Q^2 evolution of transversity distributions: applications

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ABSTRACT

We discuss Q^2 evolution of various transversity distributions with emphasis on the numerical analysis part [1]. The transversity evolution equation is now available not only for the leading-order (LO) [2] but also for the next-to-leading order (NLO) [3].

First, numerical solution of the evolution equation is discussed for the transversity distribution $\Delta_T q$. Dividing the variables x and Q^2 into small steps, we solve the integrodifferential equation by the Euler method in the variable Q^2 and by the Simpson method in the variable x. We provide a FORTRAN program for the Q^2 evolution and devolution of the transversity distribution [1]. Using the program, we show LO and NLO evolution results of the valence-quark distribution $\Delta_T u_v + \Delta_T d_v$ and the singlet distribution $\sum_i (\Delta_T q_i + \Delta_T \bar{q}_i)$. Because the results are very different from longitudinally-polarized ones, the evolution difference could be another important test of perturbative QCD in spin physics.

It is also interesting to find a finite flavor asymmetric distribution $\Delta_T \bar{u} - \Delta_T \bar{d}$ due to the NLO evolution effects [4, 1]. However, the magnitude of the perturbative contribution is very small, so that the asymmetric distribution has to be investigated together with nonperturbative mechanisms in the similar way to the unpolarized case [5]. Although the longitudinal distribution $\Delta\bar{u} - \Delta\bar{d}$ will be investigated, for example, at RHIC in W production processes, the transversity distribution $\Delta_T \bar{u} - \Delta_T \bar{d}$ cannot be measured by the W production due to the chiral-odd property. As an alternative way, the proton-deuteron Drell-Yan process is proposed [6]. We find theoretically that it is an appropriate way for finding $\Delta_T \bar{u} - \Delta_T \bar{d}$.

References

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