EE119 Discussion Section 10

(04/12/10)
Professor: Jeff Bokor   TA: Xi Luo

1. Population inversion; Pumping
   Three level VS. four level laser system

2. Optical resonator - longitudinal modes; mode spacing

   Two mirrors in a He-Ne laser are spaced apart by 25.0 cm.
   (a) What is the mode spacing?
   (b) The bandwidth of the gain curve is approximately 1300 MHz. What is the number of possible lasing frequencies?
   (c) Now the mirrors are spaced apart by 25.0 cm. Does this result in more or less possible lasing frequencies? Why?

3. Gain broadening and gain saturation
   Homogeneous broadening – lifetime broadening, pressure broadening due to increase in collision;
   Lorentzian lineshape;
   single mode operating at saturated gain.
   Inhomogeneous broadening – existence of isotopes, Doppler frequency shifts, random distribution of impurity dopants;
   Hole-burning

4. Gaussian beam – transverse beam radius; beam waist; Rayleigh range; divergence half-angle; Gaussian beam with mirrors and with a lens.

   A particular He-Ne laser has a far-field divergence angle of 1 mrad at the wavelength 632.8 nm.
   (a) What is beamwaist, w_o?
   (b) What is the Rayleigh range? What is the beam size at the Rayleigh range?
   (d) What is the beam size and radius of curvature at 10 meters?
   (e) At what distance is the spot size 3 cm?
   (f) Now insert a lens with focal length +25 cm at a distance of 2 meters. What is the radius of curvature just after passing through the lens?
   (g) What is the smallest spot size after the lens? (Assume the clear aperture of the lens is large compared to the beam spot size)
   (h) This lens can sustain laser powers of up to 10 mW/cm^2 without damage to the surface. What is the maximum power at which the laser should be operated in order to avoid damage to the lens?