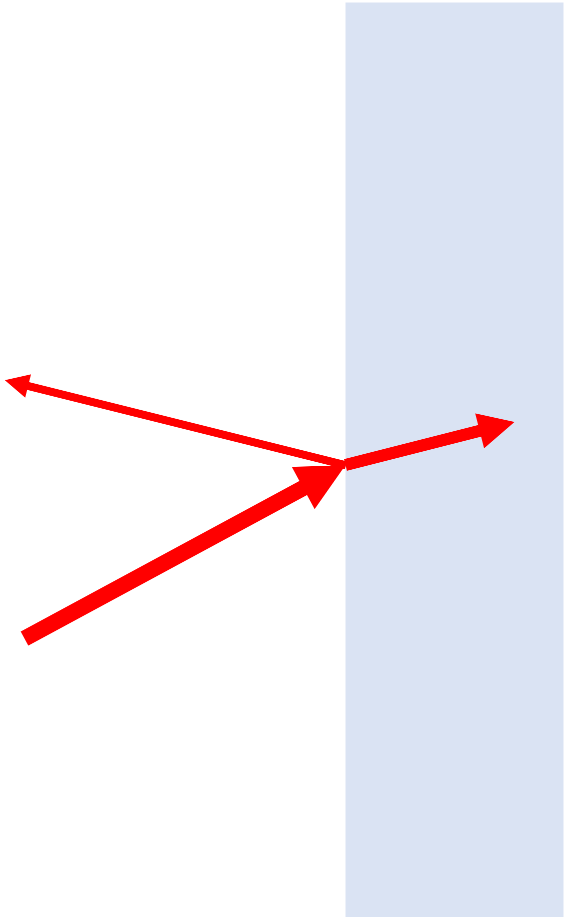
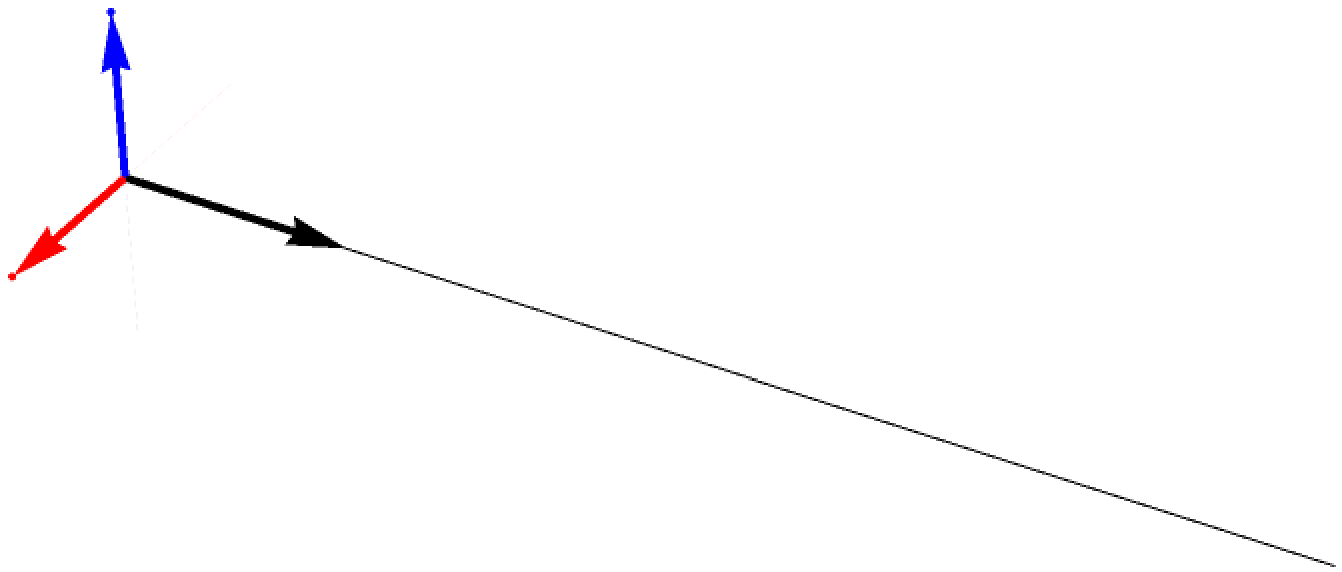
Pogled skozi okno

