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I N T R O D U C T I O N

Correlations in Many Nucleon Systems :

A decisive step in the understanding of a system of many nucleons was provided by the recognition of the fact that the scattering of nucleons is hindered by the Pauli principle which effectively limits the final available states to those above the Fermi level. Since the interaction of two nucleons which are sufficiently far apart (dominated by the single pion exchange contribution) contains only low Fourier components, the long ranged part of the force is essentially unable to elevate the nucleons above the Fermi level, leading to the concept of a 'healing distance' beyond which the relative wavefunction of two nucleons in the many nucleon system remains unperturbed. Nevertheless, the two nucleon interaction does possess a short ranged repulsion followed by an attractive force (presumably arising from the exchange of mesons such as π, ρ, ω etc or from uncorrelated multi-pion states); and this part of the force does possess Fourier components corresponding to large momenta and gives rise to short range correlations, which occur within a distance typically of the order of magnitude of 1 fm. The genesis of the short range correlation in many nucleon systems arising from the two nucleon interaction with the Pauli principle playing its inhibitory role is generally studied from two theoretical approaches :-

a) The perturbative method developed by Brueckner, Bethe and Goldstone among others, and

b) The variational approach recently brought into focus by Clark, Ristig, Fantoni, Rosati & Pandharipande;

extensive comparative studies between these two methods are also available and have stimulated reviews by several authors.

Apart from such short ranged correlations the nuclei exhibit collective motions which correlate the motions of many nucleons necessitating the introduction of collective variables and related concepts such as those which underlie the liquid drop model of the nucleus. This co-operativity manifests itself in the shape deformation of nuclei, the appearance of vibrational and rotational spectra, as well as in the enhancement (over single particle estimates) of EM transition probabilities.

This thesis is dedicated to a study of short and long ranged correlation in nuclei, organised respectively in chapters 1,2 and Chapters 3,4 of the work. Chapters 1 and 2 deal successively with the perturbative and variational approach to short ranged correlations. In Chapters 3 and 4. hydrodynamic limit of Schrödinger equation and the nature of co-operativity in the Lipkin model are discussed*. The matter contained in this thesis also appears in the following publications :-

J. Phys. G 5. (1979) 757
Zeits f Phys. A290 (1979) 269
J. Phys. G 3 (1977) 1077

and was reported in Dept. of Atomic Energy Symposia in 1977 (Pune), 1978 (Bombay I.I.T.) and 1979 (Madras I.I.T.).

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