Computer Program for the Relativistic Mean Field Description of the Ground State Properties of Even-Even Axially Deformed Nuclei

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We present a Fortran program for the calculation of the ground state properties of axially deformed even-even nuclei in the framework of Relativistic Mean Field Theory (RMF). In this approach a set of coupled partial differential equations have to be solved self-consistently: the Dirac equation for the nucleons moving in self-consistent fields and the Klein Gordon equations for the meson fields and the electro-magnetic field, whose sources are scalar and vector densities determined of the nucleons. For this purpose the Dirac spinors as well as the meson fields are expanded in terms of anisotropic oscillator wave functions in cylindrical coordinates. This requires a matrix diagonalization for the solution of the Dirac equations and the solution of an inhomogeneous matrix equation for the meson fields. For the determination of the Coulomb field the Greens function method is used.

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Density Dependent Relativistic Mean Field Theory in Deformed Nuclei

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We perform density dependent relativistic mean field calculations for deformed nuclei in order to examine the possibility of describing nuclear deformation properties in a parameter-free framework. The results are compared with experimental data and with results from earlier phenomenological relativistic mean field calculations using non-linear terms in the σ-field.

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Application of the Effective Gauge Invariant Nuclear Lagrangian for Nuclear Matter and Finite Nuclei

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A chiral approach is investigated in the nuclear structure context, all vector fields of this approach being treated as the Yang-Mills fields, the pion being the only Goldstone particle. The two-pion exchange generated by the lagrangian considered is simulated by a scalar-isoscalar field $S_\pi$essential ingredients of the present treatment: σ-field, a chiral partner of the pion; and $\Sigma$the ω-meson; these fields are responsible for maintaining the chiral symmetry and producing the non-linear structure of the equations of motion. These fields form also a mechanism for essentially reducing the value of the incompressibility modulus up to phenomenologically desirable values. Good values of K is a remarkable feature of the present approach.

Two models (MI and MII) are constructed. Both models reproduce reasonably well the nuclear matter observables and bulk properties of finite nuclei in the mean field approximation. In model MII σ-field is frozen ($\sigma = \sigma_0$, $m_\sigma = \infty$). This reduces the number of parameters. However, MII gives results comparable to those obtained in MI. The density distributions in MII are even better than in MI. Both models MI and MII may be utilized as working models.

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