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New Approach for Calculation of Valence Quark Distributions in the Nucleon

We develop a non-perturbative model for valence PDFs based on the quark interactions in the mean field of the nucleonic interior. The model is based on the separation of three valence quarks from the residual nucleon system which is the source of the mean field. The PDFs are calculated within effective light-front diagrammatic approach which allows to introduce light-front valence quark and residual system wave functions. Within the model we obtained a new relation between the position of the peak of xq(x) distribution of the valence quark and the effective mass of the residual system, mR: xp ~ 1/4(1 - mR/mN) and explained the difference in the peak positions for d- and u- quark distributions due to expected larger residual mass in the case of valence d- quarks. We evaluated the Q2 dependence of the mass of the residual system and its effective size which gives a new insight on the effects of QCD evolution on the mean field of the nucleon. The model also introduces a new dynamics for high x generation of the valence quarks and predicts the value of d/u ratio in the $x \longrightarrow 1$ limit. We demonstrate how the evaluated wave functions of valence 3q- and residual systems can be used in calculations of other observables such as nucleon form factors, generalized and transverse momentum distributions as well as target fragmentation functions.

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