	Experimental Opportunities for u and d Distributions at Large x with 12-GeV Electrons	Paul Souder
3.00	Coffee	
3.20 - 3.50	Deep Inelastic Scattering on ^{3}H and ^{3}He Targets	Makis Petratos
3.50 - 4.20	d/u ratio at Large x	Silvano Simula
4.20	Discussion	

Possible measurements of $g_1(x, Q^2)$ on ^7Li

OSCAR A. RONDON
INPP - University of Virginia

Nuclear medium effects on spin structure

1.- UNPOLARIZED AND PREDICTED POLARIZED EMC EFFECTS

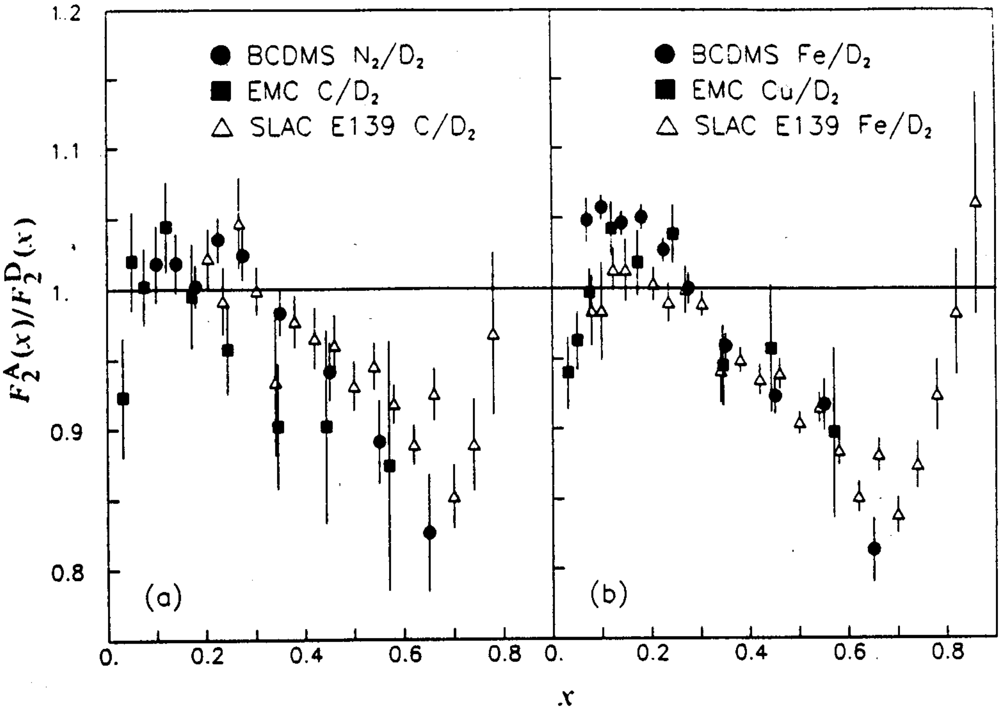
2.- PROPERTIES OF ^7Li

3.- ^7Li AS POLARIZED TARGET MATERIAL

4.- g_1 EXTRACTION USING ^7LiH

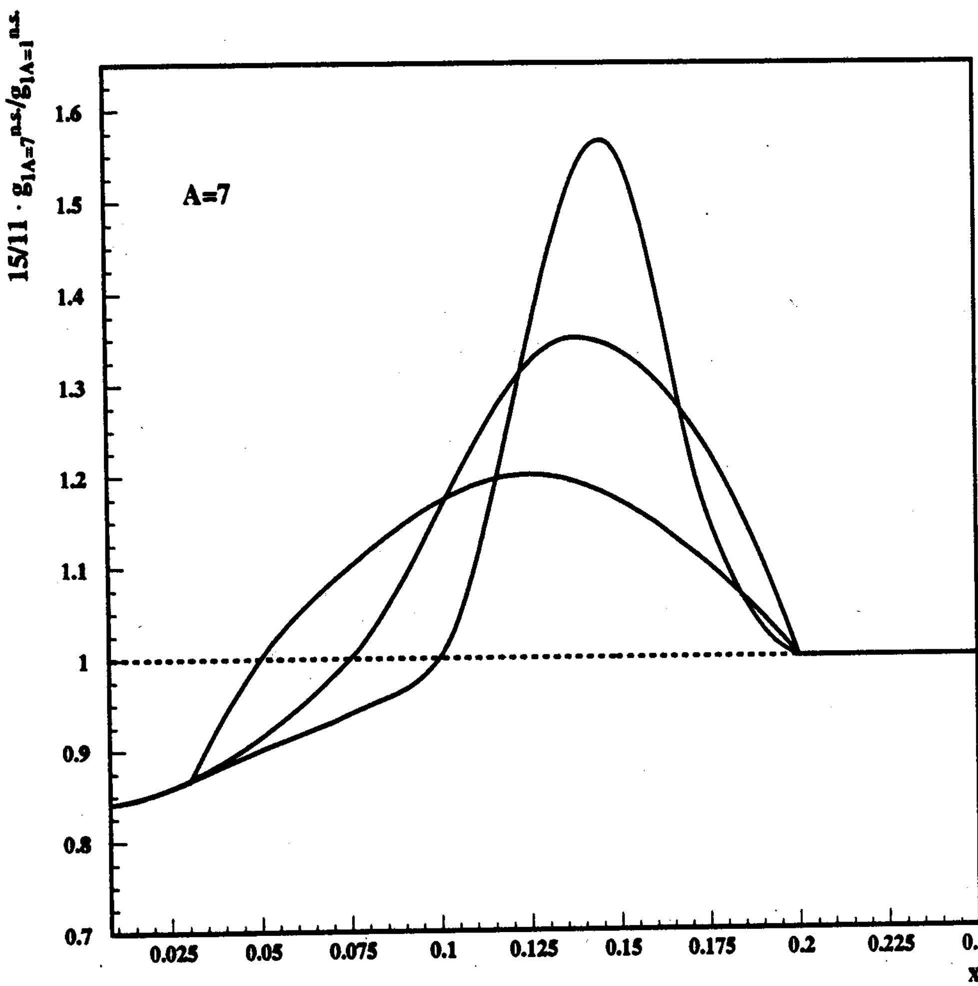
5.- RATE ESTIMATES FOR 12 AND 48 GeV BEAMS

EMC effect



Review of Particle Properties 1988

The ratio of nucleon structure functions $F_2^A(x)/F_2^D(x)$ for nuclear targets A compared to deuterium D, measured in deep inelastic electron (SLAC-E139) and muon (BCDMS, EMC) scattering: (a) medium-weight targets (A = N, C), (b) heavy targets (A = Fe, Cu). Only statistical errors are shown. The SLAC-E139 data were evaluated as cross section ratios σ^A/σ^D but are equal to structure function ratios if $R = \sigma_L/\sigma_T$ is independent of A. References: BCDMS — G. Bari et al., Phys. Lett. 163B, 282 (1985); and A.C. Benvenuti et al., Phys. Lett. B189, 483 (1987); EMC — J. Ashman et al., CERN-EP/88-06 (1988); SLAC-E139 — R.G. Arnold et al., Phys. Rev. Lett. 52, 727 (1984); and SLAC-PUB-3257 (1983).



Guzey & Strikman hep-ph/9903508

FIG. 1. $g_{1A=7}^{n.s.3/2}(x,Q^2)/g_{1A=1}(x,Q^2)$ as a function of x. The straight dashed line is the impulse approximation. The solid lines is a result of our calculation of shadowing and modeling of enhancement, which preserves R.

