HALL-A STRANGE QUARKS APPROVED PROGRAM

PAC-17 WORKSHOP
JANUARY 29, 2000

KEES DE JAGER
JEFFERSON LABORATORY

Hall A Approved Proposals

- E91-004 Measurement of Strange Quark Effects E. Beise A
  Using Parity-Violating Elastic Scattering
  from ^{4}He at Q^2= 0.6 (GeV)^2

For nuclei with N = Z the parity-violating asymmetry depends on G_E^s only:

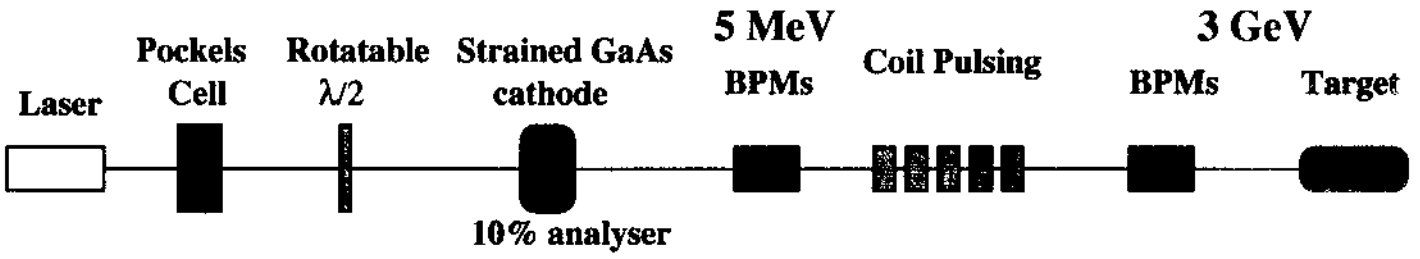
$$A = \frac{G_F}{\pi\alpha\sqrt{2}}\left[\sin^2\theta_W + \frac{1}{2}\frac{G_E^s}{(G_E^p + G_E^n)}\right]$$

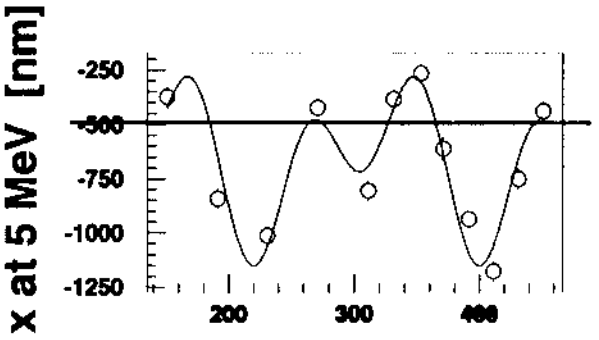
Measure on top of 2nd maximum of ^{4}He charge form factor at ~ 0.6 (GeV/c)^2
Requires high luminosity cryotarget
Goal: 30 % statistical error in Standard Model asymmetry

Hall A Approved Proposals (cont.)

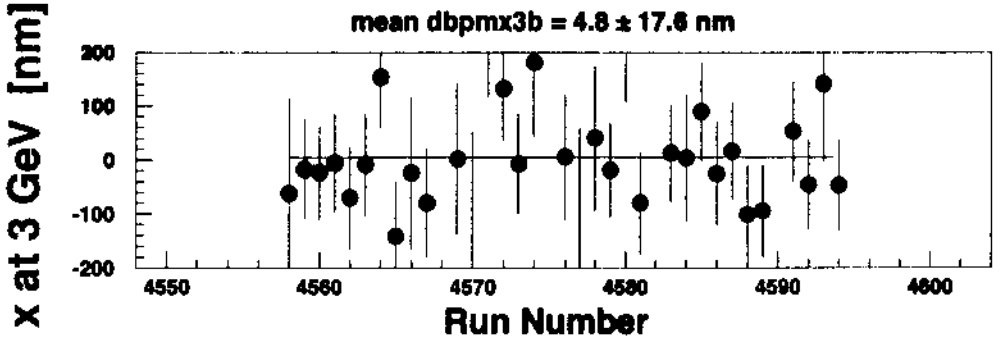
•	E91-010	Parity Violation in Elastic Scattering from the Proton and ^{4}He	J.M. Finn P. Souder	A completed
•	E99-115	Constraining the Nucleon Strangeness Radius in Parity Violating Electron Scattering	K. Kumar D. Lhuillier	A
•	E99-012	A Clean Measurement of the Neutron Skin of ^{208}Pb through Parity-Violating Electron Scattering	R. Michaels P.A. Souder G. Urciuoli	resubmitted

