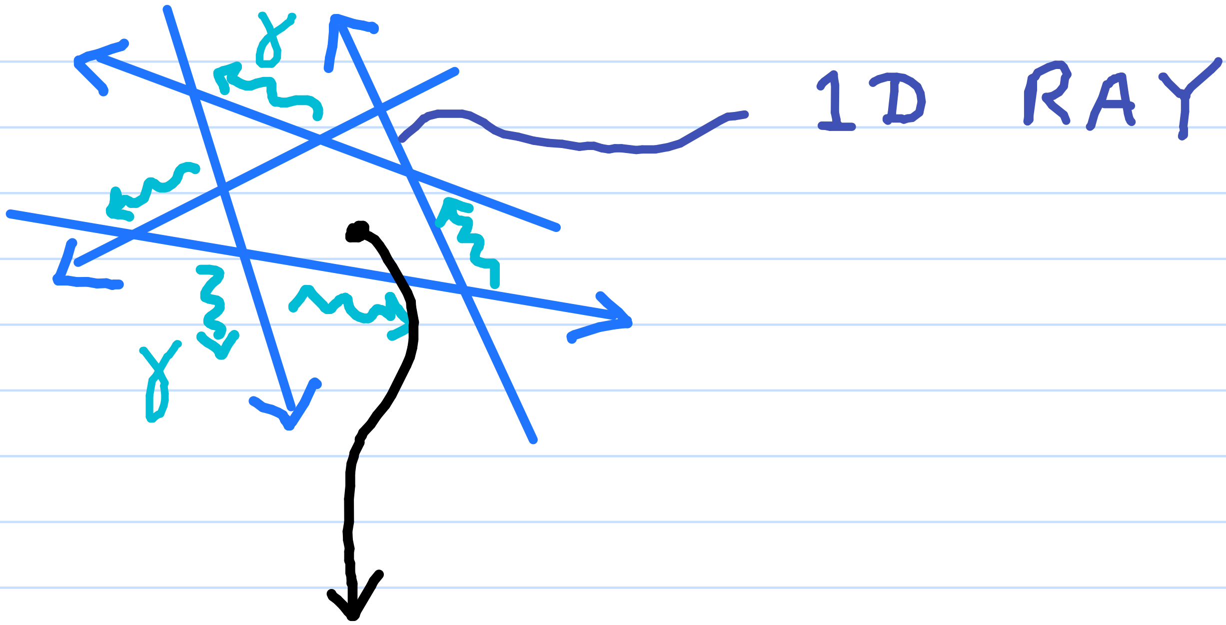
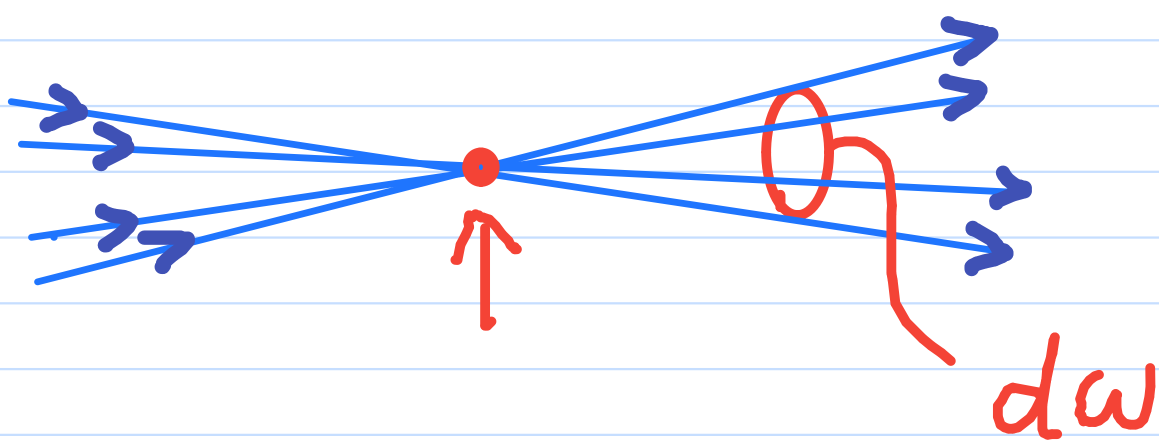
RADIATION

