PHYSICS STATUS 1/00

- Accelerator capabilities continue to grow:
  - 5.5 GeV beam delivered for physics! (3 months in FY99)
  - dramatic advances continue in $\vec{e}$ beams
- Experimental program continues to progress well:

Hall	Physics Began	Experiments Completed (full/partial)	Experiments Completed (equivalent)
C	10/95	12 / 2	12.8
A	5/97	10 / 4	11.3
B	11/97	1 / 42	20.6
Totals	Today	23 / 48	44.7
Totals	(PAC16)	14 / 42	29.0

PHYSICS STATUS 1/00 (cont.)

- Publication Stream Continuing

Type of Publication	1998	1999*
Phys Rev Lett and Phys Lett	9	12
Other Refereed Journals	5	1
Invited Talks in Conf. Proc.	16	16
Instrumentation Papers	2	4
Contributed Papers	52	96

*as of 10/99

PhD Production

Year	# of PhDs
1997	6
1998	21
1999*	16
In progress	97

*as of 10/99

Operations Experience: FY99, Q1 FY00

FY99 operations exceeded the reduced goals (30 vs 34 weeks) set set by funding limitations by delivering a higher multiplicity (postponing major setups); Q1 of FY00 progressing well

Metric	**FY99 Goal**	**FY99 Achieved**	**FY00 Q1 (prelim)**
Beam Delivered (weeks)	31	31.9	9.6
Beam Availability (%)	75%	71.3%	81.0%
Hall Availabilities			
Hall A (%)	75.5%	94.9%	96.9%
Hall B (%)	70%	85.0%	93.1%
Hall C (%)	77.5%	65.2%	70.6%
Overall (3-hall ops avge)	73.5%	83.2%	86.9%
Hall Multiplicity	2.0	2.61	2.41
Physics Delivered (weeks)	**35.1**	**44.6**	**14.5**

Accelerator Development – CY99

- Enhanced Reliability
  - emphasis on preventative maintenance
- Polarized beam:
  - reduce crosstalk between halls
  - modify existing gun to horizontal and install 2nd horizontal gun
  - test stand for rapid cathode evaluation
  - 1999 Goals include:

    40% @ 180 μA

    75% @ 80 μA w/ good lifetime
- 5.5 GeV reliable (5-10% loss from rf trips)
- Continue evolutionary energy upgrade
  - complete in-situ helium processing
  - re-install repaired cryomodule
  - reach ~6 GeV capability in 1999
- Long-term work on:
  - 2nd generation polarized source
  - Cryomodule optimized for 12 GeV Ops

progress

progress

✓

✓

✓

✓

✓

✓

✓

(2000)

progress

Accelerator Goals – CY00

- Enhanced Reliability
  - Continue preventive maintenance
  - Initiate predictive maintenance
- Polarized Beams:
  - P~75% @ 100 μA/Hall with good lifetime
  - Substantial reduction in helicity-correlated beam parameters
  - Initiate development of lasers for G0
- Demonstrate 6 GeV capability
- Stability
  - Improve fast feedback system
- Long-term work on:
  - Cryomodule optimized for 12 GeV Ops

Physics Program Since PAC 16 (6/99 - 12/99)

- **Hall A:**

Experiment	Spokesperson	Status
HAPPEX (completion)	Souder/Finn	✓
Proton polarization in $d(\gamma,\vec{p})n$	Gilman/Holt	✓
Proton polarization in $d(\gamma,\vec{p})\pi^0$	Gilman/Holt/ Meziani	✓
Large angle deuteron photodisintegration	Gilman/Holt/ Meziani	✓
Polarization transfer in $d(\vec{e},e'\vec{p})$	Ulmer/Finn/ Jones	✓
High Momentum Structure in $d(e,e'p)$	Ulmer/Jones	1/10 ✓
High-Q^2 $^3He(e,e'p)$	Saha/Epstein/ Mougey	Running (~1/6 ✓)

Physics Program Since PAC 16 (6/99 - 12/99)

- **Hall B:**
  - CLAS Level II trigger now working; data rate reaches 125 Mevents/day for g3 data
  - Physics continues to progress well:

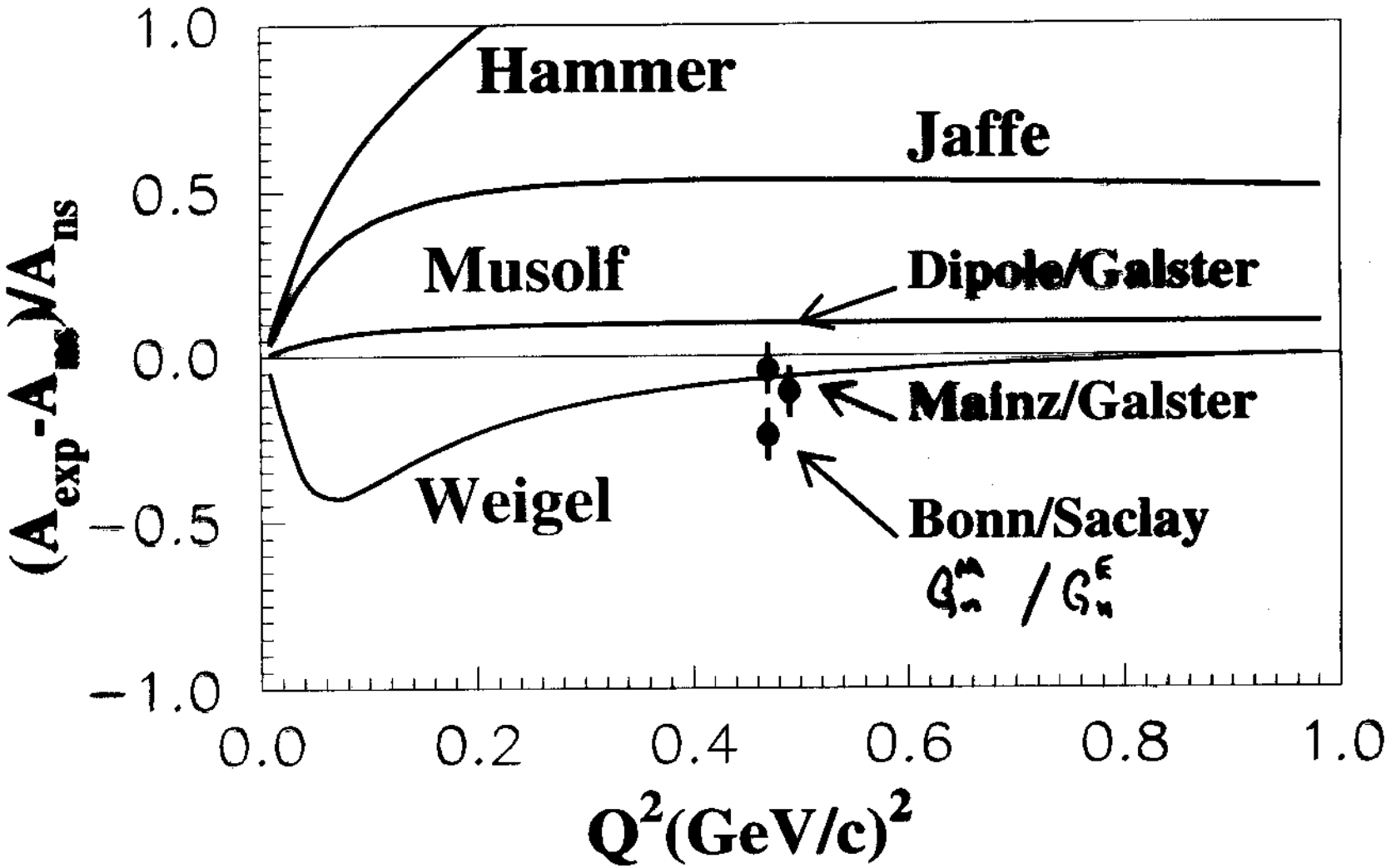
Run Group	# of expts	% done
g6 (II)	2	65 + 15 = 80
g1 (II)	6	15 + 46 = 61
g3	3	76
g2	4	72

