Precision Measurement of Neutron Asymmetry A$_1^n$ at Large x$_{Bj}$ Using CEBAF at 5.7 GeV

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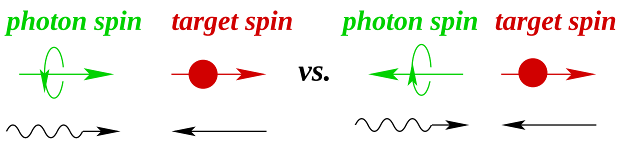
Physics Motivation

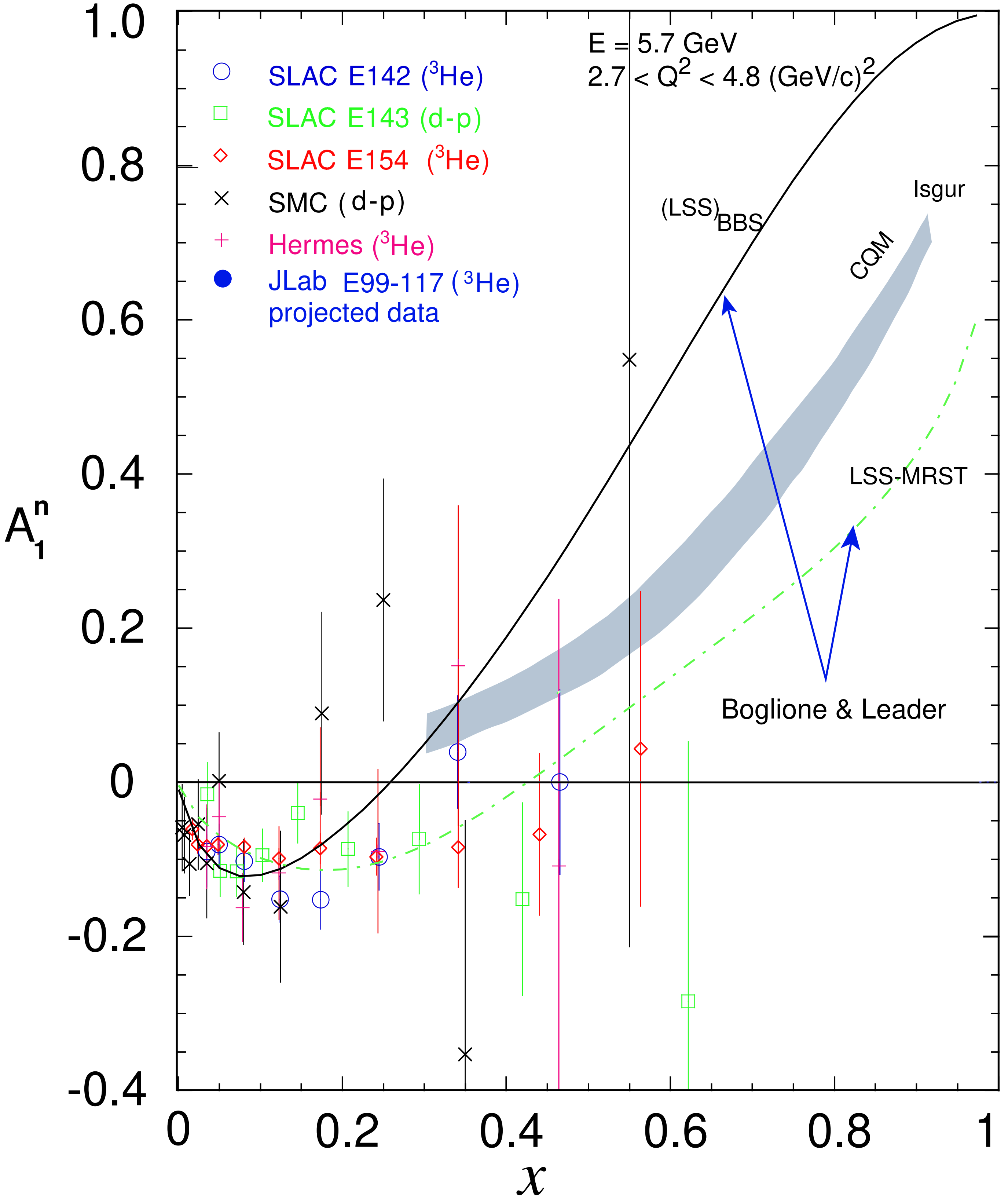
- What is A_1^n?

