
KOLOKVIJ FIZIČKOG ODSJEKA

Vrijeme: utorak, 11. 12. 2007., 15:15 sati (točno)
Mjesto: Fizički odsjek, Bijenička c. 32, predavaonica F08

EXOTIC NUCLEAR STRUCTURE: COVARIANT ENERGY DENSITY FUNCTIONALS AND BEYOND

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The framework of covariant energy density functionals has been applied in the description of a variety of nuclear structure phenomena, not only in spherical and deformed nuclei along the valley of beta-stability, but also in exotic systems with extreme isospin values and close to the particle drip-lines. The latest advances in phenomenological density functionals, as well as new microscopic approaches and constraints will be reviewed.

Self-consistent covariant mean-field models have recently been extended to include additional correlations related to restoration of broken symmetries and to fluctuations of the quadrupole deformation. This approach enables a quantitative description of the evolution of shell-structure, deformation and shape coexistence phenomena in nuclei with soft potential energy surfaces, and singular properties of excitation spectra and transition rates at critical points of quantum shape phase transitions.

The relativistic quasiparticle random-phase approximation has been employed in studies of dynamical aspects of exotic nuclear structure. New and interesting results include the evolution of low-lying dipole strength in neutron-rich nuclei and the isotopic dependence of the pygmy dipole resonance, prediction of the occurrence of pygmy dipole resonances in proton-rich nuclei, calculations of beta-decay rates of r-process nuclei, and modelling charged-current neutrino-nucleus reactions.

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