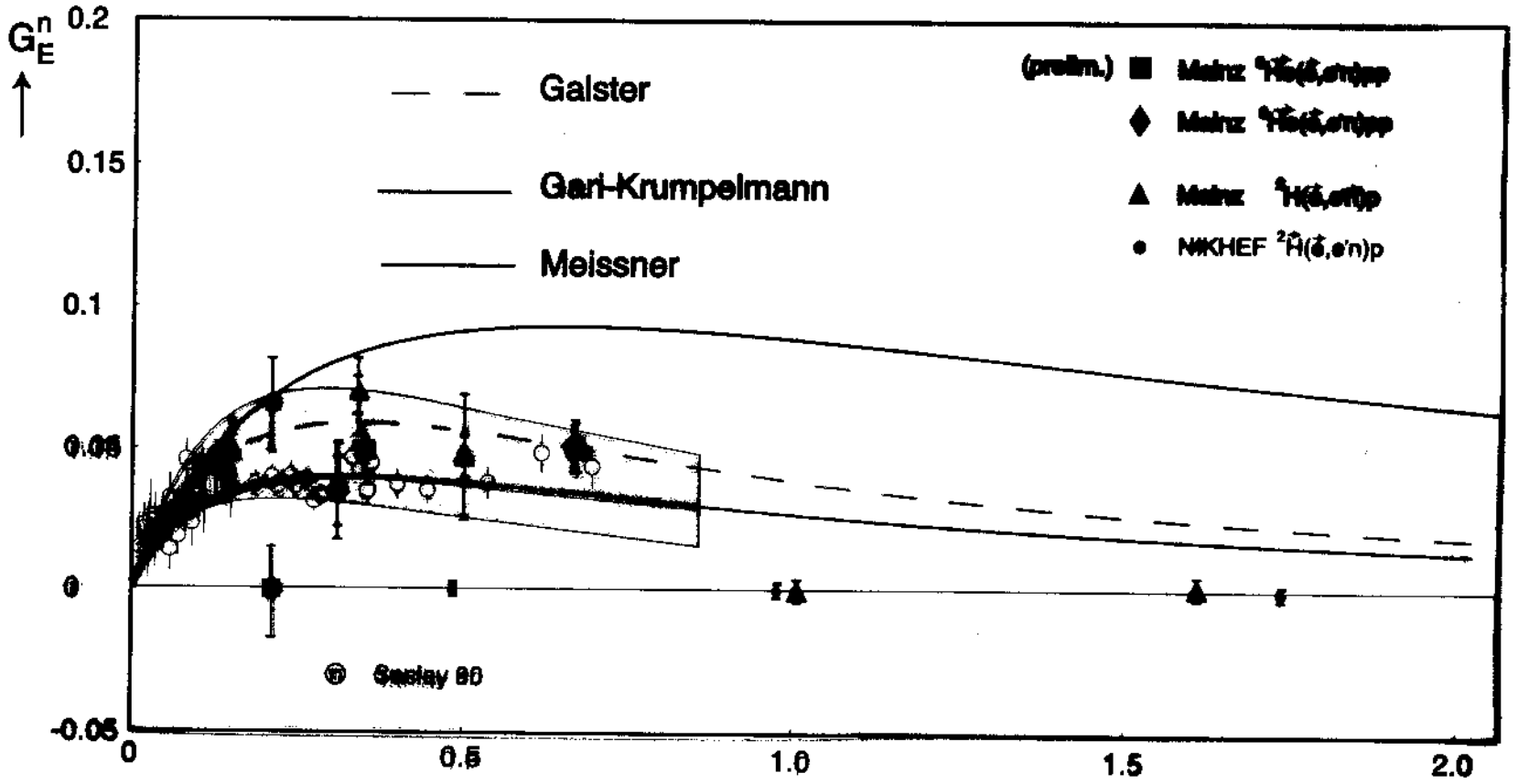
Physics Program Since PAC 16 (6/99 - 12/99)

- **Hall C:**

Experiment	Spokesperson	Status
Q^2 and A dependence of QE scatt.	Milner	✓
Resonance region L/T separation	Keppel	✓
Correlated spectral functions	Sick	✓
Electroproduction of K's and light hypernuclei (II)	Zeidman	✓

