Brent Jones

Monday 2/2/15 NOTES E.M. Radiation

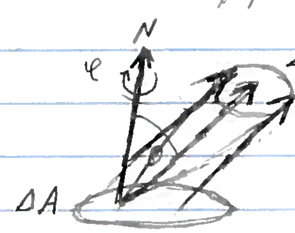
$F_{Earth,\lambda} = \frac{\Delta E(\lambda \cdots \lambda + d\lambda)}{dt\, dA}$ Area perp to line of sight.

- light we see comes from photosphere

Energy density: How much energy carried by photons in range of λ per unit volume

$\frac{dE(\lambda \cdots \lambda + d\lambda)}{dVolume} = \boxed{u_\lambda} d\lambda$ if small interval it's proportional to $d\lambda$

ex.) BB (Black Body radiation) energy density $u_\lambda = \frac{8\pi hc}{\lambda^5} \cdot \frac{1}{e^{hc/\lambda kT} - 1}$ $\frac{J}{m^3}/m$



$\Delta\Omega = \Delta\varphi \cdot \sin\theta\, \Delta\theta$

$= -\Delta\varphi \cdot \Delta\cos\theta$

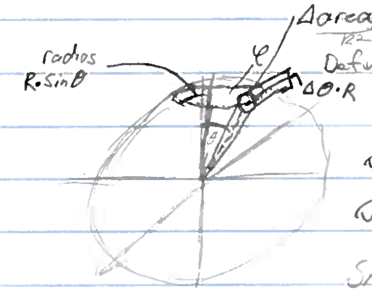
In a certain direction.

- Can use this to deduce flux.

- Specific Intensity: $\frac{dE(\lambda \to \lambda + d\lambda)}{dt\, \Delta A\, \Delta\Omega} = \cos\theta \cdot \boxed{I_\lambda(\theta)} d\lambda$

Energy per unit time out of an area · prob to go in that direction

$I_\lambda = \frac{W}{m^2 s r}/m$



$\Delta area = \frac{\Delta\Omega}{R^2} = \sin\theta\, \Delta\theta\, \Delta\varphi$

Define a pt on sphere

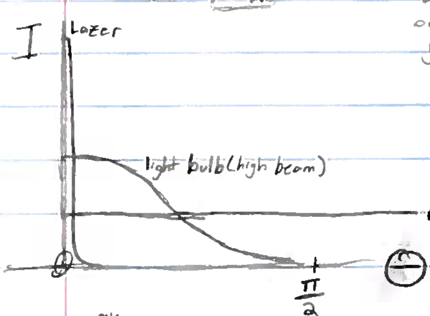
$R = 1$

$0 \leq \theta \leq \pi$

$0 \leq \varphi \leq 2\pi$

$SA = 4\pi r^2 = 4\pi$

$\sin\theta\, \Delta\varphi$



avg $\langle I_\lambda \rangle = \frac{1}{4\pi} \int I_\lambda\, d\Omega$

Total solid angle $= \int_0^\pi \sin\theta\, d\theta \int_0^{2\pi} d\varphi$

$2 \quad 2\pi \quad = 4\pi = \frac{\text{Surface of sphere}}{R^2}$

- $\frac{dE}{dt\Delta A} \cdot \frac{Prob(\theta, \varphi)}{\Delta\Omega}$

$dE = u_\lambda \cdot \Delta A \cdot c\, dt \cos\theta = u_\lambda \frac{dE}{dt \Delta A} = \cos\theta$

$= u_\lambda d\lambda\, c \cos\theta \frac{Prob(\,)}{\Delta\Omega} = \cos\theta\, I_\lambda\, d\lambda$

$I_\lambda = c \cdot u_\lambda \cdot \frac{Prob}{\Delta\Omega}$

avg $\langle I_\lambda \rangle = c \cdot \frac{1}{4\pi} u_\lambda$

- BB: $\frac{2hc^2}{\lambda^5} \cdot \frac{1}{e^{hc/\lambda kT} - 1} = I_\lambda$ $I_{all\ directions} = \sigma T^4$
- $P = \frac{E}{c}$ $F_{z\,momentum} = \frac{1}{c}\cos^2\theta \cdot I_\lambda d\lambda$ $\boxed{P^{(d)}_{Pressure,z} = \frac{2}{c}\cos^2\theta \cdot I_\lambda d\lambda}$ only for $\Theta < \frac{\pi}{2}$

Find pressure difference

Total pressure in $\hat{z}$-direction: $dP_z = \int_0^{2\pi} d\varphi \int_0^{\pi/2} d\cos\theta\, \frac{2}{c}\cos^2\theta\, I_\lambda\, d\lambda$

Isotropic $I_\lambda \rightarrow P_z = \frac{4\pi}{3c} \cdot \langle I_\lambda \rangle = \frac{1}{3} u_\lambda$