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Methods Of Teaching The Topics Of Nuclear Physics In The Course Of Physics

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ABSTRACT

This article reflects the process of studying the section of atomic physics in a general physics course - the concepts of natural and social processes that learners master. The methodology of teaching topics in the section is given in the example of a topic development.

KEYWORDS

Physics system, physics education, pedagogical technologies, laboratory work, physics course, effective teaching, distance learning, radioactivity, Alpha, beta and gamma rays.

INTRODUCTION

Introduction of nuclear physics in physics education on the basis of modern pedagogical technologies, computer and information technologies, animations on educational sites on the Internet, widespread use of virtual laboratory work and multimedia, their introduction into the physics system of academic lyceums, creation of modern programmed pedagogical tools. period requirement.

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Recommendations suggested by pedagogical scientists to improve the teaching of the department of nuclear physics of the general physics course play an important role in distance learning, modular pedagogical technologies. In the development of education, non-traditional educational technology is used in the effective teaching of sections of the physics course. Internationally, research is being conducted on the effective use of technical means for the development and improvement of physics teaching, the improvement of knowledge, skills and abilities on the basis of non-traditional teaching technologies, taking into account the intellectual potential and individual abilities of students.

MATERIALS AND METHODS

Such an approach requires the development of students' ability to master learning materials on the basis of innovative technologies, the following is an example from the development of jars prepared using such pedagogical technologies. Course Title:

Natural radioactivity. Alpha, beta and gamma radiation. Nuclear reactions

PLAN

1. Natural radioactivity

2. Alpha, beta and gamma rays

3. Nuclear reactions

Radioactivity. The French physicist A. Beckerel began to study the effect of light on uranium salts in order to determine whether the phenomenon of phosphorescence is observed in uranium salts under the influence of light, as well as in X-rays. On March 1, 1896, as the photographic plate darkened, he discovered that the uranium salt emitted invisible rays that had the ability to penetrate objects strongly.

Beckerel soon discovered that uranium itself had the ability to emit radiation. He then observed that such a phenomenon also existed in the thorium atom. The phenomenon of spontaneous emission of light from objects without external influences is called radioactivity. Radioactivity is characteristic of the heaviest elements of the Mendeleev periodic table. In 1898, French scientists M. Skladovskaya-Curie and P. Curie isolated two new substances from uranium mineral that are much more radioactive than uranium and thorium. They were called polonium and radium.

Radioactive atoms emit three different rays during spontaneous fission (Figure 9). They are -lights. -Right is not affected by magnetic and electric fields. Affects magnetic and electric fields – rays. Depending on the result of the effect, it is possible to know that-rays have positive and-rays have negative charges. In fact, -rays are ionized helium atoms, and -rays are made up of electrons. -rays are high-energy electromagnetic waves with the shortest wavelengths.

In 1903, E. Rutherford and F. Soddy discovered that in the process of radioactivity, one chemical element is transferred to another chemical element. For example, the conversion of radium to radon. In the process of radioactivity, energy is released. For example, 600 g of energy is released from 1 g of radium during radiation.

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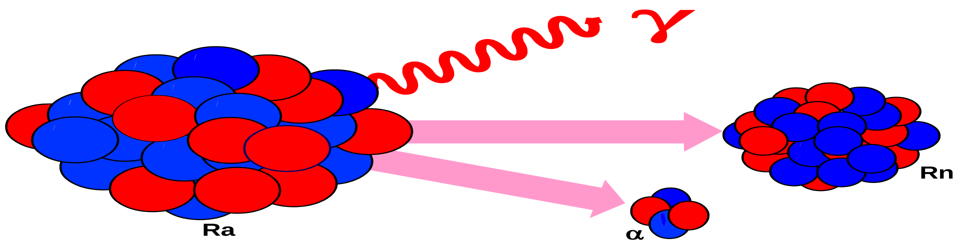
Fractions α-β-γ. The nature of the alpha particle began with the determination of its charge. It is determined using an electrometer. The magnitude of the charge of the alpha particle determined in this way -particle is a helium atom.α-particle was determined from the ratio.