HAPPEX Result -- Comparison to Strangeness Models



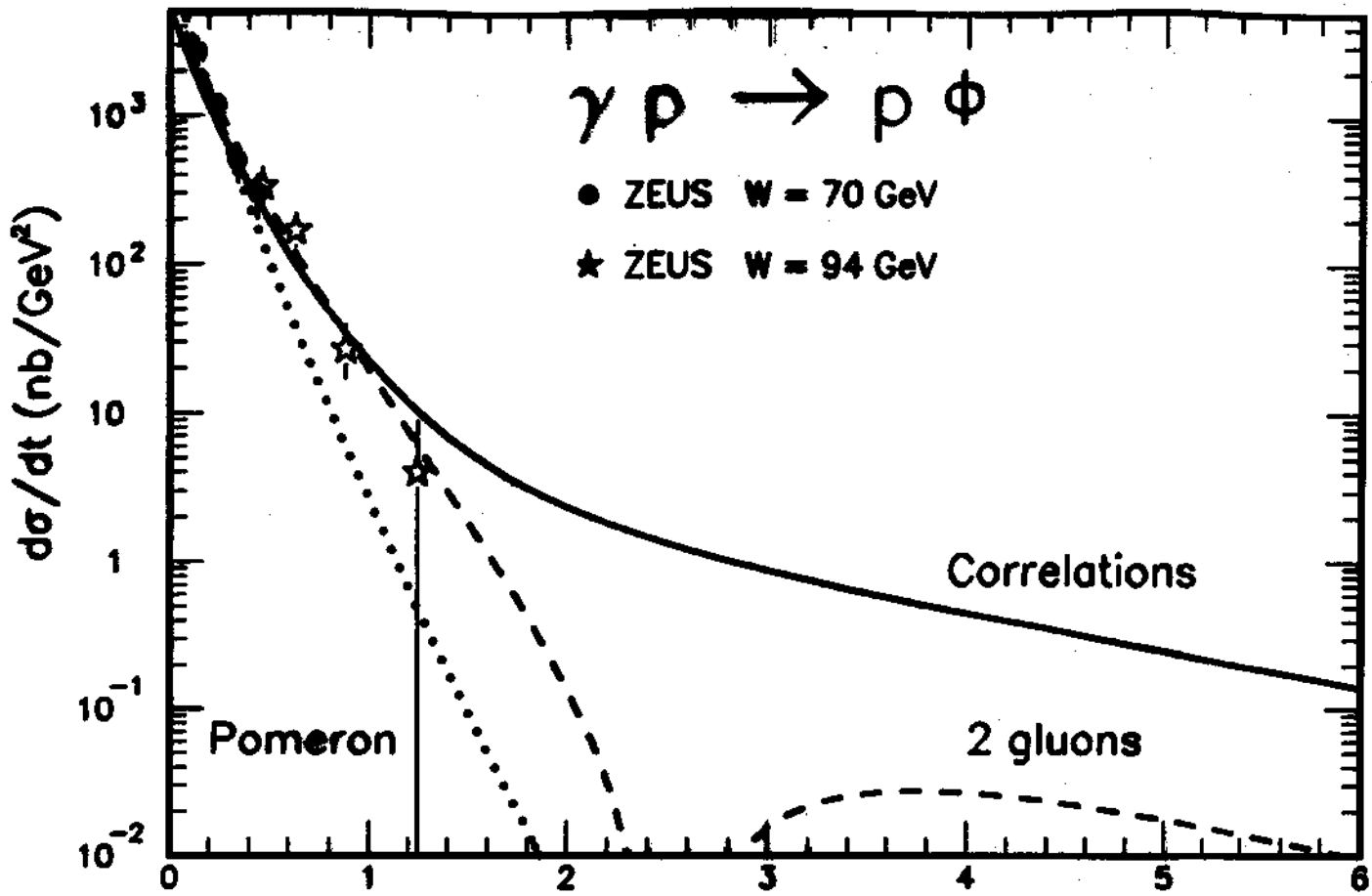


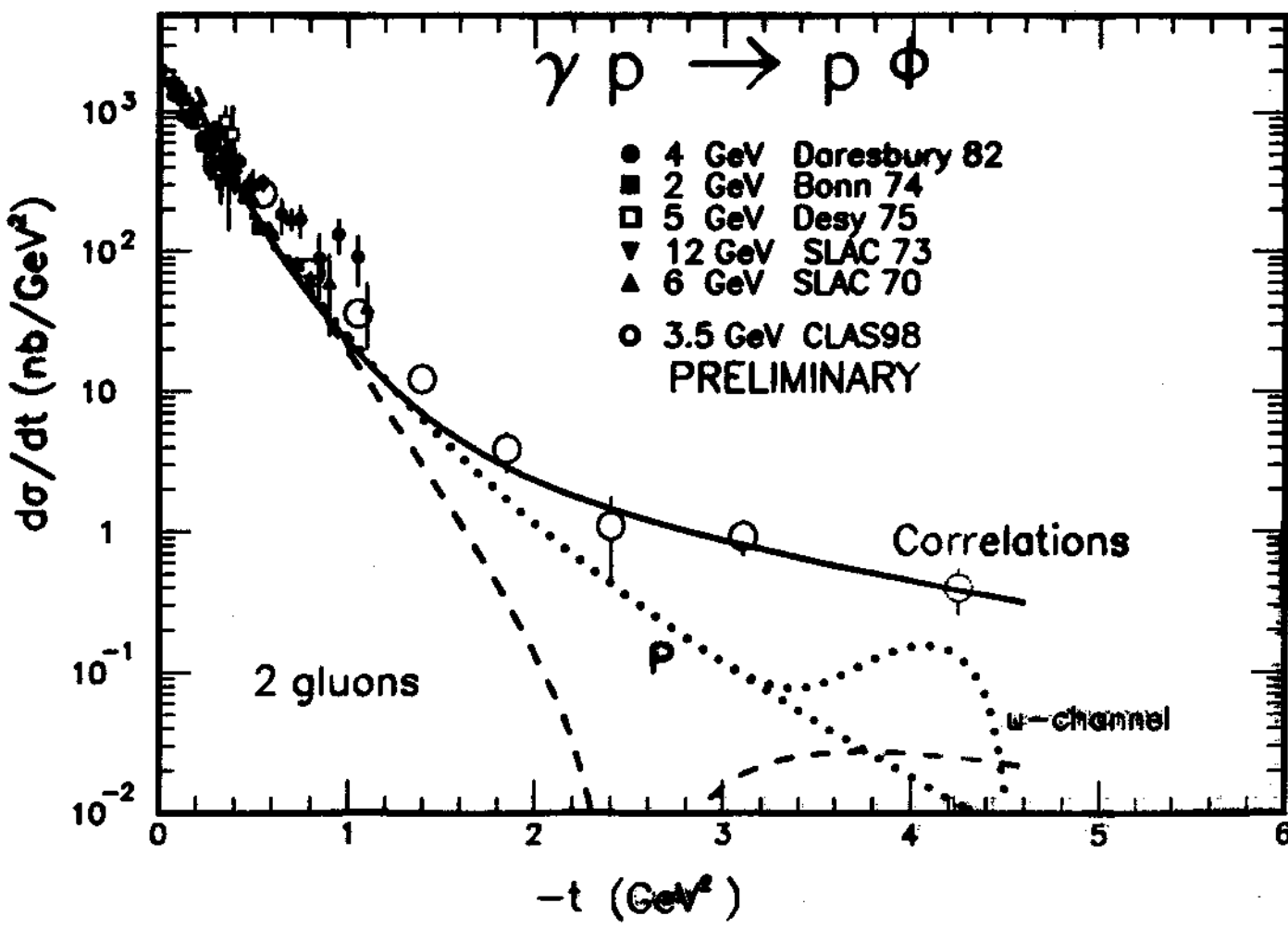
Predicted accuracy

at NIKHEF
■ E94-05 $^3\vec{He}(\vec{e},e'n)pp$

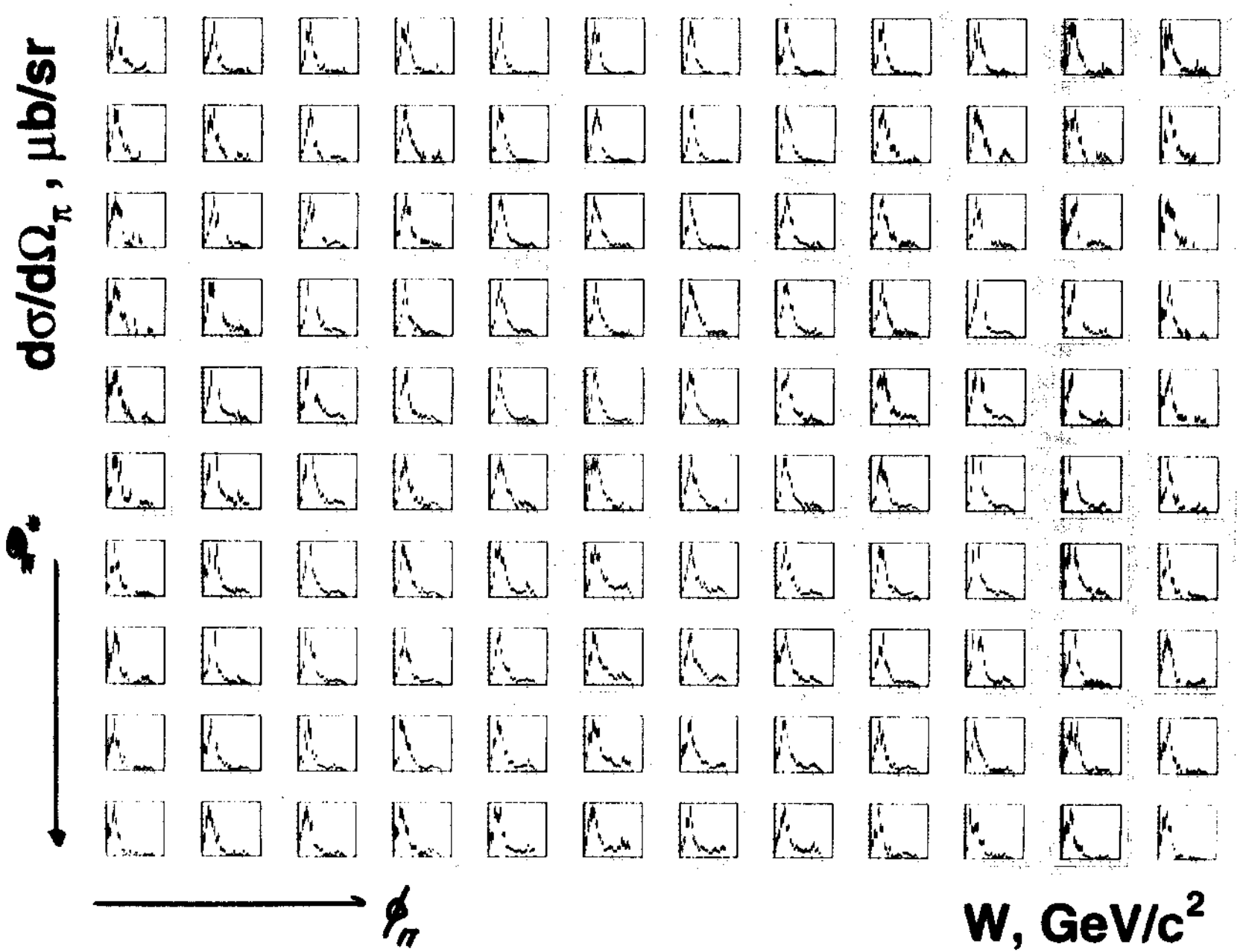
at JLab
▲ E93-026 $^2\vec{H}(\vec{e},e'n)p$
♦ E93-038 $^2H(\vec{e},e'\vec{n})p$

to letter submitted


γ p → p φ
ZEUS W = 70 GeV
ZEUS W = 94 GeV
Correlations
Pomeron
2 gluons
dσ/dt (nb/GeV²)


γ p → p φ
4 GeV Daresbury 82
2 GeV Bonn 74
5 GeV Desy 75
12 GeV SLAC 73
6 GeV SLAC 70
3.5 GeV CLAS98
PRELIMINARY
Correlations
2 gluons
P
u-channel
dσ/dt (nb/GeV²)
−t (GeV²)

$\rho\pi^0$ $Q^2=0.40(GeV/c)^2$, $\Delta Q^2=0.100(GeV/c)^2$



Unpolarized Electroproduction Cross Section

