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Saint Petersburg State University
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Contents

DIFFRACTION PROCESSES IN ELASTIC SCATTERING OF 16-O BY MEDIUM NUCLEI

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As one of the methods for the experimental detection of the multicluster structure of atomic nuclei, the authors proposed a method for expanding the experimental angular distributions of differential cross sections for elastic diffraction scattering into multicluster components [1-2]. Within the framework of the diffraction theory and under the assumption of total absorption inside the interaction sphere, the authors obtained expansions of the total amplitudes of the angular distributions of the differential cross sections for elastic scattering of 16-O, in particular, on 28-Si at energies of 20.83 MeV [3] and 240 MeV [4].

The experimental data are described within the framework of the theory of diffraction scattering as a superposition of wave functions on an absolutely black nucleus and on its absolutely black substructures (for example, alpha clusters) [2]. Figures 1 and 2 show the fitting results. Satisfactory agreement is seen between the theoretical curves and experimental data. In Figure 1, there is a discrepancy with theory in the range of back angles from 160 to 177 degrees. This is due to the limited applicability of this model, which, within the framework of this paradigm, does not take into account other nuclear phenomena. Thus, the interaction of 16-O ion beams with 28-Si revealed clumps of nuclear matter with characteristic radii of 1 fm and 0.5 fm. The analysis of the differential cross sections for elastic scattering of 16-O already at 40-Ca by this method has shown itself to be unsatisfactory, which speaks in favor of the "dissolution" of clusters in the mean nucleon field of the nucleus.

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SPATIAL DISTRIBUTIONS OF RADON ISOTOPES IN THE TIEN SHAN (ALMATY REGION) FOOTHILL REGIONS AND IN THE NEVA LOWLAND (ST PETERSBURG REGION)

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The territory of the Republic of Kazakhstan is characterized by a complicated radiation situation due to the active development of extractable natural resources (coal, non-ferrous metals and uranium), the geological features of the certain areas of ground surface, seismically activity and the highlands in the southern regions. In this context, radioactive gases and their decay products formed in uranium and thorium (natural radioactivity) decay chains have a big influence on the common radiation background. These radioactive elements, from the depths of the lithosphere, come into the surface atmospheric layer. Then, such radionuclides entered to the human body by the breathing processes and it is a main case for the human internal exposure. The exposure level is determined by the radionuclide mixture of the inhaled air which depends on a number of factors. The key role in this mixture is played by the radon isotopes and their decay products. There were discovered more than 30 radon isotopes, but only four of them are formed in nature: 222-Rn, 220-Rn, 219-Rn, 218-Rn, and only two isotopes: 222-Rn, 220-Rn are responsible for approximately 50% of the average annual effective dose of internal human exposure [1].
The natural radiation background in the regions of the Republic of Kazakhstan has average value approximately 3.1 mSv / year [2], and the total dose from natural and industry radioactive sources in average per person is about 4 mSv / year. This is in 1.5 times higher than the average dose accepted in the world for the human society [2]. In this case it has to be interesting to study of the radon isotopes spatial distribution in the foothill regions of the Tien Shan, located in the Almaty region. Because the tectonic faults and the mountain rocks are the additional sources of the radon emanations. On the other hand, there is an additional interest to compare the experimental data obtained in mountainous areas with the data of the radon distribution obtained in the Neva lowland at zero height above mean sea level (St. Petersburg region). An additional interest for the study of the radon formation processes is connected with the development of new buildings (in big and rapid growth cities) with the increased energy efficiency [3].
In present work the new data on spatial distribution of radon isotopes were obtained for the foothills of the Tien Shan (Almaty region) at different heights above mean sea level: from 600 to 2500 meters. Finally, the radon isotopes distribution map with the corresponding values of its concentration has been plotted. Similar experimental investigations were carried out in the Neva lowland area (St. Petersburg region). All the measurements were done at the altitude above the sea level which did not exceed 50 m. Based on the obtained values of radon concentration it was made the conclusion about spatial distribution of the radon isotopes in this region.
The reported study was supported by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP09258978).