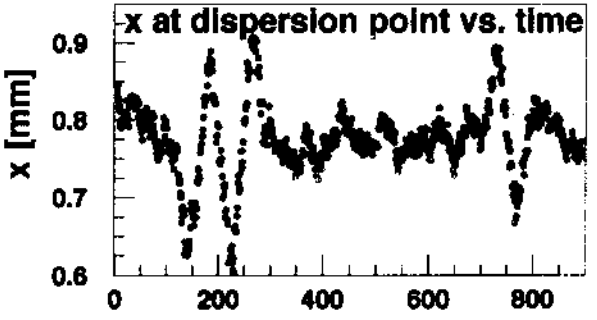
Position Differences





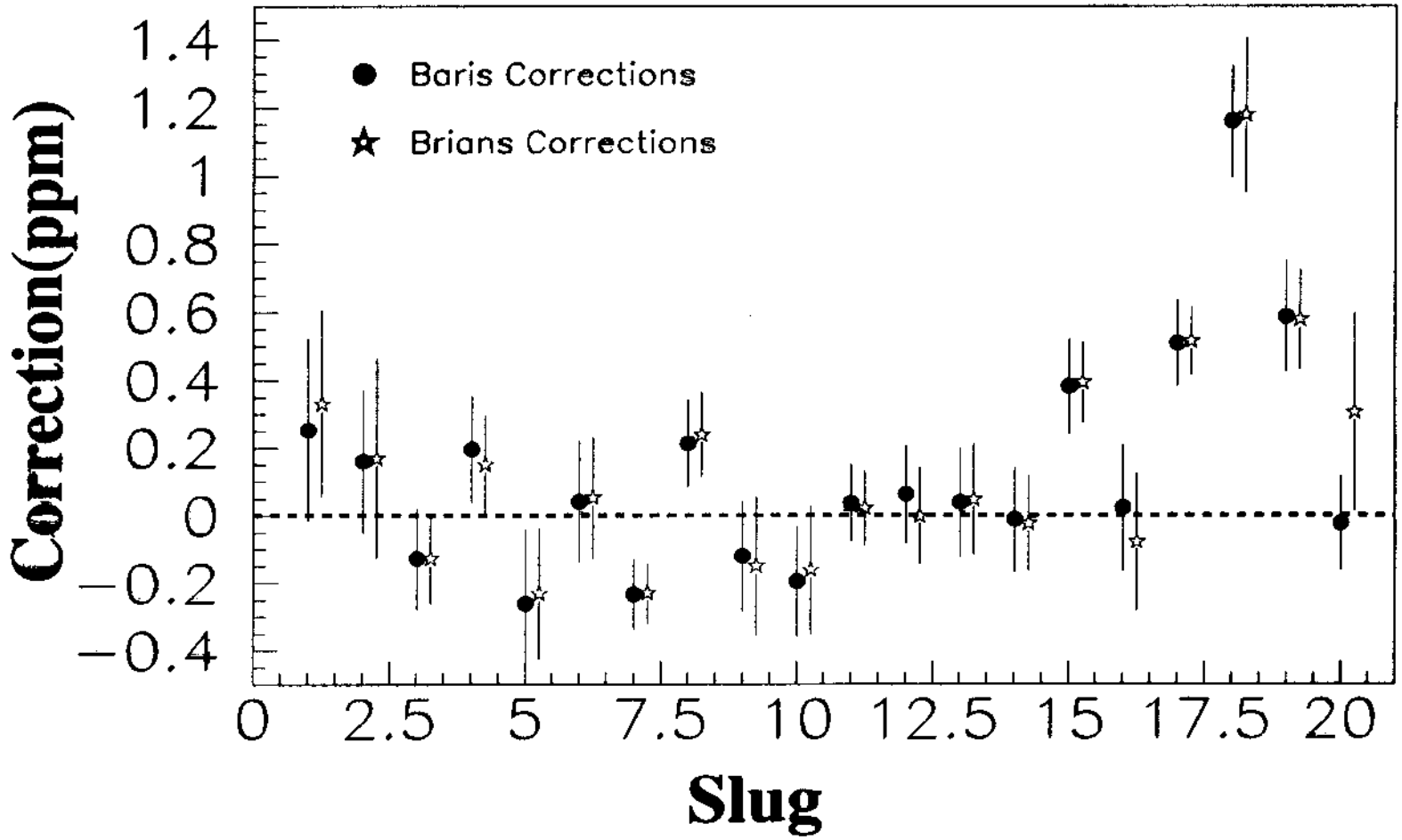
* *maintain < 500 nm at 5 MeV*
* *leads to < 20 nm in Hall A*
* *leads to 0.15 ppm systematic correction*