$$\sigma_u = \sigma_T + \epsilon\,\sigma_L + \epsilon\,\sigma_{TT}\cos 2\phi + \sqrt{\epsilon(1+\epsilon)}\,\sigma_{LT}\cos\phi$$

$$\sigma_u = a + b + \epsilon\, c\, \sin^2\theta^* \cos 2\phi + \sqrt{\epsilon(1+\epsilon)}\, d\, \sin\theta^* \cos\phi$$

$$a + b = \sum_n A_n \cos^n \theta^*_\pi \qquad c = \sum_n C_n \cos^n \theta^*_\pi \qquad d = \sum_n D_n \cos^n \theta^*_\pi$$

Multipole Expansion (s,p wave πN)

$$\begin{aligned}
A_0 &= \frac{P^*_\pi W}{MK}\Big(\tfrac{5}{2}|M_{1+}|^2 - 3Re(M_{1+}E^*_{1+}) + Re(M_{1+}M^*_{1-}) \\
&+ \tfrac{9}{2}|E_{1+}|^2 + |E_{0+}|^2 + |M_{1-}|^2 + 3Re(E_{1+}M^*_{1-}) \\
&+ \epsilon\frac{q^2}{|q^*|^2}\big(|S_{1-}|^2 + |S_{0+}|^2 + 4|M_{1-}|^2 - 4Re(M_{1-}S^*_{0+})\big)\Big)
\end{aligned}$$

