# EE119 Lab 5: Lasers

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In this lab you will examine the properties of He-Ne lasers.

1. The gain medium (a mixture of Helium and Neon gases) is the same for the two lasers; what accounts for differences between the two lasers?

2. What can you say about the laser beam coming out of the He-Ne lasers? Is it diverging, converging, or collimated? (Caution: Use a notecard. Don't look into the laser beam.)

3. Place a linear-polarization filter in front of the He-Ne lasers. What can you say about the polarization state and (consequently) the exit window of each laser? What might account for the difference you see between the two lasers?

4. Measure the diameter of the laser beam when it exits the laser, and then measure the diameter of the laser beam at approximately 1.5 m away from the laser. Which laser is more divergent?

5. The Rayleigh range, $z_R$, is the distance at which the beam radius (also known as the beam waist) has increased from the narrowest point by a factor of $\sqrt{(2)}$. Estimate the Rayleigh range for the two lasers.

6. Now place a 76.2 mm convex lens immediately at the output of one of the lasers. What effect does this lens have on the collimation of the beam? See p. 77 of the notes.

7. Measure the beam diameter (the radius of the beam is also known as the beam waist) at approximately 1.5 meters away from the lens. It doesn't matter what the exact distance is, but you should try to measure it somewhat accurately. Use the yardstick. From this, calculate the beam waist at its narrowest point (i.e. when it is as close to collimated as possible). Use the relationship

$$w(z) = \frac{\lambda z}{\pi w_0}$$

where w is the beam waist at distance z from the collimated point, and $w_0$ is the narrowest point of the beam. This relationship is valid when the distance the beam has traveled is much greater than the collimation length, i.e. $z \gg z_R$. With this in mind, why do you think we put in the lens after the laser before calculated?