

Out-Of-Plane Polarization Angle

Ryan Zielinski

11/02/2016

BACKGROUND

- Following conventions of Refs:
 - M. Anselmino, A. Efremov, E. Leader. “*The Theory and Phenomenology of Polarized Deep Inelastic Scattering.*” <https://arxiv.org/abs/hep-ph/9501369>
 - A. Thomas, W. Weise. “*The Structure of the Nucleon.*” ISBN: 978-3-527-40297-7
 - A. Manohar. “*An Introduction to Spin Dependent Deep Inelastic Scattering.*” <https://arxiv.org/abs/hep-ph/9204208>
- The two polarized cross-section differences are:

Parallel:

$$\frac{d^2\sigma^{\uparrow\uparrow}}{dE'd\Omega} - \frac{d^2\sigma^{\downarrow\uparrow}}{dE'd\Omega} = \frac{4\alpha^2}{Q^2} \frac{E'}{E} \left[MG_1(\nu, Q^2) \{E + E' \cos\theta\} - Q^2 G_2(\nu, Q^2) \right]$$

In terms of ...

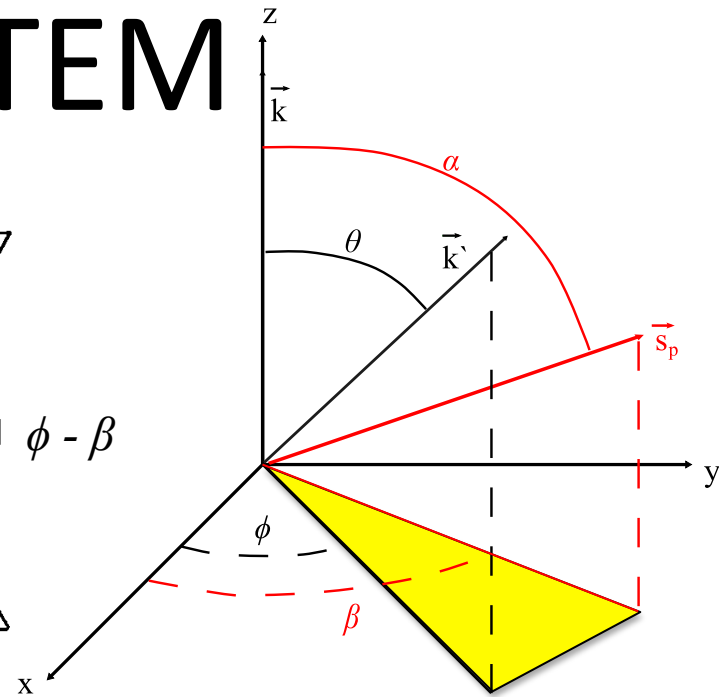
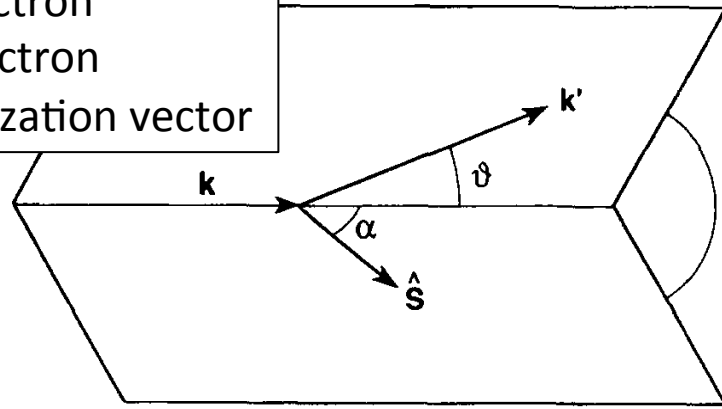
$g_1(x, Q^2) = M^2 \nu G_1(\nu, Q^2)$ $g_2(x, Q^2) = M \nu^2 G_2(\nu, Q^2)$

Perpendicular:

$$\frac{d^2\sigma^{\uparrow\Rightarrow}}{dE'd\Omega} - \frac{d^2\sigma^{\downarrow\Rightarrow}}{dE'd\Omega} = \frac{4\alpha^2}{Q^2} \frac{E'^2}{E} \sin\theta \cos(\phi - \beta) \left[MG_1(\nu, Q^2) + 2EG_2(\nu, Q^2) \right]$$

COORDINATE SYSTEM

k = incoming electron
 k' = outgoing electron
 S = proton polarization vector



Parallel:

$$\frac{d^2\sigma^{\uparrow\uparrow}}{dE'd\Omega} - \frac{d^2\sigma^{\downarrow\uparrow}}{dE'd\Omega} = \frac{4\alpha^2}{Q^2} \frac{E'}{E} \left[MG_1(\nu, Q^2) \{E + E' \cos\theta\} - Q^2 G_2(\nu, Q^2) \right]$$

Perpendicular polarized cross section has additional angular dependence

Perpendicular:

$$\frac{d^2\sigma^{\uparrow\Rightarrow}}{dE'd\Omega} - \frac{d^2\sigma^{\downarrow\Rightarrow}}{dE'd\Omega} = \frac{4\alpha^2}{Q^2} \frac{E'^2}{E} \sin\theta \cos(\phi - \beta) \left[MG_1(\nu, Q^2) + 2EG_2(\nu, Q^2) \right]$$

$$\begin{aligned} g_1(x, Q^2) &= M^2\nu G_1(\nu, Q^2) \\ g_2(x, Q^2) &= M\nu^2 G_2(\nu, Q^2) \end{aligned}$$

Out-of-plane angle between polarization plane and scattering plane

QUESTIONS

- How do we plan on measuring the out-of-plane component?
 - Maybe helpful to look at how RSS/SANE covered this issue?
- Is it the same for both HRS?
 - Can this explain differences in PERP asymmetries between LHRS/RHRS?
- Treated as a systematic or do we have to make the correction?