GENERAL 3D RADIATION FIELD:

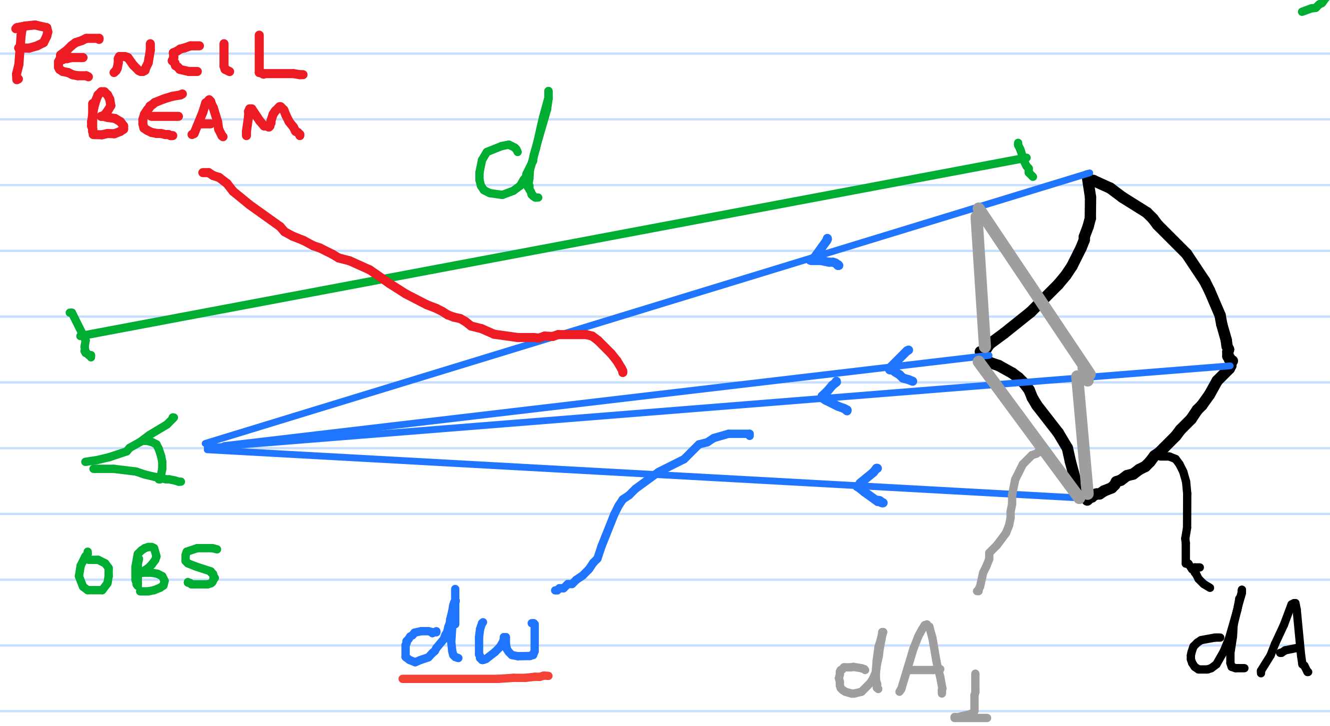


PENCIL BEAM:



SUBTENDS SOLID ANGLE dω

SOLID ANGLE, ω (STERADIANS, "STER")



IF $dA_\perp \ll d^2$:

2D SMALL-ANGLE APPROX:

