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PROPERTIES AND APPLICATIONS OF LASERS

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ABSTRACT: An electron magnetic radiation (EMR) laser is a specialized form of electromagnetic radiation that exhibits particular characteristics and may be utilized in a broad variety of field applications. This type of laser falls under the category of electromagnetic radiation. High levels of directionality, high levels of monochromaticity, high levels of coherence, and high levels of intensity are some of the properties that lasers possess within their range of operation. Additional features include high levels of intensity. These characteristics of lasers serve as a source of inspiration for the creation of a new laser device that has the potential to be utilized in a broad variety of different environments.

Keywords: *Electron magnetic radiation (EMR) laser, Laser properties, Directionality, Monochromaticity, High intensity.*

1. INTRODUCTION

LASER is the acronym for light amplification by stimulated emission of radiation. Laser is one of the priceless invalidation of the 20th century, Einstein gave the theoretical basis for the working of laser in 1916 through stimulated emission, The Haiman built the first laser device 1960.A javan developed the He-Ne gas laser, the first gas laser Pater has constructed the CO2 laser indispensable in various industries. Argon ion laser is one of the ion laser which is capable of producing many wavelength ranging from 3510_5200A^{o}, semiconductor laser is Designed for reading and writing data in computer.

Lasers deliver coherent, monochromatic, well-controlled, and precisely directed light beams. A priori, therefore, lasers would seem Tobe poor choices for general-purpose illumination, however, they are ideal for concentrating light in space, time, or particular wavelengths. Lasers have been regularly used to measure, cut, drill, weld, read, write, send messages, solve crimes, burn plaque out of arteries, and perform delicate eye operations. Over and over again the laser has proved to be an extremely practical tool. Nevertheless, lasers have also proved their usefulness in non-practical applications, especially in the realm of art and entertainment. Lasers are involved in almost all aspects of these fields, from “light shows” to Compact Discs (CDs) and Digital Video Discs (DVDs), to special effects in the movies. Some other commonplace application of lasers are as Laser pointers, barcode scanners, laser printers, etc. Still, much of the important modern day celebrated applications lie in the fiber-optic communication, laser machining and fabrication, trace element detection, laser metrology and medical imaging. Characteristics of Laser: Laser have lightly interesting characteristics.

Directionality: Leaser suite light in one direction which is parallel to the axis of the resonant cavity (A pair of mirrors) the conversation light is exited in all directions. This features are useful in metrology. (Astronomical distance measurement)

Mono chromaticity: Laser light is highly monochromatic i.e. single colored light with single wavelength. The wavelength spread is less than 10A^{0}. Ordinary light source has spread of wavelength in the range of 100A^{o} to 1000A^{o}.

Coherence: In laser a large no of identical photos is generated through stimulated emission and they have phase correlation to through each other. such light is called coherent light. the phase correlation is not maintained among the photos in ordinary light.

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Intensity: Light in a laser propagates as plane waves. the laser beam contains a beadle of parallel rays. the divergence of helium neon (He-Ne laser) is 10^{-3} radiation. Light from a conversation source spread in all directions in the form a spherical wave front so it is divergent.

Lasers in Industry: Elegant application were developed in Industry they are welding, catting and drilling applications

Welding: High welding rates are possible with CO2 laser, stainless steel plate can be welded at a speed of 10 cm/sec any complex shapes can be welded using computers which control the deflection of laser beams

Cutting: CO2 laser are used for cutting purpose. Low carbon steel plate of 1 cm thick are cut at a rate of 1 cm/ sec, any desired shapes can be cut laser are used in apparel parks to cut an argent number of models and sizes of dresses.

Drilling: laser save used to drill aerosol nozzbs and orifice with accuracy laser are used to drill holes in sensitive material like ceramics, etc. holes of micron order can be drilled .this is not possible by drill bit

Lasers in electronic industry: Material process in is important in Electronic industry few examples are given below

Scribing Brittle ceramic and semiconductor wafers are scribed to break them. Low powder CO2 laser is suitable here.

Trimming: Thickness and resistance of a film are inversely related thickness is gradually reduced by trimming until a suitable or expected resistance the film is obtained

Lasers in Medicine: Here we discuss retinal welding, cataract removal laser angioplasty, bloodless surgeries

Retinal Welding: Retina is light sensitive layer. If it is torn or extends, it may lead to blindness. the red blood cell of retina strongly absorbs green light of argon ion laser, becomes softer and welds back to the eye ball

Cataract Removal: The grey colored opaque layer on the eye ball is called cataract. It may lead to permanent blindness if not received in time. It is removed by laser easily.

Laser Angioplasty Nd: YAG laser are used to remove artery blocks the laser beam is sent through optical fiber to the region of blockage, The excess growth of plaque is stopped and regulator the blood flow without need for bypass surgery.

Kidney and Gall Stones: Laser beams sent through an optical fiber smashes the stones in to small pieces

Bloodless surgery: The blood vein cuts are fused at their tips by the IR laser and excess bleeding stops. This technique is used to stop bleeding and reduces time duration of surgeries.

Lasers in Defense: Laser beams itself can destroy equipment, it is also useful in ranging, guiding weapons etc. details are given under

Range of the target: The distance is measured by taking the time of round trip , The velocity of moving target can also be calculated by using Doppler shift of light signal Nd: YAG laser is used for this purpose

Guided missiles: The laser beam is used as error signal. and also as correcting signal. The missile knows the correct position of the target by these two signals and it explodes on the target precisely. The IR light of CO2 laser is used here.

