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Equilibrium ground-state deformation of medium and heavy nuclei calculated on the basis of deformed Woods–Saxon potential with variable surface diffuseness

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Potential energy surfaces in (β, γ) coordinates and equilibrium ground-state deformations of nuclei with $50 \leq A \leq 240$ are calculated using a simple model based on the Mottelson–Nilsson approach where the potential energy of deformation is taken as a sum of occupied levels in an ellipsoidally deformed one-particle potential well. Parameters of the real part of the global optical potential [1] evaluated at the Fermi surface are taken as the initial undeformed spherical Woods–Saxon potential. In the course of deformation the thickness of the diffuse surface layer in the direction of the normal to the surface is kept constant by the requirement that the gradient of the form-factor is independent on the angular variables. The enclosed volume of the deformed potential is equal to the volume of the initial spherical case. It was found, however, that in order to adequately describe experimental data the diffuseness parameter of the potential had to be adjusted with a small correction factor less than 1\%, represented as a function of the deformation parameters β and γ. Such correction can serve as an indirect way of inclusion of residual interaction in the model, selecting the correct local minimum of the potential energy. Connection between the diffuseness parameter and the value of the surface energy is demonstrated on the example of spherical and deformed nuclei. The pairing effect is taken into account using the BCS model.

Predicted deformations of about 100 isotopes are compared with the nuclear deformation database [2], based on experimental compilation of static electric quadrupole moments [3], and with other theoretical calculations.

1. A. Koning and J. Delaroche, Nucl. Phys. A 713, 231 (2003).
2. http://cdfe.sinp.msu.ru/services/radchart/radmain.html
3. N. Stone, At. Data Nucl. Data Tables 90, 75 (2005).

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