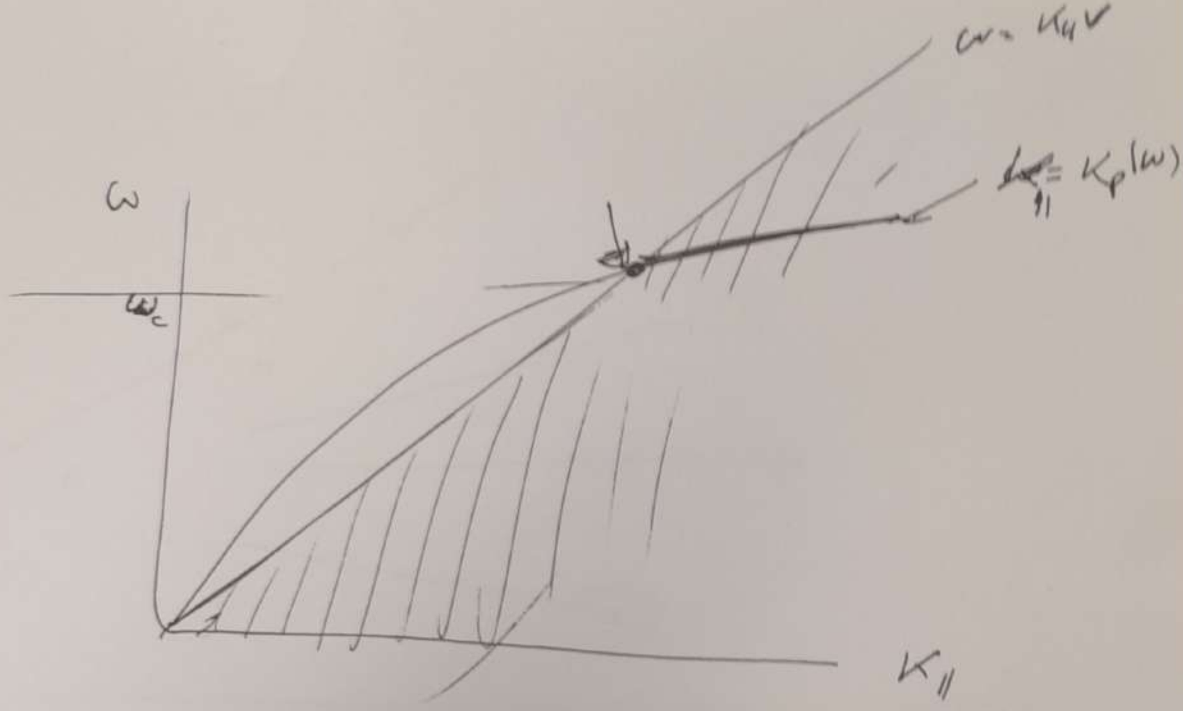
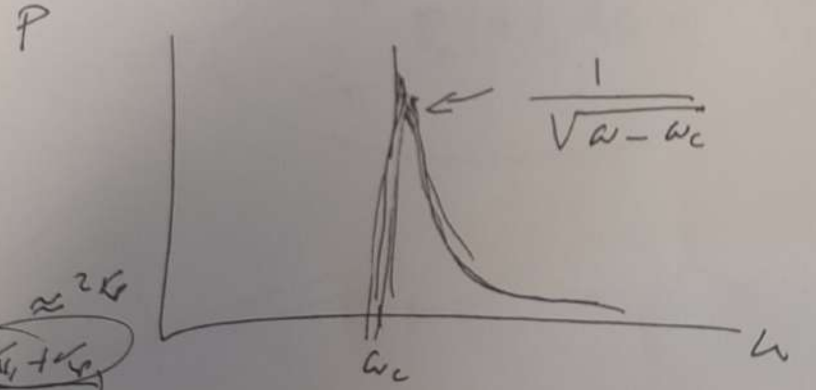