$$d\omega \approx \frac{dA_\perp}{d^2}$$

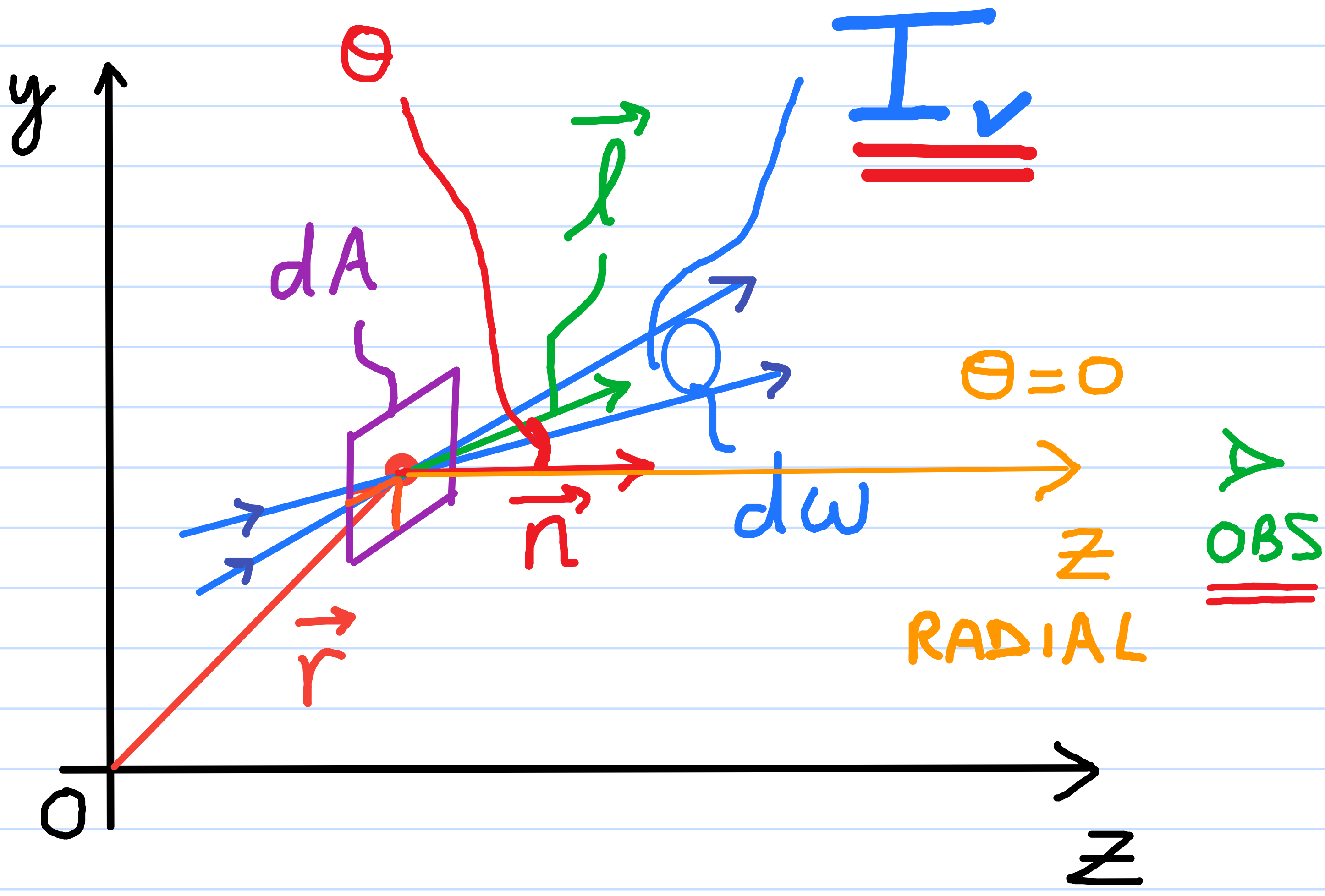
$0 \le \omega \le 4\pi$ STER

RADIATION AMOUNT:

I_ν, J_ν, $\mathcal{F}_\nu$, P_ν, μ_ν

MONOCHROMATIC SPECIFIC INTENSITY

$I_\nu(\vec{r}, \vec{l}, t, \nu)$ (erg/s/cm²/STER/Hz)



GEOM. PROJECTION FACTOR:

$$\vec{l}\cdot\vec{n} = \vec{l}\cdot\hat{k} = \cos\theta \equiv \mu$$

dE_ν = RADIATION E IN BEAM CROSSING dA IN FREQ. INTERVAL ν TO $\nu + d\nu$ IN TIME INTERVAL dt (erg) :

$$dE_\nu(\vec{r}, \vec{l}, t, \nu)$$
$$\equiv I_\nu(\vec{r}, \vec{l}, t, \nu)\, dt \left\{ dA\, (\vec{n} \cdot \vec{l}) \right\} d\omega\, d\nu$$

