Parity-Violating Electron Scattering From ^{4}He

Preliminary Results from Summer 2004

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The HAPPEX Collaboration

California State University, Los Angeles - Syracuse University -

DSM/DAPNIA/SPhN CEA Saclay - Thomas Jefferson National Accelerator Facility -

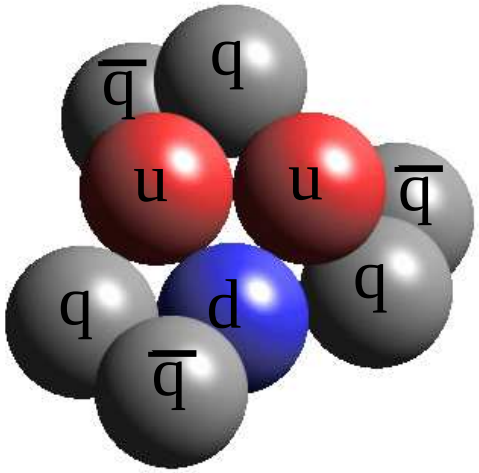
INFN, Rome - INFN, Bari - Harvard University - Indiana University - University of Virginia -

University of Massachusetts - Florida International University - University of New Hampshire -

Massachusetts Institute of Technology - College of William and Mary

Motivation - Nucleon Strangness

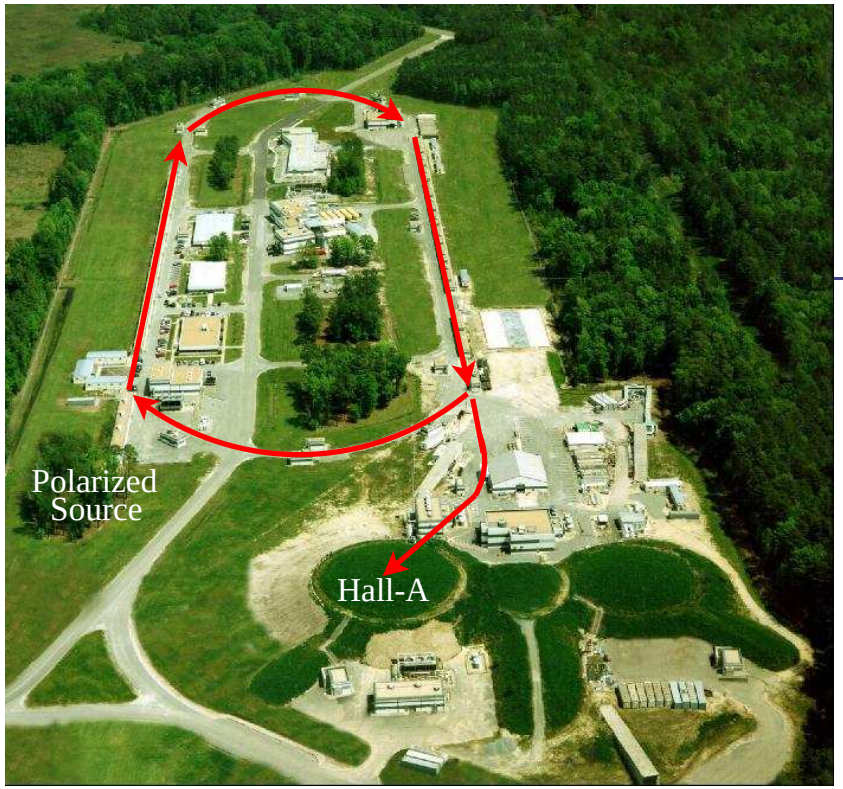
- Theoretical Motivation $\langle N|s\gamma^{\mu}\overline{s}|N\rangle$:
  - ⋆ Isolation of $G^{s}_{E,M}$ through $N(\vec{e},e')$
- Other Previous & Current Experiments
  - ⋆ Bates-SAMPLE
  - ⋆ JLab-HAPPEX('98-'99), G_0
  - ⋆ Mainz-A4



$$A^{PV} = \frac{\sigma_R - \sigma_L}{\sigma_R + \sigma_L} \qquad \left\{ A_0 = \frac{-G_F Q^2}{\sqrt{2}\pi\alpha} \right\}$$

$$A^{PV}_{^4He} = -\frac{A_0}{2}\left(2\sin^2\theta_W + \frac{G^s_E}{G^{p\gamma}_E + G^{n\gamma}_E}\right)$$