$$-k_\parallel v < \omega = \vec{k}_\parallel \cdot \vec{v} < k_\parallel v$$



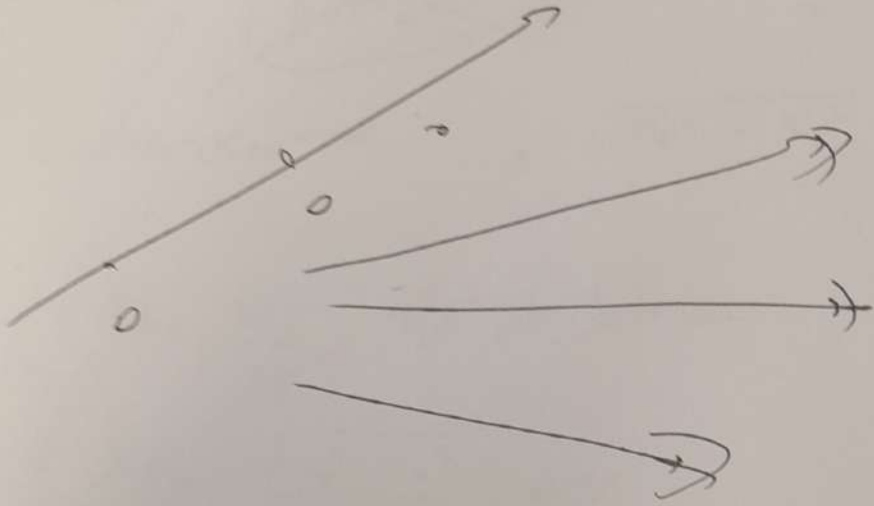
$$r = \frac{R_p}{k_\parallel - k_p} \frac{\overbrace{k_\parallel + k_p}^{\approx 2k_p}}{k_\parallel + k_p} \simeq \frac{2k_p R_p}{k_\parallel^2 - k_p^2}$$

$$k_x = \frac{\omega}{v} - \frac{2\pi n}{a}$$

$$\sqrt{k_x^2 + k_y^2} = k_p(\omega)$$

$$|k_x| \le k_p(\omega)$$

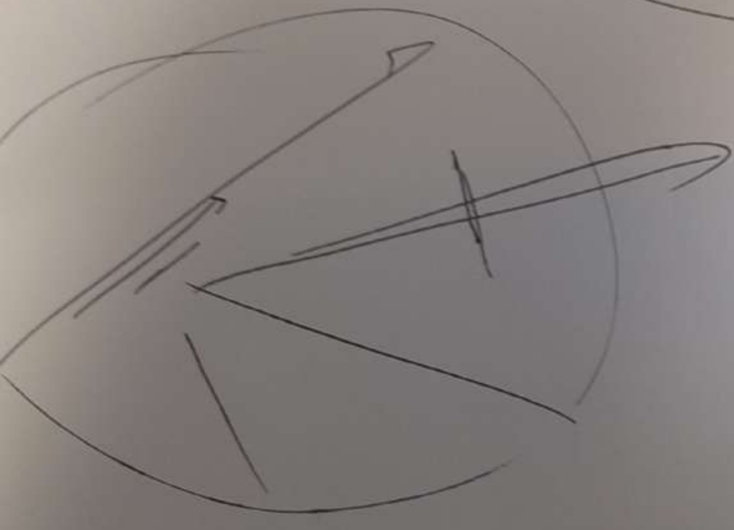
$$\Longrightarrow$$

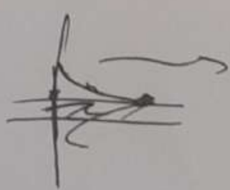


at $z=0$

$\vec{E}(\vec{R},\omega) =$

$\Rightarrow \int_{-\pi}^{\pi} P_n(\theta)\, d\theta = P_n$



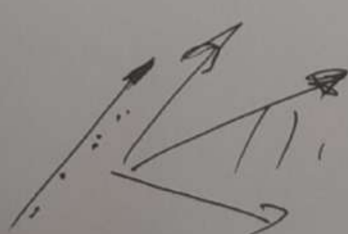


ω

$\downarrow$

$k_p(\omega) = \sqrt{k_x^2 + k_y^2}$ $\quad k_y \longleftrightarrow \theta$

$k_x = \frac{\omega}{v} - \frac{2\pi m}{a}$



$$r = \frac{2 R_p k_p^2}{k_x^2 + k_y^2 - k_p^2}$$

$$-\frac{R_p}{2\pi a}$$

$$\phi^{\infty\,dip}_{ind,\,pp} = \cancel{\frac{2\pi i\,(k_?)\,R_p\,k_p}{(2\pi)^2 a\,(k_?)\,k_p}} \sum_n e^{i k_{xn} x}$$

$$\cancel{R_x\,k_{xn}\,x} \quad e^{i\sqrt{k_p^2 - k_x^2}\,|y|}\, e^{-i k_p (z_p - z)}$$

$$\left(\cancel{x} p_x \frac{k_x}{\cancel{k_p}} \cancel{e^{i k_p (z_0 - z)}} + \cancel{x} p_y \frac{\sqrt{k_p^2 - k_x^2}}{\cancel{k_p}} \; e? + i p_z k_p \right)$$

