Problem 7: Optics Solution Fall 2011

Solution:

(a) The depth of focus is given by $2z_0 = \dfrac{2\pi W_0^2}{\lambda}$

For $\lambda = 633$ nm and $W_0 = 1$ cm, the depth of focus $2z_0 \sim 1$ km from the above formula.

(b) For a symmetrical cavity, the spot size is given by

$$W_0^2 = \frac{\lambda}{\pi}\sqrt{\frac{d}{2}\left(R-\frac{d}{2}\right)}$$

Therefore,
$$2W_0 = 2\sqrt{\frac{\lambda}{\pi}\cdot\left[\frac{d}{2}\left(R-\frac{d}{2}\right)\right]^{1/4}}$$

(c) The confocal cavity is much easier to align than the plane-parallel type. Also, with confocal spherical mirrors, the diffraction losses of low-order modes are negligibly small compared with the plane-parallel resonators.

(d) Spot size at the center $W_0 = \sqrt{\dfrac{\lambda d}{2\pi}}$, spot size at either mirror $W_0 = \sqrt{\dfrac{\lambda d}{\pi}}$