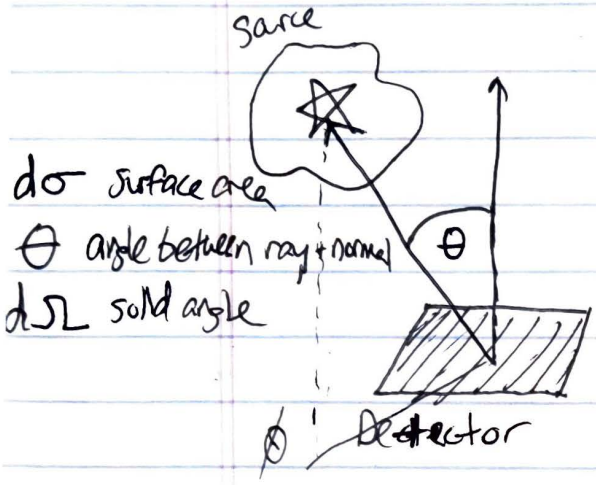
Astro 426

Lecture 1, Aug 19, 2019

Radiometry

Brightness / Intensity / $I_\nu, I_\lambda, L_\lambda, L_\nu$

Brightness does not depend on distance



Brightness per unit frequency / unit wavelength:
specific intensity / spectral intensity / spectral brightness

Why: source properties, detector properties vary w/ λ, ν

Brightness: photons per unit area per unit time per unit solid angle

power per unit area per unit time per unit solid angle per freq. interval

$$I_\nu = \frac{dP}{(\cos\theta\, d\sigma)\, d\nu\, d\Omega}$$

$W\, m^{-2}\, Hz^{-1}\, ster^{-1}$

Theorem: Specific Intensity is conserved along any ray in empty space.

Brightness is the same at the source as at the detector/observer

Moon is bigger, but not brighter, through a large telescope

S (Flux) depends on distance (or size of telescope) for $\theta \ll 1$

$$S_\nu \equiv \int_{source} I_\nu(\theta, \phi) \cos\theta\, d\Omega \approx \int_{source} I_\nu(\theta, \phi)\, d\Omega$$

integrate over solid angle subtended by source

Flux has units of $W m^{-2} Hz^{-1}$ or Jansky ($10^{-26} W m^{-2} Hz^{-1}$)

$\int_{source} d\Omega \propto 1/d^2$

$S_\nu \propto d^{-2}$

$L_\nu = 4\pi d^2 S_\nu$