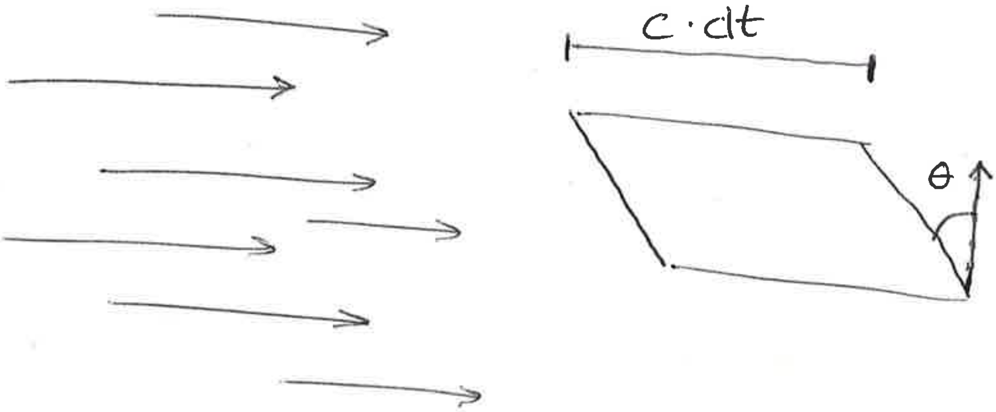
Transport theory

$p(x)$ - # particles per unit volume

dV - volume

t - time

A - area



particles that flow through the surface dA on time dt is equal to the number of particles ~~that flows throu~~ in volume

$dA\cdot c\,dt\cdot\cos\theta$

$$N = p(x,\omega,\lambda)\cdot\underbrace{c\cdot dt\cdot dA\cdot\cos\theta}_{dV}\, d\omega\cdot d\lambda$$

ω - direction of flow

λ - wavelength

Flux Energy/time

$$\Rightarrow \quad \phi = \frac{p(x,\omega,\lambda)\cdot c\cdot dt\cdot dA\cdot\cos\theta\cdot d\omega\cdot d\lambda}{dt}\cdot E$$

Light Transport

Radiance: $B(x) = \int_{\Omega} L(x \to \Theta) \cos\Theta \, d\omega_{\Theta}$

The total radiant power leaving area dA_x and arriving at dA_y is,

$$(d^2\phi)_{xy} = L(x \to y) \cos\theta_x \, d\omega_{xy} \, dA_x$$

$d\omega_{xy}$ - solid angle under which dA_y is seen from ~~dA_x~~ x.

The total radiant power arriving area dA_y from area dA_x is,

$$(d^2\phi)_{yx} = L(y \leftarrow x) \cos\theta_y \, d\omega_{yx} \, dA_y$$

If we assume that no enery is lost between the two ~~pot~~ surfaces i.e. medium is vacum and no additional lightsources effect dA_y then from conservation of energy $(d^2\phi)_{xy} = (d^2\phi)_{yx}$.

$$\Rightarrow L(x \to y) \cos\theta_x \, d\omega_{xy} \, dA_x = L(y \leftarrow x) \cos\theta_y \, d\omega_{yx} \, dA_y$$

$$= \left\{ \begin{array}{l} d\omega_{xy} = \left\{ \dfrac{dA}{r} \right\} = \dfrac{\cos\theta_y \cdot dA_y}{r_{xy}^2} \\ d\omega_{yx} = \qquad = \dfrac{\cos\theta_x \, dA_x}{r_{xy}^2} \end{array} \right\} =$$

$$\Rightarrow L(x \to y) \cdot \cos\theta_x \cdot \frac{\cos\theta_y \cdot dA_y}{r_{xy}^2} dA_x = L(y \leftarrow x) \cos\theta_y \cdot \frac{\cos\theta_x \, dA_x}{r_{xy}^2} \cdot dA_y$$

$$\Rightarrow L(x \to y) = L(y \leftarrow x)$$