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Institute of Nuclear Physics

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NUCLEAR SCIENCE AND TECHNOLOGIES

ABSTRACTS

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2nd International Conference "Nuclear and Radiation Technologies in Medicine, Industry and Agriculture"

5 th ISTC-CERN-JINR-Kazakhstan Summer School on High Energy Physics, Accelerator Technologies, Nuclear and Radiation Physics, Nuclear Medicine

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В сборнике представлены тезисы докладов участников III Международного научного форума в области фундаментальной и прикладной ядерной физики, радиационной физики твердого тела, радиационной экологии, методов анализа, применения ядерных и радиационных методов в медицине и промышленности.

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EFFECTIVE TRIAXIALITY OF EVEN-EVEN NUCLEI WITH QUADRUPOLE AND OCTUPOLE DEFORMATIONS

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The fundamental properties of the nuclear shape are expressed by the parameter quadrupole deformation β and asymmetry parameter γ. The parameter β is related to the intrinsic quadrupole moment and describes the magnitude of departure from the spherical shape along given axis. At $\gamma=0$ and $\gamma=\pi/3$ corresponds to the axially symmetric prolate and oblate shapes, respectively. The intermediate values of γ, within $0<\gamma<\pi/3$, give the triaxial shapes. Furthermore, evidence of triaxial γ-deformations of the nuclear form has long been known in nuclear spectroscopy. For example, some characteristics such as surface oscillations, signature inversion, and chiral doublets, possibly caused by γ-deformations are observed in many nuclei. The non-axially-symmetric nuclei are soft or triaxial has been extensively investigated in the framework theoretical approaches that are based on a rigid triaxial potential and a completely γ-flat (γ-unstable) potential. Recently, for description energy levels with alternating parity of even-even nuclei with triaxial quadrupole and octupole deformations (γ-η-deformations), in the region lanthanides and actinides an approximation triaxial rotator model (in the case K-mixing, K are the projections of the angular momentum on the third axes of the intrinsic frames) was used.

The collective spectra of atomic nuclei with axial-symmetry (K=0) quadrupole and octupole deformations are characterized by rotational bands with alternating parity. Yrast and non-yrast energy bands with alternating parity of deformed axial-symmetry even-even nuclei was described within a collective model with non-adiabatically coupled quadrupole and octupole degrees of freedom. Where satisfactorily reproduced the strucutre of the yrast and first non-yrast alternating-parity sequences in the rare-earth nuclei ^{150}Nd, ^{152,154}Sm, ^{154}Gd, ^{156}Dy, ^{162,164}Er and the actinides ^{232,234,236,238}U. Where the hamiltonian of the axial-symmetry even-even nuclei has an exact I(I+1) dependence and the observed or estimated deviations from such a simple energy dependence is actual task.

It should be noted that in the experiments one can observe energy bands, which cannot be explained within framework the nuclei models with axially-symmetric multipole deformations. For example, the spectrum of γ-band energy levels. Therefore, the purpose of the present work is to develop the model of atomic nuclei with triaxial quadrupole and octupole deformations. We calculate values energy levels and are compared with available experimental data and the implemented analysis allows us to make a conclusion about the relevance of the applied model formalism.

EFFECT OF CLUSTER POLARIZATION ON THE SPECTRUM OF THE ^{6}Li NUCLEUS

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Recently, a significant influence of different types of polarization has been detected in numerous theoretical investigations of thermonuclear reactions and the structure of some light nuclei involved. It has been demonstrated that among different types of polarization, the cluster polarization has largest impact in light nuclei, as it significantly affects the formation of bound and resonant states of compound nuclei. In the present paper, we study effects of cluster polarization on the spectrum of resonance states and cross sections of nuclear reactions in the ^{6}Li nucleus.

To study the structure of the ^{6}Li nucleus and the effects of cluster polarization, a microscopic three-cluster model is used [1]. This model involves two three-cluster configurations α+p+n and 3H+d+p and it therefore allows us to take into account all dominant binary channels: α+d, ^{5}He+p, ^{5}Li+n and ^{3}H+^{3}He. Thus, the model reduces three-cluster problem to a set of binary channels. The Gaussian and oscillator basis of functions are employed to expand the wave functions of two-cluster subsystems and three-cluster compound system as well. The main advantages of the model used are: (i) it takes into account the Pauli principle, (ii) it provides an accurate description of the internal structure of interacting two-cluster subsystems, and (iii) reduces the Schrödinger equation to a system of linear algebraic equations.

The pairwise semi-realistic nucleon-nucleon potential of Minnesota [2] was chosen as the potential describing the interactions between nucleons.

The analysis of the obtained results shows that cluster polarization has a rather strong effects on the structure of the bound and resonance states of the ^{6}Li nucleus, it significantly changes their energies and widths. It is demonstrated that the polarization shifts the energy of the ground state of the nucleus and the 3+ resonant state by more than 1MeV. We also noticed a decrease of the total widths of all the considered resonances, especially the resonant 3+ state, the width of which is decreased by almost 14 times.

Visualization of cluster polarization is performed for two channels: ^{4}He+d and ^{5}He+p. For the first channel, the polarizability of the deuteron d (i.e., the change of its size) is shown when it approaches ^{4}He, and for the second channel, the polarizability of ^{5}He is displayed when it interacts with a proton. It is also shown that the results obtained within present model are consistent with results of other microscopic models and are in a fairly good agreement available experimental data.

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ESTIMATION OF MULTIPLICITY AND CHARACTERISTICS OF THERMALIZATION OBTAINED IN THE HOLOGRAPHIC APPROACH USING ADS$_5$ WITH PHANTOM BLACK HOLE

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Study of the quark-gluon plasma formed as a result of the collision of heavy ions is currently being underway both in experimental facilities and in theoretical works. In the holographic approach, the formation of quark-gluon plasma in four-dimensional Minkowski space is described by the formation of black holes in a five-dimensional anti-de Sitter space AdS_5. And with the help of the entropy of five-dimensional black hole, determined by the area of the trapped surface, the multiplicity of particle formation in the heavy ions collision is estimated [1-5]. At the same time, the process of black hole formation in the AdS_5 in holographic language also describes the process of the transition of quark-gluon plasma in the four-dimensional Minkowski space to the state of thermodynamic equilibrium [6-8]. For a more accurate description of the experimental data, the AdS_5 is modified, for example, by adding some fields to it.

In our work, for a holographic fluid dual to the AdS_5 with phantom black hole, taken as a model of quark-gluon plasma formed by heavy ions collisions in the corresponding problem of five-dimensional gravity, we have investigated the thermalization process and have estimated produced particles multiplicity.

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СОДЕРЖАНИЕ

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