Its size is 6.62 • 10–24 g. This hydrogen atom has a mass four times greater than 1.62 • 10–24 g. Based on such experimental evidence, it proves that the α3.19 • 10 –19 Kl, which is twice the electron charge. His gesture is positive. $\frac{e}{m}$ particle is a helium atom.α-particle was determined from the ratio. Its size is 6.62 • 10–24 g. This hydrogen atom has a mass four times greater than 1.62 • 10–24 g. particle is equal to a few electron volts. It serves as an ideal projectile for studying the structure of the atomα-particle is 1.6 • 10–9 cm / s. The magnitude of the velocity depends on the isotope and the radioactive element. The kinetic energy of a α-particle in a magnetic field, its velocity was determined.



Decomposition of the radium nucleus into particles

When the radium nucleus emits a particle, it loses 4 nucleons and passes to the radioactive Radon. Radon is also a source of particles.

Beta – decay. **Radioactive isotope (β)particle decays, the charge of the atomic nucleus increases to a unit positive charge, but the mass does not change. $A = Z + N$ the number of neutrons in the radioactive isotope decreases together due to the equivalence. The reaction is written as follows.**

$${}^{A}_{Z}X_1 \rightarrow {}^{A}_{Z+1}X_2 + {}^{0}_{1}e$$

Example: When ${}^{210}_{84}P_0$ a polonium isotope is formed, ${}^{210}_{83}Bi \rightarrow {}^{210}_{84}P_0 + \beta$ the bismuth isotope must emit a β-particle.

The reaction is as follows (Figure 2)

As you can see from the graph, When a β-particle leaves an atom, its positive charge increases by one unit, but β- the velocities of the particles are continuous (Fig. 35). the atomic mass A does not change.

The velocities of β-particles vary from small to large, meaning that they have a continuous energy distribution.

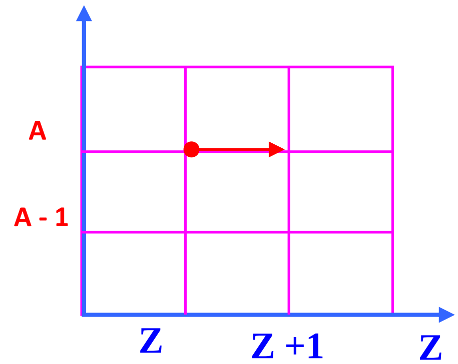


Figure 2

β - In the process of decay, the neutron, proton and electron in the nucleus split and the electron leaves the nucleus. However, this does not explain the continuous energy distribution of β-particles.

Pauli was able to solve the problem in 1931. According to Pauli, two particles are involved in β-decomposition. Pauli was able to solve the problem in 1931. According to Pauli, two particles are involved in β-decomposition.

They are electronic and neutrino. The mass of a neutrino is very small compared to the mass of an electron, and it has no charge, that is, an electrically neutral particle. As a result, the total energy is divided into electron and neutrino energies. If an electron emits a large amount of energy, a neutrino emits a small amount of energy, and vice versa. Its existence has been proven by indirect methods.

Gamma radiation γ – rays are observed along with α and β particles during the decay of the atomic nucleus. Interference and diffraction experiments have shown that the nature of γ-rays corresponds to the nature of X-rays. Experiments on interference and diffraction have shown that the nature of γ-rays is consistent with the nature of X-rays. His the energy is determined by indirect photo-effect, Compton effect methods. Gamma rays are very short electromagnetic waves that depend on changes in the energy state of the atomic nucleus.

Artificial fission of the nucleus. In 1919, Rutherford bombed one atom with a particle to form another. Example: When α-particles bombard nitrogen gas, oxygen and hydrogen atoms are formed.

The mass of the nucleus and the binding energy.

Using a mass spectrometer, the masses of the nuclei are compared, and the mass difference of the helium atom in the normal and metastable states is also determined. In most cases, the mass of the nucleus is found from Einstein's equation ($E = mc^2$).

The energy used by the nucleus to divide into free nucleons is called the binding energy of the nucleus. The energy relationship between the atomic number Z and the mass number A and the mass of the nucleus M (Z, A) is as follows

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$$E = (ZM_{\rho} + (A - Z)M_n - M(Z_1 A))c^2$$

M_{ρ} - mass of free proton, M_n - free netron mass. The mass of these two nucleons is of great importance. The mass of a proton is found with great precision by measuring the ratio of charge to mass. The neutron mass is determined based on

the reactions in which the deuteron participates. If is the mass M_d of a deuteron, its binding energy $E_d = (M_p + M_n - M_d)c^2$

M_{ρ} - known from experience, M_d / M_p the value of the ratio is found by mass spectrometric measurements, then the value M_d of is determined. his reaction is written as follows.