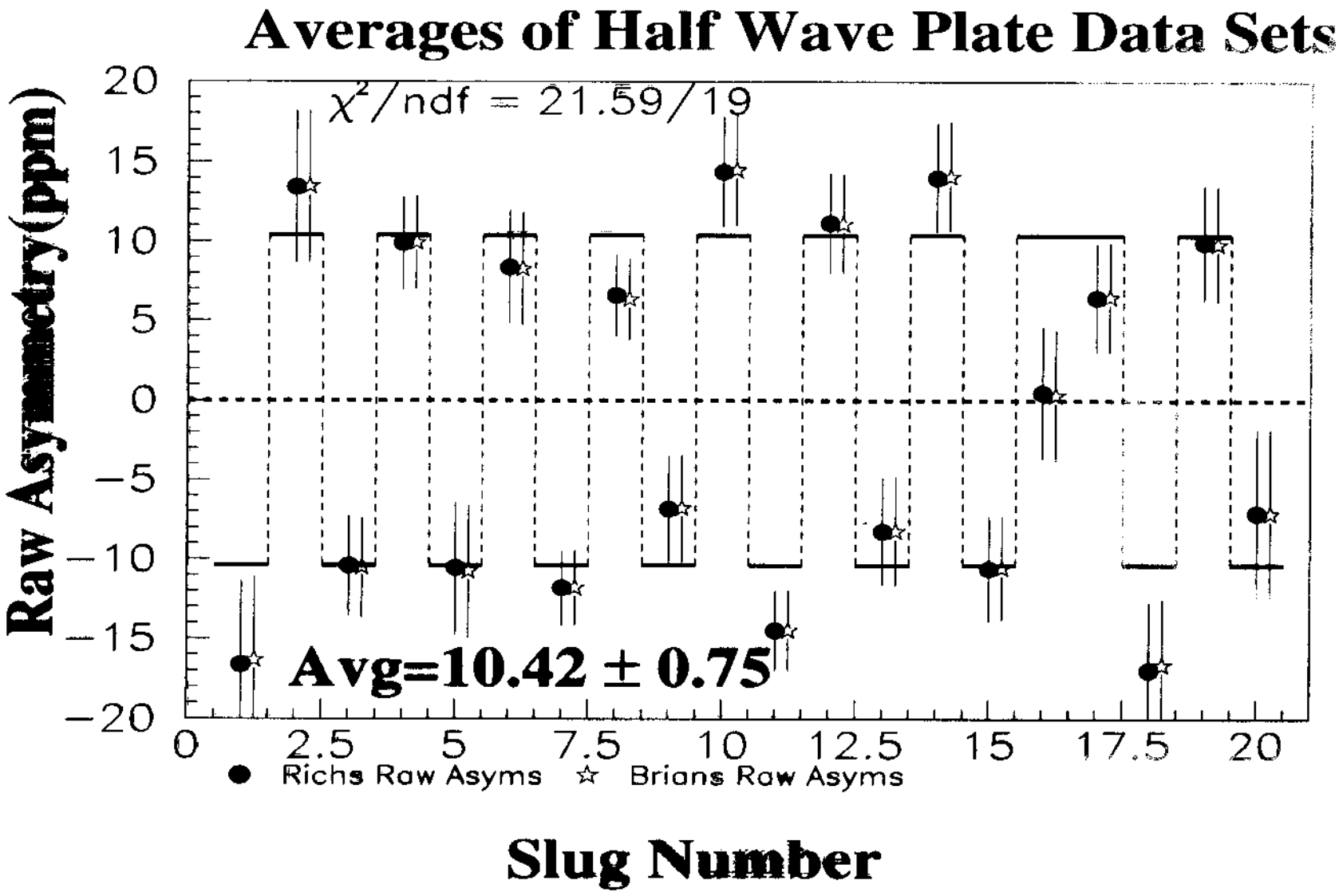


HAPPEX 1999

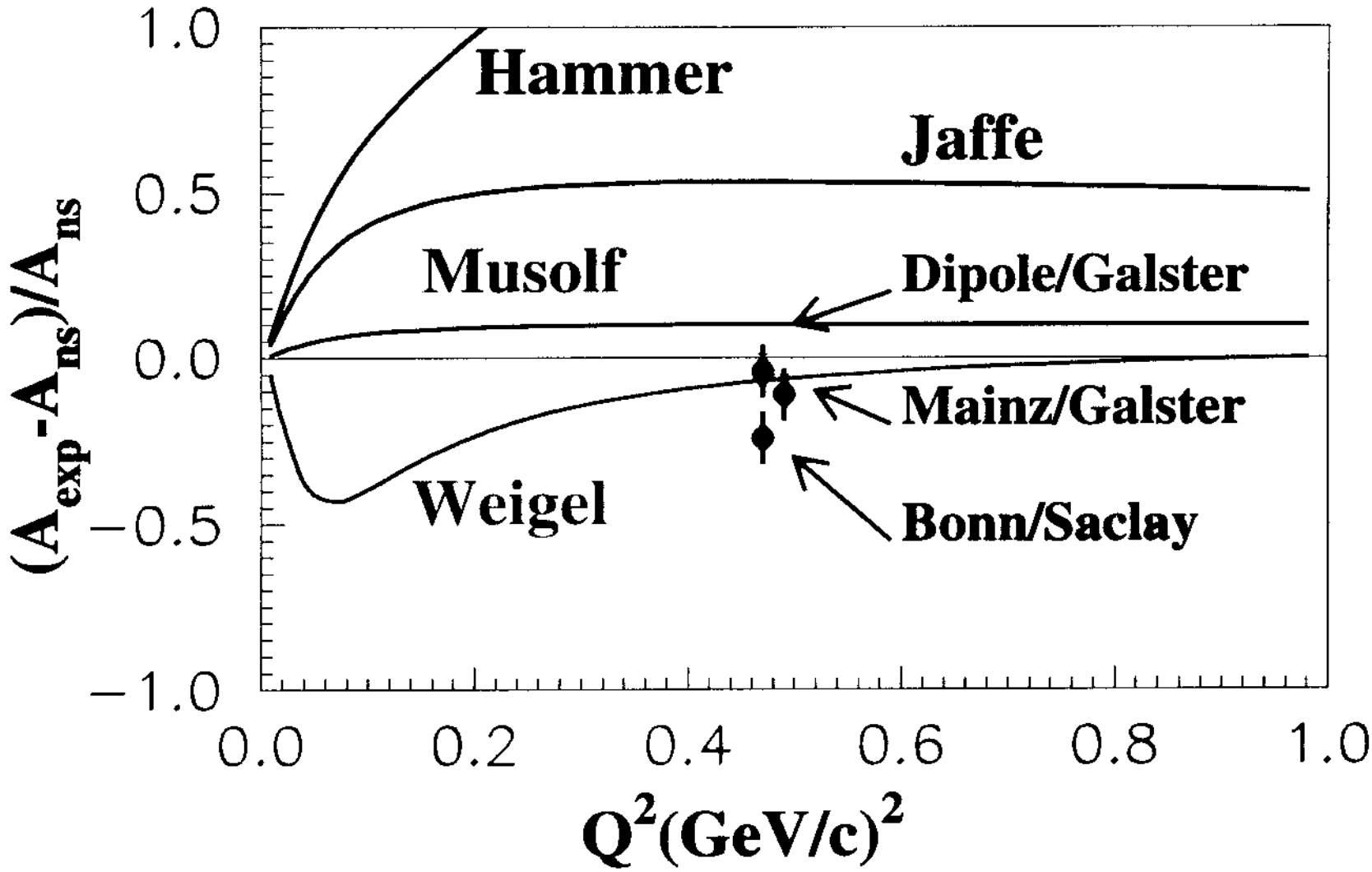
Corrections due to Monitor Difference