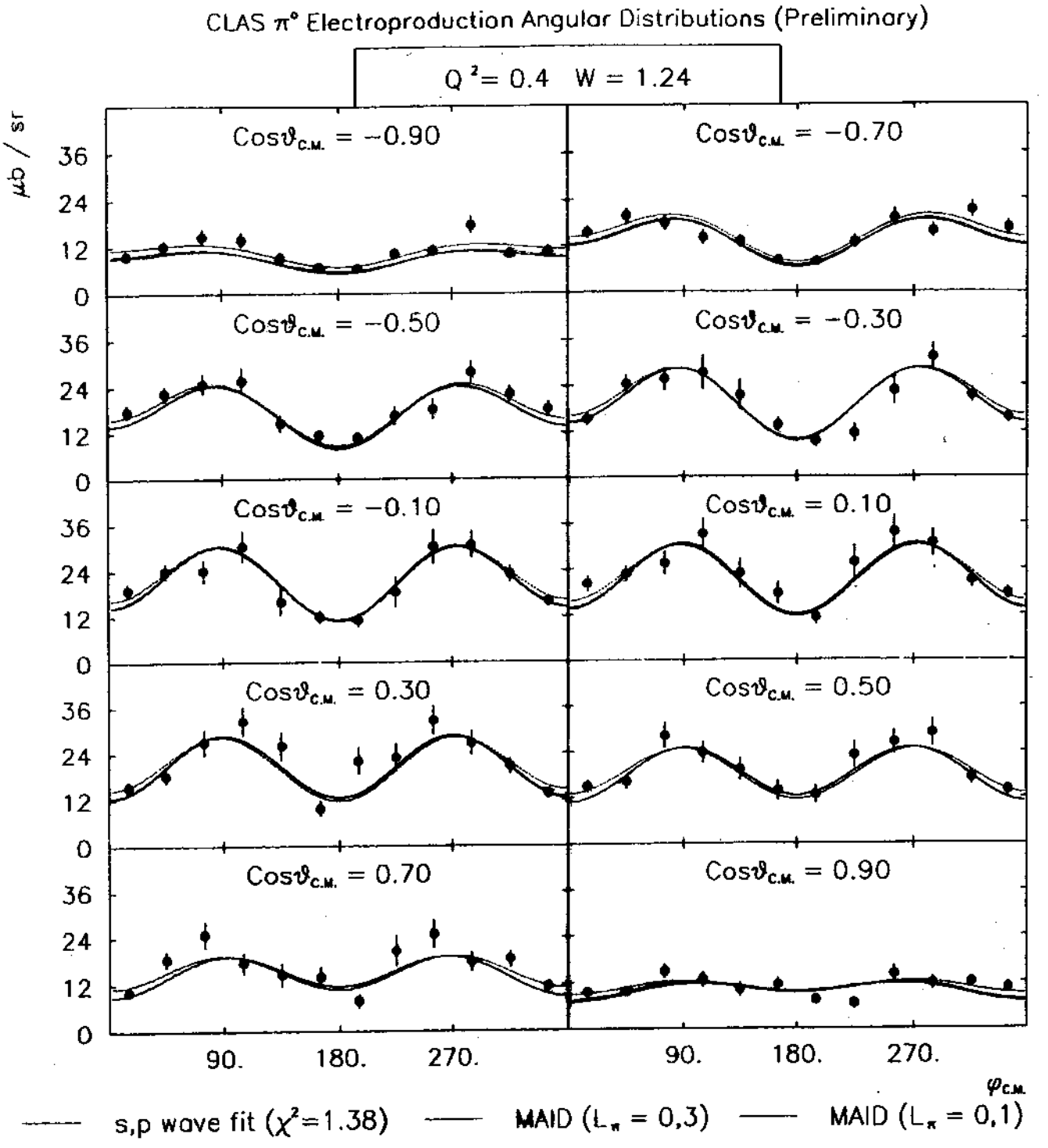
$$\begin{aligned}
A_1 &= \frac{P^*_\pi W}{MK}\Big(2Re(E_{0+}M^*_{1+}) \\
&+ 6Re(E_{0+}E^*_{1+}) - 2Re(E_{0+}M^*_{1-}) \\
&+ \epsilon\frac{q^2}{|q^*|^2}\big(8Re(S_{0+}S^*_{1+}) + 2Re(S_{0+}S^*_{1-})\big)\Big)
\end{aligned}$$

