1. Elektromagnetische Welle im Vakuum

$$E_x = 0; \quad E_y = 30\cos\left(2\pi * 10^8 t - \tfrac{2\pi}{3} x\right); \quad E_z = 0$$

(a) $\omega = 2\pi * 10^8 \ 1/\mathrm{s}$

$f = \frac{\omega}{2\pi} = \underline{\underline{10^8 \ 1/\mathrm{s}}}$

(b) $k = \frac{2\pi}{3}$

$\lambda = \frac{2\pi}{k} = \underline{\underline{3 \ \mathrm{m}}}$

(c)

Direction: $\underline{\underline{\hat{x}}}$

(d)

2. Photonen-Ping-Pong

(a)

(b)

(c)

3. Stehende Wellen

$$\vec{E}(\vec{r},t) = \operatorname{Re}\left(\vec{E}_0\, e^{i\vec{k}\vec{r}-i\omega t}\right)$$

(a)

$$\vec{E}_1(\hat{x},t) = \operatorname{Re}\left(\vec{E}_0\, e^{i\vec{k}\hat{x}-i\omega t}\right)$$
$$\vec{E}_2(-\hat{x},t) = \operatorname{Re}\left(\vec{E}_0\, e^{-i\vec{k}\hat{x}-i\omega t}\right)$$
$$\vec{E} = \vec{E}_1 + \vec{E}_2 = \operatorname{Re}\left(\vec{E}_0\, e^{i\vec{k}\hat{x}-i\omega t} + e^{-i\vec{k}\hat{x}-i\omega t}\right)$$

(b)

$$\vec{E}_1(\hat{x},t) = \operatorname{Re}\left(\vec{E}_0\, e^{i\vec{k}\hat{x}-i\omega t}\right)$$
$$\vec{E}_2(\hat{y},t) = \operatorname{Re}\left(\vec{E}_0\, e^{i\vec{k}\hat{y}-i\omega t}\right)$$
$$\vec{E} = \vec{E}_1 + \vec{E}_2 = \operatorname{Re}\left(\vec{E}_0\, e^{i\vec{k}\hat{y}-i\omega t} + e^{-i\vec{k}\hat{x}-i\omega t}\right)$$

(c)

(d) $\omega_1 = 2\omega_2$

$$\vec{E}_1(\hat{x},t) = \operatorname{Re}\left(\vec{E}_0\, e^{i\vec{k}\hat{x}-i\omega_1 t}\right)$$
$$\vec{E}_2(-\hat{x},t) = \operatorname{Re}\left(\vec{E}_0\, e^{-i\vec{k}\hat{x}-i\omega_2 t}\right)$$
$$\vec{E} = \vec{E}_1 + \vec{E}_2 = \operatorname{Re}\left(\vec{E}_0\, e^{i\vec{k}\hat{x}-i2\omega_2 t} + e^{-i\vec{k}\hat{x}-i\omega_2 t}\right)$$

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