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Three-Dimensional Imaging and Spin - from Valence Quarks to the Sea

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From un-polarized Deep inelastic scattering (DIS) it is known that describing the properties of the nucleon by just three valence quarks is not sufficient for most properties. Even in the Quark model one only can describe the nucleon mass by dressing the bare quarks. The actual bare quark masses as obtained by the Higgs mechanism only make up about 1% of the total mass of the nucleon with the rest dynamically created by the strong interaction. The study of the the strong interaction thus is the study of the 99% of the visible mass of the universe. The best way to understand QCD is by studying the quark and gluon properties in the nucleon such as its momentum distribution, its helicity contribution as well as its three-dimensional dynamics. The valence quark helicity contributions have been well measured by semi-inclusive DIS measurements making use of the knowledge of the unpolarized distributions and fragmentation functions. Similarly first insights into the three dimensional structure have been made in semi-inclusive and exclusive DIS. Some knowledge is still missing at larger Bjorken x which is expected to be obtained from the JLAB12 upgrade and some RHIC transverse spin measurements. The non-valence quark quantities are not as well known yet. Recent RHIC measurements for the first time indicate a nonzero contribution of the gluon spin to the nucleon at intermediate x. Sea quarks at similar x will be reasonably constrained by the RHIC W program which directly accesses sea quarks and SIDIS measurements. However in order to study the total spin contribution to the nucleon lower x measurements are necessary in the future as the uncertainties due to extrapolation are still substantial and can alter the interpretation completely as it had between the first SLAC experiments and EMC. Similarly, a broad x range will be necessary to access the three-dimensional structure which allows us to more directly study the quark and gluon dynamics in the nucleon and provides some relation to the orbital angular momentum via the Ji sum rule. Consequently the first existing measurements need to be augmented by JLAB 12 at the high x range and in particular by EIC at mid to lower x with high precision. The current status of our knowledge on the quark and gluon spin contributions to the nucleon and its three-dimensional structure will be discussed. An brief outline of future measurements will be given as well.