LXIV MEETING ON NUCLEAR SPECTROSCOPY AND NUCLEAR STRUCTURE

LXIV INTERNATIONAL CONFERENCE

«NUCLEUS 2014»

FUNDAMENTAL PROBLEMS OF NUCLEAR PHYSICS, ATOMIC POWER ENGINEERING AND NUCLEAR TECHNOLOGIES

BOOK OF ABSTRACTS

July 1–4, 2013
Minsk
Belarus

MINSK
2014

RUSSIAN ACADEMY OF SCIENCES
JOINT INSTITUTE FOR NUCLEAR RESEARCH
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July 2, Wednesday, 9:00

Section II

Experimental Investigations of Nuclear Reactions Mechanisms

July 2, Wednesday, 9:00

Section III

Theory of Atomic Nucleus and Fundamental Interactions

THE MEASUREMENTS OF DIFFRACTION OF THE ANGULAR DISTRIBUTIONS OF ALPHA PARTICLES WITH ENERGIES 29 MeV ON NUCLEI ^{59}Co, ^{197}Au, ^{209}Bi

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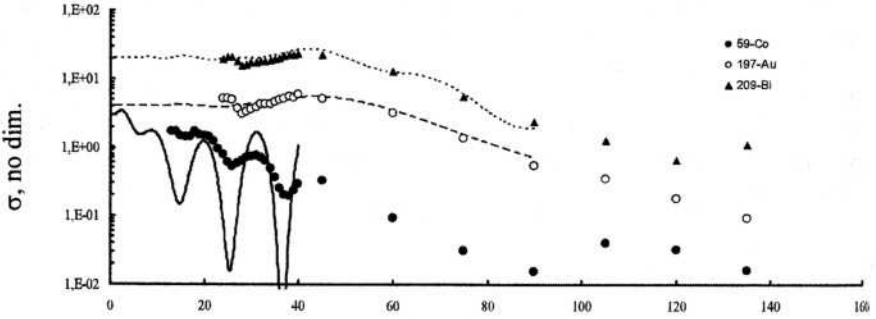
Fraunhofer and Fresnel nuclear diffraction was measured for the study of the odd shape of medium and heavy nuclei, in which, as a rule, collective states are not discovered and inelastic scattering can not be measured due to insufficient energy resolution of the spectrometer. The diffraction of angular distributions of differential cross sections of elastically scattered alpha particles with energy 29 MeV on nuclei ^{59}Co, ^{197}Au, ^{209}Bi was measured. Alpha-particle beam was extracted from the isochronous cyclotron U-150M (Republic of Kazakhstan).



The figure shows the experimental angular distributions compared with theoretical calculations in the framework of parameterized phase analysis. Fit into the angle responsible for the Fraunhofer scattering mechanism yielded average size of studied nuclei. A theoretical optimization of parameters in the range of small angles (Fresnel mechanism) yielded signs of deformation of these odd nuclei. Together with the analysis of the world's available literature data in this paper concludes their positive (^{209}Bi, ^{197}Au) and negative (^{59}Co) deformation that agrees satisfactorily with the systematization of work [1, 2].

1. A.V.Yushkov // Phys. of Elem. Part. and Atomic Nucl. 1993. V.24(2). P.348
2. V.V.Dyachkov *et al.* // Izv. RAN. Phys. 2012. V.76(8). P.1011.

THE PHENOMENON OF DIFFRACTION RISE OF CROSS SECTIONS IN THE FORWARD HEMISPHERE OF ANGLES AS THE EFFECT OF NUCLEAR AND CLUSTER INTERFERENCE

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Meitner has proposed in 1921 the idea that the main structural unit of the nucleus is an alpha particle. Rutherford also adhered to the concept Meitner, assuming that the core consists of alpha particles [1].

The clustering of nuclear structure is understood in two ways in modern physics of clusters. First, the wave function of the nucleon associations can be "spread" over the entire volume of the nucleus with an increased probability of correlated motion of nucleons, regardless of their spatial localization in the nucleus. At the same time an effective amount of alpha-clusters in the nucleus is much more than $A/4$ [2]. Secondly, from the inception of the concept of clusters been attempts detections nucleon associations based on the concept of separate clusters in the volume of the nucleus. For example, the irradiation of light nuclei by high-energy protons observed dominant to fly alpha particles.

In this paper we attempt to search for the effects of separate clusters in the angular distributions of elastic scattering at the wavelength variation of the incident alpha particles is $\lambda\!\!\!^{-} \le R_\alpha < R$. There is well known phenomenon of the rise of differential cross sections in the forward hemisphere of angels in physics of the elastic scattering of light ions on light nuclei. To explain the effect of rise the cross section based on the consideration of light nuclei as much alpha-clustered structures: ^{12}C nucleus consists of three alpha clusters ^{16}O - four alpha-clusters and so on until the nucleus ^{40}Ca. Description cross section multi-cluster structure of the nucleus in the spatial differentiation of alpha-clusters can be represented in a simplified manner without Coulomb amplitude as the square of the sum of the amplitudes of scattering particles on the absorbent black core and absorbing black components - alpha-clusters

$$\sigma'(\theta) = D_0 \left| \sum_{i=1}^{n} A_i(R_i, \theta) \right|^2 = D_0 \left| \sum_{i=1}^{n} a_i \cdot J_1(kR_i\theta) \right|^2,$$

where D_0 - the normalization factor; $A_i(R_i, \theta)$ – amplitude at the *i*-th cluster substructure of the nucleus; a_i – relative statistical weight of diffraction scattering at the *i*-th cluster of the nucleus; n - number of cluster structures in the nucleus. A global analysis of the angular distributions, apparently, clearly shows the existence of spatially separate alpha clusters evident in the effect of rise cross sections.

1. G.A.Hakimbaeva. Historical Review. 1975. 105 p.
2. V.G.Neudachin *et al.* Nucleon Associations in Light Nuclei. 1968. 414 p.

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