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8.1 Properties of Heavy and Superheavy Nuclei

by I.Muntian, A.Parkhomenko, Z.Patyk and A.Sobiczewski

Studies of the properties of the heaviest nuclei have been continued. Calculations of the masses of the heaviest nuclei have been performed within a macroscopic-microscopic approach [1]. Attention has been given to an analysis of the (static) fission-barrier height of these nuclei [2-4]. In particular, the role of higher-multipolarity deformations of a nucleus, taken in the analysis, has been studied for both spherical and deformed (in their ground state) nuclei. The problem of existence of superheavy nuclei which are superdeformed in their ground state, predicted in the literature, has been checked with the use of a macroscopic-microscopic model [5]. Our results do not support these predictions. To meet the needs of experimental physicists recently performing α- and γ-spectroscopic studies of odd-A heaviest nuclei, single-particle spectra of these nuclei have been calculated [6, 7]. The results indicate that the calculations reasonably reproduce the ground state of the nuclei and the sequence of the lowest excited states, while the average deviation between calculated and measured excitation energies is about 300 keV.

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8.2 Pairing Properties of Exotic Nuclei Far from the Stability Line

by Z.Patyk

Studies of the pairing properties, especially for new measured [1, 2, 3] neutron-deficient nuclei far from the stability line, have been performed. We compared an experimental pairing Δ_3 extracted from 3-mass formula, with the BCS pairing Δ_{BCS} calculated with the Woods-Saxon single particle energy spectrum. Strong dependence of the pairing Δ_3 on nuclear isospin, experimentally observed for deformed exotic nuclei from Sn up to Pb isotopes, has been supported by theoretical analysis. As a result, the new pairing strength was parameterized with two constants for protons (p) and neutrons (n)

$G_{p(n)}=g_0/A+(-)g_1(N-Z)/A^2$

with g_0=20.8 MeV and g_1=22.4 MeV [3]. With this paring parameterization the rms, the quantity reflecting an agreement between the experimental Δ_3 and the theoretical pairing Δ_{BCS} was reduced to 130 keV.

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8.3 Theoretical Research on Properties and Formation of Superheavy Elements

by R.Smolańczuk

Theoretical investigations of shell structures, magic numbers, energies, shell corrections, masses, deformations and decay properties of superheavy elements have been performed [1]. Theoretical investigations of the formation probabilities for superheavy nuclei have been performed as well [2]. Predictions for future experiments have been given [1, 2]. ^{293}118 and ^{294}119 have been predicted [2] to be the best isotopes for the discovery of the superheavy elements with atomic numbers 118 and 119, respectively.

These reactions might also give an opportunity for the discovery and measurements of the properties of the variety of spherical and deformed superheavy elements that could be obtained through the consecutive decays of elements 118 and 119.

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