Symmetry-projected Hartree-Fock-Bogoliubov Equations

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Symmetry-projected Hartree-Fock-Bogoliubov (HFB) equations are derived using the variational ansatz for the generalized one-body density-matrix in the Valatin form. It is shown that the projected-energy functional can be completely expressed in terms of the HFB density-matrix and the pairing-tensor. The variation of this projected-energy is shown to result in HFB equations with modified expressions for the pairing-potential Δ and the Hartree-Fock field Γ. The expressions for these quantities are explicitly derived for the case of particle number-projection. The numerical applicability of this projection method is studied in an exactly soluble model of a deformed single-j shell. published in Nucl. Phys. **A665** (2000) 71

Temperature Dependent Relativistic Mean Field Theory for Hot Nuclei

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The study of hot or highly excited nuclei is of prime importance both experimentally and theoretically. The experimental study is based upon the fission type or heavy ion reactions. The theoretical studies usually introduce the partition function and then calculate the relevant quantities like level density, entropy, excitation energy etc. etc. Such past theoretical investigations used the statistical model employing the spectra of independent particles moving in an average deformed nuclear potential - thereby calculating the energy surface within the Strutinsky method as a function of deformation for various excitations. This approach is not self-consistent in the sense that the deformation is not calculated self-consistently at each temperature excitation. Therefore, the temperature dependent mean field approach such as temperature dependent Hartree-Fock method with density dependent interaction of Skyrme type is then more appropriate. Such a self-consistent calculation also yields the average potential, single particle states and their occupation probabilities etc. at each temperature. This then enables to calculate important quantities like excitation energy, entropy, level density parameter etc. and also to answer the question at what temperature shell effects disappear. The results of calculations with the Skyrme-III interaction reveal that the deformation disappear at around T$\sim$3 MeV for ^{168}Yb, where the minima of the free energy occurs at zero deformation. On the other hand the Strutinsky type calculation yields zero deformation in general at lower temperatures e.g. T$\sim$1.8 MeV for ^{168}Yb. We show here that this difference in the value of temperature T perhaps is due to the value of the effective mass <1 appearing in Skyrme-III interaction.

Relativistic mean field theory has been shown to be very successful for the description of a variety of nuclear properties even for those where the conventional non-relativistic DDHF description was deficient. Therefore, it is worthwhile to extend RMF to include temperature resulting in the temperature dependent RMF and to carry out explicit numerical calculations. We present and discuss some of our temperature dependent relativistic mean field results for a few selected representative spherical (^{208}Pb, ^{298}GG) and deformed (^{168}Er, ^{168}Yb, ^{150}Sm) nuclei, with the the following objectives: to demonstrate the feasibility of carrying out such calculations in practice, to bring out the salient general features, to compare these with the corresponding temperature dependent Hartree Fock results obtained with the density dependent interaction of the Skyrme type. published in Phys. Rev. **C62** (2000) 054610 (1-8)