CALC. MOLAR MASS OF MATERIAL

(1) $$a_{MATERIAL} = \sum_i a_i n_i$$

FIND DECREMENT (δ) IN MATERIAL'S REAL REFRACTIVE INDEX

(2) GOAL: $$\delta = \frac{r_e \lambda^2}{2\pi} \sum_i N_i f_i \quad (2.1)$$

N_i: # DENSITY OF ATOMIC SPECIES i — atoms/cm³

(2.1) $$N_i = N_A n_i \frac{\rho_{MATERIAL}}{a_{MATERIAL}}$$

n_i = # i / # MATERIAL (ie, $CsPbBr_3$: $n_1 = 1$, $n_2 = 1$, $n_3 = 3$)

ρ_{MAT} = MATERIAL DENSITY

a_{MAT} = FROM (1)

✓ $\frac{\text{atoms}}{cm^3} = \frac{\text{atoms}}{\text{mol}} \frac{\text{mol}}{g} \frac{g}{cm^3}$

f_i = TAKEN FROM TABLES

$$\Rightarrow \sum_i N_i f_i = \frac{N_A \rho_{MATERIAL}}{a_{MATERIAL}} \sum_i n_i f_i = X$$

(2.2) $$\delta = \frac{r_e \lambda^2}{2\pi} X$$

(3) CALCULATE EXTINCTION COEFF. FOR A MATERIAL

$$\mu = N_{MATERIAL} \sigma_{MATERIAL}$$

$$N_{MAT.} = N_A \frac{\rho_{MAT}}{a_{MAT}}$$

$\gamma_1 = 1 \cdot$ MATERIAL $\quad$ MATERIAL $\quad$ MAT. $\quad$ q_{MAT}

↑ # DENSITY $\quad$ ↑ TOTAL ATTEN. X-SEC.

$\frac{\#\text{ATOMS}}{cm^3}$ $\quad$ $\frac{cm^2}{\text{ATOM}}$

(3.1) $\quad \sigma_{MAT} = \sum n_i \sigma_i$ ← TAKEN FROM MUCAL.

NOTE: OUTPUT IS IN $\frac{\text{BARNS}}{\text{ATOM}}$ $\quad (1\ \text{BARN} = 10^{-28}\ m^2)$

(3.2) $\Rightarrow \mu = \frac{N_A \rho_{MAT}}{q_{MAT}} \sigma_{MAT.} \left(\frac{10^{-24}\ cm^2}{1\ \text{BARN}} \right)$ ↙

TOTAL PHASE SHIFT WHEN GOING THROUGH MATERIAL STACK

(4) $\quad \phi(\lambda) = \frac{2\pi}{\lambda} \int_0^z \delta'(z)\, dz$

$$\boxed{\phi(\lambda) = \frac{2\pi}{\lambda} \sum_i \delta_i t_i}$$