How well do we know the polarized parton densities in the nucleon at present ?

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Abstract

We present a critical assessment of what can be learned about the polarized parton densities from the present data on inclusive and semi-inclusive polarized DIS. Although the quality of the data has significantly improved in the past few years, the uncertainty in determining the polarized strange sea quark and gluon densities is still very large.

Bearing in mind the limited range in x and Q^2 and the accuracy of the present data, almost all QCD analyses supplement the DIS data with information stemming from low-Q^2 weak interaction reactions. We draw attention to some problems in the combined use of high-Q^2 deep inelastic scattering (DIS) data and low-Q^2 hyperon β-decay data in the determination of the polarized parton densities. We explain why factorization schemes like the JET or AB schemes are the simplest in which to study the implications of the DIS parton densities for the physics of the low-Q^2 region.

A new study of the sensitivity of the polarized parton densities to a breakdown of the SU(3) flavour symmetry treatment of the hyperon β-decays is presented. It is demonstrated that except for the strange sea quarks and the gluons the other densities are essentially those determined by the SU(3) analysis of the data. It is important to stress that the singlet quark density, as well as its first moment, $\Delta\Sigma$ (the spin of the nucleon carried by the quarks), are virtually unchanged by the SU(3) breaking. The mean value of $\Delta\Sigma$ in the JET scheme ranges from 0.34 to 0.40 and within the errors is not far from the value 0.60 expected in low-Q^2 quark models.

Despite the great progress of the past few years, the two challenging questions concerning the parton spin structure of the nucleon are still the gluon polarization Δg and the flavour decomposition of the sea quarks. It is expected that the Spin Physics Program at RHIC, as well as the future DIS experiments (COMPASS at CERN, HERMES at DESY and the Jefferson Lab. Spin program) will answer these questions very soon.