$$A_1^n = \frac{\sigma_{\frac{1}{2}} - \sigma_{\frac{3}{2}}}{\sigma_{\frac{1}{2}} + \sigma_{\frac{3}{2}}}$$

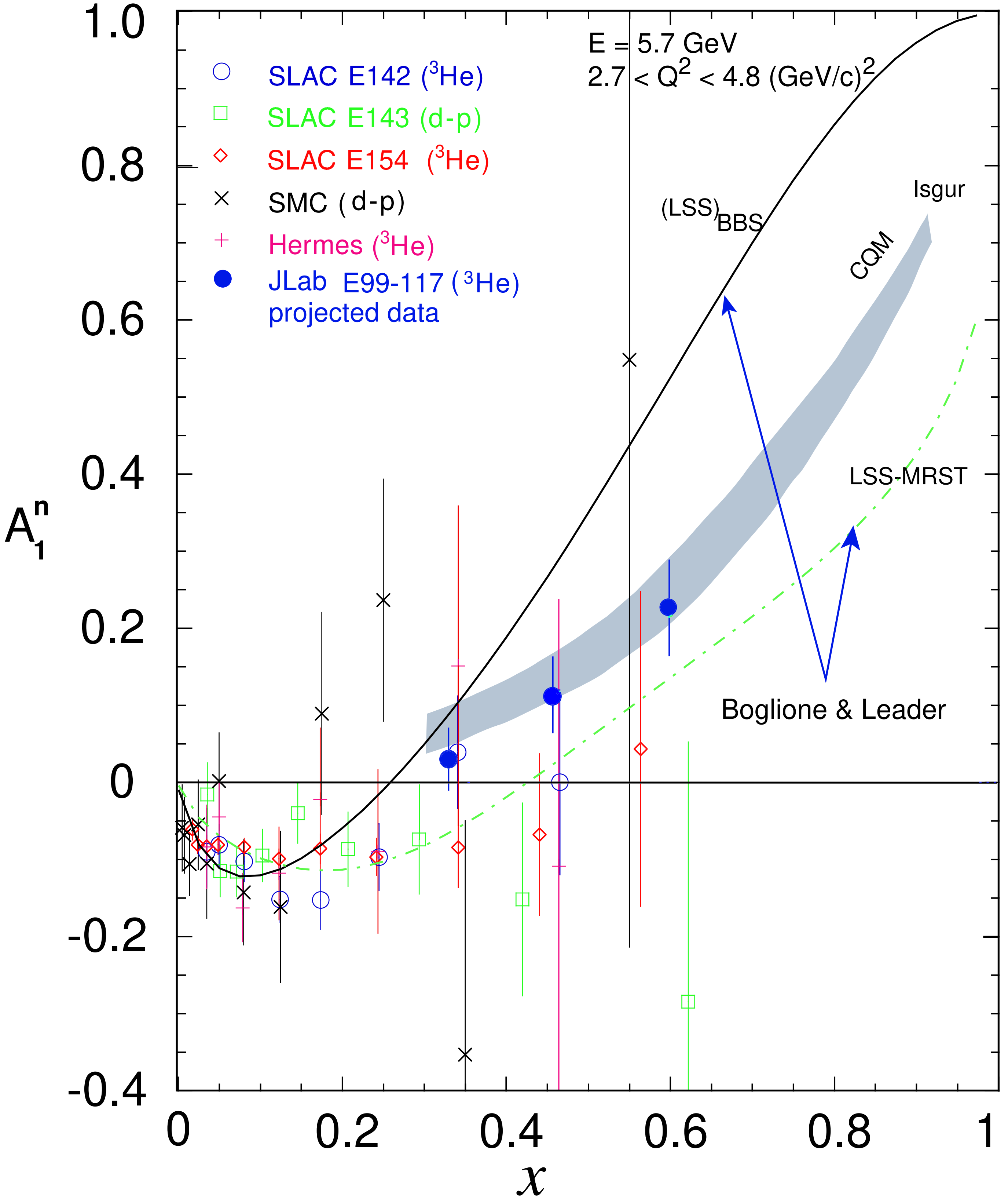


$$A_1 = \frac{g_1(x,Q^2) - \gamma^2 g_2(x,Q^2)}{F_1(x,Q^2)}$$

- Theories
  - Naive SU(6): $A_1^n = 0$
  - Hyperfine perturbed constituent quark model and pQCD
    - $A_1^n = 1$ at $x = 1$
    - $A_1^n > 0$ at high x



E = 5.7 GeV
2.7 < Q^2 < 4.8 (GeV/c)^2
SLAC E142 (3He)
SLAC E143 (d-p)
SLAC E154 (3He)
SMC (d-p)
Hermes (3He)
JLab E99-117 (3He)
projected data
(LSS)BBS
Isgur
CQM
LSS-MRST
Boglione & Leader
A1n
x



SLAC E142 (^{3}He)
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E = 5.7 GeV
2.7 < Q^2 < 4.8 (GeV/c)^2
(LSS)$_{BBS}$
Isgur
CQM
LSS-MRST
Boglione & Leader
A_1^n
x
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
0
0.2
0.4
0.6
0.8
1

Experiment E99-117

- Spokespersons: J. P. Chen, Z. -E. Meziani, P. Souder