Laser as destroyer: Laser with proper power can disable the enemy weapons .IR sensors on guided missiles and electric eyes of satellites can be damaged. Megawatt power laser are used to destroy the weapons.

Lasers in optical communication: The enormous bandwidth 10^5 GHZ and other attractive features of laser are suitable for their use in optical fiber communication.

LIDAR Light Detection and Ranging. Remote crop details, Atmosphere pollutants at a specific altitude

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2. LASER IMAGING AND HOLOGRAPHY

The coherence of laser light is crucial for interferometry and holography, which depend on interactions between light waves to make extremely precise measurements and to record three-dimensional images. The result of adding light waves together depends on their relative phases. If the peaks of one align with the valleys of the other, they will interfere destructively to cancel each other out; if their peaks align, they will interfere constructively to produce a bright spot. This effect can be used for measurement by splitting a beam into two identical halves that follow different paths. Changing one path just half a wavelength from the other will shift the two out of phase, producing a dark spot. This technique has proved invaluable for precise measurements of very small distances. Holograms are made by splitting a laser beam into two identical halves, using one beam to illuminate an object. This object beam then is combined with the other half— the reference beam—in the plane of a photographic plate, producing a random-looking pattern of light and dark zones that record the wave front of light from the object (Fig. 4). Later, when laser light illuminates that pattern from the same angle as the reference beam, it is scattered to reconstruct an identical wave front of light, which appears to the viewer as a three-dimensional image of the object. Holograms now can be mass-produced by an embossing process, as used on credit cards, and do not have to be viewed in laser light.

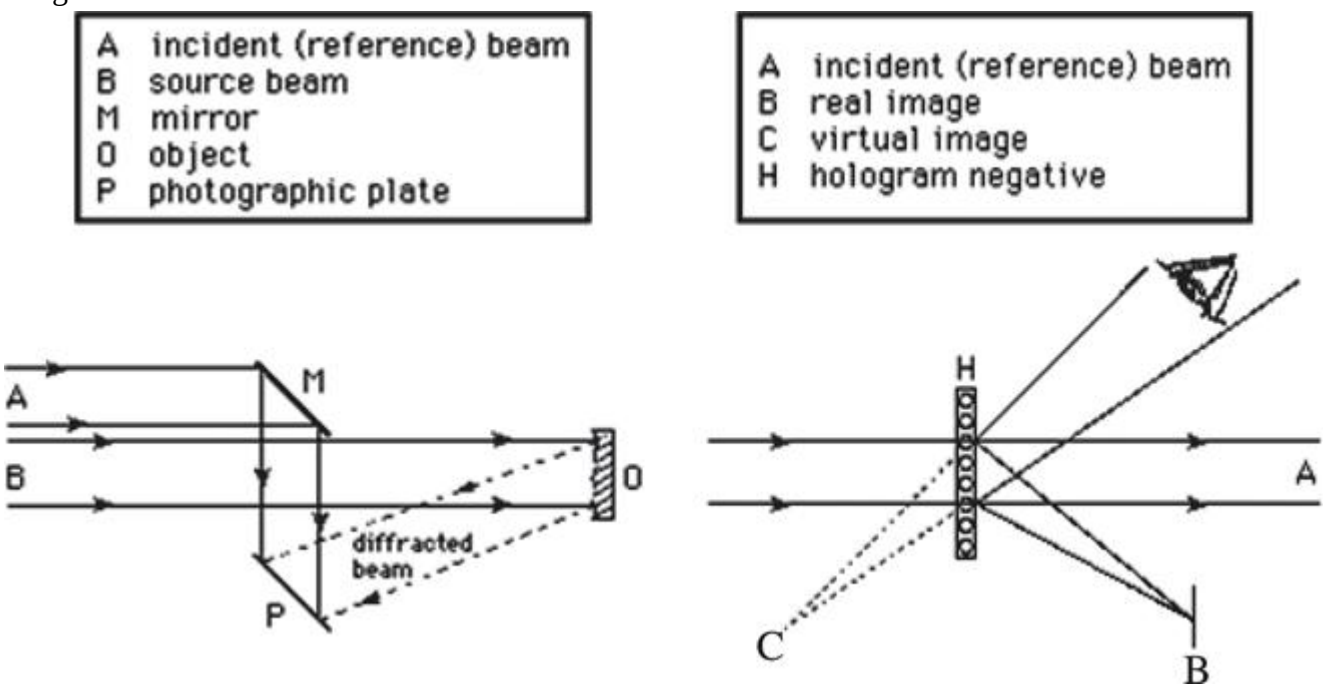

Figure 4: Schematic of Holography process where the laser beam is split into three components. First two beams are needed to create the hologram which is viewed with the help of the third.

Conclusion: laser is a new form of electrical radiation and it has novel structure characteristics. these characteristics given rise to interesting application in various fields if life argon-ion laser has medical and entertainment uses. there is vast potential of designing new lasers with previous application

Weed control by lasers: there are two components. The first one is the AI scanner which identify the weed among the crop saplings. The second component is the controlled laser beam Which is capable of focusing on the weed. The weed is fired to death by using powerful laser beam. The rate of destruction is 100000 weed per hour by blue laser light.

LIDAR: Light detection and ranging is the expansion for LIDAR has wide range of applications. Autonomous vehicles, robotics drone navigation. Environmental monitoring. Forest management and many more. The frequency of laser light is modified after reflecting from the target.

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