Lecture (9)

Laser

Mean of LASER

Light Amplification

by Stimulated Emission of

Radiation

❑ Properties of Laser Light

- **The light emitted from a laser is monochromatic, that is, it is of one color/wavelength. In contrast, ordinary white light is a combination of many colors (or wavelengths) of light.**

- **Lasers emit light that is highly directional, that is, laser light is emitted as a relatively narrow beam in a specific direction. Ordinary light, such as from a light bulb, is emitted in many directions away from the source.**

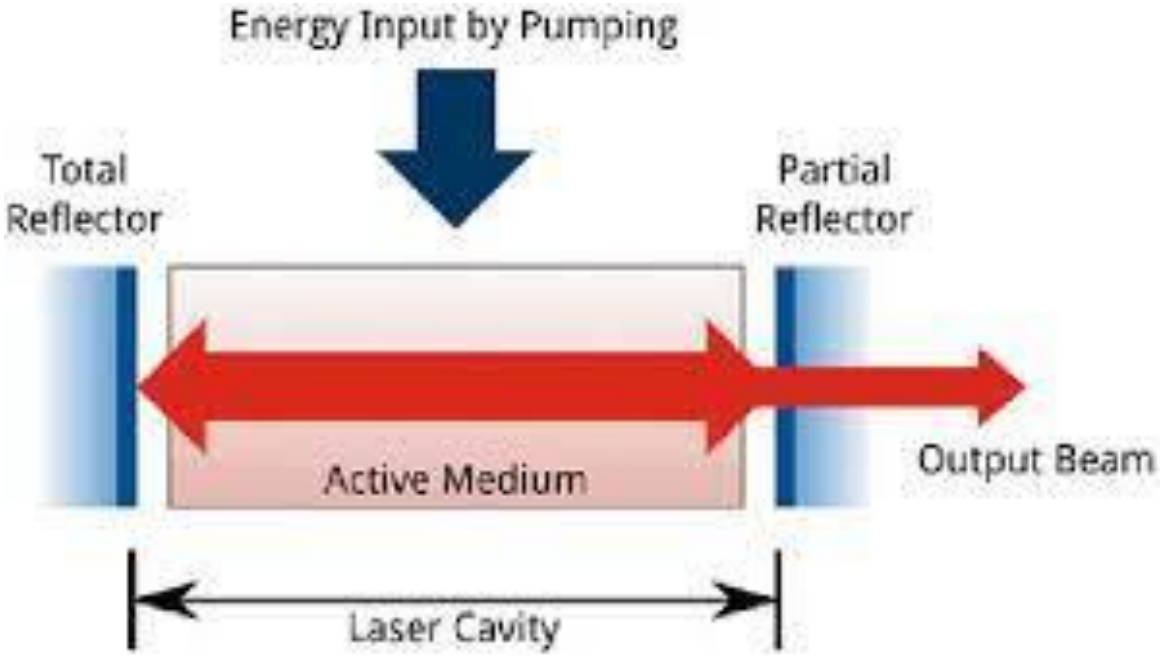
- **The light from a laser is said to be coherent, which means that the wavelengths of the laser light are in phase in space and time. Ordinary light can be a mixture of many wavelengths.**

Basic Components of Laser

1. **Active medium or laser medium**

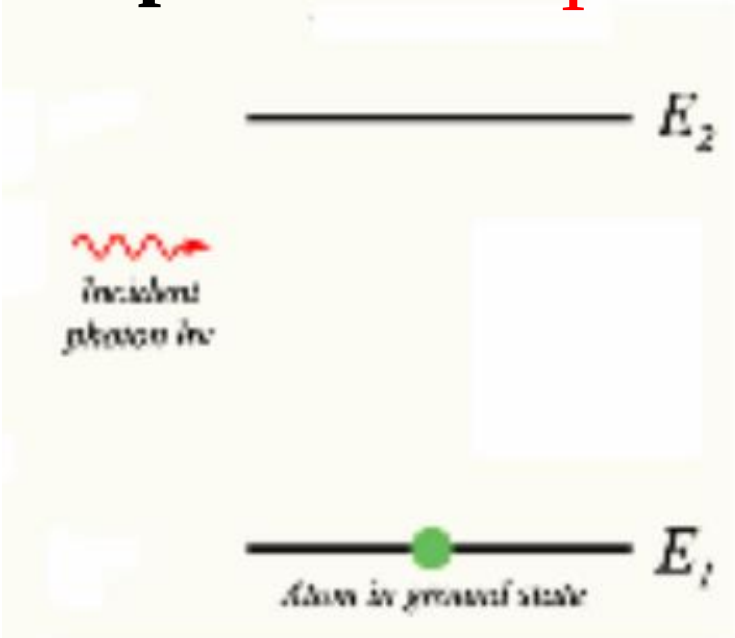
2. **An energy source (referred to as the pump)**

