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Study of Gas Laser Operation

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Annotation: This article is mainly about gas lasers, optical base, screen, diffraction grating (round), rulers were used the purpose of writing this article is to study the structure and operation of a gas laser, to measure the wavelength of laser radiation using a diffraction type. Laser light is used in surgery to perform non-invasive incisions of tissues, because under its influence the edges of the cut tissue are welded to prevent capillary mining. Used in oncology to break down cancer cells. (Because the laser light is strongly absorbed in them). In ophthalmology, laser light is used to “weld” the iris, which is intensified, and to create microscopic holes in the sclera to drain the fluid inside the eye to treat glaucoma.

Keywords: Gas laser, optical base, screen, diffraction grating (round), rulers, absorption, Spontaneous radiation, Forced radiation,

Quantum electronics is a branch that studies methods for amplifying and generating electromagnetic vibrations using the phenomenon of forced radiation.

Quantum (energy quantum), one of the basic concepts of modern physics, is a finite (indivisible (energy) particle) quantity that atoms, molecules, and nuclei can absorb or emit in the interaction of a microsystem. In the steady state, atomic energy has discrete values. When a system moves from one state to another, its energy emits (or absorbs) a quantum of energy - a photon - equal to the difference between the energies of those states. The magnitude of the energy quantum E is equal to the product of the Planck constant h and the wave frequency ν.

$$E = h \cdot \nu \qquad h = 6{,}62 \cdot 10^{-34}\ j \cdot sec$$

A quantum generator is a generator of electromagnetic waves. The quantum generator uses the radiation of forced electromagnetic waves (quantum) of excited atoms, molecules, ions, and so on. A quantum generator operating in the optical range was developed in the 1960s and is called a laser. A quantum generator emits light waves in a very short range. The atomic structure is very important in the principle of operation of the laser. The energy states (orbits) of the atoms that make up matter are different. An atom with a particle in the lower orbit is stable, and an atom with a particle in the upper orbit is unstable. In the upper orbit, the particle does not stay long, after a certain time, the particle falls into the lower orbit and the atom emits light by itself. If a particle in a high-energy state (orbit) does not fall to itself, that is, to a more stable energy state, it can be "pushed" down. When a photon is absorbed by an atom, the photon energy is converted into the internal energy of the atom and becomes an excited energy state. After a certain time, it irradiates the received energy spontaneously and returns to its original state or steady state (Fig. 1).

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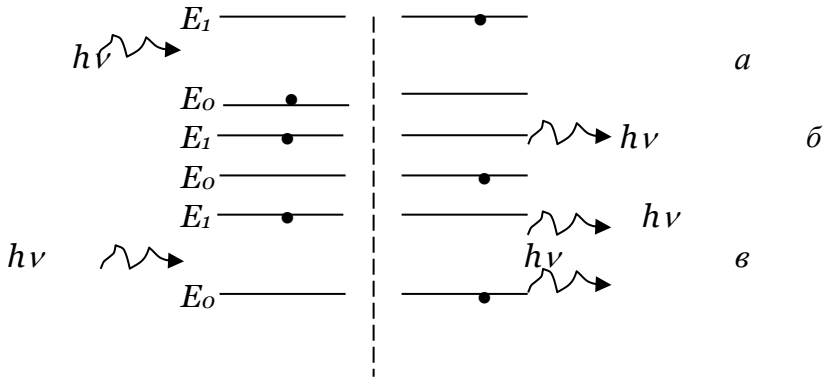

Figure 1.

Forced Absorption, Spontaneous Radiation, Forced Radiation, Spontaneous (free) radiation is the spontaneous electromagnetic radiation of atomic systems in the awakened state. Spontaneous radiation occurs when an excited system moves from a higher energy level E_1 to a lower energy level E_o.

Photon energy $h\nu = E_2 - E_1$ determined by It is not possible to clearly limit the time of spontaneous radiation, it will be at some time interval. Most light sources (e.g., incandescent lamps) are spontaneous illuminators. In spontaneous radiation, because the frequency of the photons oscillates in a range ($\Delta\nu$), it is monochromatic, coherent, and nonpolar. The intensity of light scattered in the environment can be reduced as a result of its absorption and scattering by molecules (atoms) of matter. Under normal conditions, the intensity of light passing through an environment is weakened. In such an environment, light is absorbed more.

In an active environment with forced radiation, it is possible to amplify the light. But most of the particles in such an environment need to be converted into an energetic state that has the property of radiating. Such light-amplifying environments are inverted (inverse) environments with active or particle energy levels. In an inverted environment, particles in an energy level are more abundant than particles in any energy level that are relatively small. An optical quantum generator consists of an active medium, a vibrating device, and resonators, and according to the active medium, lasers are divided into the following groups.

1.Lasers made of solids and liquids. 2. Gas lasers. 3. Semiconductor and other types of lasers. In order to activate the environment, there must be an external stimulus that “awakens” (activates) the particles. During an electric discharge, some of the neon atoms move from the primary level 1 to the excited level 3. For neon atoms, the lifetime at this level is small and the atoms move to I- or 2-levels. In this, the Boltsmann distribution takes place. To create an inverted environment, one must somehow increase the placement in level 3 and decrease the level in level 2. Helium atoms help to

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increase the placement in level 3. The excited level of helium corresponds to level 3 of the neon, so energy transfer occurs when an excited helium atom collides with an unexcited neon atom. The discharge tube of the helium neon laser is placed in the middle of the mirrors. Mirrors together are also called resonators.

The mirrors are made of multi-layer dielectric coating, the reflection coefficients of these coatings are 98-99% and do not absorb light.

The transmittance of one mirror is usually 2% and that of the other is not less than 1%. Typically, lasers operate in pulsed or continuous mode. The main properties of lasers are: its orientation (narrow distribution), monochromaticity, coherence, intensity. Today, lasers are widely used in biology, chemistry, engineering, and medicine. Laser eye surgeries are performed to restore lost vision. One of the most common eye diseases is retinal detachment.

The laser is used in surgery as a very fine, very neat "light knife".

The laser passes through the blood vessels, coagulates the blood, and burns the tissue in the affected area, allowing operations such as cutting the kidneys, liver, intestines, and organs to be performed without bleeding. Laser is also widely used in oncology: it heats the tumor tissue and destroys its structure. Laser is also used in practical medicine in the treatment of polyarthritis, radiculitis. The laser light accelerates the healing of the broken bone. Because the human body does not transmit light, in the treatment of some internal organs, light is transmitted to the patient using light bulbs. Laser is widely used in the study of changes in the environment under the influence of light (nonlinear optics), color and volume images (holography). Determination of the wavelength of laser radiation is performed using a diffraction grating. A set of a large number of identical slits spaced at equal distances from each other is called a diffraction grating.

The distance α between the centers of adjacent holes is called the grid constant or period. The condition for the formation of a light path (maximum) on the screen is as follows $\alpha \sin \varphi = \pm k\lambda \quad (k = 0,1,2...)$ determined from the formula.

In this case λ is the wavelength, α is the grid constant, k is the order of the light path (maximum).

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