Exotic nuclear structure: relativistic mean-field and beyond

D. Vretenar[1], T. Nikšić[1,2], N. Paar[3], P. Ring[2]

[1] *Physics Department, Faculty of Science, University of Zagreb, Croatia*
[2] *Physik-Department der Technischen Universität München, D-85748 Garching, Germany*
[3] *Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany*

The self-consistent relativistic Hartree-Bogoliubov (RHB) model has been very successfully applied in the description of a variety of nuclear structure phenomena, not only in spherical and deformed nuclei along the valley of β-stability, but also in exotic nuclei with extreme isospin values and close to the particle drip-lines [1]. This framework has recently been extended to include additional correlations related to the restoration of rotational symmetry and particle numbers, and fluctuations of quadrupole deformation [2]. A new model has been developed which uses the generator coordinate method to perform configuration mixing calculations of angular momentum and particle-number projected wave functions, generated in the RHB model with point-coupling effective interactions. This approach enables a quantitative description of the evolution of shell-structure, deformation and shape coexistence phenomena in weakly-bound nuclei with soft potential energy surfaces. Recent data on shape coexistence in the $A \approx 70$ mass region, and in neutron-deficient Pb and Hg isotopes have been analyzed.

Based on the RHB model, the relativistic (proton-neutron) quasiparticle random-phase approximation (RQRPA) has been developed and 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 [3], the relation between the neutron skin of nuclei and the difference of excitation energies of Gamow-Teller resonances and isobaric analog states [4], and the prediction of the occurrence of pygmy dipole resonances in proton-rich nuclei [5].

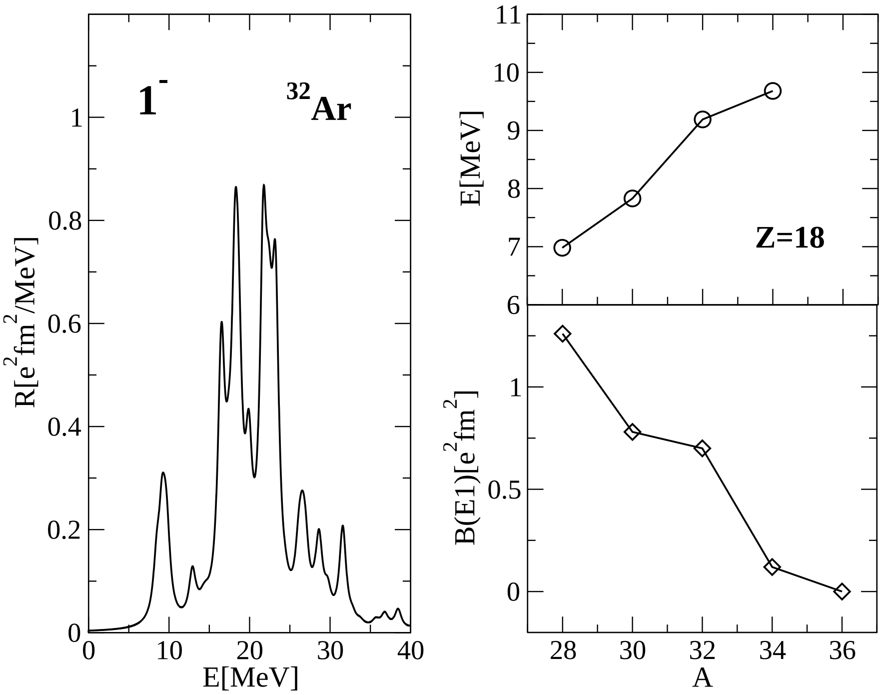

Figure 1: *Proton pygmy dipole resonance in ^{32}Ar.*

[1] D. Vretenar, A.V. Afanasjev, G.A. Lalazissis, P. Ring, Phys. Rep. 409, 101 (2005).
[2] T. Nikšić, D. Vretenar, P. Ring, Phys. Rev. C 73, 044320 (2006).
[3] N. Paar, T. Nikšić, D. Vretenar, P. Ring, Phys. Lett. B 606, 288 (2005).
[4] D. Vretenar, N. Paar, T. Nikšić, P. Ring, Phys. Rev. Lett. 91, 262502 (2003).
[5] N. Paar, D. Vretenar, P. Ring, Phys. Rev. Lett. 94, 182501 (2005).