Jefferson Lab: CEBAF & Hall-A



HAPPEX at $Q^2 = 0.1\ \mathrm{GeV}^2$

	A^{PV}	Rel.Error	Precision
^{4}He	7.8 ppm	3.0%	234 ppb
H	-1.4 ppm	6.4%	90 ppb

$E_0 = 3.0\ \mathrm{GeV}$ $\quad \theta_{scat} = 6°$

80% Polarization

$30\ \mathrm{Hz}$ Rapid Helicity Flip

High Systematic Accuracy $\rightarrow$

Careful Polarized Source Setup

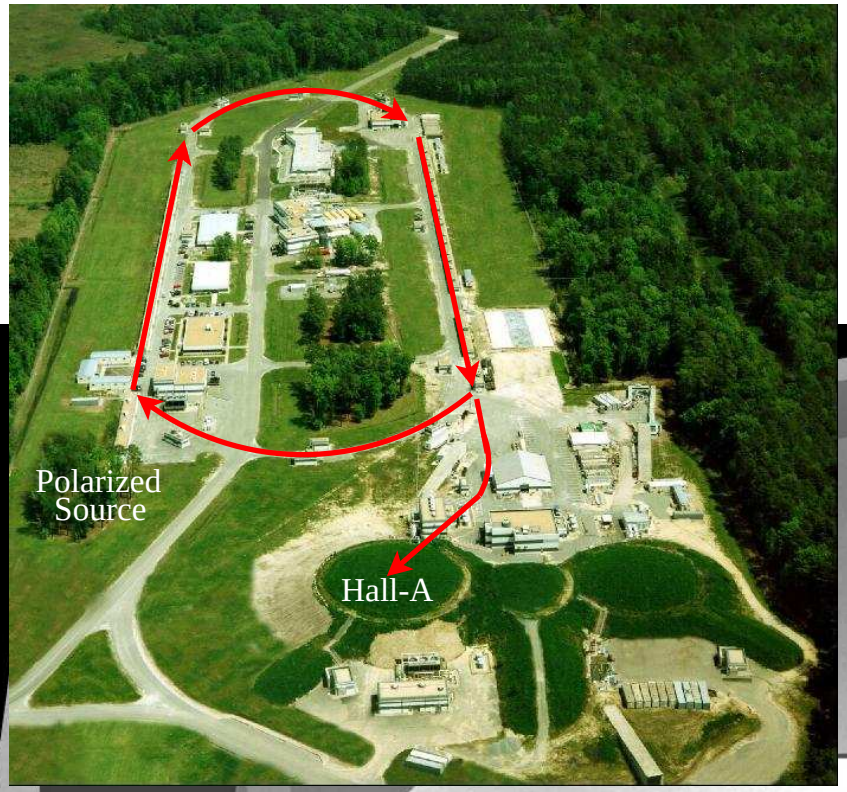
Active Feedback

Slow Helicity Reversal

Measure Detector Sensitivies

Jefferson Lab: CEBAF & Hall-A

HAPPEX at $Q^2 = 0.1\ \mathrm{GeV}^2$



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HAPPEX at $Q^2 = 0.1\ \mathrm{GeV}^2$

HAPPEX-HRS DAQ

- Integrating Mode (high current)
  Event Rate $\sim 12\ \mathrm{MHz}$
- Counting Mode (low current)
  Q^2 Measurement
  Detector Alignment

