LXIII MEETING ON NUCLEAR SPECTROSCOPY AND NUCLEAR STRUCTURE

LXIII INTERNATIONAL CONFERENCE

NUCLEUS 2013

FUNDAMENTAL PROBLEMS OF NUCLEAR PHYSICS AND ATOMIC POWER ENGINEERING

DEDICATED TO 70th ANNIVERSARY OF THE NATIONAL RESEARCH NUCLEAR UNIVERSITY «MEPhI»

BOOK OF ABSTRACTS

October 8 - 12, 2013
Moscow
Russia

SAINT-PETERSBURG
2013

RUSSIAN ACADEMY OF SCIENCES
THE STATE ATOMIC ENERGY CORPORATION «ROSATOM»
INSTITUTE FOR NUCLEAR RESEARCH OF THE
RUSSIAN ACADEMY OF SCIENCES
NATIONAL RESEARCH NUCLEAR UNIVERSITY «MEPhI»
SAINT-PETERSBURG STATE UNIVERSITY
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NEW METHOD FOR DETERMINATION OF THE WAVE FUNCTIONS OF THE MULTI-CLUSTERS IN LIGHTEST AND LIGHT NUCLEI BY A PARAMETERIZED PHASE ANALYSIS

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At last time it is developed multi-cluster model of nuclei. Great progress has been made in light nuclei – ^{6,7}Li, ^{9}Be [1] that multi-cluster structure is theoretically strictly justified. One of the methods of experimental detection multi-cluster structure is the decomposition of the experimental angular distributions of the elastic scattering of the differential cross sections on the diffraction multi-cluster components. The best way of such an expansion is parameterized phase analysis.

We used the theory of diffraction scattering in its simplest form.

For describe the multi-cluster section will describe the structure of the nucleus as the sum of the cross sections of diffraction multi-cluster

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

where a, a' - relative statistical weight of the diffractive scattering at the i-th cluster core; R - radius of the i-th cluster cores; n – count of cluster structures in the nucleus.

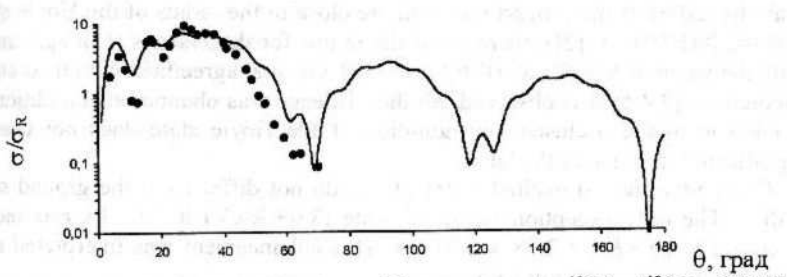

Fig. 1. Angular distributions of the elastic diffraction scattering $^{12}C(\alpha,\alpha)^{12}C$ E_α=139MeV. Points – experimental data [2]; curve – calculation on the formula (1).

The Fig. 1 shows the results of fitting the multi-cluster parameters of the formula (1). Best fit can be seen from two effects: 1) the best way to fit the experimental theory with R_1 = 2.5 fm; R_2 = 0.44 fm; 2) the first time we managed to describe the rise above the Rutherford cross sections for light nuclei due to alpha-particle fashion elastic scattering (scattering of alpha particles on the alpha-particle clusters).

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FRESNEL NUCLEAR DIFFRACTION AS A NEW PROBE OF THE FORM OF NUCLEI

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Diffraction, nuclear processes are precision instrument for measuring the size and shape of atomic nuclei. Most up to date with these goals has only been used type of nuclear Fraunhofer diffraction [1,2]. However, the theory of Fresnel scattering of heavy ions with the higher-order non-sphericity of the parameter [3-5] contained a prediction that the experimental determination of the nuclear non-spherical character of the quadrupole shifts by the Fresnel phase.

In this work we define and measure the Fresnel oscillation periods and phase shifts corresponding to examine the forms of heavy and odd nuclei. Actuality of such problems is related to the fundamental inaccessibility of the diffraction measurements of the shape of odd nuclei and forms of heavy and super heavy nuclei.

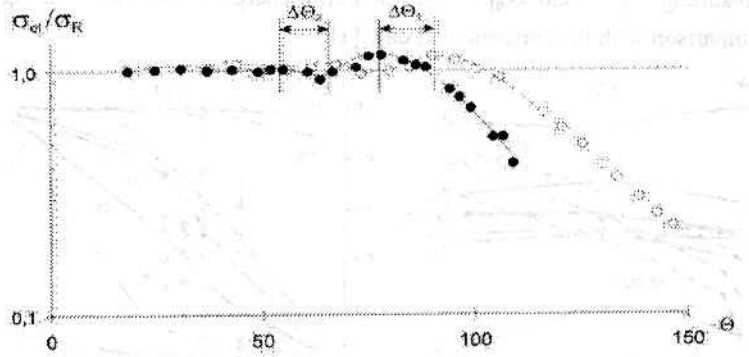

Fig. 1. Fresnel diffraction scattering type oxygen ions with an energy of 42 MeV ^{58}Ni (light points) and ^{64}Ni [6] (black points), $\Delta\Theta_1$, $\Delta\Theta_2$–the relative phase shifts of the first and second peaks.

Phases shifts $\Delta\Theta_1$, $\Delta\Theta_2$ (Fig. 1) are associated with the sign of the nuclear deformation β_2. $\beta_2 = +0.17$ for ^{58}Ni and $\beta_2 = -0.18$ for ^{64}Ni [7].

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THE MEASUREMENT OF THE ELASTIC SCATTERING OF ALPHA-PARTICLES WITH ENERGY 29 MeV ON ^{24}Mg, ^{25}Mg

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Measurements of the angular distributions of the differential cross sections of elastically scattered alpha particles with an energy of 29 MeV in the nuclei ^{10}B, ^{24}Mg, ^{25}Mg performed on extracted beams of alpha particles of the isochronous cyclotron U-150M INP.

The scheme of accelerated ion beam transport from chamber of cyclotron to chamber of scattering [1,2], located at a distance of 24 m from the exit of the beam of the accelerator chamber includes a system of quadrupole lenses, two turning, diluting, targeting two of the magnet system and collimators. All measurements were carried out on measuring and computing complex laboratory, the foundation of which is the system of multi-dimensional analysis of the processes on the basis of electronic components ORTEC [3].

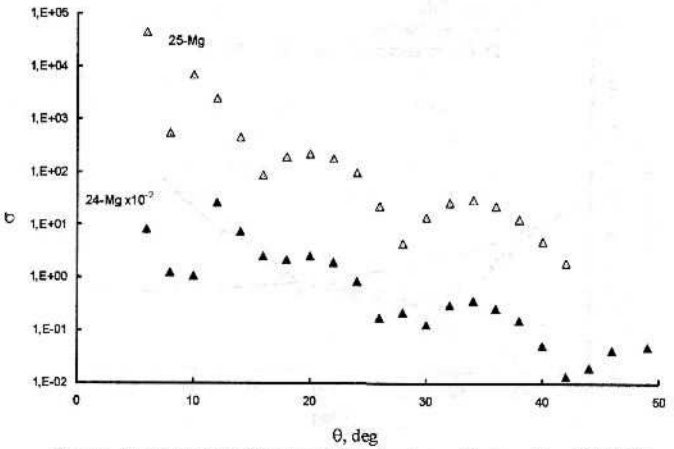

Fig. 1. Angular distributions of the elastic scattering, E_α=29 MeV.

The figure shows the angular distribution of the differential cross sections of elastically scattered alpha particles on the test targets.

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