Chapter-VIII

SUMMARY AND CONCLUDING REMARKS

In this thesis we discussed the low energy nuclear physics phenomena from a QCD point of view. As the nucleons are the constituents in this domain special emphasis has been given on them. Though it is beyond doubt that QCD is the underlying theory of strong interactions, its exact solution is yet to be achieved. Particularly in the low energy regime, corresponding to the low momentum transfer, it is very much complicated as the coupling constant is too high in this region. To uncover the mystery of QCD it may be attacked from different sides. Here we adopted three different approaches to explain the low energy nuclear physics phenomena. The only similarity of these three approaches is that all of them are non-perturbative. Out of these three approaches the relativistic Hartree Fock and the Skyrmion model follow from the large $N_c$ QCD and the third one, the QCD sum rule method, is based on the operator product expansion through some non-vanishing vacuum condensates which vanish in ordinary perturbation theory. In QCD there is no approach which could
explain the theory completely. Anyway they may complement each other. Relativistic Hartree Fock model not only describes the baryon properties, - it may be applied to nuclear matter which has been discussed. In our problem we have taken Richardson potential in the vector part but this potential has been modified by Ding, Huang and Chen [111] combining the asymptotic freedom at large $Q^2$ with the multi-gluon effect at lower $Q^2$. So the model may be further studied with this modified potential. At present Skyrmion model has got special interest. It not only describes the ground state energy, it also reproduces the excitation energy. It is being tried to find a true effective Lagrangian to describe low energy phenomena of nuclear physics. Hadron properties from QCD sum rules have boosted our knowledge in this field and it is hoped that it will provide further information in understanding the reality. Consistency among these three approaches along with other models has also been found and a QCD based explanation for changes in nucleon properties in nuclear medium has been accounted.

There are outstanding problems in QCD. For example: transitions, involving detailed knowledge of wave functions,
do not agree with experiment, in any model. The recently discovered experimental polarization phenomenology is also unexplained. We would like to study these in the future.