Quark-antiquark asymmetry of the nucleon strange sea

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An incompatible feature of the chiral quark soliton model (CQSM) as compared with many other effective models of QCD like the MIT bag model is that it can give reasonable predictions not only for the quark distributions but also for the *antiquark distributions*. This is due to the field theoretical nature of the model, which enables us to carry out nonperturbative evaluation of the parton distribution functions with full inclusion of the valence and the *Dirac-sea* quarks in the rotating mean field of hedgehog shape. This feature is also believed to play a decisive role in investigating hidden strange quark excitations in the nucleon, which entirely have non-valence character. The main purpose of the present study is to give theoretical predictions for the unpolarized as well as the longitudinally polarized strange quark distributions in the nucleon on the basis of the CQSM generalized to flavor $SU(3)$, with account of the SU(3) symmetry breaking effects due to the mass difference between the strange and nonstrange quarks. (This effective mass difference Δm_s between the strange and nonstrange quarks is the only one additional parameter of the model necessary for the flavor $SU(3)$ generalization.) A paticular emphasis is put on the asymmetry of the s- and $\bar{s}$- quark distributions, which is believed to contain valuable information on the nonperturbative dynamics of QCD at low renormalization scale.

As an example of our predictions, we show in Fig. 1 the ratio of $s(x)$ and $\bar{s}(x)$ at $Q^2 = 20\,\mathrm{GeV}^2$. Here, the solid and dashed curves are respectively the predictions of the $SU(3)$ CQSM with and without the $SU(3)$ symmetry breaking corrections, whereas the thin and thick shaded areas represent the phenomenologically allowed regions for this ratio, respectively obtained by CCFR group and by Barone et. al. One clearly sees that observed x dependence for this ratio is quite sensitive to the $SU(3)$ symmetry breaking effects. We have also investigated the longitudinally polarized distributions to find that the s-$\bar{s}$ asymetry is much larger for the polarized distributions than for the unpolarized ones. We also find that the predictions of the $SU(3)$ CQSM for the longitudinally polarized distributions including the strange quarks are qualitatively consistent with the recent elaborate analyses carried out by Leader, Sidorov and Stamenov.

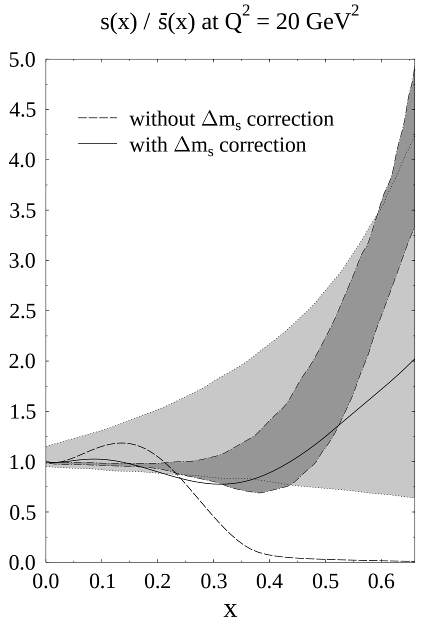

Figure. 1 : The theoretical predictions for the ratio $s(x)/\bar{s}(x)$ at $Q^2 = 20\,\mathrm{GeV}^2$ with and without Δm_s corrections in comparison with the CCFR fit and Barone et al's fit.