Study of Neutron Spin Structure at Low Q^2 Using Polarized ^3He Target

Seonho Choi^a for The Jefferson Lab E94010 Collaboration

^a Temple University, Philadelphia, Pennsylvania 19122

We have measured the electron- ^3He longitudinal and transverse spin dependent inclusive cross sections $^3\text{He}(\vec{e}, e')$, in the resonance region (up to $W \simeq 2.5\text{GeV}$), over a wide range of four-momentum transfer ($Q^2 = 0.03 - 1\text{GeV}^2$). The longitudinally polarized electron beam of energy ranging from 0.86 to 5.1 GeV of the Thomas Jefferson National Accelerator Facility was scattered at a fixed angle of 15.5° , on a high pressure polarized ^3He target in Hall A¹.

From this measurement, the spin dependent structure functions $g_1(x)$, $g_2(x)$ of the neutron have been extracted and various moments (see Fig. 1) were evaluated, among which the Generalized GDH integral on the neutron.

The study of the GDH integral and other higher moments of spin dependent structure functions offer an important opportunity to study Quantum Chromodynamics (QCD), especially in the transition region between the nucleonic domain (low Q^2) and the perturbative QCD domain (large Q^2).

Figure 1: Forward spin polarizabilities γ_0 and δ_{LT} of the neutron² at low Q^2 . Blue squares are for δ_{LT} and red circles are for γ_0 . Orange band shows systematic error for δ_{LT} and green band for γ_0 . While our result is in reasonable agreement with MAID, our lowest Q^2 points are at odds with chiral perturbation calculation.

References

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