Самодифракция и самофокусировка

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Основа нелинейной теории

$$P = f(E) \approx \kappa_1 E + \kappa_2 E^2 + \kappa_3 E^3 + o(E^4)$$

$$E < \frac{e}{a^2} \qquad E > \frac{e}{a^2}$$

$$P \approx \kappa_1 E \qquad P \approx \kappa_1 E + \kappa_2 E^2 + \kappa_3 E^3$$

$$P = \frac{\kappa_2 E^2}{2} + \left(\kappa_1 E + \frac{3}{4}\kappa_3 E^3\right)\cos\omega t +$$

$$+ \frac{\kappa_2}{2} E^2 \cos 2\omega t + \frac{\kappa_3}{4} E^3 \cos 3\omega t$$

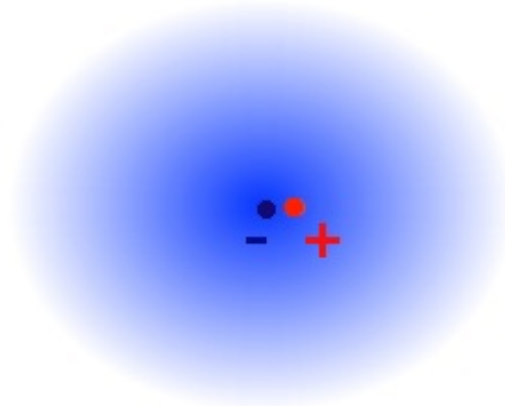
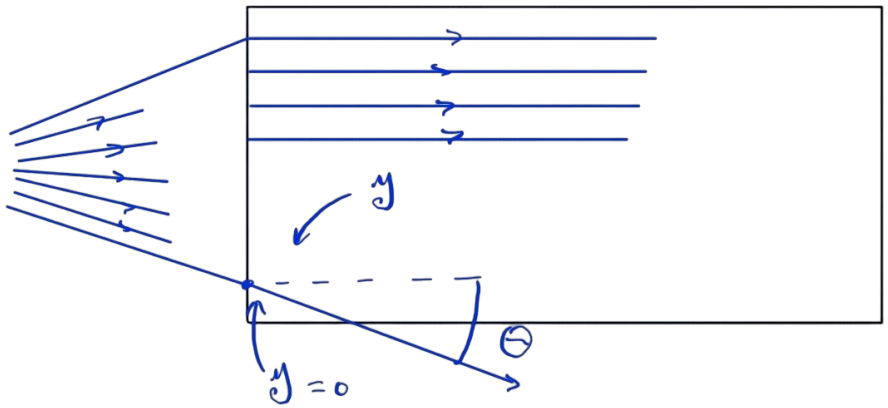


Рис.: $E_a = \frac{e}{a^2} = 10^8\, W/cm$

Самофокусировка

$$D = E + 4\pi P = \left(1 + 4\pi \frac{P}{E}\right) E = \varepsilon E$$

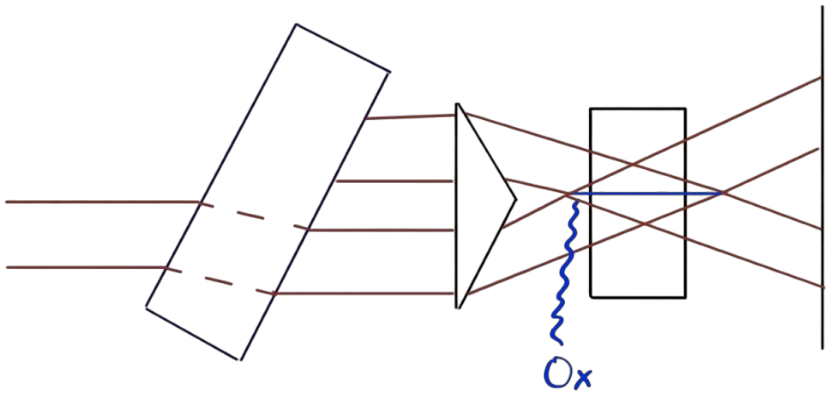
$$\begin{aligned} n &= \sqrt{1 + 4\pi \frac{P}{E}} = \\ &= \sqrt{1 + \frac{4\pi}{E}\left(\kappa_1 E + \frac{3}{4}\kappa_2 E^3\right)} \approx \\ &= \sqrt{1 + \frac{4\pi}{E}\kappa_1} + \frac{3/4\kappa_2 E^2}{2\sqrt{1 + \frac{4\pi}{E}\kappa_1}} \\ &= n_0 + n_1 I \end{aligned}$$

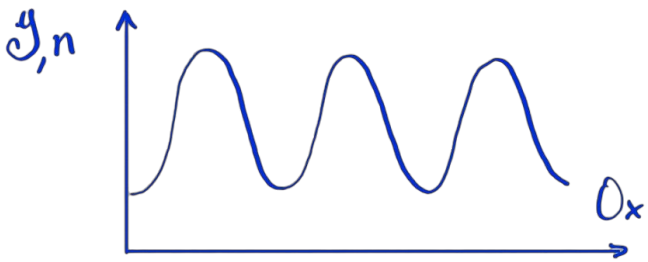


$$\sin\left(\frac{\pi}{2} - \theta\right)(n_0 + n_2 I) = n_0$$

$$\theta^2 = 2\frac{n_2}{n_0} I$$

Самодифракция





$$I = 2I + 2I \cos\left(\frac{4\pi}{\lambda} n_0 x \sin 2\theta\right)$$

$$n = n_0 + n_2(I) + \Delta n(x)$$