- First precise data on A_1^n at high x
- Test our fundamental understanding of valence quark picture
- Distinguish between naive SU(6), and pQCD or hyperfine perturbed quark models

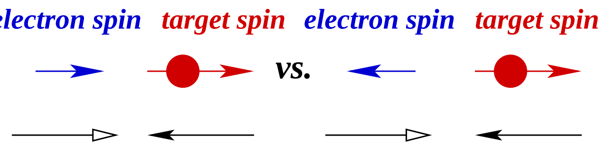
- Ph.D. Student: X. Zheng

Experiment Procedure

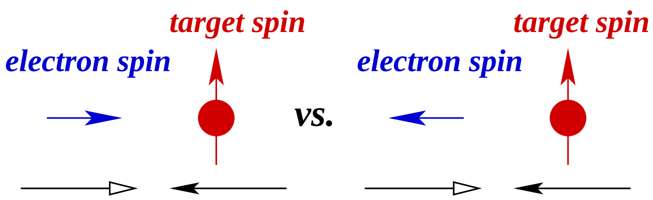
- What do we measure?

Electron asymmetry in $\vec{e} - {}^3\vec{H}e$ deep inelastic scattering

$$A_{||} = \frac{\sigma^{\uparrow\downarrow} - \sigma^{\uparrow\uparrow}}{\sigma^{\uparrow\downarrow} + \sigma^{\uparrow\uparrow}}$$



$$A_{\perp} = \frac{\sigma^{\downarrow\leftarrow} - \sigma^{\downarrow\rightarrow}}{\sigma^{\downarrow\leftarrow} + \sigma^{\downarrow\rightarrow}}$$



- From $A_{\perp}$, $A_{||}$ to A_1

$$A_1 \quad = \quad \frac{A_{||}}{D(1+\eta\xi)} - \frac{\eta A_{\perp}}{d(1+\eta\xi)}$$

- From $A_1^{^3He}$ to A_1^n