PH522 Intro: Gaussian Beams

Objective: You will measure the variation with distance of a Gaussian beam, and compare with theory. You will also study the transformation of a Gaussian beam by a lens and check with ABCD matrices.

Equipment: 1) Commercial 2 mW HeNe laser

2) a positive lens of focal length 30 cm.

2) Power meter

3) Knife edge on a translation stage

Procedure:

1) Observe the HeNe laser spot on the wall and note (without measurement) that it is much larger than at the laser output.

2) Position the power meter far downstream so that it intercepts the full laser power.

3) Position the translation stage and knife edge near the laser output, and record the measured power as a function of the position of the knife edge. Use your data to determine the beam waist, w(z).

4) Repeat this procedure for at least three other positions z. Make sure you include some measurements very far away from the laser output.

5) Plot your measured values of w(z) vs. the positions z at which they were measured. You might also choose to plot $w(z)^2$ vs. z^2, which should be linear.

6) Assume that w_0 is at the HeNe output and check if w(z) follows the formula for Gaussian beam propagation.

7) Place a 30 cm lens 1 m in front of the laser. After the lens, the beam will have a new focal position and size at that position.

8) Using an index card, try to estimate the location of the beam waist by observing the variation of the spot size. Record your best estimate of the new w_0 location in your lab book. Compare with predictions from the ABCD rule.

9) Measure the asymptotic angular divergence of the new beam by observing the spot a large distance beyond the lens and assuming that the diameter of the spot is 2w(z). With this, estimate the new value of w_0.