$\cos\theta = \mu$

$$= I_\nu(\vec{r}, \vec{l}, t, \nu)\, dt\, (\mu\, dA)\, d\omega\, d\nu$$

$$\therefore\ I_\nu \equiv \frac{dE_\nu}{dt\, (\mu\, dA)\, d\omega\, dt}$$

(erg/s/cm^2/STER/Hz)

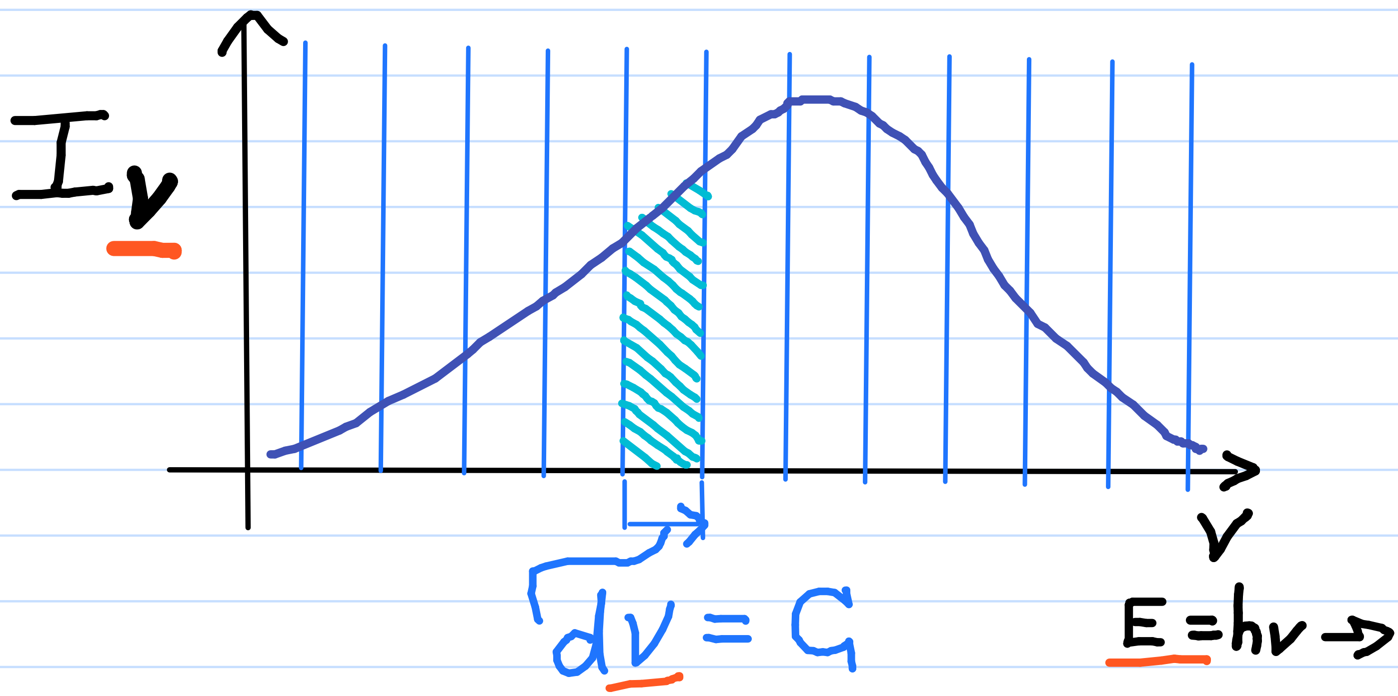
dE_{λ} = RADIATION E IN BEAM CROSSING dA IN WAVELENGTH INTERVAL λ TO $\lambda + d\lambda$ IN TIME INTERVAL dt (erg):