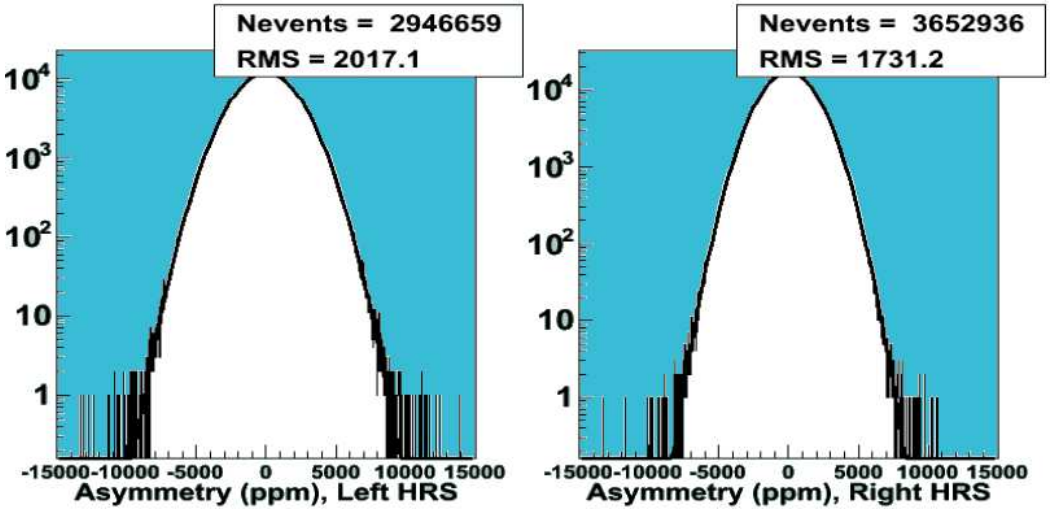
^{4}He Raw Asymmetry Results

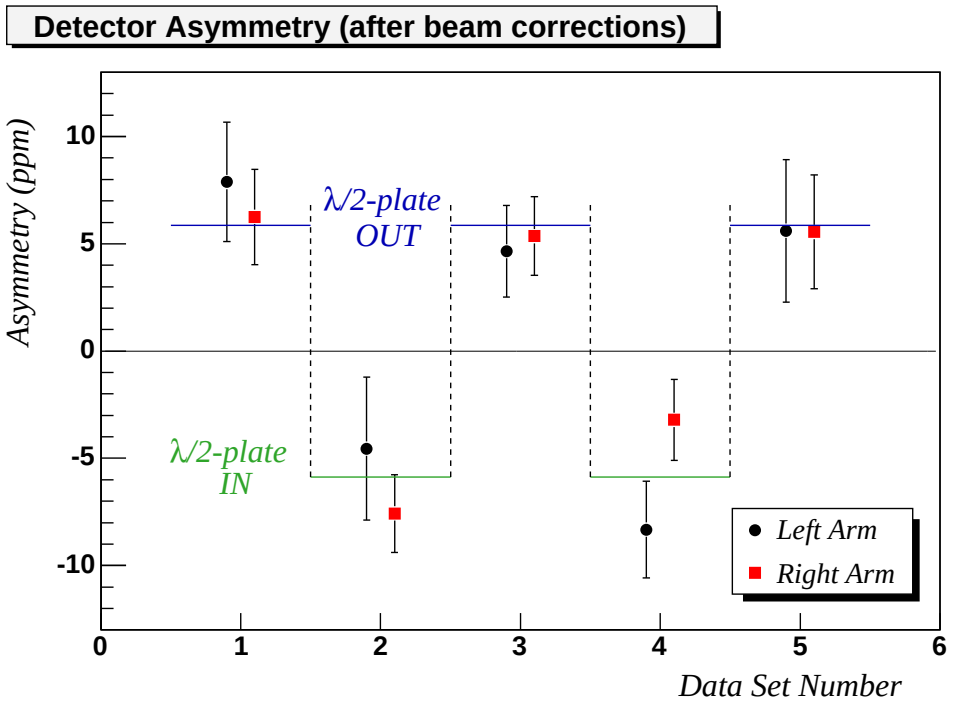
Raw PV Asymmetry

(before normalization)

$$A_{raw} = +5.87 \pm 0.71\ (\text{stat})\ \text{ppm}$$

Beam Corrections < 0.2 ppm





- ^{4}He Quasi-Elastic Background: estimated fraction at $3\% \pm 3\%$ $\Rightarrow 300$ ppb systematic error
- Q^2, Polarization, other normalization errors are comparable

