Compressed Nuclei in a Schematic Relativistic Mean-Field Description

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The relativistic mean-field approximation is extended to compressed nuclei by adding a constraint to the Lagrangian that models an external pressure. For a constraint depending on the meson fields we calculate total energies, intrinsic nuclear energies, single-particle energies, and densities of compressed nuclei. At some critical compression remarkable changes of the nuclear structure are found resembling phase transitions. These changes are connected with discontinuities in the single-particle structure caused by compression.

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Mapping the Proton Drip Line from $Z = 31$ to $Z = 49$ ◇

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The structure of proton drip line nuclei in the $60 < A < 100$ mass range is studied with the Relativistic Hartree Bogoliubov (RHB) model. For the elements which determine the astrophysical rapid proton capture process path, the RHB model predicts the location of the proton drip-line, the ground-state quadrupole deformations and one-proton separation energies at and beyond the drip-line. The results of the present theoretical investigation are compared with available experimental data. For possible odd-Z ground state proton emitters, the calculated deformed single-particle orbitals occupied by the odd valence proton and the corresponding spectroscopic factors are compared with predictions of the macroscopic-microscopic mass model.

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Isoscalar Compression Modes in Relativistic Random Phase Approximation ◇

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Monopole and dipole compression modes in nuclei are analyzed in the framework of a fully consistent relativistic random phase approximation (RRPA), based on effective mean-field Lagrangians with nonlinear meson self-interaction terms. The large effect of Dirac sea states on isoscalar strength distribution functions is illustrated for the monopole mode. The main contribution of Fermi and Dirac sea pair states arises through the exchange of the scalar meson. The effect of vector meson exchange is much smaller. For the monopole mode, RRPA results are compared with constrained relativistic mean-field calculations. A comparison between experimental and calculated energies of isoscalar giant monopole resonances points to a value of $250 \sim 270$ MeV for the nuclear matter incompressibility. A large discrepancy remains between theoretical predictions and experimental data for the dipole compression mode.

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