HAPPEX Result -- 1999 Run



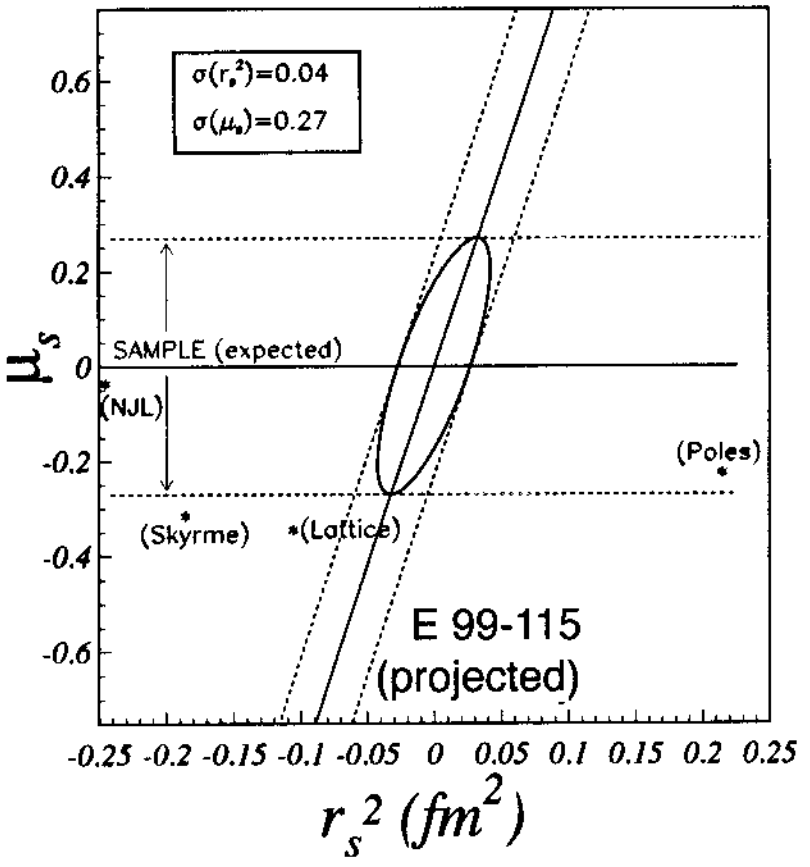
HAPPEX Result -- Comparison to Strangeness Models



