Abstract

Almost 30 years ago the EMC experiment discovered that the quark helicity contribution to the nucleon spin is small. Afterwards this result was confirmed by several other experiments. It came as a surprise, as it contradicts the expectation from simple models which otherwise were quite successful in describing the nucleon properties. A possible solution for this "spin puzzle" is that gluons are polarised. Therefore, gluon polarisation measurements are of great importance and motivated the flagship measurement of the COMPASS proposal.

In this monograph details about the direct measurement of the gluon polarisation in the nucleon, extracted from the data of the COMPASS experiment at CERN are presented. A novel method, the so-called all-p_{T} method, was developed by the author who was also responsible for the corresponding analysis in COMPASS.

The proposed method allows simultaneous extraction of the gluon polarisation and spin-dependent asymmetry A_1, resulting in a considerable reduction of statistical and systematic uncertainties by a factor of 1.6 and 1.8, respectively, compared with the previously used method. The analysed data cover the kinematic region of $Q^2 > 1$ GeV^2, which allows the use of perturbative QCD. The obtained result of the gluon polarisation at LO pQCD is $\Delta \mathrm{g/g} = 0.113 \pm 0.038 \pm 0.036$ for average nucleon momentum fraction carried by the gluon about 0.10 and average hard scale of 3 GeV^2. The obtained results suggest that the gluon polarisation in the nucleon is positive. This observation is in line with recent NLO QCD fits, which include RHIC pp data.