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Mean Field Quarks on the Light Front

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We develop a non-perturbative, light-front approach for valence quark x-distribution in the nucleon to explain quark interactions in the mean field of the nucleonic interior. The main motivation for the model is to obtain a mean field description of the valence quarks as a baseline upon which to study the short-range quark-quark interactions that generate the high x tail of valence quark distributions. Our non-perturbative model is based on a residual system of the nucleon in which one assumes a factorization of the short-range valence quark and long-range dynamics. The nucleon structure functions are calculated using light-front dynamics and the effective Feynman diagrammatic approach is used to introduce valence quark and residual wave functions. The parameters of these wave functions are fixed by the position of the peak of $x f q(x)$ distribution of valence quarks at Q_0 corresponding to the charm-quark mass. With few parameters we achieved a very reasonable description of the up and down valence quark distributions in the moderate x region ($x \leq 0.5$) were one expects the mean field dynamics to dominate. The model however systematically underestimates the high x region where we expect enhanced contribution from partonic correlations.

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