3. **An optical resonator consisting of a mirror .**



❑Basic Principles of Light Emission and Absorption

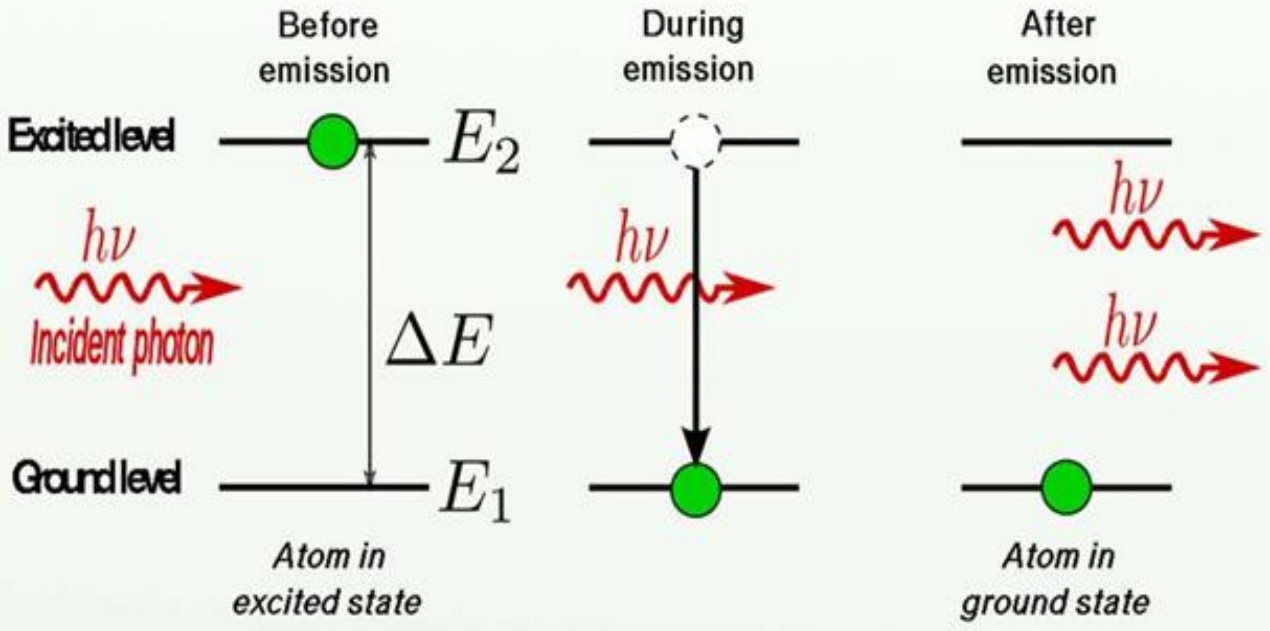
➢ **Rate of Absorption = B N_1 I**



B Einstein's Coefficient for Stimulated Absorption.

