Université Med Boudiaf – M'sila Faculté des Sciences - Département de Physique LMD M1 Théorique

Cours Anglais Scientifique 2

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Cours 1

Text

Atoms are the basic units of matter and the defining structure of elements. The term "atom" comes from the Greek word for indivisible, because it was once thought that atoms were the smallest things in the universe and could not be divided. We now know that atoms are made up of three particles: protons, neutrons and electrons — which are composed of even smaller particles such as quarks.

Atoms were created after the Big Bang 13.7 billion years ago. As the hot, dense new universe cooled, conditions became suitable for quarks and electrons to form. Quarks came together to form protons and neutrons, and these particles combined into nuclei. This all took place within the first few minutes of the universe's existence, according to CERN.

Protons and neutrons are heavier than electrons and reside in the nucleus at the center of the atom. Electrons are extremely lightweight and exist in a cloud orbiting the nucleus. The electron cloud has a radius 10,000 times greater than the nucleus.

Protons and neutrons have approximately the same mass. However, one proton weighs more than 1,800 electrons. Atoms always have an equal number of protons and electrons, and the number of protons and neutrons is usually the same as well. Adding a proton to an atom makes a new element, while adding a neutron makes an isotope, or heavier version, of that atom.

The nucleus was discovered in 1911 by Ernest Rutherford, a physicist from New Zealand, who in 1920 proposed the name proton for the positively charged particles of the atom. Rutherford also theorized that there was also a neutral particle within the nucleus, which James Chadwick, a British physicist and student of Rutherford, was able to confirm in 1932.

Virtually all the mass of the atom resides in the nucleus. The protons and neutrons that make up the nucleus are approximately the same mass (the proton is slightly less) and have the same angular momentum, according to Lawrence Berkeley National Laboratory.

The nucleus is held together by the "strong force," one of the four basic forces in nature. This force between the protons and neutrons overcomes the repulsive electrical force that would, according to the rules of electricity, push the protons apart otherwise. Some atomic nuclei are unstable because the binding force varies for different atoms based on the size of the nucleus. These atoms will then decay into other elements, such as carbon-14 decaying into nitrogen-14.

Questions

I) Read the text carefully and answer the following questions:

1 – Give a title to the text

2- What are the   four basic forces in nature ?

3- When were the first atoms created?

4 – Who discovered the nucleus ?

5- What is the nucleus made of ?

6- What is the origin of atom name ?

7- Who is James Chadwick and what was his contribution to atomic physics?

8- What are the similarities and differences between protons and neutron?

II) Use superlatives, comparatives and adverbs (while, whereas, likewise....etc) to answer the following questions

1- What are similarities and differences between electron and proton?..

2- What is the difference between the masses of electron, proton and neutron ?..

3- Compare the size of the electron orbit and the size of the nucleus

III) Fill in the gaps

1- Protons are …................. charged particles found within atomic nuclei (type of charge)

2- Electrons are …... …............compared to protons and neutrons. (mass)

3- The …...... …..of neutrons in a nucleus determines the isotope of that ….........

4- Ordinary hydrogen has …......... proton and …. …...electron and …. ….......neutrons.

5 -The nucleus of …............. material …........ three different types of radiation, alpha, beta and gamma.

6 -The stability of the nucleus of an atom is maintained by the …........ between the …......................... force among protons and the …................................ .forces holding the nucleus together.

IV) Using your own words, write an abstract of the text

Cours 2

Electromagnetic spectrum (1/2)

Do you know what is meant by spectrum, a spectrum is a group of different wavelengths and frequencies. The different types of radiations like infrared radiation, visible, UV radiation or waves are constituted as electromagnetic spectrum.When a ray of light falls on the prism a sequence of colours are produced ,which is called as visible spectrum.

The thermal radiations with high temperature and higher wavelengths are called as infrared radiations. Ultraviolet radiations are not visible to human eyes due to their lower wavelengths.

Significantly all these waves differ in their means of production and properties, but still they have some common features like

1- When they are described in terms of oscillating electric and magnetic fields, they are perpendicular to each other . Thus they are called as electromagnetic radiations

2- In the electromagnetic radiations both the electric and magnetic fields oscillate perpendicular to the direction of propagation of radiation.

