

Calculations to determine η and iron lamina thickness Δx

From Quantum Mechanics (Semiclassical Treatment of Radiation) we know that :

$$\eta = 1 - e^{-\kappa \alpha \Delta x}$$

For resonance frequencies (Absorption /Emission spectrum) we have : $\kappa \gg 1$.
For others frequencies $\kappa \approx 1$. The *attenuation* constant α is given by :

$$\alpha = \omega \sqrt{\frac{1}{2} \epsilon \mu \left[\sqrt{1 + (\sigma / \omega \epsilon)^2} - 1 \right]}$$

For $\sigma \gg \omega \epsilon \Rightarrow \alpha = \sqrt{\pi \mu \sigma f}$ and consequently ,

$$\eta = 1 - e^{-\kappa \Delta x \sqrt{\pi \mu \sigma f}}$$

Thus for $\Delta x = 10 \text{ mm}$; $f = 0.001 \text{ Hz}$; $\mu = \mu_i = 4000 \mu_0$; $\sigma = 1.03 \times 10^7 \text{ S/m}$ we obtain :

$$\eta = 1 - e^{-0.127} = 1 - 0.88 = 0.12$$

$$\eta = 0.12$$