N_1 Population in the Ground State

➢**Rate of stimulated emission = $A\,N_2\,I$**

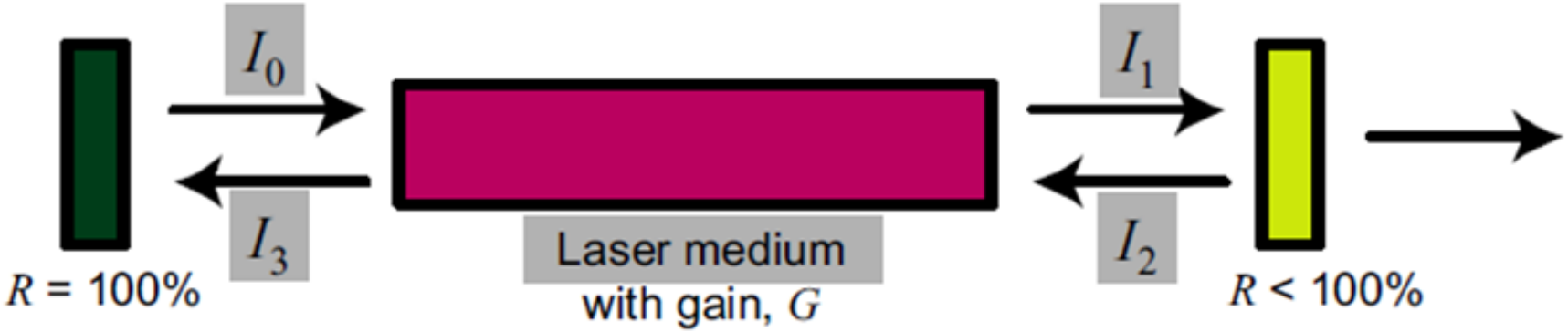


https://en.wikipedia.org/wiki/File:Stimulated_Emission.svg

A Einstein's Coefficient for Stimulated Emission

N_2 Population in the Excited State

❑ Threshold Condition



A laser action will be achieved if the beam increases in intensity during a round trip

$I_3 > I_0$ **Gain > Loss**

This is called achieving Threshold

❑ Population Inversion

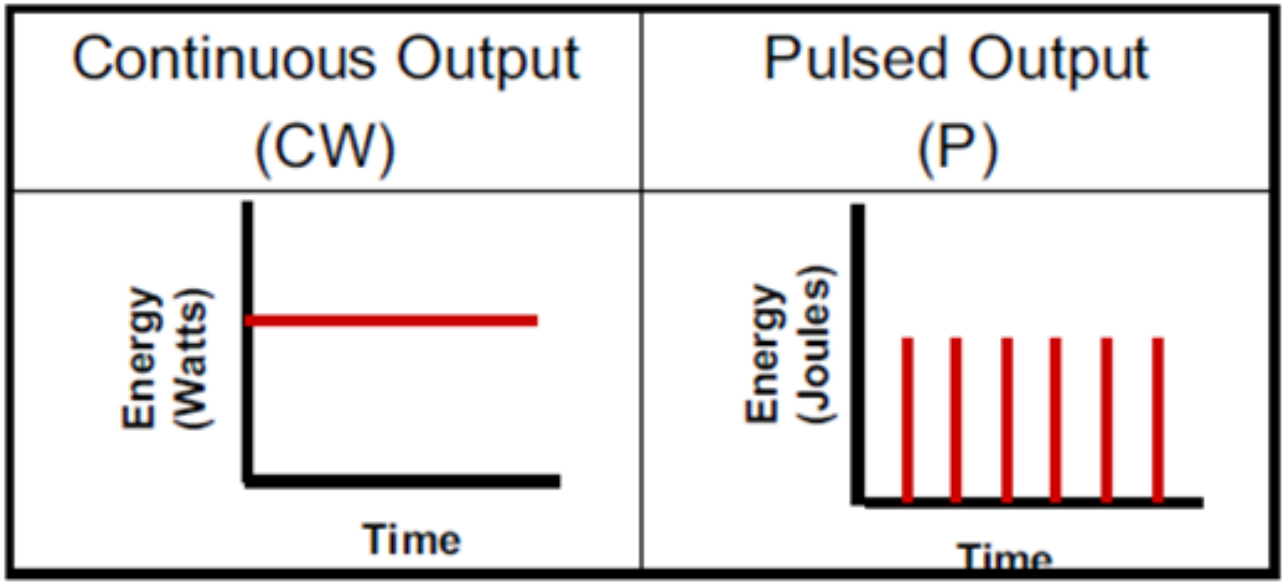
$$B N_2 I > A N_1 I$$

$$N_2 > N_1$$

In order to achieve inversion, we must pump the laser medium in some way and choose our medium correctly. Population inversion is the necessary condition for laser action.

❑ Laser Output

The output of a laser may be continuous having constant amplitude known as continuous wave or it may be pulsed, which is achieved by using the techniques of Q-switching and Mode locking`



❑ Applications of LASER

- **Medicine**
- **Industry**
- **Military**
- **Law enforcement:**
- **Research**
- **Commercial products:**
- **Entertainment:**

Dr. Ali samir Awad