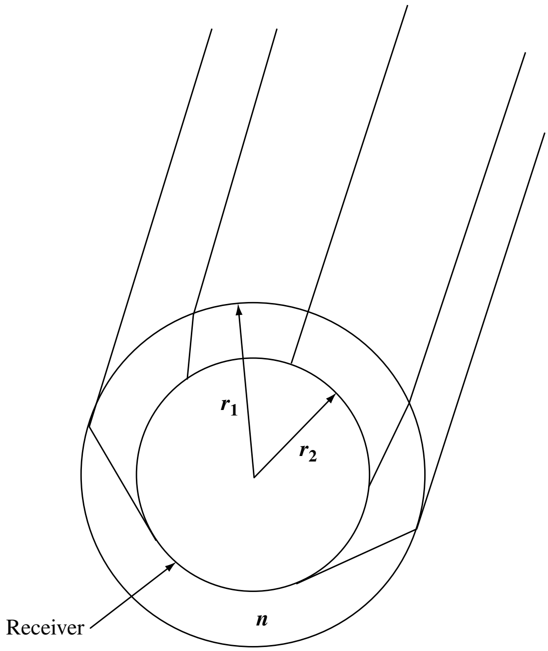

Figure 11.26 The ideal spherical concentrator of concentration ratio n^2

shown that the output intensity is uniform when the illumination is uniform over all directions within the acceptance angle. Such is not the case in practice, however, because the sun provides a localized region of the sky that is much brighter than the surrounding acceptance region (assuming that the acceptance angle is greater than the sun's half angle). A simplified version shown in Figure 11.27 uses planar reflectors and is often called a v-trough. The v-trough concentrator has a maximum intensity concentration of 3, thereby avoiding the hot spots of the CPC.

Referring to the symbols in Figure 11.27, some rather tedious but straightforward calculations indicate that the concentration ratio of the v-trough concentrator is (hint: use the law of signs on the triangle inside the trough)

$$C = 1 + \frac{2\sin\theta_m \cos(\theta_i + 2\theta_m)}{\sin(\theta_i + \theta_m)}$$

When $\theta_i = 0$, one obtains $C = 1 + 2\cos(2\theta_m)$, so the concentrator is clearly not ideal. In fact, it reaches a maximum concentration of 3 for small θ_m, that is, steep mirrors.

It should not be thought that the v-trough is necessarily inferior to the CPC concentrator. Besides the reduction in hot spots, it can be easier to manufacture, especially with flat glass mirrors. For wide acceptance angles and reasonable maximum exit angles such as 60°, v-troughs closely approach ideal concentrators. For example, when $\theta_i = 30^\circ$ and $\theta_m = 15^\circ$, then $\theta_{out} = 60^\circ$ and $C = 1.37$. This is 79% of the ideal concentration.