1.6: Relation between Flux and Intensity

For an isotropic radiator,

$$\Phi=4\pi I. \tag{1.6.1}$$

For an anisotropic radiator

$$\Phi=\int I d\omega, \tag{1.6.2}$$

the integral to be taken over an entire sphere. Expressed in spherical coordinates, this is

$$\Phi=\int_0^{2\pi}\int_0^{\pi} I(\theta,\phi)\sin\theta d\theta d\phi. \tag{1.6.3}$$

If the intensity is axially symmetric (i.e. does not depend on the azimuthal coordinate ϕ) equation 1.6.3 becomes

$$\Phi=2\pi\int_0^{\pi} I(\theta)\sin\theta d\theta. \tag{1.6.4}$$

These relations apply equally to subscripted flux and intensity and to luminous flux and luminous intensity.

Example:

Suppose that the intensity of a light bulb varies with direction as

$$I(\theta)=0.5 I(0)(1+\cos\theta) \tag{1.6.5}$$

(Note the use of parentheses to mean "at angle θ ".)

Draw this (preferably accurately by computer - it is a *cardioid*), and see whether it is reasonable for a light bulb. Note also that, if you put $\theta=0$ in equation 1.6.5, you get $I(\theta)=I(0)$.

Show that the total radiant flux is related to the forward intensity by

$$\Phi=2\pi I(0) \tag{1.6.6}$$

and also that the flux radiated between $\theta=0$ and $\theta=\pi/2$ is

$$\Phi=\frac{3}{2}\pi I(0). \tag{1.6.7}$$