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Spin asymmetry for proton-deuteron Drell-Yan process with tensor-polarized deuteron

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Tensor-polarized parton distribution functions are new quantities in spin-one hadrons such as the deuteron, and they could probe new quark-gluon dynamics in hadron and nuclear physics. In charged-lepton deep inelastic scattering (DIS), they are studied by the twist-two structure functions b1 and b2 [1, 2]. The HERMES collaboration found unexpectedly large b1 values than a naive theoretical expectation based on the standard deuteron model [3]. The situation should be significantly improved in the near future by an approved experiment to measure b1 at JLab (Thomas Jefferson National Accelerator Facility). There is also an interesting indication in the HERMES result that finite antiquark tensor polarization exists. It could play an important role in solving a mechanism on tensor structure in the quark gluon level. The tensor-polarized antiquark distributions are not easily determined from the charged-lepton DIS; however, they can be measured in a proton-deuteron Drell-Yan process with a tensor-polarized deuteron target. In this article, we estimate the tensor-polarization asymmetry for a possible Fermilab Main Injector experiment by using optimum tensor-polarized PDFs to explain the HERMES measurement. We find that the asymmetry is typically a few percent. If it is measured, it could probe new hadron physics, and such studies could create an interesting field of high-energy spin physics. In addition, we find that a significant tensor-polarized gluon distribution should exist due to Q2 evolution, even if it were zero at a low Q2 scale. The tensor polarized gluon distribution has never been observed, so that it is an interesting future project. In this talk, I show our estimate on the spin asymmetry for the proton-deuteron Drell-Yan process with tensor-polarized deuteron [4].

References

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