Superheavy Nuclei in the Relativistic Mean Field Theory

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We have carried out a study of superheavy nuclei in the framework of the Relativistic Mean-Field theory. Relativistic Hartree-Bogoliubov (RHB) calculations have been performed for nuclei with large proton and neutron numbers. A finite-range pairing force of Gogny type has been used in the RHB calculations. The ground-state properties of very heavy nuclei with atomic numbers Z=100-114 and neutron numbers N=154-190 have been obtained. The results show that in addition to N=184 the neutron numbers N=160 and N=166 exhibit an extra stability as compared to their neighbors. For the case of protons the atomic number Z=106 is shown to demonstrate a closed-shell behavior in the region of well deformed nuclei about N=160. The proton number Z=114 also indicates a shell closure. Indications for a doubly magic character at Z=106 and N=160 are observed. Implications of shell closures on a possible synthesis of superheavy nuclei are discussed.

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Application of the Finite Element Method in Selfconsistent Relativistic Mean Field Calculations

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A C++ code is presented which calculates properties of a one-dimensional slab of nuclear matter in the framework of relativistic mean field theory. The nuclear slab is described as a system of nucleons that are coupled to exchange mesons through an effective Lagrangian. Finite element methods are used in the solution of a coupled system of partial differential equations for the nucleons and for mesons. Using a formulation based on weighted residuals, the coupled system of Dirac and Klein-Gordon equations is transformed into a generalized algebraic eigenvalue problem for the self-consistent solution.

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A New Parameterization for the Lagrangian Density of Relativistic Mean Field Theory

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A new parameterization for an effective non-linear Lagrangian density of relativistic mean field (RMF) theory is proposed, which is able to provide a very good description not only for the properties of stable nuclei but also for those far from the valley of beta-stability. In addition the recently measured superdeformed minimum in the ^{194}Hg nucleus is reproduced with high accuracy.

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