



LASERS

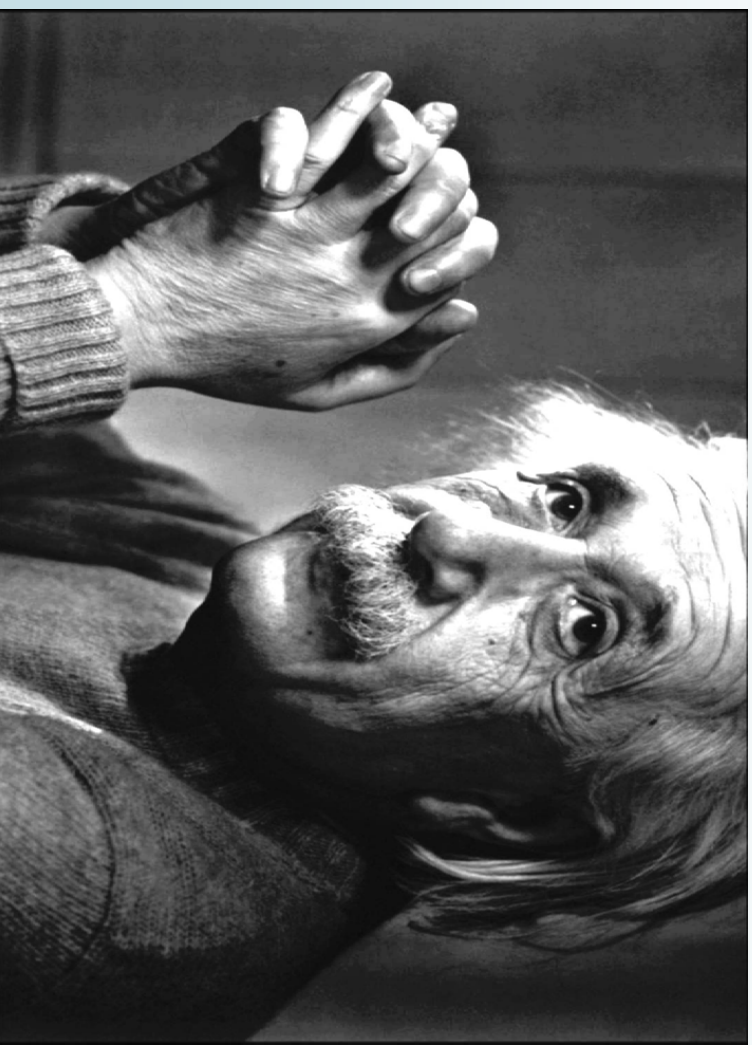
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The Definition of LASER

- ▶ A Light Amplification by Stimulated Emission of Radiation
- ▶ The word lase means
 - ▶ To absorb energy in one form
 - ▶ To emit a new form of light energy that is more useful

History of LASER

- ▶ In 1917, Albert Einstein created the foundation for the LASER



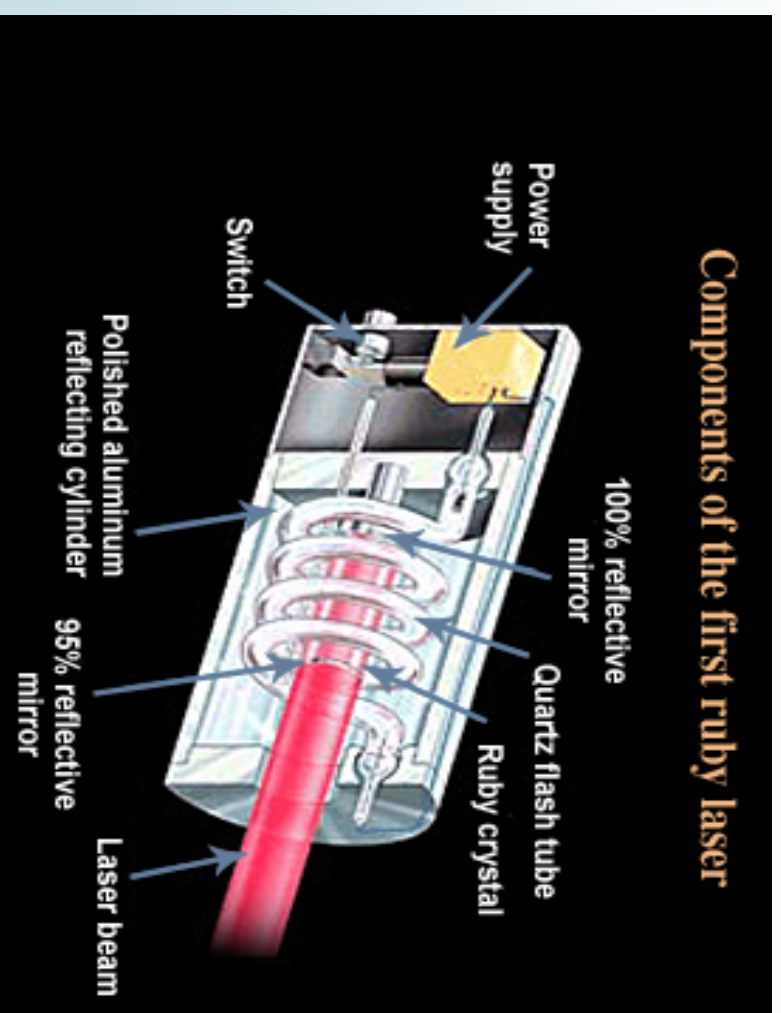
- ▶ In 1958, Charles Townes and Arthur Schawlow found theoretical basis for LASER



