Effective Field Theory for Rotational Bands in Deformed and Superdeformed Nuclei ◇

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An overview is given on the description of rotational bands in normally deformed and superdeformed nuclei in the framework of effective field theories such as the Relativistic Mean Field (RMF) theory or the Relativistic Hartree-Bogoliubov (RHB) theory. In particular we discuss recent investigations for the description of superdeformed bands in the $A \sim 30$, $A \sim 60$, $140 - 150$ and 190 mass regions and compare them briefly with the results obtained in non-relativistic mean field theories.

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Relativistic Hartree-Bogoliubov Description of Sizes and Shapes of $A = 20$ Isobars ◇

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Ground-state properties of $A = 20$ nuclei (^{20}N, ^{20}O, ^{20}F, ^{20}Ne, ^{20}Na, ^{20}Mg) are described in the framework of Relativistic Hartree-Bogoliubov (RHB) theory. The model uses the NL3 effective interaction in the mean-field Lagrangian, and describes pairing correlations by the pairing part of the finite range Gogny interaction D1S. Binding energies, quadrupole deformations, nuclear matter radii, and differences in radii of proton and neutron distributions are compared with recent experimental data.

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Relativistic Field Theories and the Microscopic Description of the Nuclear System ◇

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Since ab initio calculation in finite nuclei are still limited to applications in very light systems, the major part of the nuclear periodic table can be investigated at present only in the framework of phenomenological theories which are either based on non-relativistic density functionals or on effective relativistic Lagrangians. Their construction is determined by symmetries, by simplicity and by basic experimental facts of the nuclear system. The necessary parameters are usually adjusted to the experimentally known properties of nuclear matter, i.e. from the average properties of nuclear masses or to properties of a few finite spherical nuclei.

In recent years the application of relativistic versions of this concept, such as Relativistic Mean Field (RMF) or Relativistic Hartree-Bogoliubov (RHB) theory have been applied with great success in many areas of the periodic table. New inside has been gained in specific relativistic effects and new relativistic models are presently developed, as for instance models with density dependent coupling constants or point-coupling models allowing more systematic expansions of the relativistic energy functional.

An overview is given on modern applications of relativistic mean field descriptions of finite nuclear systems and their limits. In particular we concentrate on nuclei under extreme conditions, i.e. nuclei far from stability, where we expect considerable changes of the isospin dependent parts of the mean fields, on nuclei with extreme deformations and high spins, where the rotating mean fields play an essential role, and on the region of super-heavy elements, where high level densities make it difficult to predict new magic numbers reliably.

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