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TOPOLOGY OF DISTRIBUTION OF NATURAL RADIOACTIVITY ON THE SURFACE OF THE HUMAN BODY

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The main share of oncological diseases of the lungs and bronchi is caused by radon isotopes and their daughter decay products [1], therefore, the study of radiation damage to biological objects from radon isotopes 219Rn, 220Rn, 222Rn and their decay products is an urgent task. In Kazakhstan, lung cancer is in second place (10.4%) among oncological diseases.
The aim of this work was to study the distribution of natural alpha, gamma and beta background over the surface of the human body as an indicator of cancer risk and cancer incidence. A method of measuring the topology of distribution over biological objects and the human body of local zones of background radiation using modern electronic radiometers was developed: RKS-01A-SOLO, RKS-01B-SOLO and RKS-01G-SOLO. The distribution of alpha, gamma, and beta activity over the human body was measured in a room with the lowest background by scanning along and across the body at the closest possible distance from it. Measurements were taken at the following control points: head-4, thyroid-3, left-1.9 and right side of the chest-2.1, stomach-1 and legs-0.
According to the results (Figure 1) of measurements of the radioactivity of the control points of the human body, it can be seen that the greatest background is found in the region of the thyroid gland and in the region of the brain. These results confirm the previously known facts [2] that the accumulation of radioactivity in the human body is concentrated in adipose tissues, as well as in muscle tissue accumulations. The well-known pattern of an increase in the natural radiation background with the age of a person is associated with the effect of accumulation of radioactivity due to long-lived radionuclides. The same pattern in medicine is diagnosed as an increase in diseases in the corresponding localizations. This pattern will be investigated in the future in the pool of age categories of the population due to the fact that the risk of cancer morbidity increases with age, as well as in cancer patients in the corresponding medical institutions.
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GENERATION OF RADIATION EFFECTS FROM HIGH-ENERGY GAMMA QUANTA DURING IRRADIATION OF BIOLOGICAL OBJECTS AT THE MEDICAL LINEAR ACCELERATOR ELEKTA AXESSE

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The study of X-ray-induced mutations The white gene is becoming one of the main test objects in the study of the problem of direct and reverse mutation of its alleles under the action of X-ray radiation [1], and later under the action of neutrons and γ-radiation [2] on such biological objects as Drosophila melanogaster. Moreover, at present, Drosophila is used as a model object in the study of the influence of various environmental factors, such as high and low temperatures, the inclusion of active oxygen in the metabolism, nutritional characteristics and diabetes mellitus on longevity and fertility [3-4]. The work [5] studied the number and frequency of mutations in the white gene induced by different doses of reactor neutrons (E = 0.85 MeV) with doses from 2.5 Gy to 20 Gy, as well as by 60-Co γ-radiation with doses up to 60 Gy. In various works, gamma-ray irradiation of the studied biological objects is mainly carried out with energies up to 3 MeV. In this work, experiments have been carried out to study mutations of the radiation effect on the capabilities of new generations of Drosophila melanogaster by beams of gamma quanta with energies of 10 and 15 MeV. The radiation doses were 2 Gy, 10 Gy and 20 Gy. The electron accelerator Elekta Axesse of the Sunkar Cancer Center (Almaty, Republic of Kazakhstan) was used as a source of gamma quanta. The technique of irradiation of biological objects was tested by measuring the experimental linear absorption coefficients of 6 MeV gamma quanta obtained at this linear accelerator for elements B, C, O, S, Fe, Ba [6].

As a result of the experiments, the types of induced mutations, the dependence of the mutagenic effect on the dose were determined, and the significance of genetic effects for various energies of gamma quanta was estimated. This made it possible to develop a methodology and perform experiments on irradiation of Drosophila melanogaster to study the influence of hard gamma radiation and the occurrence of radiation effects and mutations in this energy range.

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