Brief information about the project

Name of the project	AP09058404 «Establishing patterns of radon distribution in environmental objects to study the risks of cancer through spectroradiometric monitoring» (0121PK00201)
Relevance	Most people are most exposed to radon in residential buildings and industrial premises; since the radon-222 isotope gives approximately 50–55% of the radiation dose that every inhabitant of the Earth receives annually from natural radionuclides, the radon-220 isotope adds another ~5– 10%. When inhaled, radon isotopes saturate the body's cells and the intercellular space with daughter decay products. Radon can damage the DNA of the respiratory epithelium, and it is assumed that exposure to radon is the cause of lung cancer. Thus, research in this direction is an urgent problem.
Purpose	Investigation of the dynamics of accumulation of radon isotopes and their daughter decay products (DDP) in the human body, objects of the anthropogenic environment, and, on this basis, the calculation of the risks of cancer incidence in various cohorts of the population and in different living conditions when performing monitoring measurements of the topologies of the distribution of radon isotope activity and their DDP.
Objectives	To achieve the aim of the project it is necessary to solve the following tasks: – To develop methods for measuring the topology of distribution over biological objects and the human body of local zones of background radiation using modern electronic radiometers, solid-state track detectors and spectrometric devices for registering terrestrial and biogenic beta-radionuclides; – Monitor the topology of the distribution of radon isotopes in a continuous year-round mode with the identification of daily, multi-day and seasonal variations in the emanation of radon isotopes to calculate the doses received from natural sources of radiation; – To simulate oncoradiation damage to biological objects by radon isotopes on alpha-particle beams to determine the sensitivity threshold of modern electronic radiometers, solid-state track detectors and a device for registering terrestrial beta-radionuclides. – To reveal the patterns of distribution of isotopes of radon and its daughter decay products in the human body depending on anthropogenic characteristics (gender, age, height and weight characteristics, floor of residence); – To reveal the patterns of distribution of isotopes of radon and its daughter decay products in the human body, depending on the distance of residence to the tectonic fault. – To study the dynamics of the accumulation of isotopes of radon and its daughter decay products in the human body, objects of the anthropogenic environment and its impact on cancer morbidity in the population. – To develop a radiobiophysical model of the distributions of alpha, beta and gamma background over biological objects and

	the human body, as indicators of cancer risk and oncological incidence.
Expected and achieved results	Within the framework of the study, a wide range of methods was used, including alpha radiometry, beta and gamma spectrometry, measurement of the volumetric activity of radon and its DDP, and methods of theoretical computer modeling. Obtained results and novelty: 1. Methods have been developed to measure the topology of the distribution of local background radiation zones. The novelty is the rapidity of the developed in-vivo methods. 2. The Rn emanation topology was monitored in a continuous year-round mode. A sharp deviation from the barometric formula was discovered in buildings located near the fault. Calculation of received doses and risks from natural sources of radiation was carried out based on the obtained monitoring measurements. What was new was the discovery of a pattern of evolution of doses, risks of cancer depending on the number of floors of residence, and the distance to identified tectonic faults. 3. Modeling measurements of cancer damage to biological objects using radon isotopes were carried out. What was new was the clarification of the total absorption coefficients for light and lightest chemical elements when calculating doses and risks of cancer. 4. Patterns of distribution of Rn isotopes and its DDP in the human body were constructed depending on the distance of residence to the tectonic fault and anthropogenic characteristics. It has been discovered that radioactivity accumulates locally in the human body according to an exponential law, depending on the distance of residence to a tectonic fault. 5. Radiobiophysical models of alpha, beta and gamma background distribution over biological objects and the human body have been developed. The novelty was the identification of the formation of time-integrated background radioactivity, taking into account the decay mechanisms, continuous intake of radon and its kinetics in the body.
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List of publications with links to them	1. Dyachkov V.V., Zaripova Y.A., Yushkov A.V., Shakirov A.L., Bigeldiyeva M.T., Medeubayeva A.A., Stvayeva A.E. Methods for Measuring Daughter Products of Radon Decay in the Surface Atmospheric Layer of the Earth // Physics of Atomic

	Nuclei. – 2021. – Vol. 84, Issue 11. – P. 1929-1934. https://doi.org/10.1134/S1063778821090118 (Q4, Percentile–16) 2. Zaripova Y.A., Gladkih T.M., Bigeldiyeva M.T., Dyachkov V.V., Yushkov A.V. Application of the medical linear accelerator ELEKTA AXESSE in the study of sorption properties of impurities and absorption coefficients of medium and heavy chemical elements // Journal of Physics: Conference Series. – 2022. – Vol. 2155. – 012029. DOI: 10.1088/1742-6596/2155/1/012029 (Percentile –22) 3. Zaripova Y., Dyachkov V., Gladkikh T., Bigeldiyeva M., Nasr Ahmed Nasr Diab Investigation of gamma radiation shielding features for modified structural materials for nuclear energy and nuclear medicine // Nuclear Technology & Radiation Protection. – 2023. – Vol. XXXVIII, No. 2. – P. 108-115. https://doi.org/10.2298/NTRP2302108Z (Q3, Percentile –39) 4. Zaripova Y., Dyachkov V., Bigeldiyeva M., Gladkikh T., Yushkov A. Preliminary Survey of Exposure to Indoor Radon in al-Farabi Kazakh National University, Kazakhstan // Atmosphere. – 2023. – Vol. 14, Issue 10. – 1584. https://doi.org/10.3390/atmos14101584 (Q3, Percentile –69) 5. Zaripova Y., Dyachkov V., Bigeldiyeva M. et al. The activity of ^{210}Pb in cigarette smoked in Kazakhstan. Radiat Environ Biophys. – 2023. (Q3, Percentile –55) https://doi.org/10.1007/s00411-023-01048-x 6. Zaripova Y.A., Gladkikh T.M., Bigeldiyeva M.T., Dyachkov V.V., Yushkov A.V. Method for measuring linear gamma radiation absorption coefficients at the ELEKTA AXESSE medical accelerator beam // Reports Of The National Academy Of Sciences Of The Republic Of Kazakhstan. – 2021. – Vol. 5, No. 339. – P. 126-135. DOI: https://doi.org/10.32014/2021.2518-1483.91 7. Zaripova Y.A., Dyachkov V.V., Bigeldiyeva M.T., Gladkikh T.M., Yushkov A.V. Quantitative estimation of the concentration of natural alpha radionuclides in the lungs // Reports Of The National Academy Of Sciences Of The Republic Of Kazakhstan. – 2021. – Vol. 6, No. 340. – P. 28-35. DOI: https://doi.org/10.32014/2021.2518-1483.107
Patents	1. Zaripova Y.A., Dyachkov V.V., Bigeldieva M.T., Dyusebaeva K.S., Yushkov A.V. Methods for measuring the topology of the distribution of local zones of background radiation // Author's certificate No. 37354 (date of creation: 06.16.2023), issued June 21, 2023, Republic of Kazakhstan. (in Russian)