NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 7, ISSUE 5, May. -2021

# DETECTION AND MODULATION OF OPTICAL QUANTUM GENERATORS

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**ANNOTATION:**

**This article discusses optical quantum generators, their types, detection and modulation, as well as their history and mechanism of operation.**

**Keywords: optical quantum generators, lasers, Rhodamin-6J, rays, radiophysics.**

**Optical quantum generators. (Lasers)**

**INTRODUCTION:**

In 1939, V.A. Fabrikant first proposed the idea that it is possible to create an environment that amplifies light, and that light is amplified in this environment at the expense of forced radiation. In 1953, IG Basov and AM Prokhorov, and Ch. Towns and Weber from the United States developed molecular generators that amplified electromagnetic waves at centimeter wavelengths, called generators. In 1960, T. Meyman developed a solid-state optical generator operating in the optical range. Such generators are called lasers. Depending on the type of active medium that amplifies light, lasers are divided into solid-state, gaseous, semiconductor, and liquid lasers. More precisely, the method of forced collection (optical collection) also plays an important role in the classification of types of lasers.

Mandatory assembly methods include optical, thermal, chemical, electroconvulsive and other methods. Furthermore, the type of generation can be continuous or pulsed.

Lasers consist of three main parts:

1) Active medium - a substance with a metastable state.

2) Forced collection system (optical collection) - devices that create a state of inversion in the active environment. The state of inversion is the state in which the number of atoms in the awake state is greater than the number of atoms in the ground state.

3) Optical resonator - a device that generates laser radiation.

A quantum generator is a generator of monochromatic electromagnetic waves based on the phenomenon of forced radiation. Its operation is based on the emission of photons by atoms, ions and molecules under the influence of external radiation. The first quantum generator in the OYUCH (ultra-high frequency) range. In 1955, N. G. Basov and A. M. Prokhorov and American scientists J. Gordon, H. Seyger, and Ch. Created by Towns (independent of each other). It used the NH3 handle of ammonia molecules as the active medium, hence it is called a molecular generator. Nowadays, in addition to ammonia molecules, formaldehyde molecules, cyanide acid molecules, hydrogen atoms, water, deuterium ammonia molecules and others are used in molecular generators. The disadvantage of molecular generators is the complex structure of the spectral lines. Each spectral line itself is a collection of very close lines that are difficult to separate on radio spectroscopes. A special feature of the quantum generator in the radio range is the high stability of the oscillation frequency (Du / sh — 10 ~ 13). Therefore, they are used as a quantum standard of frequency. The quantum generator, which operates in the optical range, appeared in the 1960s and is called a laser. The active environment of the laser varies: crystal, glass, gas, liquid, semiconductors. A quantum generator emits light waves in a very short range. K.g. with the first solid (ruby). - The laser was created in 1960 by the American Physicist T. Meyman, and the neon-helium (Ne - Ne) gas generator was created by the American physicists A. Javan, U. Bennett and D. Garriot. An optical quantum generator differs from light sources by its very high monochromaticity (i.e., frequency stability) and radiant power. The gas quantum generator has a radiant power of up to 5 kW in continuous mode. The solid-state generator has a radiant power of up to 1013 W. Quantum generators are used in various fields of radiophysics, optics and engineering.

A laser is an electro-optical device that emits coherent radiation. The term is derived from the English abbreviation "laser", which means Light Amplification by Stimulated Emission of Radiation, [1]. A typical laser emits light with low divergence and a strictly limited wavelength (i.e., monochrome).

Laser (Light Ampli Light cation by Stimulated Emission of Radiation), an optical quantum generator, is a device that generates radiation in the ultraviolet, infrared, and visible field ranges; one of the basic devices in quantum electronics. The first L. was created in 1960 by the American Scientist T. Meyman in ruby. Its work is based on the forced radiation of atoms and molecules. The laser converts various energies (electric, light, chemical, thermal, etc.) into coherent electromagnetic light energy in the optical range. It consists of 3 elements - energy source, active medium (substance), feedback (if the laser serves to amplify the coherent light, feedback is not necessary). The laser differs from other light sources by its coherence, monochromaticity, very small directional orientation, high spectral intensity of light, and very high oscillation frequency.

According to the active medium, lasers are divided into the following groups: 1) L made of solid and liquid; 2) gaseous L; 3) semiconductor L. In addition, excimer, chemical, etc. There are also laser types. In L., feedback is provided by an optical resonator (two mirrors). The active substance is placed between the mirrors. The light wave returns from the mirrors and passes through the active substance again, causing forced transitions. One of the mirrors is partially transparent, allowing the intensified light to go out after an infinite number of transitions.