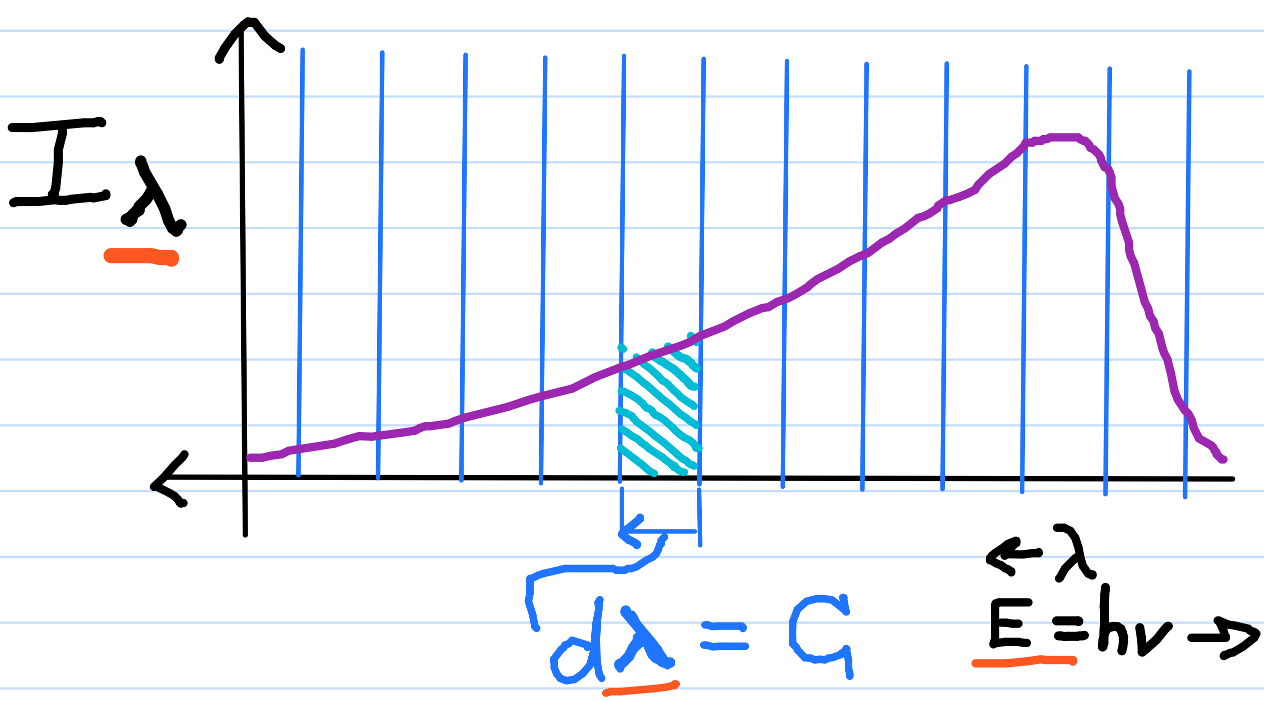
$$dE_{\lambda}(\vec{r}, \vec{l}, t, \lambda) \equiv I_{\lambda}(\vec{r}, \vec{l}, t, \lambda)\, dt\, (\cancel{\mu}\, dA)\, d\omega\, d\lambda$$

I_{λ} (erg/s/cm²/STER/nm)

$$I_{\lambda} = \left|\frac{d\nu}{d\lambda}\right| I_{\nu} = \frac{c}{\lambda^2} I_{\nu}$$

CONTINUOUS MONOCHROMATIC (SPECTRAL) I DISTRIBUTIONS:



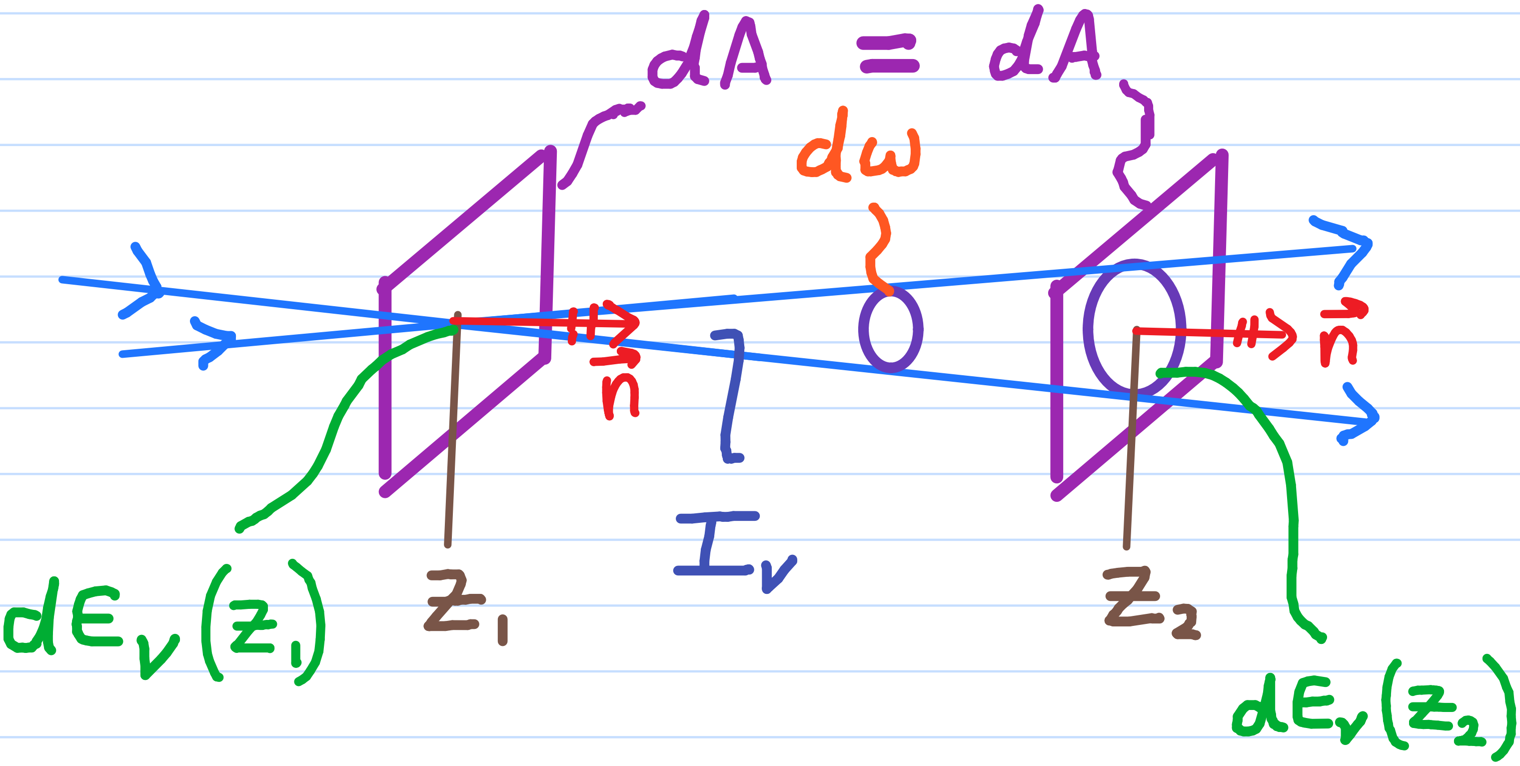


BOLOMETRIC INTENSITY,

$I(\vec{r}, \vec{l}, t)$ (erg/s/cm^2/STER)

$$I(\vec{r}, \vec{l}, t) = \int_{\nu=0}^{\infty} I_\nu(\vec{r}, \vec{l}, t, \nu)\, d\nu$$

IN A VACUUM:



IF $dt_1 = dt_2$ & $d\nu_1 = d\nu_2$:

CONSERVATION OF E:

$$dE_\nu(z_2) = dE_\nu(z_1)$$

$$\therefore \underline{I_\nu(z_2) = I_\nu(z_1)}$$

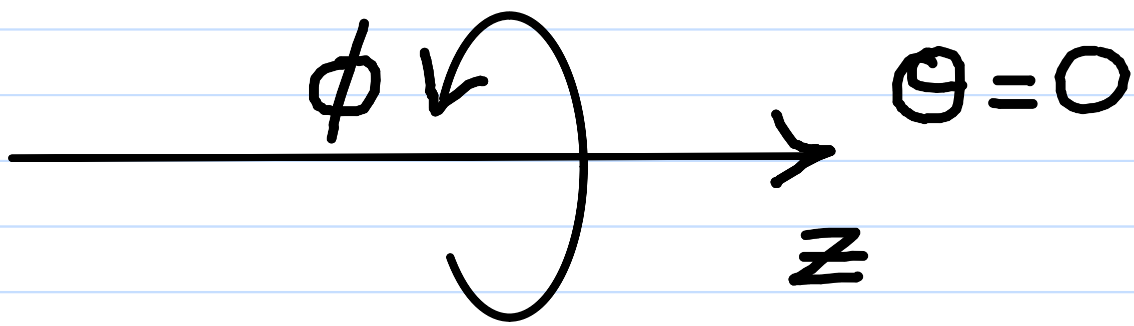
SIMPLIFICATIONS:

STASIS: $\frac{dI_\nu(\vec{r},\vec{l},\nu)}{dt} = 0$

ν- DEPENDENCE OBVIOUS

$\therefore I_\nu(\vec{r},\vec{l},t,\nu) = I_\nu(\vec{r},\vec{l})$

$= I_\nu(x,y,z\,;\,\theta,\phi)$



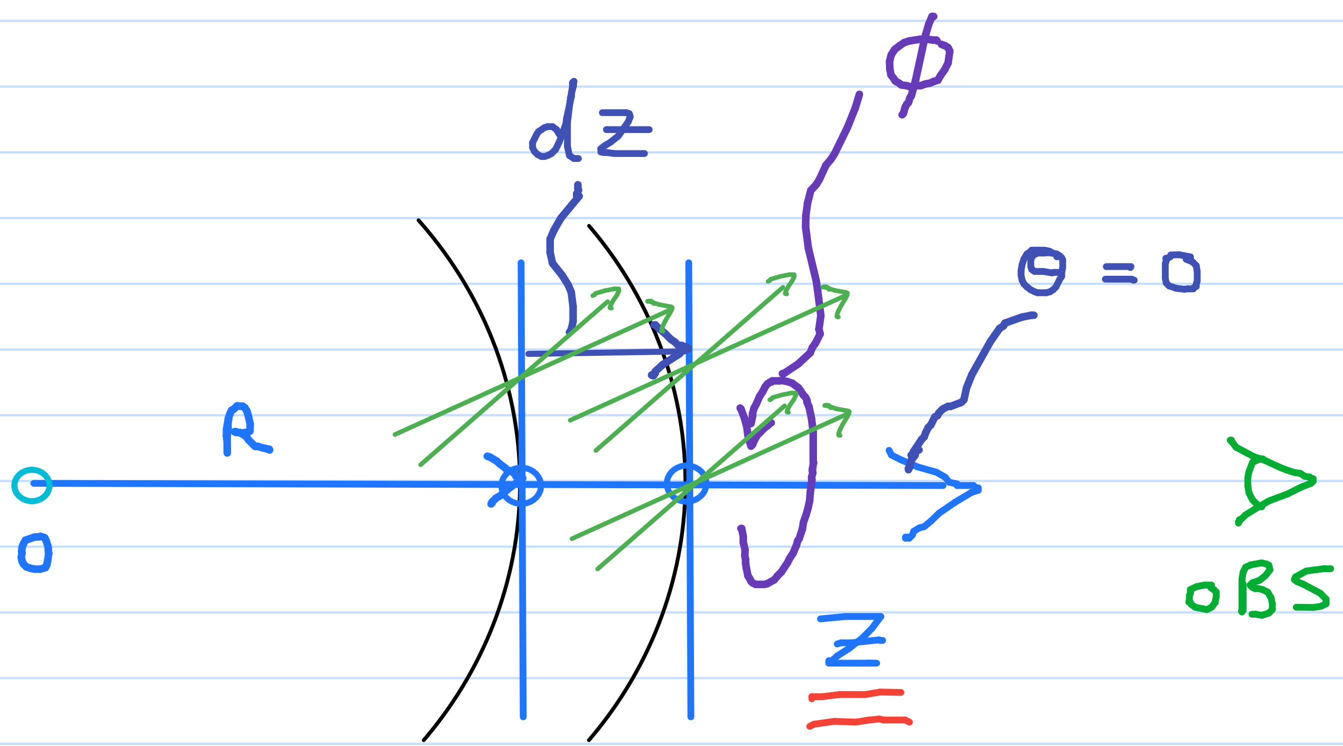
SIMPLIFICATIONS:

1D MODEL:

- PLANE-|| GEOMETRY

  + HORIZONTAL HOMOGENEITY

$\Rightarrow$ AXI-SYMMETRY ABOUT z



$$I_\nu(x, y, z; \theta, \phi) = \underline{I_\nu(z, \theta)}$$

$$= \underline{I_\nu(z, \mu)} \quad \mu = \cos\theta$$