7.4: Cavities

The amplifying medium can completely fill the space between the mirrors as the top of Figure 7.4.1, or there can be space between the amplifier and the mirrors. For example, if the amplifier is a gas, it may be enclosed by a glass cylinder. The end faces of the cylinder are positioned under the Brewster angle with respect to the axis, as shown in the middle figure of Figure 7.4.1, to minimise reflections. This type of resonator is called a **resonator with external mirrors**.

Usually one or both mirrors are convex, as shown in the bottom figure of Figure 7.4.1. We state without proof that in that case the distance L between the mirrors and the radii of curvature R_1 and R_2 of the mirrors has to satisfy

$$0 < \left(1 - \frac{L}{R_1}\right)\left(1 - \frac{L}{R_2}\right) < 1,$$

or else the laser light will ultimately leave the cavity laterally, i.e. it will escape sideways. This condition is called the **stability condition.** The curvature of a convex mirror is positive and that of a concave mirror is negative. Clearly, when both mirrors are concave, the laser is always unstable.

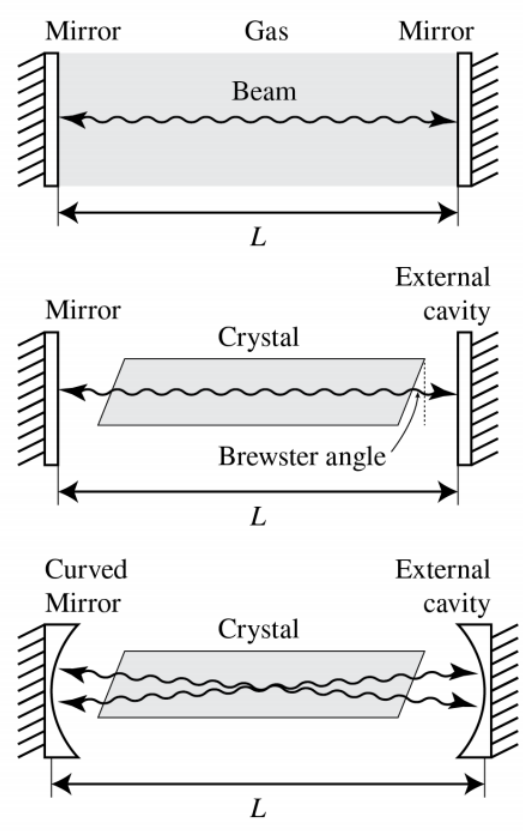

Figure 7.4.1: Three types of laser cavity. The shaded region is the amplifier. The middle case is called a laser with external cavities.