Parity Violating Electron Scattering at Very Forward Angle

E 99-115: $^{1}H(\vec{e},e')^{1}H$

Beam Energy ~ 3.2 GeV, scattering angle ~ 6° : Q^2 ~ 0.1 (GeV/c)^2



projected errors

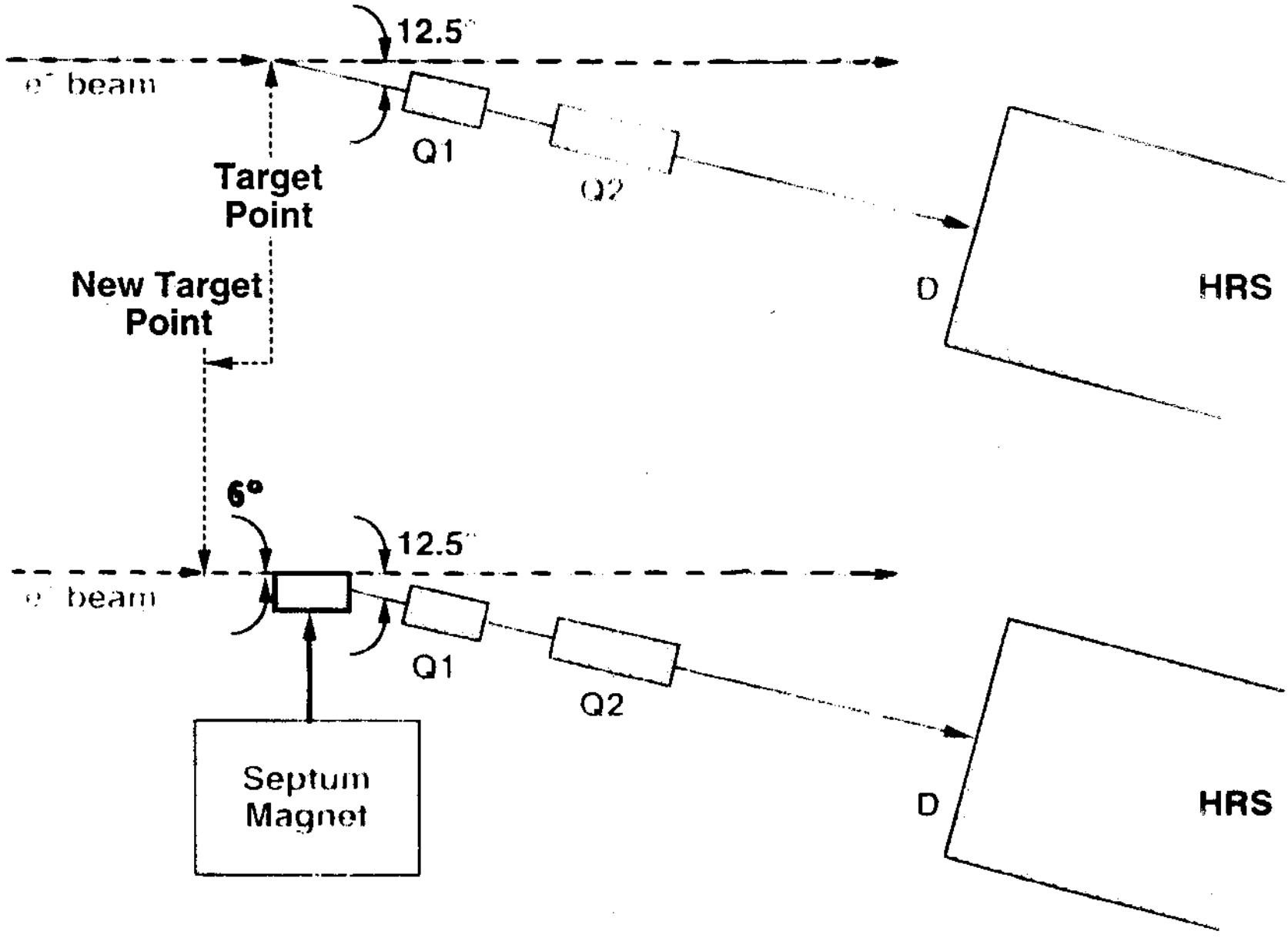
stats	*4.6%*
polarimetry	*2.0%*
background	*0.9%*
Q	*0.6%*
rad. corr.	*1.0%*
subtotal	*5.2%*
form factors	*1.4%*

Hall A Approved Proposals (cont.)

