Pygmy Dipole Resonances in Relativistic Random Phase Approximation ◇

D. Vretenar, N. Paar, P. Ring, and G. A. Lalazissis

The isovector dipole response in ^{208}Pb is described in the framework of a fully self-consistent relativistic random phase approximation. The NL3 parameter set for the effective mean-field Lagrangian with nonlinear meson self-interaction terms, used in the present calculations, reproduces ground state properties as well as the excitation energies of giant resonances in nuclei. In addition to the isovector dipole resonance in ^{208}Pb, the present analysis predicts the occurrence of low-lying E1 peaks in the energy region between 7 and 11 MeV. In particular, a collective state has been identified whose dynamics correspond to that of a dipole pygmy resonance: the vibration of the excess neutrons against the inert core composed of equal number of protons and neutrons.

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Collectivity of the Low-lying Dipole Strength in Relativistic Random Phase Approximation ◇

D. Vretenar [a], N. Paar, P. Ring, and G. A. Lalazissis
[a] Physics Department, University of Zagreb, Croatia

The relativistic random phase approximation is applied in the analysis of the evolution of the isovector dipole response in nuclei with a large neutron excess. The self-consistent framework of relativistic mean-field theory, which has been very successfully applied in the description of ground-state properties of nuclei far from the valley of β-stability, is extended to study the possible onset of low-energy collective isovector dipole modes in nuclei with extreme isospin values.

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On the Solution of the Number-Projected Hartree-Fock-Bogoliubov Equations ◇

J. A. Sheikh [a], E. Lopes, and P. Ring
[a] Tata Insitute for Fundmental Research, Mumbay, India

The numerical solution of the recently formulated number-projected Hartree-Fock-Bogoliubov equations is studied in an exactly soluble cranked-deformed shell model Hamiltonian. It is found that the solution of these number-projected equations involve similar numerical effort as that of bare HFB. We consider that this is a significant progress in the mean-field studies of the quantum many-body systems. The results of the projected calculations are shown to be in almost complete agreement with the exact solutions of the model Hamiltonian. The phase transition obtained in the HFB theory as a function of the rotational frequency is shown to be smeared out with the projection.

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