Optical Cavities

The optical cavities (also known as optical resonators) are made to amplify the light within the cavity, so the mirrors used are highly reflective. Essentially, light enters the cavity through one mirror, reflects off the opposite mirror, and returns to the first mirror, while some of it is transmitted (exits the cavity) through each mirror.

This light transmitted through the first mirror in each arm is the light that interferes at the beam splitter to form the signal.

Various types of optical resonators The cavity is designed so that the beam will remain entirely within the cavity's mirrors. These are referred to as follows where R1 and R2 are the radii of curvature of the mirrors and L is the distance between the mirrors:

a) plane-parallel	$R_1 = R_2 = \infty$
b) concentric (spherical)	$R_1 + R_2 = L$
c) confocal	$R_1 + R_2 = 2L$
d) hemispherical	$R_1 = L$, $R_2 = \infty$
e) concave-convex	$R_1 \gg L$, $R_2 = L - R_1$

There are five different types of stable two-mirror optical cavities, as shown in Figure 1. These types of resonators differ in their focal lengths of the mirrors (governed by the mirror's radius of curvature) and in their distance between the mirrors (cavity length).

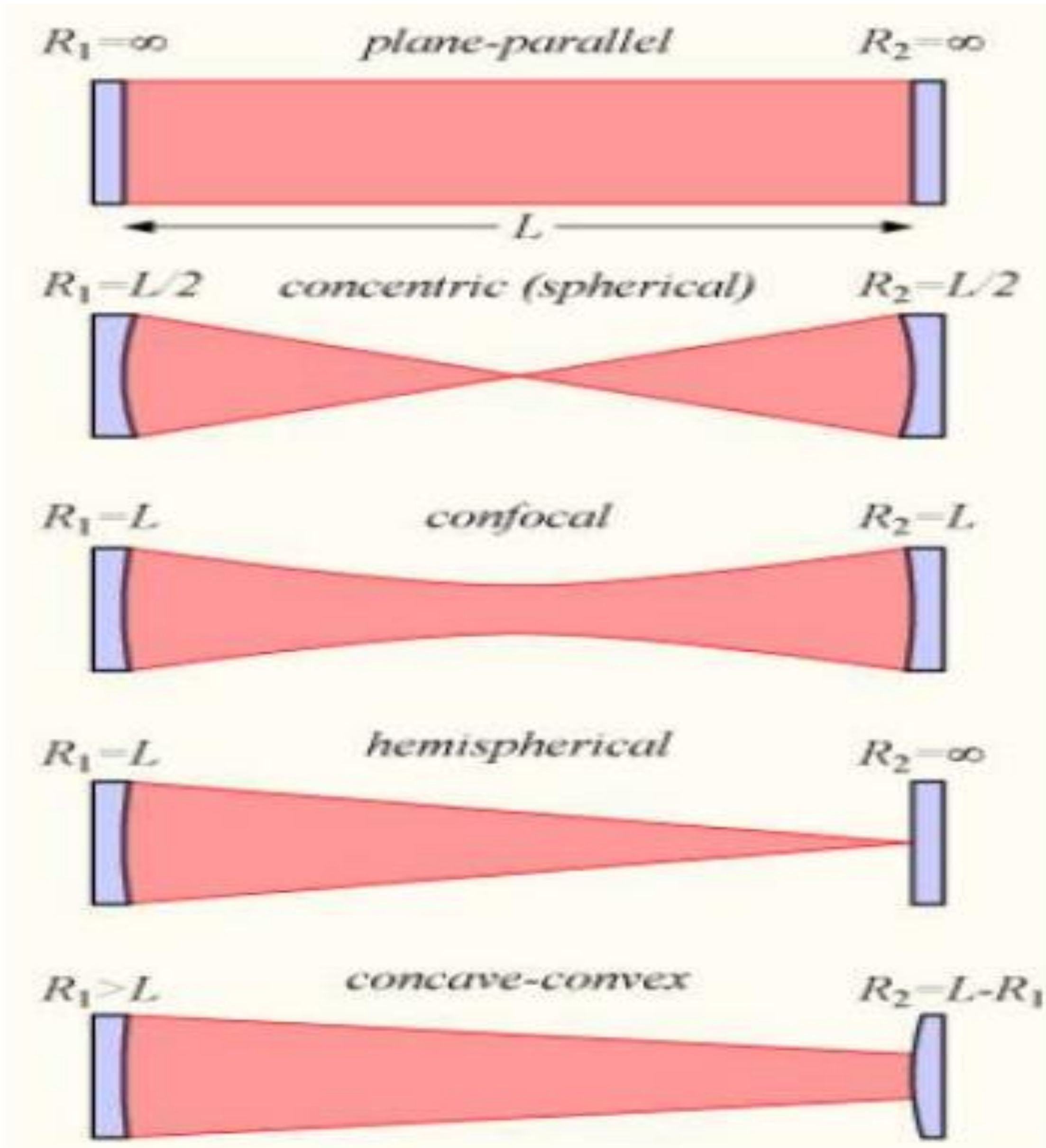

Figure 1: The five possible types of stable cavities.

There are simple mathematical formulae that indicate whether or not a cavity is stable. In its simplest form, the rule can be stated as follows: Given a cavity made of two spherical mirrors (of radii of curvature R1 and R2) separated by a distance L, the cavity is stable if

$$0 \leq g_1 g_2 \leq 1$$

Where:

$$g_1 = 1 - \frac{L}{R_1}$$

$$g_2 = 1 - \frac{L}{R_2}$$

If g1 and g2 are such that their intersection lies within the shaded region of this diagram, then the cavity is stable.