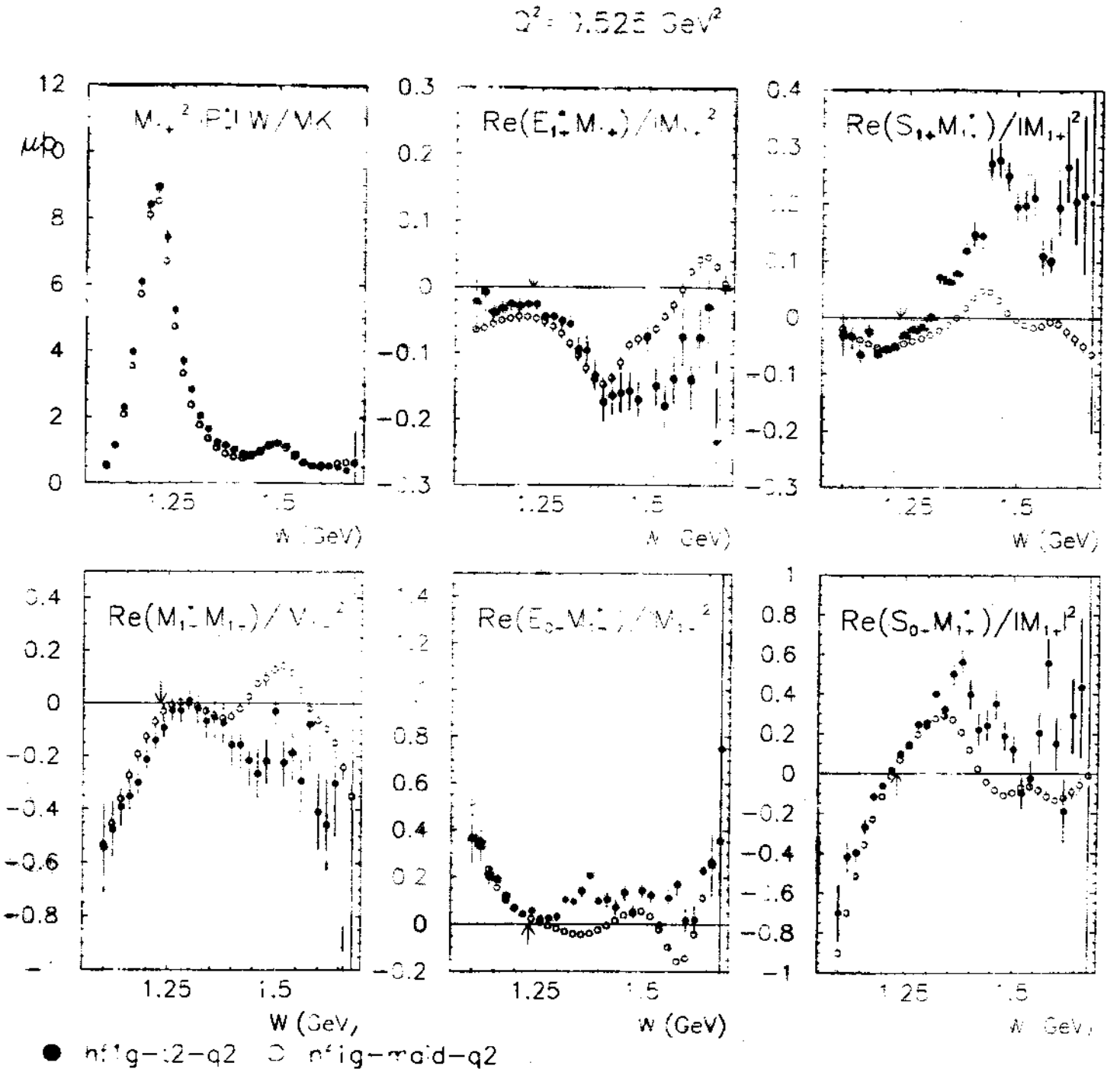
$$\begin{aligned}
A_2 &= \frac{P^*_\pi W}{MK}\Big(-\tfrac{3}{2}|M_{1+}|^2 + 9Re(M_{1+}E^*_{1+}) - 3Re(M_{1+}M^*_{1-}) \\
&+ \tfrac{9}{2}|E_{1+}|^2 - 9Re(E_{1+}M^*_{1-}) + \epsilon\frac{q^2}{|q^*|^2}\big(12|S_{1+}|^2 + 12Re(S_{1+}S^*_{1-})\big)\Big)
\end{aligned}$$

$$\begin{aligned}
C_0 &= \frac{P^*_\pi W}{MK}\Big(-\tfrac{3}{2}|M_{1+}|^2 - 3Re(M_{1+}E^*_{1+}) - 3Re(M_{1+}M^*_{1-}) \\
&+ \tfrac{9}{2}|E_{1+}|^2 + 3Re(E_{1+}M^*_{1-})\Big)
\end{aligned}$$

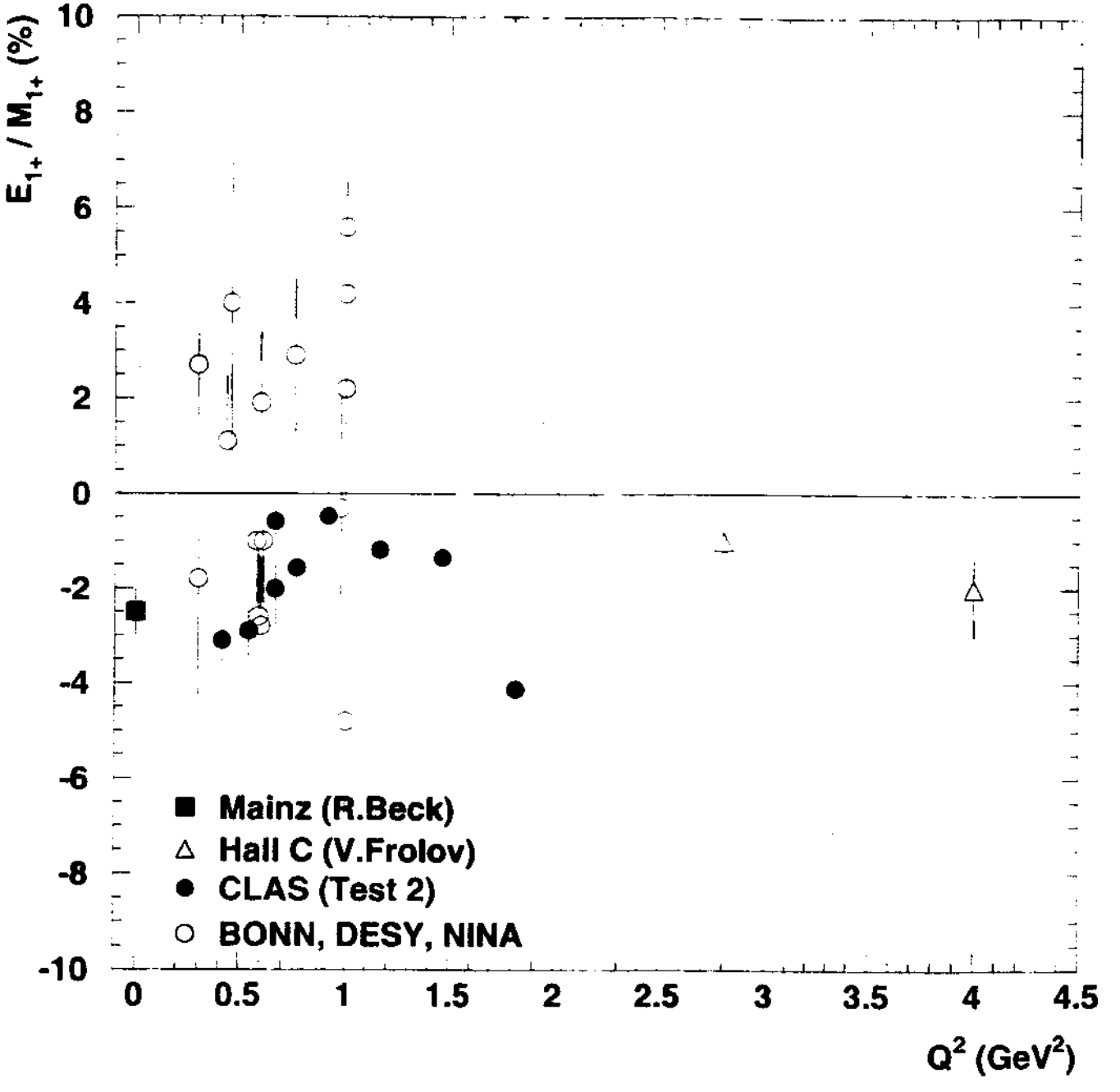
$$\begin{aligned}
D_0 &= \frac{P^*_\pi W}{MK}\sqrt{2}\sqrt{\frac{q^2}{|q^*|^2}}\big(Re(M^*_{1+}S_{0+}) \\
&- 3Re(S_{0+}E^*_{1+}) - Re(S_{0+}M^*_{1-}) + 2Re(E_{0+}S^*_{1+}) - Re(E_{0+}S^*_{1-})\big)
\end{aligned}$$