$${}_1^1H + {}_0^1n \rightarrow ({}_1^2H) \rightarrow {}_1^2H + h\nu$$

Synthesis reaction of the nucleus. **The release of energy from the addition of light nuclei is called a fusion reaction. In a synthesis reaction, light atoms combine to form a heavy nucleus, and when two high-energy deuterons collide, one deuteron absorbs the proton or neutron of the other. In the first case, a helium isotope of mass 3 is formed. As a result of this reaction, 3.25 MeV of energy is released. The reaction proceeds as follows:**

$${}_1^2D + {}_1^2D \rightarrow {}_2^3He + {}_0^1n + 3{,}25 \text{ MeV}$$

If one of the colliding deuterons adds a neutron to the other, a tritium nucleus is formed and 4 MeV of energy is released. The appearance of the reaction:

$${}_1^2D + {}_1^2D \rightarrow {}_1^3T + {}_1^1p + 4 \text{ MeV}$$

For two nuclei to undergo a fusion reaction, their nuclei must touch each other. But the nuclei have a positive electric charge, so they are pushed away from each other. As a result, energy must be transferred to the nuclei to overcome the electrostatic repulsive force. The gas in which the synthesis reaction is observed is always kept at a high temperature.

Atomic energy at room temperature is 0.025 eV. The magnitude of this energy increases with increasing temperature. In order for the energy of an atom to reach 20 KeV, it must be heated to 200 million degrees. Only at such a temperature is the synthesis reaction observed.

Decomposition reaction. Heavy nuclei break down to form light nuclei, which release energy. The decay reaction occurs when neutrons collide with a nucleus. For example, when neutrons collide with a uranium nucleus, the atomic weight splits into two nuclei and two or three neutrons belonging to the intermediate nucleus.

Chain reaction. During nuclear fission, a certain amount of neutrons are released. This phenomenon is significant. The nucleus that swallows the neutron splits off by emitting two or three more neutrons. In turn, each neutron breaks down a new nucleus and emits a certain amount of neutrons. This process is often repeated. This is why such a process is called a chain reaction. The most important thing in a chain reaction is not the energy released, but the neutrons released. The chain reaction

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makes it possible to use nuclear energy in practice. During a collision with a neutron nucleus, 190 MeV of energy is released. During the decomposition of 1 kg of core, a large amount of heat is released. For comparison, burning 1 kg of coal dissipates 7,500 calories. As a result, 1 kg of uranium nucleus is equivalent to the energy released during the decomposition of 2,500 tons of coal.

^{238}U when uranium is bombarded with slowed down neutrons, a series of decay occurs. Here is the decomposition process:

$$^{238}_{92}U + ^{1}_{0}n \rightarrow ^{239}_{92}U + \gamma$$

$$^{239}_{92}U \xrightarrow[23мин]{} ^{239}_{93}Np + e^{-} + \nu$$

$$^{239}_{92}Np \xrightarrow[2,3кун]{} ^{231}_{94}Pu + e^{-} + \nu$$

$$^{239}_{92}Pu \xrightarrow[24000йил]{} ^{235}_{92}U + ^{4}_{2}He$$

Game of intelligence. The group is divided into two groups. Each group is given a separate name and the question and answer begins. Each question is given 1 minute to think. The group is discussed.

INTELLIGENCE QUESTIONS

1. Boltsman constant
2. The first law of thermodynamics
3. Is it possible to make the first type of perpetuum mobile?
4. What process is called an adiabatic process?
5. What is the work done in the adiabatic process ?

"CLUSTER" method

The new theme is supported by a cluster. The word cluster is derived from English and means a bunch of grapes. New students were given homework. The teacher explains the conditions of the game to the students. The teacher writes a word on the board on the topic. Students write the words related to this word. Then the teacher asks a question on a new topic. Students summarize the answer by combining the words on the board. This creates a bunch of grapes.

STAGE III: (FINAL PART)

Conclusion: Students who scored during the lesson, students who actively participated will be evaluated.

Homework: (3 minutes)

Physics Part II Ganiyev A.G. Natural radioactivity from the book .Alpha, beta and gamma radiation. Nuclear reactions.

CONCLUSION

Thus, the process of studying the department of atomic physics in a general physics course - learners 'mastery - has its own periods, such as natural and social processes. It is necessary to analyze the beginning of the topic, the content of the text of each topic, the interrelation of words and concepts, in terms of the stated idea, physical phenomenon, definition and process, to generalize them.

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