Nuclear magnetic and spin properties of ^7Li

$I^\pi = \left(\frac{3}{2}\right)^-$ $\mu = 3.26\,\mu_N$ $\nu_{NMR} = 16.54\ MHz\,T^{-1}$

Shell model with j-j coupling

State	Protons	Neutrons
$p_{3/2}$	p↑	n↑ n↓
$s_{1/2}$	p↑ p↓	n↑ n↓

Shell model $\mu = 3.79\,\mu_N$

Spin states: $|m_\ell, m_s; m_j\rangle$

$m_j = \pm 3/2$ $|\pm1, \pm 1/2; \pm 3/2\rangle$ $m_j \parallel m_s$ always

$m_j = \pm 1/2$ $\sqrt{\frac{1}{3}}\,|1, -1/2; 1/2\rangle + \sqrt{\frac{2}{3}}\,|0, 1/2; 1/2\rangle$

$m_j \parallel m_s$ 1/3 of the time

$\sqrt{\frac{1}{3}}\,|-1, 1/2; -1/2\rangle + \sqrt{\frac{2}{3}}\,|0, -1/2; -1/2\rangle$

Net $m_j \parallel m_s$ $\frac{2}{3}$ of the time = proton polarization is $\frac{2}{3}\,P_{^7Li}$

Proton polarization $< \frac{2}{3}$ when other levels are included.

Cluster model of ^7Li = triton + α core; triton = $p_{3/2}$ nucleons.

Effective proton spin in triton = 88% of triton spin

" " " $^7Li \cong \frac{2}{3} \cdot 0.88 = 59\%$ of ^7Li

Some neutron polarization $\lesssim -4\%$ (opposite Li spin)

^7Li as polarized Target material

Chemical form	Polarization	B & T T – K	Dilution	Density $g\,cm^{-3}$	Radiation resistance $d\ (P = P_0/2)$	Expt./Notes
^7LiH	94% Li: 99% H	6.5–0.2	$\lesssim 1/8$	$\lesssim 0.8$		Abragam
$^7Li^2H$	~80% Li: 25% ^2H	5–1.1	$\lesssim 1/9$	~0.82	$\gtrsim 3\times10^{15}\ e\,cm^{-2}$	E155 (4.6% ^7Li)
^7Li	~10-20%	>6 <0.3	$\lesssim 1/7$	0.53	$\gg 10^{16}\ e\,cm^{-2}$	Overhauser effect.

Rate estimates for measuring g1 with a 7LiH polarized target

Eo GeV	theta °	x	Q^2 $[GeV/c]^2$	A‖	Cross section nb/(srGeV)	Rate Hz	Counts for 3% stat	Time hours
12.0	25.0	0.078	1.65	0.13	3.3	0.36	7.4E+06	5682
		0.124	2.54	0.197	2.4	0.39	3.1E+06	2184
		0.200	3.87	0.298	1.7	0.41	1.2E+06	826
48.8	3.0	0.078	3.41	0.064	88.6	339.9	3.0E+07	25
		0.124	4.15	0.076	104.0	473.4	2.1E+07	12
		0.200	4.49	0.084	127.0	636.5	1.5E+07	7

Assumptions and input parameters	Lithium	Proton
LiH Polarization P_l	80%	80%
Beam polarization		70%
Statistical error		3%
Dilution factor for 7LiH		~ 1/8
Luminosity [Hz/nb]		>80
Spectrometer solid angle [msr]		10

← to measure a 20% effect with $\gtrsim 3$ S.D. precision, and expected systematic errors of 5 to 6%

Possible improvements:

- 12-15cm long target in solenoid, instead of 3 cm in Helmholtz coils

  Can it be cooled at 80nA ?

  Can it be seen by spectrometer at 25° ?

- 20-25 msr $\Delta\Omega$ spectrometer: limited to $0.05 \leq x \leq 0.2$.

Times at 12 GeV could improve by factor $\sim \frac{1}{10}$

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