3- All electromagnetic waves are transverse in nature.

So electromagnetic radiation travels the same speed, the speed of the radiation is equal to the speed of the light in vacuum C is equal to v(nu) lambda, is equal to 3 into 10 power 8 meters per second.

The waves traveling with velocity of light and consisting of oscillating electric and magnetic fields perpendicular to each other and also are perpendicular to the direction of propagation are called as electromagnetic waves.

Such waves with different ranges of frequencies constitute an electromagnetic spectrum.

Questions

I) Read the text carefully and answer the following questions

1- What is an electromagnetic wave ?

2- What is the difference between the infrared and ultraviolet radiations ?

3- Define frequency and wavelength, what is the relationship between them ?

4- What are the parts of electromagnetic spectrum, put them in an axis following

decreasing order of frequency ?

Electromagnetic spectrum (2/2)

The electromagnetic waves your eyes detect – *visible light* – oscillate between 400 and 790 (THz). The wavelengths are roughly the size of a large virus: 390 – 750 nanometers .

Red has the longest wavelength, and violet the shortest. When we pass sunlight through a prism, we see that it's actually composed of many wavelengths of light. The prism creates a rainbow by redirecting each wavelength out at a slightly different angle.

To study the universe, astronomers employ the entire electromagnetic spectrum. Different types of light tell us different things. Radio waves and microwaves, which have the lowest energies, allow scientists to pierce dense, interstellar clouds to see the motion of cold gas.

Infrared light is used to see through cold dust; study warm gas and dust, and relatively cool stars; and detect molecules in the atmospheres of planets and stars. Most stars emit the bulk of their electromagnetic energy as visible light, that sliver of the spectrum our eyes can see. Hotter stars emit higher energy light, so the color of the star indicates how hot it is. This means that red stars are cool, while blue stars are hot. Beyond violet lies ultraviolet (UV) light, whose energies are too high for human eyes to see. UV light traces the hot glow of stellar nurseries and is used to identify the hottest, most energetic stars.

X-rays come from the hottest gas that contains atoms. They are emitted from superheated material spiraling around a black hole, seething neutron stars, or clouds of gas heated to millions of degrees.

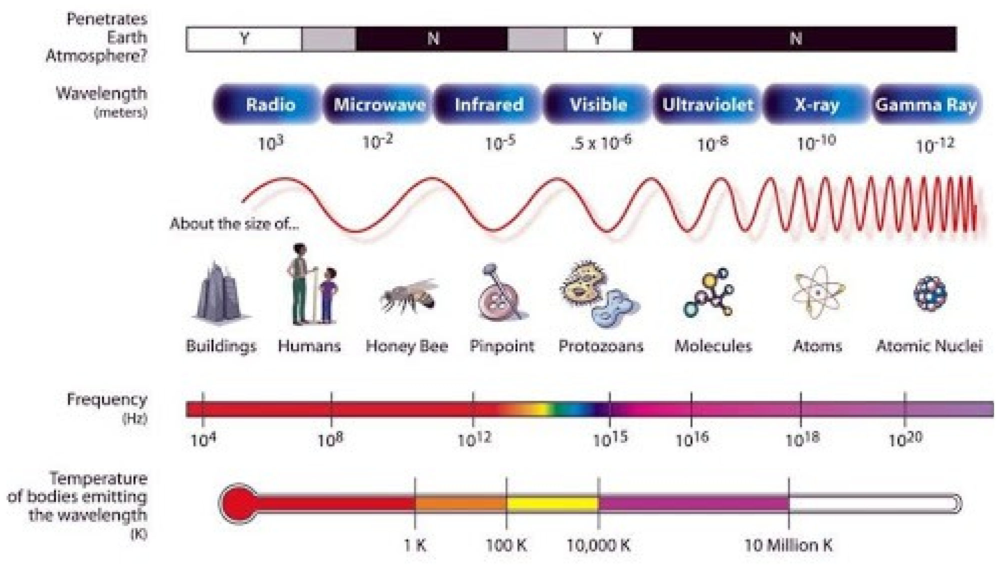
Gamma rays have the highest energies and shortest wavelengths on the electromagnetic spectrum. They come from free electrons and stripped atomic nuclei accelerated by powerful magnetic fields in exploding stars, colliding neutron stars, and supermassive black holes.