$$\begin{aligned}
D_1 &= \frac{P^*_\pi W}{MK}6\sqrt{2}\sqrt{\frac{q^2}{|q^*|^2}}\big(Re(M^*_{1+}S_{1+}) \\
&- Re(S_{1+}E^*_{1+}) - Re(S_{1+}M^*_{1-}) - Re(S_{1-}E^*_{1+})\big)
\end{aligned}$$

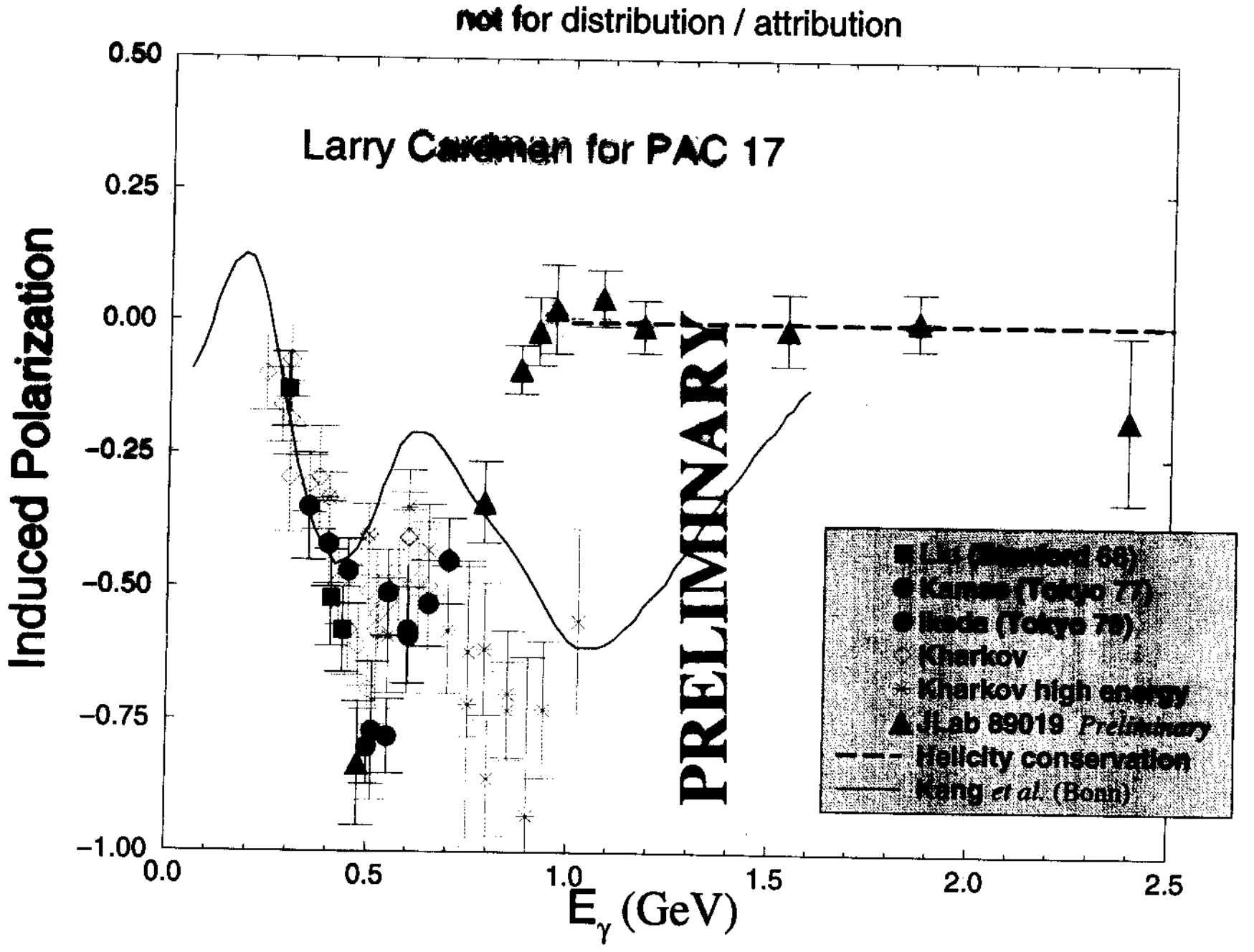

CLAS π° Electroproduction Angular Distributions (Preliminary)
Q² = 0.4 W = 1.24
μb / sr
Cosϑc.m. = −0.90
Cosϑc.m. = −0.70
Cosϑc.m. = −0.50
Cosϑc.m. = −0.30
Cosϑc.m. = −0.10
Cosϑc.m. = 0.10
Cosϑc.m. = 0.30
Cosϑc.m. = 0.50
Cosϑc.m. = 0.70
Cosϑc.m. = 0.90
0
12
24
36
90.
180.
270.
φc.m.
s,p wave fit (χ²=1.38)
MAID (Lπ = 0,3)
MAID (Lπ = 0,1)


Q² = 0.525 GeV²
Re(E1+M1+)/|M1+|²
Re(S1+M1+)/|M1+|²
Re(M1-M1+)/|M1+|²
Re(E0+M1+)/|M1+|²
Re(S0+M1+)/|M1+|²
W (GeV)
nfig-12-q2
nfig-mold-q2

CLAS π^o Electroproduction Angular Distributions (Preliminary)



E89–019: $\gamma d \rightarrow pn$ at 90°_{cm}



Experimental Program Status
January 2000

Hall	Approved Experiments				Cond. Approved Expts
	# Expts Completed (full/partial)	Total Days Run	# Expts in Queue	Days to be Run	
A	10 / 2 × ½ / 1 × .10 / 1 × .17	200	22	530	5
B	1 /15 × .27 / 8 × .50 / 4 × .27 / 6 × .61 / 4 × .72 / 3 × .76 / 2 × .80	169	33	364	5
C	12 / 1 × ½ / 1 × ¼	223	15	357	3
Total	23 / ~22	592	70	1,251	14

Backlog: 151 weeks (~6 years) in Hall A
104 weeks (~4 years) in Hall B
102 weeks (~5 years) in Hall C

Schedule for 1/00 - 12/00 (end of published schedule)

- Hall A
  - High-Q^2 electrodisintegration of ^{3}He
    (Saha/Epstein/Mougey)
    (started 12/99)
  - Polarization transfer in $^4He(\vec{e},e'\vec{p})$
    (Ent/Ulmer)
  - N→Δ and Roper via $(\vec{e},e'\vec{p})$
    (Frullani/Sarty/Kelly)
  - Short range correlations in $^4He(e,e'p)$
    (Templon/Mitchell)
  - G^E_p to higher Q^2
    (Perdrisat, et al.)