- ▶ In 1960, Theodore Maiman built the first LASER by using a ruby crystal medium



- ▶ Ruby crystal is composed of aluminum oxide, where some of the aluminum atoms have been replaced with chromium atoms. Chromium gives the ruby its vibrant red color
- ▶ In a ruby laser, a ruby crystal is formed into a cylinder. A fully reflecting mirror is placed on one end and a partially reflecting mirror on the other.
- ▶ A high-intensity lamp is spiraled around the ruby cylinder to provide a flash of white light that triggers the laser action.



Properties of Laser


- ▶ Monochromatic
 - ▶ Emit only one wavelength
- ▶ Coherence
 - ▶ All the emitted photons bear a constant phase relationship with each other in both time and phase
- ▶ Collimated
 - ▶ Travel In one direction



LASER VS. LIGHT

Laser vs. Cynosure Pulsed Light

CYNOSURE

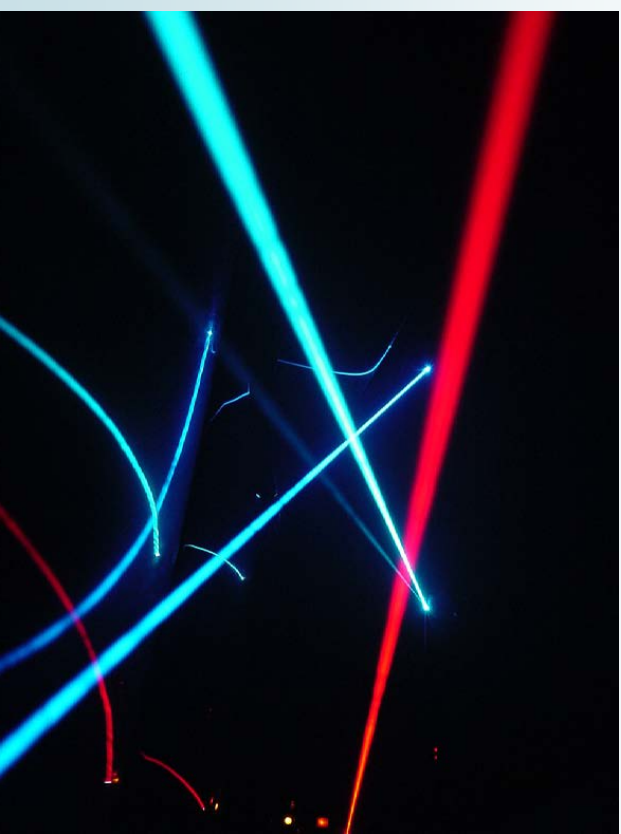


- Monochromatic
- Coherent
- Collimated

- Polychromatic
- Non-coherent
- Non-collimated light

How LASER is Produced?