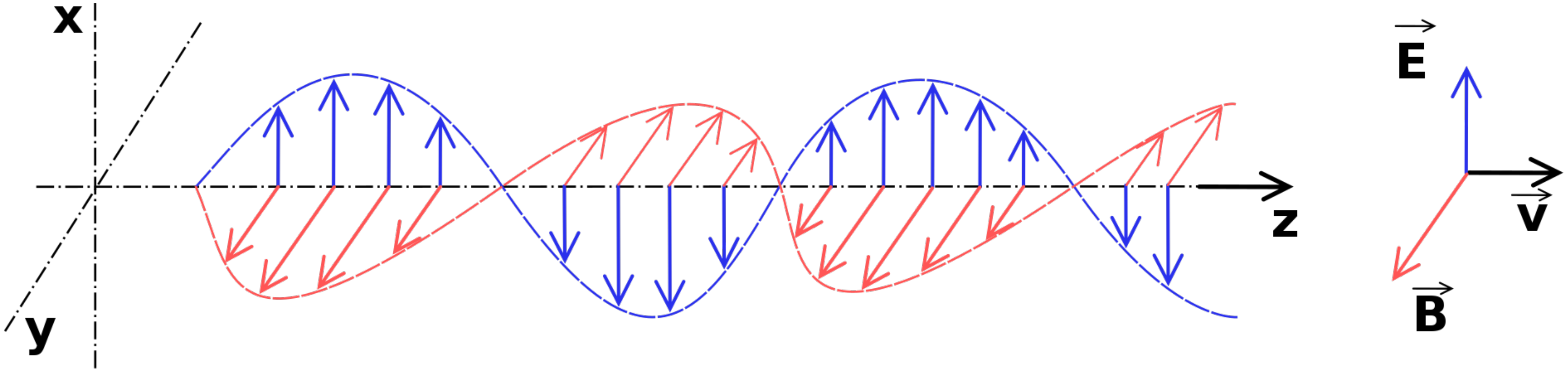
Zakaj se svetloba odbije od šipe?



Svetloba je elektromagnetno valovanje



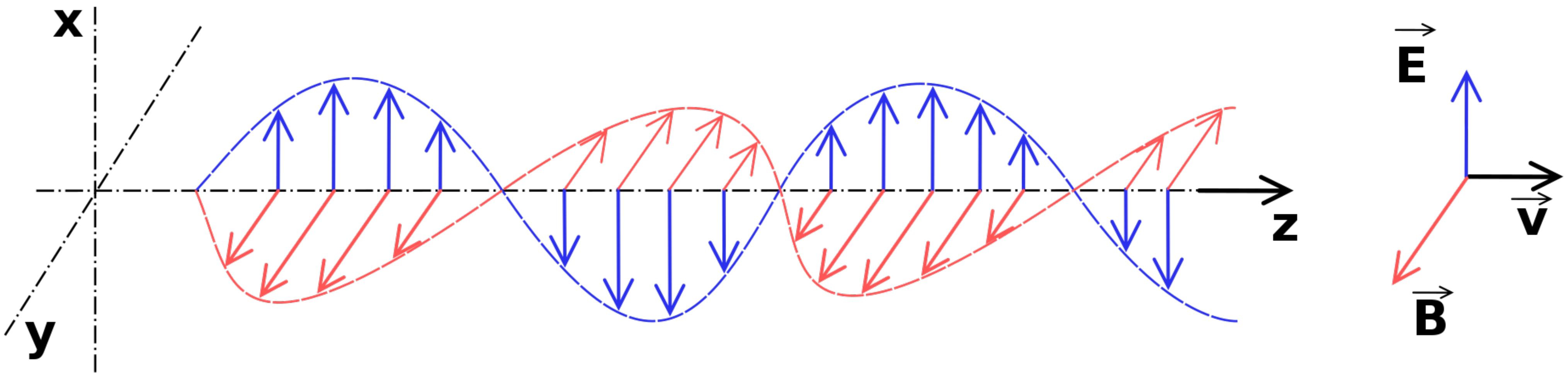
valovanje električnega in magnetnega polja



