PES UNIVERSITY ONLINE

ENGINEERING PHYSICS

K Raghavendra Rao, Ph.D.

Department of Science and Humanities

PES UNIVERSITY ONLINE

Class #38

Laser System Requirements and Gain

1. Active species
2. Energy Pump
3. Resonating Cavity
4. Round trip gain

ENGINEERING PHYSICS
LASERS: Requirements

➢ *Suggested Reading*

1. Lasers: Fudamentals and Applications

K Thyagarajan, A Ghatak

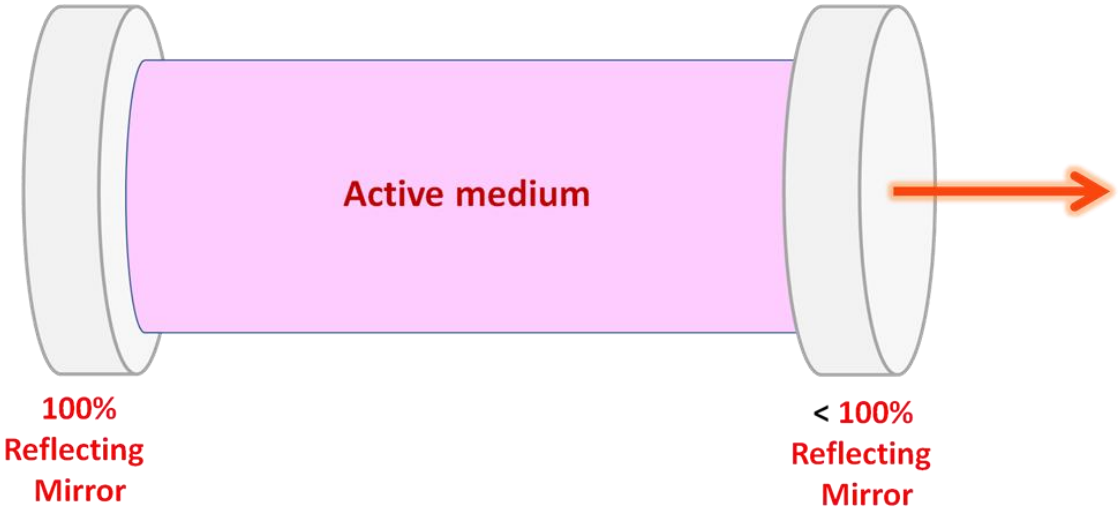
2. Course material developed by the Department

➢ *Reference Videos*

https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/laser-fundamentals-i/

ENGINEERING PHYSICS

Laser Requirements: Active Species/Medium

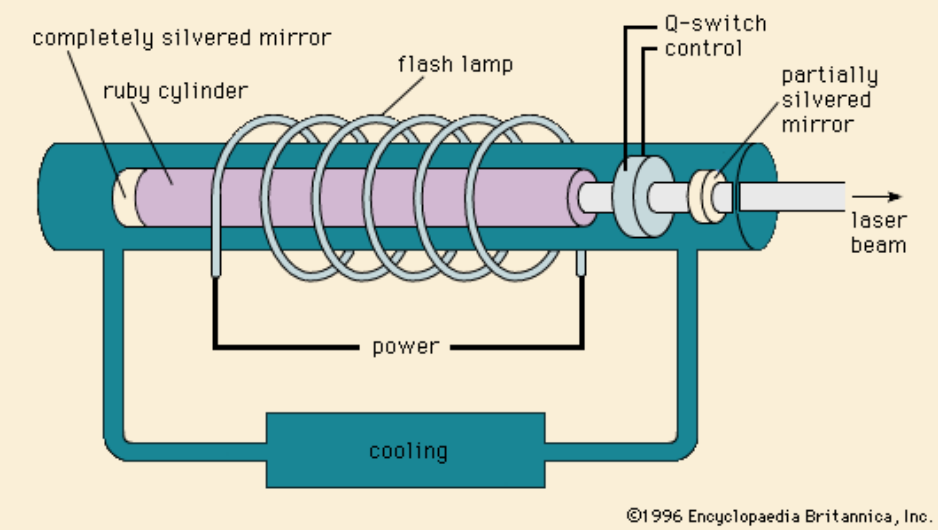


- The active medium is the material medium enclosed between the mirrors (solid or liquid or gas)

- Acts as the host with suitable energy levels amongst which transitions take place and population inversion can be achieved.