- ▶ LASER is a form of energy at which the human eye is sensitive.
- ▶ LASER as electromagnetic waves emitting radiant energy in tiny package.
- ▶ Each photon has a characteristic frequency and its energy is proportional to its frequency



Einstein's quantum theory of radiation

In 1917, according to Einstein, the interaction of radiation with matter could be explained in terms of three basic processes:

- ▶ Absorption
- ▶ Spontaneous Emission
- ▶ Stimulated Emission

Absorption

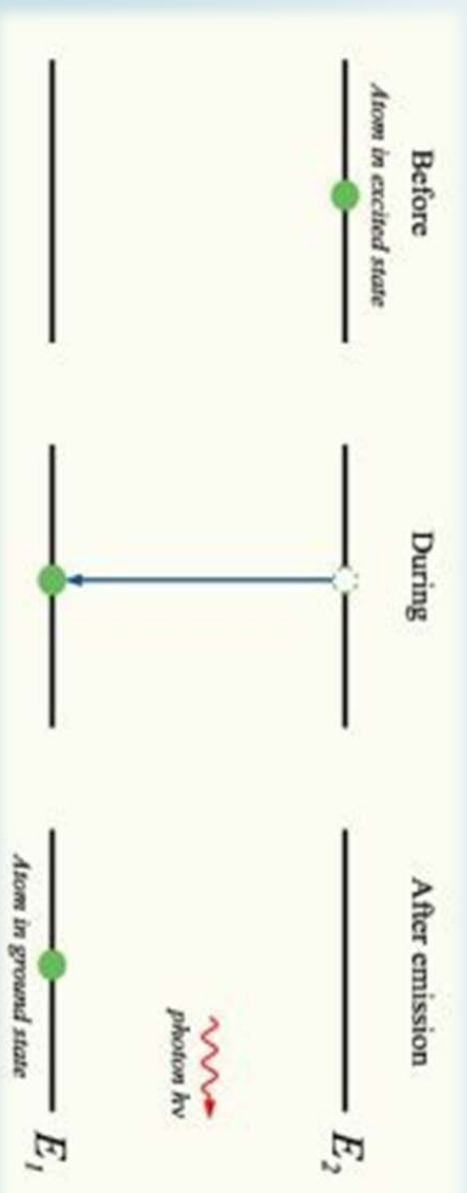
As we know the amount of energy (E) can be determined by the equation:

$$E=hf$$

where **h** is Planck's constant (6.63×10^{-34} J/SEC) and **f** is the photon frequency. This process, whereby atomic excitation occurs due to the movement of an electron from its ground state to a high-energy orbital is termed 'absorption'.

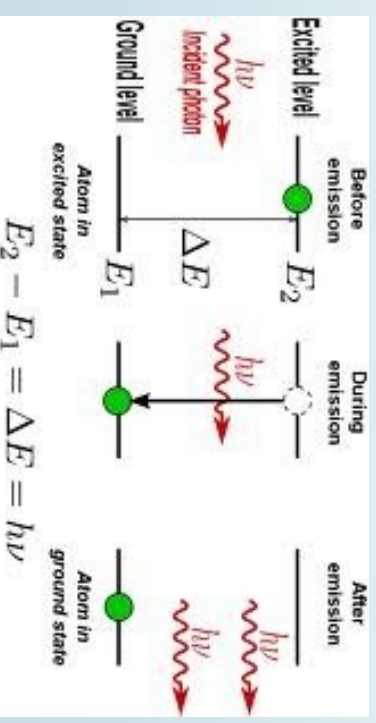
Spontaneous Emission

- It is a process in which there is an emission of a photon whenever an atom transmits from a higher energy state to lower energy state without the aid of any external agency



Stimulated Emission

- ▶ Stimulated Emission is the basis of the LASER production
- ▶ It's a process in which there is an emission of a photon whenever an atom transits from a higher energy level to lower energy level under the influence of an external agency like inducing photon.



Applications of LASER

- ▶ Industry:
 - Cutting and welding
 - Guidance systems (test the quality of materials)
- ▶ Medicine:
 - Laser scalpel
 - Eye surgery



- ▶ Science:
 - ▶ Spectroscopy
 - ▶ Precise measurements
- ▶ Radars
- ▶ Consumer:
 - Laser lights
 - CDs and DVDs





Thanks for your listening

Sources

- <http://www.sciencedirect.com/science/article/pii/S1472029917302424>
- <http://www.sciencedirect.com/science/article/pii/S0263436812001849>
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