<u>Questions</u>

1- Compare the temperature of different parts of the spectrum using superlatives and comparatives.

2- Use the following adverbs to describe some parts of the spectrum : *however, since, because of, whereas, because of*

3 - Translate the text.



Cours 3

Compton Effect

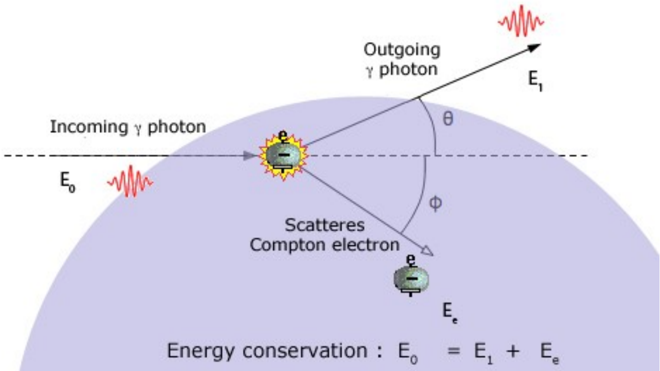
Photons as projectiles and electrons as targets

The Compton effect is the name given by physicists to the collision between a photon and an electron. The photon bounces off a target electron and loses energy. These collisions referred as *elastic* compete with the photoelectric effect when gamma pass through matter. It contributes to their attenuation.

The effect was discovered in 1922 by the american physicist Arthur H. Compton. Compton received the Nobel Prize in Physics in 1927. He demonstrated the particle nature of electromagnetic radiation. It was a sensational discovery at the time.

Compton collisions can be viewed as elastic collisions between a photon and an electron. These elastic collisions become predominant when the photon energy becomes large compared to the energy that holds the electron in an atom, its binding energy. For a light atom such as carbon, the Compton effect prevails on the photoelectric effect above 20 keV. For copper it is above 130 keV, and for lead 600 keV.

In this gamma energy range, which is rather extended , the phenomenon concerns all the electrons of the atom, whereas in the photoelectric effect these are the two electrons from the innermost K shell, which play a role. For an absorber, it is the density of electrons that is crucial in the range where Compton effect dominates. Lead has thus also an advantage over lighter materials, even if less important than for the photoelectric effect, which came at the fourth power of the high electrical charge of its nucleus.



Collision between a photon and an atomic electron

The Compton effect occurs for most of the atomic electrons. A gamma photon plays the role of a projectile that collides with an electron in an atom that serves as a target. Gamma was represented as a punctual particle because of its very short wavelength at the atomic scale. As the vast majority of electrons posses a smaller energy than the one of gamma, physicists are accustomed to neglect it and to consider the electron as a target at rest. In the collision, the electron is put in motion at a certain angle, while the gamma scattered with another angle loses its energy.

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Source : https://www.radioactivity.eu.com/site/pages/Compton_Effect.htm

Questions

1- What is the Compton effect

2 – When does the Compton collisions become predominant ?

3- When does the Compton effect prevail the photoelectric effects for carbone, copper and lead ?

4- What is the nergy range of photons in Compton scattering ?