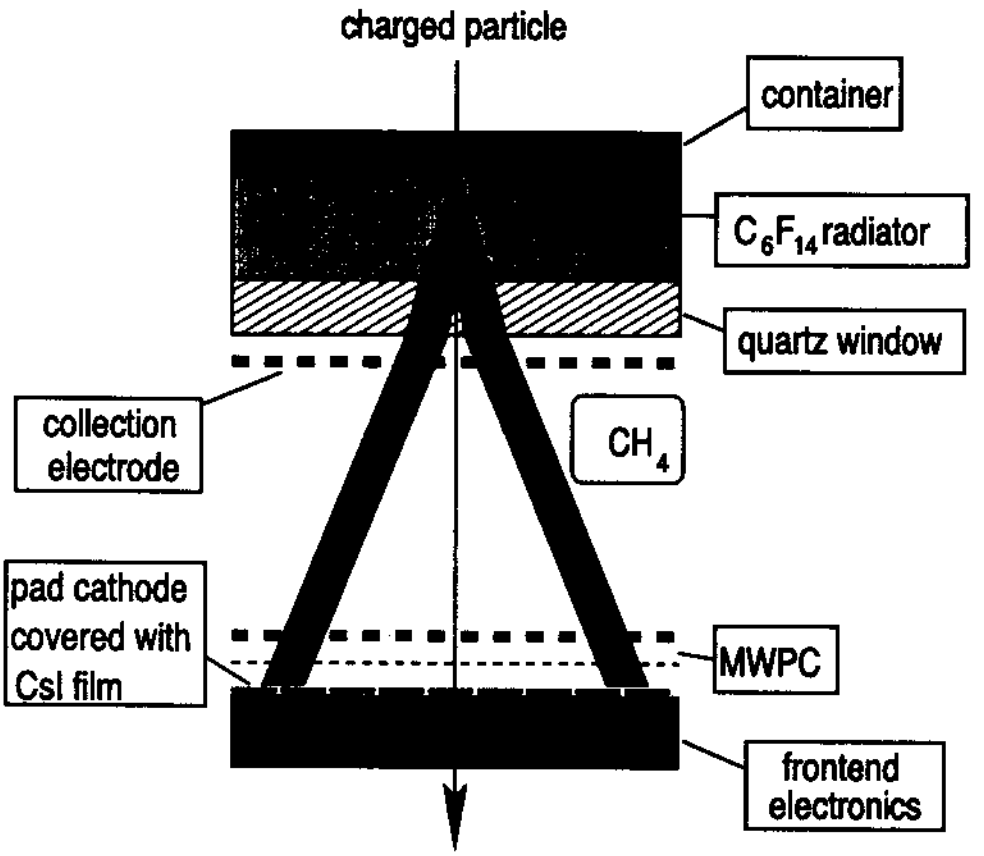
• E94-107	High Resolution 1p-Shell Hypernuclear Spectroscopy	S. Frullani F. Garibaldi P. Markowitz T. Saito J. LeRose	B^+

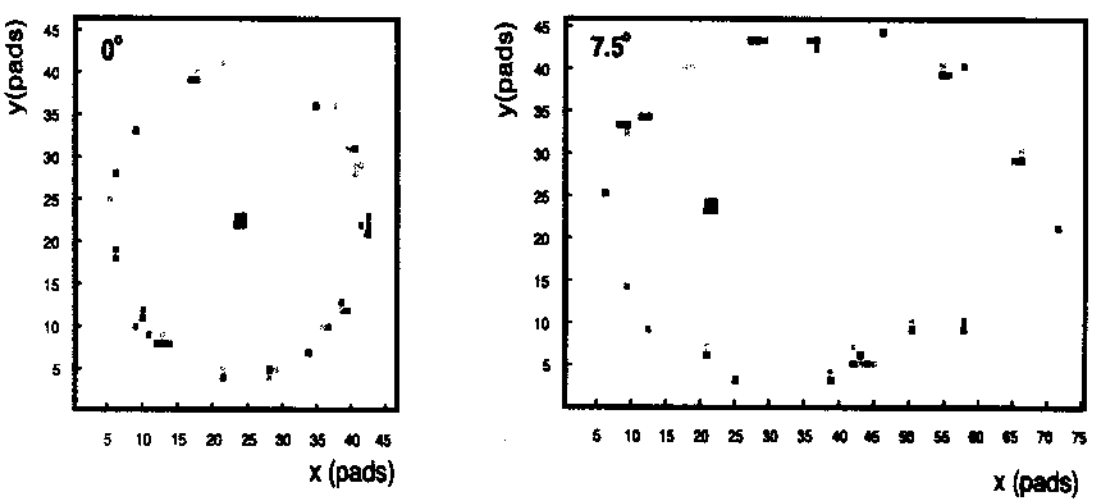
Study hypernuclear spectroscopy in ^{7}Li, ^{9}Be, ^{12}C and ^{16}O.
Measure (e,e'K) coincidences at 6° in both HRS spectrometers.
Septum magnets are under construction.