ENGINEERING PHYSICS

Laser Requirements: Active Species/Medium



- The presence of the meta stable states increases the probability of population inversion which is a prime condition for laser action.

Examples

Ne gas in He-Ne laser

- Cr ions in Al_2O_3 crystal in Ruby laser
- Nd dopants in YAG crystal in NdYAG laser

ENGINEERING PHYSICS

LASER Requirements: Energy Pump

- To achieve population inversion in an active medium, an external energy source is needed.

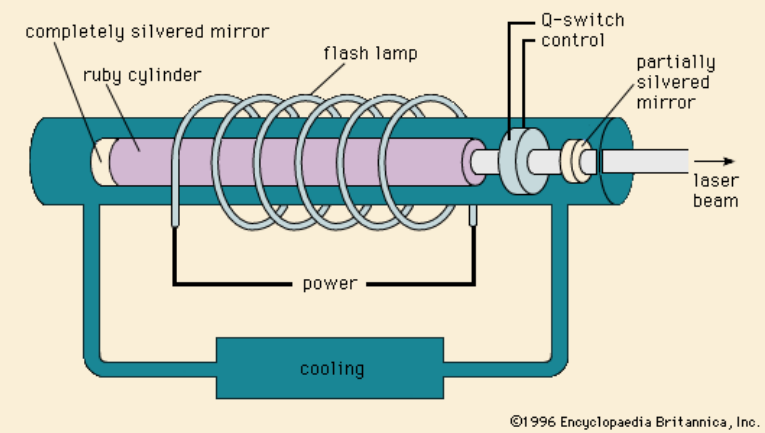
- The external energy sources could be

Optical (flash lamp) Ruby laser, NdYAG laser

Electrical (electrical discharge) HeNe, CO_2 lasers

Chemical, Dye lasers.

Etc, depending on the type of the laser

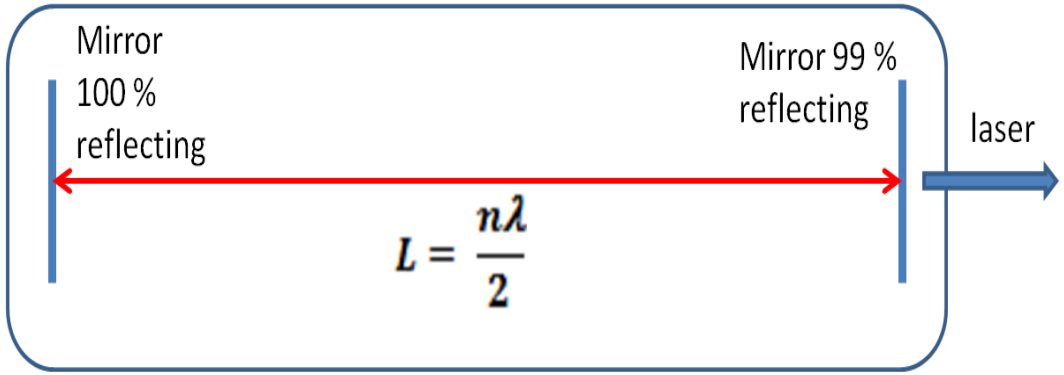


- In the case of gas lasers, generally an electrical discharge is a sufficient source for exciting the medium.

ENGINEERING PHYSICS

Laser Requirements: Resonating Cavity

- Resonating Cavity allows amplification of the intensity of the beam and makes it unidirectional emission



- Consists of two mirrors of various geometries and coatings creating standing waves

- Because of the energy amplification due to stimulated emission

- The laser comes out of the partially reflecting mirror

- Photons travelling in directions not perpendicular to the mirrors are not amplified

Laser system requirements

Check Your Understanding (Yes/No)

1. ***Energy pump is required because we need population inversion***

2. ***A resonating cavity amplifies the beam intensity***

3. For a resonating cavity $L=n\lambda$

4. Losses in resonating cavity are insignificant

THANK YOU

Raghavendra Rao K, Ph.D.

Associate Professor, Department of Science and Humanities

raghavendrarao@pes.edu