Beyond the relativistic mean-field approximation: configuration mixing calculations

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The framework of relativistic self-consistent mean-field models is extended to include correlations related to the restoration of broken symmetries and to fluctuations of collective variables. The generator coordinate method is used to perform configuration mixing of angular-momentum and particle-number projected relativistic wave functions. Intrinsic wave functions are generated from the solutions of relativistic mean-field equations, with a constraint on the mass quadrupole moment. The model, currently restricted to axially symmetric shapes, employs a relativistic point-coupling (contact) nucleon-nucleon effective interaction in the particle-hole channel, and a density-independent δ-interaction in the pairing channel. Both global and spectroscopic properties of nuclei are discussed [1-3]. In addition, an implementation of the five-dimensional collective Hamiltonian for quadrupole vibrational and rotational degrees of freedom is developed. The parameters are determined by constrained self-consistent mean-field calculation for triaxial shapes. The model is applied to nuclei in the Z=60, 62 and 64 with $N \sim 90$ region of the periodic chart [4,5,6].

Results of configuration mixing calculations indicate the need for an improved effective interaction. One possible approach is to start from the existing phenomenological finite-range interactions, and perform a mapping on a zero-range effective interaction [7]. Another possibility is to adjust the interaction directly to ground-state properties of a large set of nuclei. An overview of the most recent attempts to adjust reliable global effective point-coupling interaction will be presented [8].

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