Tensor Spin Observables

New tensor structure functions\[^2\]

\[
W_{\mu\nu} = -F_1 g_{\mu\nu} + F_2 \frac{P_\mu P_\nu}{\nu} \\
-b_1 r_{\mu\nu} + \frac{1}{6} b_2 (s_{\mu\nu} + t_{\mu\nu} + u_{\mu\nu}) \\
+ \frac{1}{2} b_3 (s_{\mu\nu} - u_{\mu\nu}) + \frac{1}{2} b_4 (s_{\mu\nu} - t_{\mu\nu}) \\
+i \frac{g_1}{\nu} \epsilon_{\mu\nu\lambda\sigma} q^\Lambda s^\sigma \\
+i \frac{g_2}{\nu^2} \epsilon_{\mu\nu\lambda\sigma} q^\Lambda (p \cdot q s^\sigma - s \cdot q p^\sigma)
\]

JLab E12-13-011, A- Rating, C1 Approved

Tensor Structure Function \( b_1 \)

Close-Kumano sum rule\[^3\]

6-quark hidden color\[^4\]

OAM\[^5\]

Pionic effects\[^4,6\]

Polarized sea quarks\[^6\]

\[
b_1 = \frac{q^0 (x) - q^{\pm} (x)}{2}
\]

\( ^2\text{H} = \text{n} + \text{p} \quad \Rightarrow \quad b_1 = 0 \)

- Property of spin-1 nuclei
  - Vector \( P_z = p_+ - p_- \)
  - Tensor \( P_{zz} = (p_+ + p_-) - 2p_0 \)

- Development of a high luminosity, high tensor polarized target has promise as novel probe of nuclear physics

- Of all tensor observables, currently only elastic \( t_{20} \) is well measured\[^1\]

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\[^1\] IA Rachek \textit{et al}, PRL 98, 182303 (2007)
Tensor Spin Observables

**JLab LOI12-14-002: Tensor Asymmetry**

\( A_{zz} \) in the \( x > 1 \) Region

Similar to \( t_{20} \), but in QE SRCs and pn dominance

Direct probe of tensor force

Better understanding of s/d

Final state interaction models[^1]

Encouraged for full submission by PAC42

\[
A_{zz} \propto \frac{1}{2} \frac{d^2 - sd}{s^2 + d^2}
\]

**JLab LOI12-14-001: Search for Exotic Gluonic States in the Nucleus**

\( b_4 \) in \( x < 0.3 \) region

Insensitive to bound nucleons or pions

Any non-zero value indicates exotic gluonic components

Encouraged for full submission by PAC42

**JLab E97-102: Measurement of the (e,e’p) Cross Section on Tensor-Polarized Deuterium**

Sensitive to NN effects, similar to \( A_{zz} \)

Although approved with A-, it never ran

With 12 GeV upgrade, can run with 2× statistics

**Future of Tensor Measurements**

Upcoming approved measurement of \( b_1 \)

2 upcoming proposals

2 structure functions to explore

13 proceedings from Tensor Workshop

[^1]: W Cosyn, M Sargsian, arXiv:1407.1653