Schedule for 1/00 - 12/00 (end of published schedule)

- Hall B
  - Run portions of 3 major experiment groups:

		% done	% sched
(e1)	Dytman	27	+21
(e5)	Brooks	0	+67
(eg1)	Kuhn	27	+55

  - Run Rad Phi experiment E94-016 (Rubin)
  - Convert CLAS from TACL to EPICS

Schedule for 1/00 - 12/00 (end of published schedule)

- Hall C
  - HNSS (Tang) (installation in progress)
  - To be followed beginning in the 2nd half of '00 by two G^E_n measurements:
    (Madey/Kowalski), then
    (Day/Mitchell)

Experimental Program Status
January 2000

Hall	Approved Experiments				Cond. Approved Expts
	# Expts Completed (full/partial)	Total Days Run	# Expts in Queue	Days to be Run	
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Total	23 / ~22	592	70	1,251	14

Backlog: 151 weeks (~6 years) in Hall A
104 weeks (~4 years) in Hall B
102 weeks (~5 years) in Hall C

PAC17 Proposals

Hall	# of Proposals	Days Requested
A	2	40
B	0	0
C	4	71
Totals	6	111

Number	Title	Contact Person	Hall	Days
00-001	Withdrawn			
00-002	F_2^N at Low Q^2	C. Armstrong	C	7
00-003	A Clean Measurement of the Neutron Skin of ^{208}Pb Through Parity Violating Electron Scattering	R. Michaels	A	30
00-004	Duality in Meson Electroproduction	C. Armstrong	C	15
00-005	Study of Excited Intermediate States in p(e,e'K)S° Reactions	P. Gueye	C	15
00-006	G0 Experiment	D. Beck	C	34
00-007	Proton Polarization Angular Distribution in Deuteron Photo-Disintegration	R. Gilman	A	10

PAC targets remain ~1 month/Hall/PAC
(~2/3 of "equilibrium rate")

In addition there are two letters of intent:

- Coherent Photoproduction of Pseudoscalar Mesons from Closed-Shell Nuclei (A. Sarty)
- Study of the Parity Non-conserving Force Between Nucleons Through Deuteron Photodisintegration (B. Wojtsekhowski)

Jeopardy Issues

- No Jeopardy Experiments for PAC17
- The Jeopardy "wall" hits with PAC18
  - 15-17 experiments in Hall A
  - 5-7 experiments in Hall C
- PAC Overload!
  - divide jeopardy experiments between PAC18 and PAC19
  - Volunteers or Lottery
- PAC18 & 19 allocations will correspond to 30 days plus 1/2 of the previously-approved time for the experiments under jeopardy
- Allocations will be corrected for conditionally approved experiments (5 in Hall A, and 2 in Hall C) that are in jeopardy:
  - 1/2 the actual PAC conditionally approved time or 1/2 the average beamtime per approved experiment

JLab @ Higher Energies

- Initial evolutionary upgrade of our scientific capabilities (4 → 6 GeV) nearly complete
  - 5.5 GeV delivered for 3 months in FY99
  - 6 GeV to be available in 2000
  - done w/ negligible impact on operations
- Upgrade to 12 GeV, 100% DF is the next major step
  - Timescale delayed by our failure to be included in DOE 5-year plan
  - Best guess is now 2004-7
  - The next NSAC Long Range Plan is the next major hurdle (likely to start this Fall, and be submitted in 2001)
  - A major, user-driven effort will be necessary to realize this goal

JLab @ 12 GeV

- Planning for 12 GeV Progressing Well:
  - Hall collaboration meetings
  - 2 summer workshops
  - Ongoing design studies
  - Hall D activities
  - January '00 User Workshop

    125 users

    Parallel sessions on 5 research topics

    - Exclusive Reactions and Skewed Parton Distributions
    - Parton-Hadron Duality
    - Hadrons in the nuclear medium
    - Valence Quark Structure
    - Threshold Charm Production
  - "White Paper" activities to follow with October 2000 completion goal

- The Hall D Initiative Is Moving Rapidly
  - PAC15 Letter of Intent
  - Preliminary design report submitted
  - Cassel Committee Review (12/99)
  - PAC17 consideration

Hall D Review (12/6-7/99)

D. Cassel, Cornell (chair)
J. Domingo, JLab
D. Geesaman, ANL, and JLab PAC Chair
F. Close, CERN and JLab PAC
W. Dunwoodie, SLAC
D. Hitlin, Caltech
G. Young, ORNL

Endorsed the project and the broad plans of the collaboration:

- the project is "very high priority physics" and "will permit a *definitive* search for mesons with exotic quantum numbers, particularly hybrid states and glueballs."
- "JLab is *unique* in being able to provide the high quality, low emittance, CW photon beams required for this experiment."
- "The general design of the detector is technically sound"
- R&D is needed

The Energy Upgrade "White Paper"

- Must Include:
  - Physics motivation (defining key "big questions" the upgrade will address)
  - Detailed examples of experiments addressing these big questions
  - Detailed designs for the accelerator and experimental equipment upgrades necessary to support this physics program
  - Key technical issues resolved

SUMMARY

- CEBAF is delivering 1st class physics and continues to evolve:
  - Polarized beams now ~30 μA @75%; aiming for 100 μA
  - 5.5 GeV delivered; aiming for 6
  - Steady improvements in availability

- The research program is fully underway:
  - Base equipment in all three halls performing remarkably well
  - Stream of 1st class physics publications:
    well-established in Hall C,
    started in Hall A,
    within 6-9 months in Hall B

- Progress toward the realization of the next Long Range Goal of 12 GeV, but lots of hard work still to be done