HISTORY OF THE DEVELOPMENT OF THE HYDROGEN ATOM

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Abstract. *This article discusses the history of the hydrogen atom, the chemical elements, and isolated hydrogen atoms.*

Key words: *hydrogen, atom, chemical elements, physics, theory.*

ИСТОРИЯ РАЗВИТИЯ АТОМА ВОДОРОДА

Аннотация. *В статье рассматривается история атома водорода, химических элементов и изолированных атомов водорода.*

Ключевые слова: *водород, атом, химические элементы, физика, теория.*

A hydrogen atom is an atom of the chemical element hydrogen. An electrically neutral atom contains one positively charged proton and one negatively charged electron bound to the nucleus by the Coulomb force. Atomic hydrogen makes up about 75% of the baryonic mass of the universe

Isolated hydrogen atoms (called "atomic hydrogen") are extremely rare in everyday life on Earth. Instead, a hydrogen atom tends to combine with other atoms in compounds or with another hydrogen atom to form simple (diatomic) hydrogen gas, H 2 . In plain English, "atomic hydrogen" and "hydrogen atom" have overlapping but distinct meanings. For example, a water molecule contains two hydrogen atoms, but no atomic hydrogen.

Atomic spectroscopy shows that, contrary to the predictions of classical physics, there is a discrete infinite set of states in which the hydrogen atom can exist. Attempts to develop a theoretical understanding of the states of the hydrogen atom were important to the history of quantum mechanics, since all other atoms can be roughly understood through detailed knowledge of this simplest atomic structure.

Boron theory for the hydrogen atom. One of the greatest physicists of the 20th century, Danish N. He was lucky. Its main goal was to explain the laws of line spectra found based on experiments on the basis of Rutherford's nuclear model. Bohr, who understood this well, put forward the idea that the radiation or light absorption of an atom consists of quanta. Thus, in 1913, quantum theory was applied to Rutherford's nuclear model, and a theory of the hydrogen atom was created that could explain the experimental results. In general, it is called quantization, when the values of the magnitudes take not desired, but selected values that obey a certain rule. The theory based on quantization is called quantum theory.

The basis of Bohr's theory is the following two postulates. Each of these postulates aims to overcome the two shortcomings of Rutherford's model that we noted above.

1. Postulate about stationary (stable) states: there are stationary states in the atom, and stationary orbits of electrons correspond to these states.

Electrons are only in these stationary orbits and do not emit radiation even when they move with acceleration.

The angular momentum (momentum) of an electron in a stationary orbit is determined by the quantized value and the following condition: where me is the mass of the electron; rn — radius of n-orbit; vn is the speed of the electron in this orbit; mv/n is the angular momentum of the electron in this orbit; n is not equal to zero (n t- 0)an integer, called the principal quantum number; (h — Planck's constant).

So, according to Bohr's first postulate, an electron in an atom can move not along any orbit, but along certain orbits called stationary orbits. During this movement, it does not emit radiation, that is, its energy does not decrease. If its energy does not decrease, it will not enter the nucleus and the atom will not disappear. Thus, this postulate eliminates the first drawback of Rutherford's model.

The postulate about frequencies: only when an electron moves from one stationary orbit to another, it emits (or absorbs) one photon whose energy is equal to the difference between the energies of these stationary states: hn = En-Em, where En and Em are energies of electrons in n- and m-stationary orbits, respectively.

If En > Em, a photon is emitted. In other words, the electron moves from a high-energy state to a lower-energy state, that is, from a stationary orbit far from the nucleus to a stationary orbit closer to the nucleus. If En < Em, the photon is absorbed and the opposite of the above reasoning occurs.

From the expression, it is possible to determine the frequencies at which radiation occurs, that is, the linear spectrum of an atom:

So, according to Bohr's second postulate, an electron cannot emit radiation of a desired frequency, but only radiation whose frequency satisfies the condition (27.3). And that is why the radiation spectrum of an atom is not continuous but has a continuous (linear) appearance. So Bohr's second postulate eliminates the second shortcoming of Rutherford's model.

First bar radius. Let's look at the simplest atom - the hydrogen atom. It consists of a nucleus consisting of one proton and one electron moving around it in a circular orbit. The nucleus attracts the electron with the Coulomb force and gives it centripetal acceleration, i.e.:

Here e is the charge of the electron and proton, £0 is the electrical constant. Now we can determine vn from the expression, and putting the result, we find the following expression for rn: where n is the number of the electron stationary orbit (more precisely, the stationary state of the atom). For example, if we take n = 1, we get the value of the radius of the first stationary orbit of the electron in the hydrogen atom. This radius is called the first Bohr radius and is used as a unit of length in atomic physics:

rB = 0.528- 10-10 m.

Also, r2 = 4rB, etc.

Energy levels in an atom. The values that atomic energy in a stationary state takes are called energy levels.

According to Bohr's theory, the atomic nucleus is stationary. Therefore, the total energy of the atom E, the rotational kinetic energy of the electron Ek, and the potential energy of interaction of the electron with the nucleus is equal to the sum of Eps, i.e.

E=Ek+Ep

2. The role of hydrogen energy Hydrogen energy has a huge industrial chain that covers hydrogen preparation, storage, transportation and refueling, fuel cells and terminal applications.

In power generation, hydrogen energy can be used to produce clean energy to balance energy demand and address power supply shortages during peak hours.

Hydrogen energy can be mixed with natural gas for heating, which is one of the low-carbon energy sources that can compete with natural gas in the future.

In the aviation industry, which emits more than 900 million tons of carbon dioxide each year, hydrogen energy is the main way to develop low-carbon aviation.

In the military field, the hydrogen fuel cell has the advantages of silence, can produce continuous current, high energy conversion, which is an important condition for underwater stealth.

Hydrogen energy vehicles, hydrogen energy vehicles have good combustion performance, fast burning, high calorific value, abundant reserves and other advantages. Hydrogen energy has a wide range of sources and applications that can effectively reduce the share of fossil energy.

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