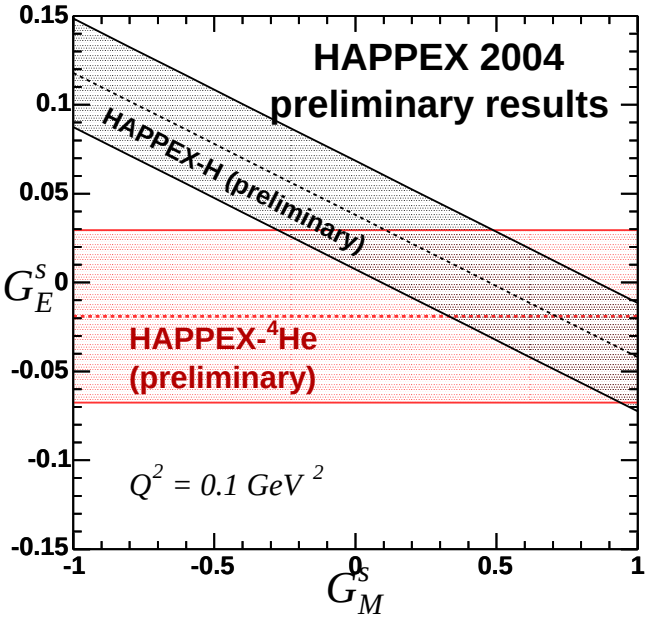
^{4}He Physics Result

$$A_{phys} \text{ (after all corrections)}$$
$$+7.40 \pm 0.89 \text{ (stat)} \pm 0.57 \text{ (syst) ppm}$$

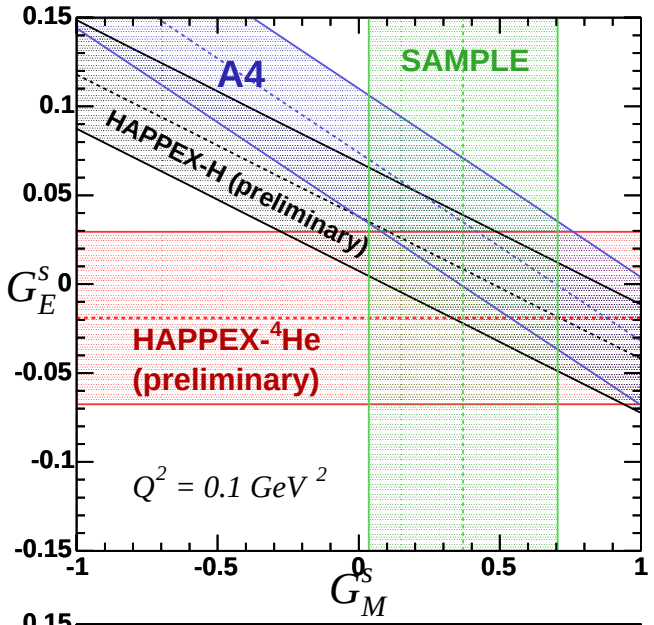
Preliminary!

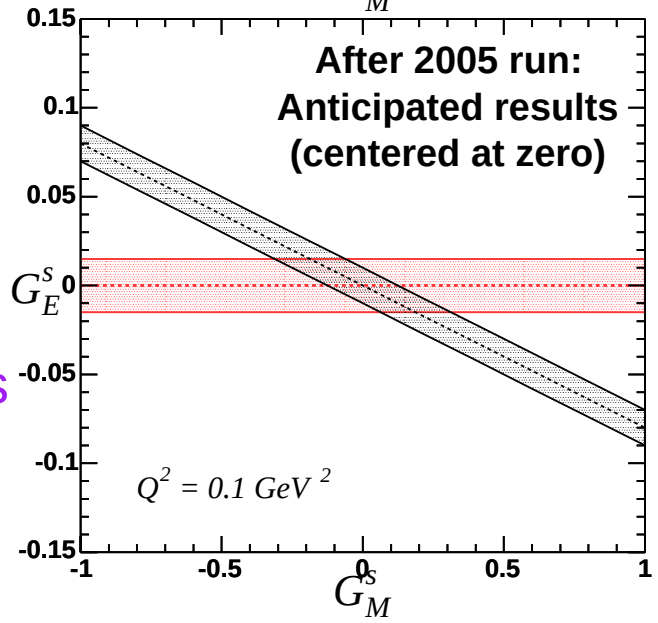
Theory (no strange quarks): $+7.82$ ppm

$$G_E^s = -0.019 \pm 0.041 \text{ (stat)} \pm 0.026 \text{ (syst)}$$



- Normalization Errors Dominate
- Ongoing Analysis
- Remainder of statistics in Fall 2005





HAPPEX-He Error Budget

False Asymmetries	214ppb
Polarization	281ppb
Linearity	148ppb
Radiative Corrections	148ppb
Q^2 Uncertainty	259ppb
Aluminum quasi-elasic background	50ppb
Helium quasi-elasic background	300ppb
Total	570ppb