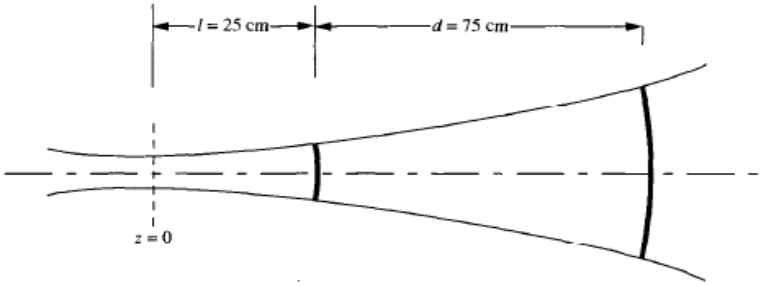
Laser Physics-I (PHYC/ECE 464), Fall 2022

Homework #5, Due Monday Oct. 3

1

In the stable optical cavity shown in the diagram below, the plane $z = 0$ occurs at a distance 25 cm to the left of M_1 with the beam parameter $z_0 = 125$ cm. The distance between the two mirrors is 75 cm.

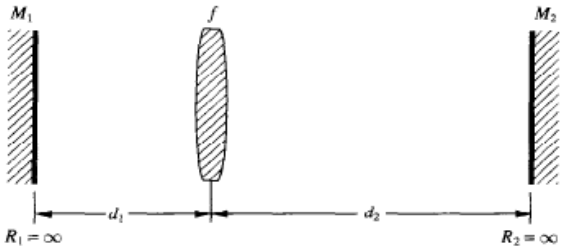


(a) Find a formula for the resonant frequency of the $TEM_{m,p,q}$ mode.
(b) Find the difference between the resonance frequency of the $TEM_{1,2,q}$ and $TEM_{0,0,q}$ modes.
(c) Find the radius of curvature for the mirrors M_1 and M_2.

2

Consider the optical cavity consisting of two flat mirrors with a converging lens as shown in the accompanying diagram.

(a) What are the stability limits for this cavity? Express your answer in the form of an inequality involving the ratio of d_1/f and d_2/f.
(b) Construct a stability diagram expressing this inequality.

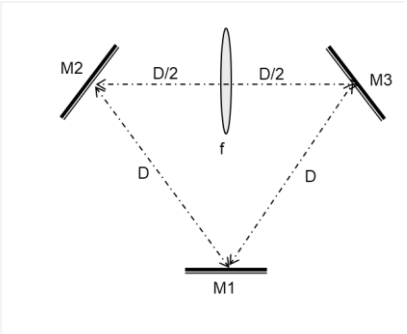


3

Find the spot sizes at the mirrors M_1 and M_2 of the cavity shown in Problem **2**

4.

Consider the ring laser cavity shown in the accompanying diagram.



(a) Show an equivalent-lens waveguide for this cavity and identify a unit cell starting at mirror 1.
(b) What is the transmission matrix for this unit cell?
(c) What are the values of D/f that make this a stable cavity?
(d) Where is the location (z=0) of minimum beam waist (w_0)? Explain.
(e) Obtain w_0 in terms of given parameters and λ_0.