In the principle of operation of the laser, the work of the atomic structure is important. 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 high orbit, the particle does not last long. After some time, the particle falls into a lower orbit and the atom emits light. In high-energy states (orbits), it can be pushed down if it does not fall into a more stable state. This is called forced irradiation in science. Just as a single stone rolled down a mountain rolls down several stones, if a single particle of matter is pushed, the particles in all orbits move. The light emitted by the atom is combined with the absorbed light to form two lasers, four eights, and so on. These rays are amplified by a quantum generator (similar to an electrical signal amplifier) that converts them into highly directed light (energy). Due to the energy source (alternating current, high or very high frequency current, optical or laser light, electron beam), the electrons in the active substance move to higher (excited) levels, and the inversion state (number of electrons at higher level N2 is lower than at lower level N). ) occurs. When they are exposed to an energy source (such as light), the active substance is activated. The energy given to the electrons increases several thousand times, and then takes the form of laser light. In addition, the amplification factor Kk of the laser beam in the device must be much larger than the energy loss coefficient Ky (KkJ.). When these conditions are met, laser light generation can be achieved.

The laser has 2 different operating modes. If a continuous energy source is used in it, continuous thin light can be produced. If the source gives pulsed energy, the laser emits light pulses.

Lasers made of solids (eg ruby L.) use a red crystalline glass rod made of aluminum oxide (A12O3) with the addition of up to 0.05% chromium (Sg3 +) ions (activator). The sapphire is cylindrical in shape with optical resonant mirrors at both ends of the sapphire axis. The light emitted from the pulsed lamp creates vibrations. When the light of the lamp falls on the ruby, the chromium ions become "activated" by activating the green and yellow parts of the radiation spectrum emitted by the lamp. The result is an active environment ready for radiation, with light quanta multiplying along the axis of the sapphire in the form of a shower directed vertically at the mirror. The power of light generated in ruby L. reaches up to 20 kW. Their f.i.k. 0.1% to 10% each. The generation of the laser light depends on the activator passing through the energy levels. The wavelength of the infrared light produced in it is>. = 0.69 μm. Solid Ls The neodymium The laser uses a glass rod (CaWO4) with the addition of neodymium (Nd3 +) ions as the active substance. This laser emits infrared light with L. = 1.06 μm.

Rodamin-6J, pyranine, tripaflavin, and others are used instead of the active substance in L. made from liquid bodies. Using alcohol, acetone, toluene, etc., as a solvent for the dye, the active substance is placed in a glass cuvette (Fig. 2). The schematic structure of a nitrogen laser-induced dye laser is shown. In gaseous L. [the first gas laser (He-Ne) mixture was created by the American scientist A. Javan], the active medium consists of a gas (or gas mixture). Mac, helium-neon (Ne-Ie) active medium consists of a mixture of helium and neon gases (Figure 3). The gas mixture is activated by an electric discharge. In this day-to-day laser, generation occurs when Ne passes between levels. It emits light of 3 wavelengths: ^. = 0.63 μm (red light), L2 = 1.15 μm and X3 = 3.39 μm (infrared light). From gaseous L. (CO2 + N2) emits light of length X = 10.6 μm. Ionic and Chemical Lasers are also Gas Lasers. The active medium in ionic L. contains ionized atoms, while the chemical laser contains atoms that have "awakened" in chemical reactions (argon L.i operating on ionic surfaces emits blue light). The Department of Quantum Radiophysics of the National University of Uzbekistan (NUU) has developed a compact light SO2 L.i, which works on transistor autogenerators in the field of ultra-high frequencies.

In semiconductor, GaAs lasers, the active medium is made up of semiconductors. In such a laser, the medium is activated using optical and electron currents. In this type of laser, the laser transitions occur between the conduction-valence bands and the donor receptor surfaces. These are called laser diodes. A semiconductor diode consists of a crystal plate with a thickness of 0.1 mm and a surface area of several mm2 (Figure 4). When a direct current is passed through these diodes, the electrons pass into the upper zone or levels and an inversion state occurs. When electrons move to the lower zone (or levels), laser light generation is observed due to the energy released as a result of recombination of electron holes. The wavelength of the infrared light emitted by the GaAs laser is ^. = 0.84 μm. Semiconductor Ls include CdS (blue light), CdTe (red, dark red light), and CaSb (red; infrared light). Semiconductor Ls have a simple structure, are small in size, and can last a long time.

The light intensity in Ls is in the order of solid-state lasers, liquid-type lasers, gaseous lasers, and semiconductor lasers, f.i.k. semiconductor lasers, liquid lasers, gas lasers, and solid-state lasers. The thinness of the beam is best in gas lasers and worst in semiconductor lasers. The size and weight of the device are the largest in solid-state L., gaseous and liquid, medium in solid-state lasers, and smallest in semiconductor L. The light of various Ls ranges from ultraviolet to the visible field and the infrared range.

L. is widely used in various fields. Solid Ls in laser spectroscopy, L. technology (solid, cutting, welding, piercing), nonlinear optics, gaseous Ls in standardization of frequency and length, optical systems grinding, surveying, Ls chemistry, medicine; Semiconductor Ls are compact and light, and are widely used in optical communication systems, audio and video systems, night vision devices, optical data processing, and projection L television. Chemical L.s are used in atmospheric composition control systems. L.s are used in criminology, terrestrial, long-distance and underwater optical communication, fiber-optic telephone communication systems, L. CD-making, surgical operations, ophthalmology, controlled thermonuclear fusion.

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