

1.6: Relation between Flux and Intensity

For an isotropic radiator,

$$\Phi = 4\pi I. \quad (1.6.1)$$

For an anisotropic radiator

$$\Phi = \int I d\omega, \quad (1.6.2)$$

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

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

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

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

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

$$I(\theta) = 0.5I(0)(1 + \cos \theta) \quad (1.6.5)$$

(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

$$\Phi = 2\pi I(0) \quad (1.6.6)$$

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

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

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