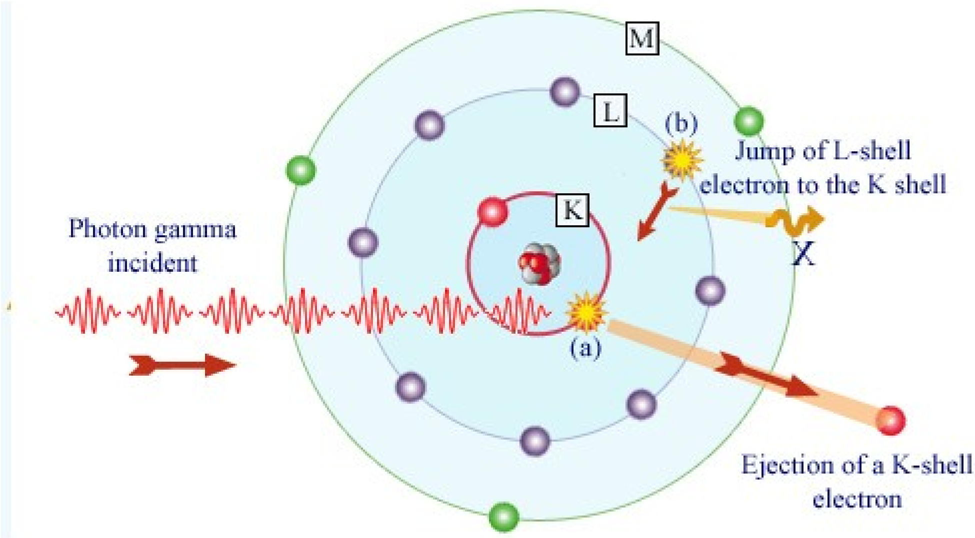
5- What are the similarities and the difference between the Compton effect and the photoelectric effect

6- Translate the underlined words

Cours 4

Photoelectric Effect

The most effective mechanism of photon absorption



Gamma absorption by an atom

The photoelectric effect occurs in two stages. First, the photon (a) takes out a bound electron in one atom. In the case of gamma photons, it is usually an electron belonging to the innermost layers L or K (as shown). Then the atom that has lost one of its inner electrons is left in an excited state. An electron from an outer layer (b) moves to occupy the vacancy left by the ejected electron. If the ejected electron belonged to the K-shell as in the figure, an X-ray is emitted during this transition.

The photoelectric effect is the phenomenon that transforms visible light, infrared and ultraviolet rays into electricity in solar panels and cells of our cameras. It is also involved in the completely different field of radioprotection : by transforming penetrating X and gamma rays into electrons easy to stop, it protects us from the effects of these radiations.

The photoelectric effect is the most effective physical phenomenon in mitigating these radiations. The gamma or X photon, absorbed by interacting with an electron bound to an atom disappears. The shell structure of atoms plays a crucial role. The photon wrest an electron only if its energy exceeds the binding energy of the electron on its shell. The probability (called cross section) to remove an electron from this shell becomes non-zero beyond this threshold.

Desexcitation X-rays : Finally, what happens to the atom left in an excited state? It inherits a surplus of energy equal to the binding energy of the expelled electron. The atom will reorganize itself and return this surplus. If the gamma has removed a K-shell electron, an electron belonging to the higher L shell will fill the vacancy left on the K-shell. During the transition a characteristic X-ray is emitted. This emission of desexcitation X-rays is sometimes called *X fluorescence*. When the X-ray is emited in dense matter it is usually absorbed after a short range.

Source : https://www.radioactivity.eu.com/site/pages/PhotoElectric_Effect.htm

Questions

I) Read the text carefully and answer the following questions

1- What is the photoelectric effect

2 – Give some exemples of the use of photoelectric effect?

3- What ist he X fluorescence ?

4- Translate the underlined words

II)Written expression

1- Use the following adverbs to rewrite phrases from the text :

However, whereas, similarly, because of

Cours 5

Text

In radioactive processes, particles or electromagnetic radiation are emitted from the nucleus. The most common forms of radiation emitted have been traditionally classified as alpha , beta, and gamma radiation. Nuclear radiation occurs in other forms, including the emission of protons or neutrons or spontaneous fission of a massive nucleus. Of the nuclei found on Earth, the vast majority is stable. This is so because almost all short-lived radioactive nuclei have decayed during the history of the Earth. There are approximately 270 stable isotopes and 50 naturally occurring radioisotopes (radioactive isotopes). Thousands of other radioisotopes have been made in the laboratory.