HRS Standard Setup



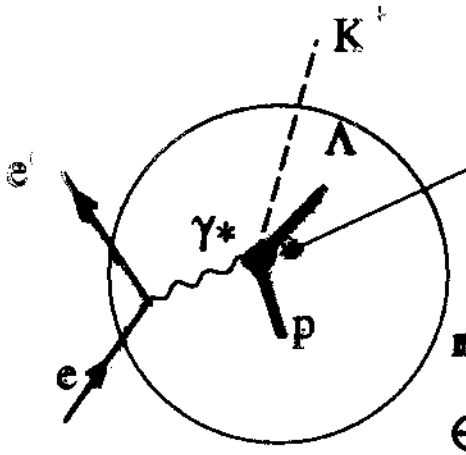
Proximity Focusing RICH





PID Capability: pi - K - p 10 sigma separation at 2 GeV/c

Hypernuclear Physics at Jefferson Lab



Elementary process

$$\gamma + p \rightarrow K^+ + \Lambda$$

nucleus - hypernucleus transition

$$e + {}^{A}Z \rightarrow e' + K^+ + {}^{A}(Z-1)_{\Lambda}$$

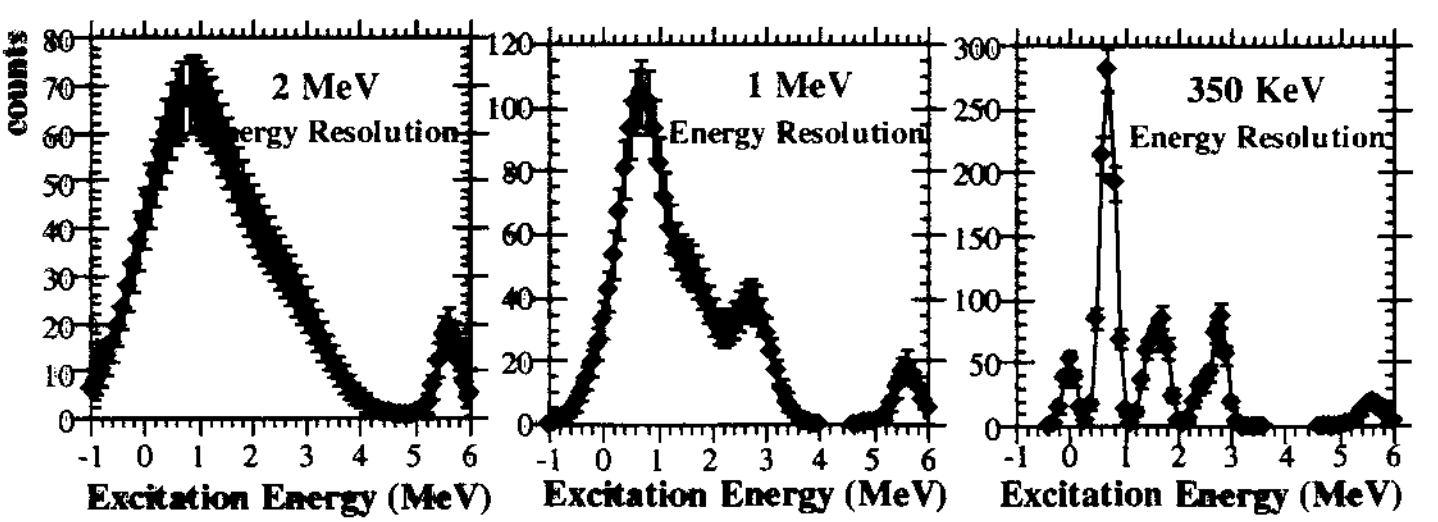
Goals of the experiments :

- **Hypernuclear spectroscopy**
- **ΛN Interaction**

  A resolution of few hundreths KeV is needed to extract the **spin-dependent** part of the ΛN potential (doublet splitting)

At CEBAF, **Hall A, 350 KeV** resolution can be achieved

The $^{9}Be(e,e'K)\,^{9}Li_{\Lambda}$ reaction vs. energy resolution



Kinematics

$E_i = 4$ GeV
$\omega = E\gamma \sim 2.2$ GeV
$p_k = 1.9$ GeV
$\theta_e = \theta_k = 6^\circ$

$Q^2 = 0.0789$ Gev^2

Energy resolution

SOURCE	RESOLUTION	Error FWHM (kev)
beam	10^{-4} of 4 GeV (4 σ)	235
e'	10^{-4} of 1.8 GeV	180
k	10^{-4} of 1.9 GeV	190
k straggling	40 KeV	40
Total		≈ 350

