Laser and Laser Systems

Main Components of Laser

A **laser is constructed** from three principal parts:

- An energy source (usually referred to as the *pump* or *pump source*),
- A *gain medium* or *laser medium*, and
- Two or more mirrors that form an *optical resonator*.

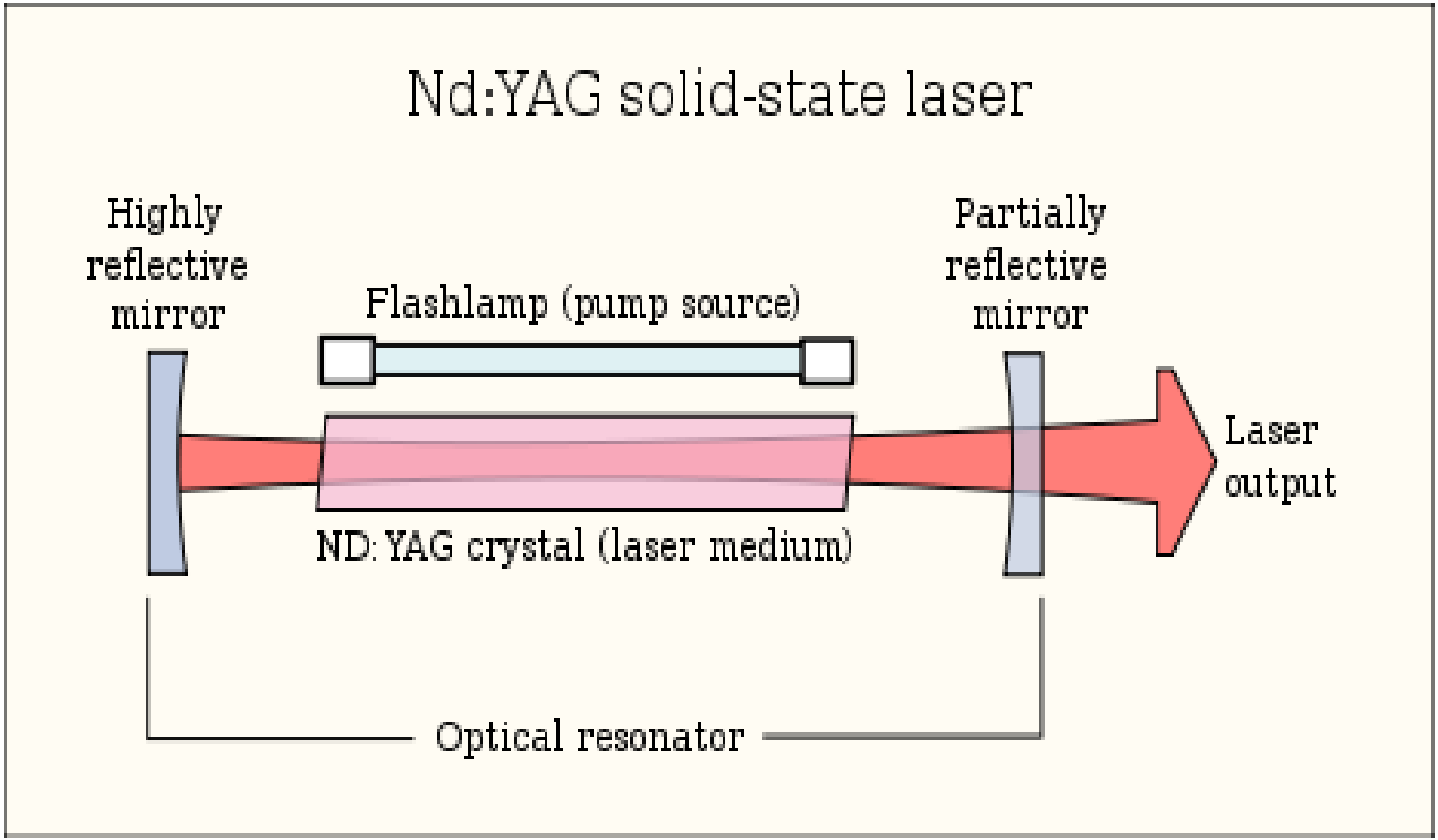

Fig.- Basic laser System

Pumping Source

The *pump source* is the part that provides energy to the laser system. Examples of pump sources include electrical discharges, flash lamps, arc lamps, light from another laser, chemical reactions and even explosive devices. The type of pump source used principally depends on the *gain medium*, and this also determines how the energy is transmitted to the medium.

A helium–neon (HeNe) laser uses an electrical discharge in the helium-neon gas mixture, a Nd:YAG laser uses either light focused from a xenon flash lamp or diode lasers, and excimer lasers use a chemical reaction.

Gain medium / Laser medium

The *gain medium* is the major determining factor of the wavelength of operation, and other properties, of the laser. *Gain media* in different materials have linear spectra or wide spectra. *Gain media* with wide spectra allow tuning of the laser frequency

The gain medium is excited by the pump source to produce a population inversion, and it is in the gain medium that spontaneous and stimulated emission of photons takes place, leading to the phenomenon of optical gain, or amplification.

Optical resonator

The *optical resonator*, or *optical cavity*, in its simplest form is two parallel mirrors placed around the gain medium which provide feedback of the light. The mirrors are given optical coatings which determine their reflective properties.

Typically one will be a high reflector, and the other will be a partial reflector. The latter is called the output coupler, because it allows some of the light to leave the cavity to produce the laser's output beam. Light from the medium, produced by spontaneous emission, is reflected by the mirrors back into the medium, where it may be amplified by stimulated emission.

The light may reflect from the mirrors and thus pass through the gain medium many hundreds of times before exiting the cavity. In more complex lasers, configurations with four or more mirrors forming the cavity are used. The design and alignment of the mirrors with respect to the medium is crucial to determining the exact operating wavelength and other attributes of the laser system.