Radioactive decay will change one nucleus to another if the product nucleus has a greater nuclear binding energy than the initial decaying nucleus. The difference in binding energy (comparing the before and after states) determines which decays are energetically possible and which are not. The excess binding energy appears as kinetic energy or rest mass energy of the decay products.

Nuclear decay processes must satisfy several conservation laws, meaning that the value of the conserved quantity after the decay, taking into account all the decay products, must equal the same quantity evaluated for the nucleus before the decay. Conserved quantities include total energy (including mass), electric charge, linear and angular momentum, number of nucleons, and lepton number (sum of the number of electrons, neutrinos, positrons and antineutrinos—with antiparticles counting as -1).

Questions

I) Read the text carefully and answer the following questions:

1 – Give a title to the text

2- What is the most common form of emitted radiation ?

3- What are the other forms of nuclear radiation ?

4- How many isotopes is there on Earth?

5 – How does appear the excess binding energy in a radioactive decay?

6 - What are the conservation laws that should be satisfied by a nuclear decay?

II) Fill in the gaps

1- Hydrogen has …................. known isotopes (number)

2- Protons and neutrons are …............................ than electrons. (mass)

3- Atoms always have …......................... number of protons and electrons.

4- Beta rays are a stream of negatively …..................

5 - Nuclear decay processes must ….............. several conservation ….........

III) Using your own words, write an abstract of the text

Cours 6

Text

The Sun is a yellow dwarf star, a hot ball of glowing gases at the heart of our solar system. Its gravity holds the solar system together, keeping everything – from the biggest planets to the smallest particles of debris – in its orbit. The connection and interactions between the Sun and Earth drive the seasons, ocean currents, weather, climate, radiation belts and auroras. Though it is special to *us*, there are billions of stars like our Sun scattered across the Milky Way galaxy. The Sun has many names in many cultures. The Latin word for Sun is "sol," which is the main adjective for all things Sun-related: solar.

With a radius of 695,508 kilometers, our Sun is not an especially large star—many are several times bigger—but it is still far more massive than our home planet: 332,946 Earths match the mass of the Sun. The Sun's volume would need 1.3 million Earths to fill it.

The Sun is 150 million kilometers from Earth. Its nearest stellar neighbor is the Alpha Centauri triple star system: Proxima Centauri is 4.24 light years away, and Alpha Centauri A and B—two stars orbiting each other—are 4.37 light years away. A light year is the distance light travels in one year, which is equal to 9,460,528,400,000 kilometers.

The Sun, and everything that orbits it, is located in the Milky Way galaxy. More specifically, our Sun is in a spiral arm called the Orion Spur that extends outward from the Sagittarius arm. From there, the Sun orbits the center of the Milky Way Galaxy, bringing the planets, asteroids, comets and other objects along with it. Our solar system is moving with an average velocity of 720000 kilometers per hour. But even at this speed, it takes us about 230 million years to make one complete orbit around the Milky Way.

The Sun rotates as it orbits the center of the Milky Way. Its spin has an axial tilt of 7.25 degrees with respect to the plane of the planets' orbits. Since the Sun is not a solid body, different parts of the Sun rotate at different rates. At the equator, the Sun spins around once about every 25 days, but at its poles the Sun rotates once on its axis every 36 Earth days.

taken and adapted from [https://solarsystem.nasa.gov/solar-system/sun/in-depth/]

Questions

I) Read the text carefully and answer the following questions:

1 - Give a title to the text

2 - Define the Sun

3 - Compare the mass and dimensions of Sun and Earth

4 - What are the nearest stellar neighbors of our Sun ?

5 - What is the location of the Solar system in the universe ?

6- What are the different motions of Sun ?

II) Find 3 comparatives and superlatives describing ‘mass’, ‘size’ and ‘distance’ from the text and use them in your own sentences

III) Fill in the gaps

1- The Sun is the …........………...….. light and heat for Earth,

2- Earth is …....….....……………..than Sun, ……………. 1.3 million Earths may ……………. …………..the volume of the Sun

3- The Sun is …..….……………...….. spiral arm of the Milky Way.

4- The rotation velocity of the Sun …………...…...the pole and the equator, because ………………

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