

# Dielektrische Verschiebung

$$\vec{D} = \underbrace{\epsilon_0 \underline{\epsilon} \cdot \vec{E}} + \vec{P}^{NL} \quad \text{mit } \vec{P}^{NL} = \epsilon_0 \underline{\chi}^{(2)} : \vec{E} \vec{E}$$

$$\epsilon_0 \vec{E} + \epsilon_0 \underline{\chi}^{(2)} \cdot \vec{E} \quad , \quad \underline{\epsilon} = 1 + \underline{\chi}^{(2)}$$


$$\Delta \vec{E}_3 - \underbrace{\nabla \nabla \cdot \vec{E}_3}_{=0 \text{ für } E_{\perp}} + \frac{\omega_3^2}{c^2} \underline{\epsilon} \cdot \vec{E}_3 = -\frac{\omega_3^2}{c^2} \underline{\chi}^{(2)} : \vec{E}_1 \vec{E}_2$$

$$\exp\{-i\omega_3 t\} \leftrightarrow \exp\{-i(\omega_1 + \omega_2)t\}$$

$$\left(\frac{\partial^2}{\partial z^2} + k^2\right) E_{\perp} = -\frac{\omega_3^2}{c^2} \chi_{\perp}^{(2)} E_{10} E_{20} \exp\{i(k_1 + k_2)z\}$$

$$\frac{\partial^2}{\partial z^2} E_{\perp} = \frac{\partial^2 F}{\partial z^2} \exp\{ikz\} - k^2 F \exp\{ikz\} + 2ik \frac{\partial F}{\partial z} \exp\{ikz\}$$

$$\frac{\partial}{\partial z} \left[ \frac{\partial F}{\partial z} + 2ik F \right] \exp\{ikz\} \quad , \quad \text{Ann. } \left| \frac{\partial F}{\partial z} \right| \ll k |F| = \frac{2\pi}{\lambda} |F|$$

$$2ik \frac{\partial F}{\partial z} \exp\{ikz\} = -\frac{\omega_3^2}{c^2} \chi_{\perp}^{(2)} E_{10} E_{20} \exp\{i(k_1 + k_2)z\}$$


$$\frac{\partial F}{\partial z} = -\frac{1}{2ik} \frac{\omega_3^2}{c^2} \chi_{\perp}^{(2)} E_{10} E_{20} \exp\{iKz\} \quad ; \quad K = k_1 + k_2 - k$$

$\int dz$  mit  $F(z=a, \omega_3) = 0$

$$F(z, \omega_3) = \dots \frac{\exp\{ikz\}}{ik} \Big|_0^z = \dots \frac{\exp\{ikz\} - 1}{ik}$$

$$= \dots \exp\left\{i \frac{kz}{2}\right\} \frac{2i \sin\left\{\frac{kz}{2}\right\}}{ik} \quad \nu k = \omega_3$$

Intensität

$$I(z) = v \varepsilon \langle \vec{E}^2 \rangle = v \frac{c^2}{v^3} \varepsilon_0 \cdot \frac{1}{2} \left(\frac{\omega_3^2}{ck^2}\right)^2 \left(\chi_{\perp}^{(2)} E_{10} E_{20}\right)^2 \left[\frac{\sin\left\{\frac{kz}{2}\right\}}{\frac{k}{2}}\right]^2$$

$$= \frac{\varepsilon_0}{8c^{(2)}} \frac{\omega_3^3}{k} \left(\chi_{\perp}^{(2)} E_{10} E_{20}\right)^2 z^2 \left[\frac{\sin\left\{\frac{kz}{2}\right\}}{\frac{k}{2}}\right]^2$$

Optische Fasern