Beam Current: $i = 100\ \mu A$

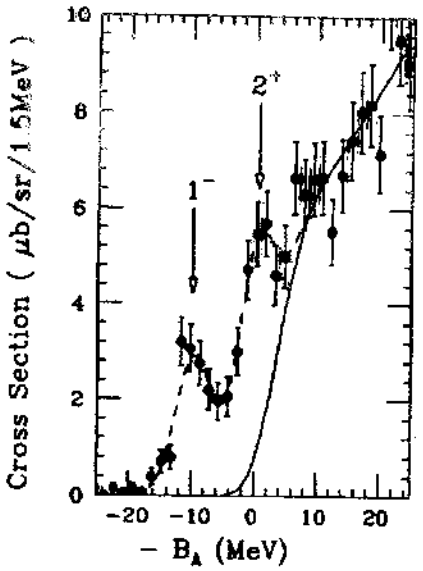
Target Thickness: $t = (5x20)\ mg/cm^2$

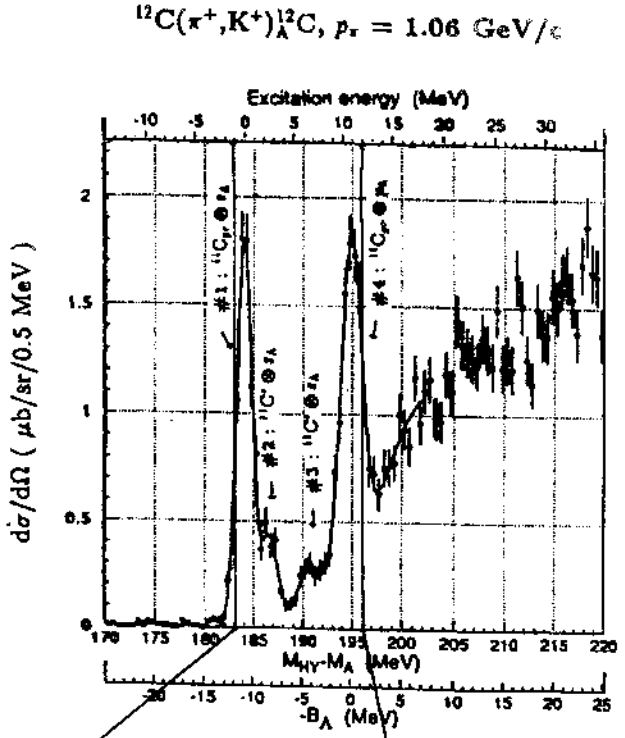
$^{12}C(\pi^+,K^+)^{12}C_\Lambda$ data taken from
M.Akei et al., NP A534 (1991) 478

Energy resolution 4 MeV

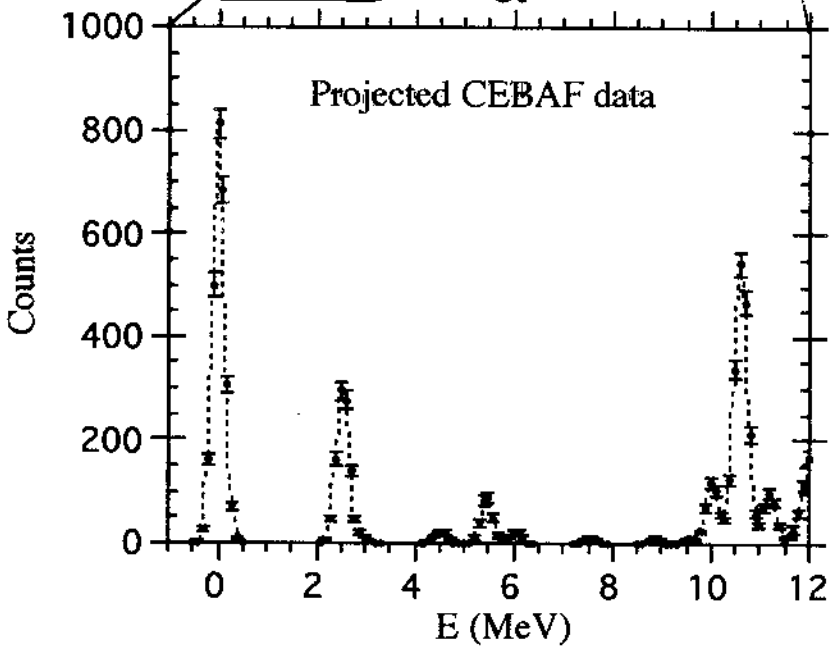
More recent **KEK data**
INS-Rep.-1037, Univ. of Tokyo, 1994

Energy resolution 2 MeV





$^{12}C(e,e'k)^{12}B_\Lambda$
350 KeV energy resolution



Hall A Approved Proposals (cont.)

• E98-108	Electroproduction of Kaons up to $Q^2 = 3$ $(GeV/c)^2$	O.K. Baker C.C. Chang S. Frullani M. Iodice P. Markowitz	B^+

Continuation of E93-018 Hall C experiment.
Separate longitudinal and transverse response functions for $^1H(e,e'K)$ reaction for $2 < Q^2 < 3$ $(GeV/c)^2$.
Extrapolate at each Q^2 the longitudinal term in t to determine the kaon form factor.
Measure the t-dependence of the cross section up to $t \sim -3$ $(GeV/c)^2$.
Use two aerogel Cerenkov detectors (or one RICH) for PID.