$$= \frac{-R_p}{2\pi a} \sum_n e^{i k_x x}\, e^{i\sqrt{k_p^2 - k_x^2}\,|y|}\, e^{-k_p (z_0 - z)}$$

$$\left(p_x k_x + p_y \sqrt{k_p^2 - k_x^2} + i p_z k_p \right)$$

---

before $\int dk_y$

$\hat{x}$ θ

$$\boxed{k_x^2 + k_y^2 = k_p^2(\omega)}$$

$$k_x = \boxed{\frac{\omega}{v} - \frac{2\pi n}{a} = k_p(\omega) \cos\theta}$$

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$$\left[k_{\parallel j} \cdot \frac{\lambda}{2\pi} = \cos\theta - \frac{c}{v} \right] = \frac{m\lambda}{a}$$

$$r_p = \frac{R_p k_p}{\sqrt{k_x^2+k_y^2}-k_p} = \frac{R_p k_p \left[\sqrt{k_x^2+k_y^2}+k_p\right]}{k_x^2+k_y^2-k_p^2}$$

$\to (k_y - \sqrt{k_p^2-k_x^2})\cdot(k_y+\sqrt{k_p^2-k_x^2})$

$$i p_x k_x \int dk_y \frac{e^{-\sqrt{k_x^2+k_y^2}(2z_p-z)}}{\sqrt{k_x^2+k_y^2}} e^{i k_y y} \quad (\quad)$$

$k_y^2 = k_p^2 - k_x^2$

$k_x^2 + k_y^2 = k_p^2$

$$= -2\pi p_x k_x \frac{e^{-k_p(2z_p-z)}}{k_p} e^{i\sqrt{k_p^2-k_x^2}\,y} \quad R_p k_p 2k_p$$

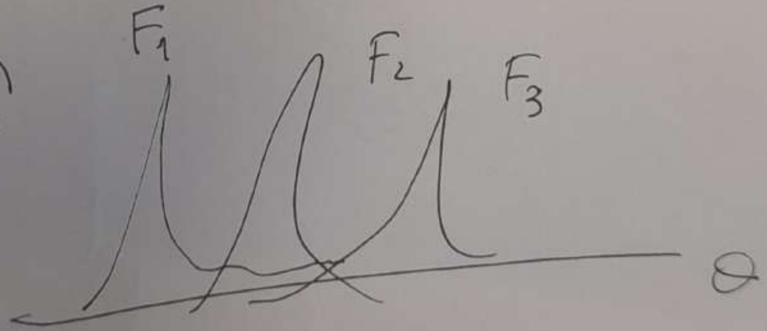
$$r_p = R_p k_p \left[\sqrt{k_x^2+k_y^2}+k_p\right]\left[\frac{\qquad}{}\right.$$

$$\frac{R_p k_p}{(k_y-\gamma)(k_y+\gamma)}$$

$\int dk_y$ $\qquad k_y = k_p \sin(\theta)$

$\downarrow$

$$\sum_n \int d\theta \; \frac{F_n(\theta)\,(\dots)}{\cancel{p}}$$



$$r_p = \frac{2R_p k_p^2}{k_x^2+k_y^2-k_p^2} \qquad 2\pi i \qquad k_y^2 \to k_p^2 - k_x^2$$

$$i 2\pi i \left(\frac{1}{(2\pi)^2 a}\right)\frac{2R_p k_p^{2}}{\cancel{k_p}} \sum_n e^{i k_{xn} x}\, e^{i\sqrt{k_p^2-k_x^2}\,|y|}\, e^{-k_p(2z_p-z)}$$

$$\left(p_x \frac{k_x}{\cancel{k_p}} + p_y \frac{\sqrt{k_p^2-k_x^2}}{\cancel{k_p}} + i p_z k_p\right)$$

$$\to -\frac{R_p k_p}{\pi a}\left(p_x k_x + p_y\sqrt{k_p^2-k_x^2} + i p_z k_p\right)$$

$$\frac{1}{\sqrt{K_p^2 - K_{xn}^2}} = \cancel{\frac{1}{K_p \sin(\theta)}}$$

$$= \cancel{\frac{1}{K_p \sqrt{1+\cos^2\theta}}}$$

$$K_{pen} = \frac{\omega}{v} + \frac{2n\pi}{a} = K_p$$

resonance

$\rightarrow \theta_n$

$$e^{iK_{xn}x + i\sqrt{K_p^2 - K_{xn}^2}\, y}$$

$$e^{i(\cos(\theta) K_p x + \sin(\theta) K_p y)}$$

$\mathrm{Im}\{k_p\} \geq 0$