

MODERN ENERGY DENSITY FUNCTIONAL AND THE STATUS OF THE EQUATION OF STATE OF NUCLEAR MATTER

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The development of a modern and more realistic nuclear energy density functional (EDF) for accurate predictions of properties of nuclei is the subject of enhanced activity, since it is very important for the study of properties of rare nuclei with unusual neutron-to-proton ratios that are difficult to produce experimentally and likely to exhibit interesting new phenomena associated with isospin, clusterization and the continuum. Adopting the standard parametrization of the Skyrme type interactions, we have determined within the Hartree-Fock (HF) mean-field approximation a new and more realistic Skyrme interaction by carrying out a fit to an extensive set of data on; (i) binding energies, (ii) "bare" single-particle energies, (iii) charge root-mean-square (rms) radii, (iv) rms radii of valence neutron orbits, and (v) the energies of isoscalar giant monopole resonances (ISGMR). We have also imposed additional constraints; (i) Landau stability constraints on nuclear matter (NM), and (ii) non-negativity of the slope of the symmetry energy density at high density of NM (up to three times the saturation density of NM), which is of importance in the study of properties of neutron star.

We will present results of our calculations of properties of nuclei and NM by employing our newly obtained EDF and address, in particular, the equation of state (EOS) of symmetric and asymmetric NM. The EOS of NM is an important ingredient in the study of various properties of nuclei, heavy-ion collisions, supernovae and neutron stars. Accurate values of the NM incompressibility coefficient, K , and the symmetry energy coefficient, J , are needed in order to extend our knowledge of the EOS in the vicinity of the saturation point of the symmetric NM and for asymmetric NM.