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PHYSICAL ESSENCE, LAWS AND IMPORTANCE IN PRACTICE OF LIGHT ABSORPTION

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Annotation: The article deeply studies the physical essence of the phenomenon of light absorption, the main parameters associated with it, mathematical models, experimental methods, as well as the practical significance of this phenomenon in science and technology. The approach covered by the author is original and, along with the physical foundations, is enriched with applications in modern technologies.
Keywords: Light absorption, optical density, absorption coefficient, spectral absorption, Bouguer's law, Vavilov-Cherenkov law, Doppler effect, electromagnetic waves, photon energy, matter-radiation interaction, spectrophotometry, medical optics, photometric analysis, wavelength, absorption spectra, optical materials, absorption properties.

Introduction

Light is a form of electromagnetic radiation that has a wave nature and particle properties, and when it collides with matter, it undergoes several different processes. One of these is the absorption of light. This phenomenon determines the color of objects around us, causes biological processes, and directly affects the operation of medical and industrial devices. This article analyzes the phenomenon of light absorption in detail from a theoretical and practical perspective.

Light absorption. Bouguer's law and its application.

Light absorption. Light absorption is the loss of light energy when passing through a substance. The reason for this is the conversion of light energy into the internal energy of the substance. As a result of absorption, the intensity of the transmitted light decreases.

Bouguer's law and its application. The intensity of light passing through a substance

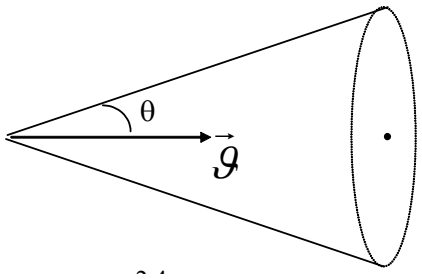
$I = Io\ e\text{-}cd$

Io is the intensity of the incident light, d is the thickness,

The concept of light absorption and the basics of physics

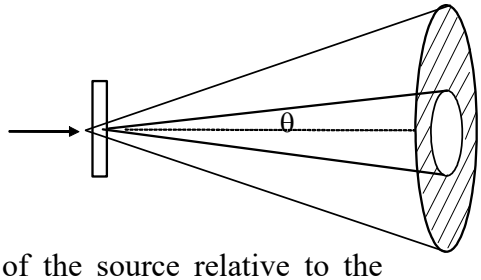
Absorption of light is the interaction of light waves with matter, in which their energy is absorbed by atoms, molecules or ions of the matter and converted into another type of energy (often heat).

Vavilov – Cherenkov. When gamma rays pass through a liquid, a weak, airy emission is produced



radiation is observed (Cherenkov). It was found that fast-moving electrons, which are knocked out by gamma rays from liquid atoms, produce this radiation.
But this is not due to braking.
It was found that when Vavilov-Cherenkov radiation occurs, the electron speed is greater than the speed of light in this medium:
U = c/n, n > 1, u < c.
If the condition c > J > c/n is met, the Vavilov-Cherenkov effect can be observed.
For example: The speed of high-energy particles emitted from the So60 isotope placed in water is 0.8 S. The speed of light propagation in water is 0.75 S. Therefore, the Vavilov-Cherenkov effect in water is observed along the sides of a cone whose axis coincides with the direction of electron motion. Radiation angle:
coc q = c/n J
Meaning. When a charged particle passes through, the weakly bound electrons move and the dipole returns to its original position, emitting an electromagnetic wave. This wave is coherent and interferes, and the radiation is attenuated in directions other than those determined by the above relationship.
Doppler effect. The Doppler effect is the change in the frequency of a signal received by an observer as a result of the motion of a source or observer relative to each other. If the frequency of the radiation is 0 and the frequency of the signal received by the observer is 0, then the theory of relativity explains the Doppler effect

$$n = n_0 \frac{\sqrt{1-\frac{\vartheta^2}{c^2}}}{1+\frac{\vartheta}{c}}$$



gives the expression. Here is the velocity of the source relative to the observer, θ is the angle between the direction of observation and the velocity. The velocity is positive if the observer and the source are moving away from each other, and negative if they are approaching each other.
This is the longitudinal Doppler effect observed when the observer moves towards the source in the direction of the straight line connecting them.
In the case J << c

$$n = n_0 \quad 1-\frac{\vartheta}{c}$$

So, when the source and observer move away from each other (relative velocity is positive), there is a shift to the long wavelength region (n<n0, l>l0). This is called a red shift. When the source and observer move closer to each other (relative velocity is negative), there is a shift to the short wavelength region (n>n0, l<l0) - a violet shift.
If q = p/2

$$n = n_0 \sqrt{1-\frac{\vartheta^2}{c^2}}$$

This is the transverse Doppler effect that occurs when the observer moves in a direction perpendicular to the line connecting it with the source. The transverse Doppler effect depends on J2; at small J it is a secondary effect relative to the longitudinal effect (~J). Therefore, this effect is very difficult to observe; it is of fundamental importance because this effect is not observed in

acoustics, that is, it is a relativistic effect. This effect was experimentally observed in 1938 by the American physicist G. Ives.

The longitudinal Doppler effect was observed in laboratory conditions by A. Belopolsky. With the help of this effect, the motion of radiating particles and objects is studied depending on the frequency shift and expansion. The Doppler effect is widely used in radio engineering and radar.

Conclusion

The absorption of light is a fundamental process with a wide scientific basis, and is the basis for the operation of various natural phenomena, technical devices, and medical practices. By fully understanding this phenomenon, the possibility of advancing technological development, solving environmental problems, and conducting scientific analyses more accurately will expand. In particular, the in-depth theoretical and experimental study of the interaction of photons with matter is one of the important tasks of modern science.

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