$$E_x = E_0 \sin(kz - \omega t)$$

$$B_y = B_0 \sin(kz - \omega t)$$

nihajni čas in valovna dolžina



$$\omega = 2\pi\nu = \frac{2\pi}{t_0}$$

$$E_x = E_0 \sin(kz - \omega t)$$

$$B_y = B_0 \sin(kz - \omega t)$$

$$k = \frac{2\pi}{\lambda} = \frac{\omega}{c}$$

polje v snovi

jakost in gostota električnega polja $\varepsilon\varepsilon_0 E = D$

jakost in gostota magnetnega polja $\mu\mu_0 H = B$

dielektričnost snovi ε

lomni količnik $n = \frac{c_0}{c} = \sqrt{\varepsilon}$

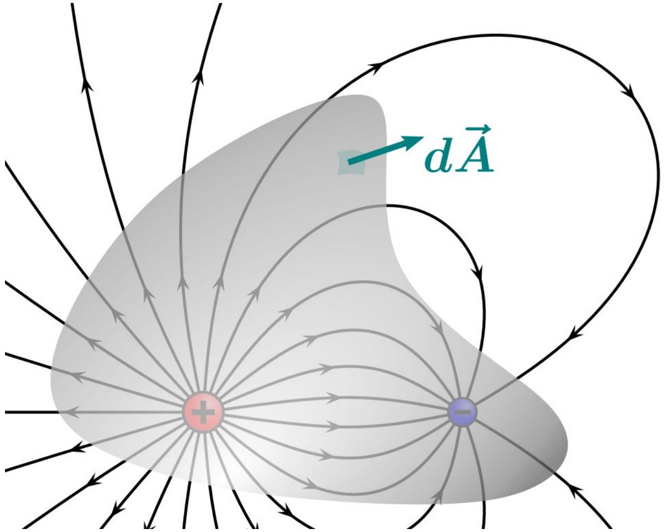
Maxwellove enačbe

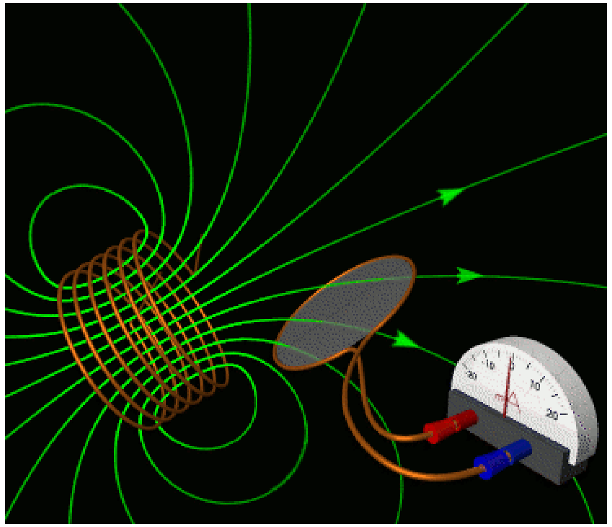
$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_0 \left(\mathbf{J} + \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t} \right)$$





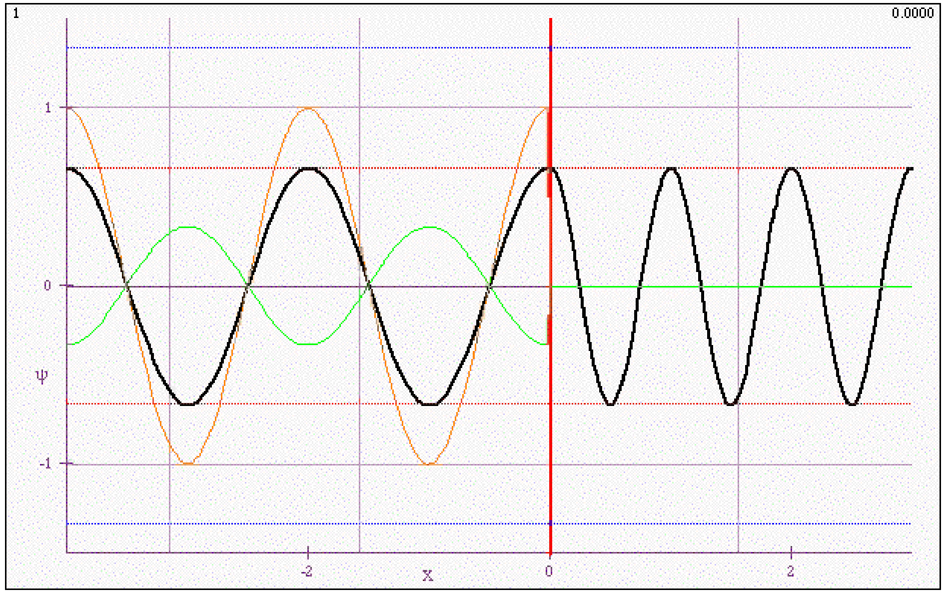
Robni pogoji

- Tangentna komponenta jakosti električnega polja je zvezna (indukcijski (Faradayev) zakon)
$$\vec{n}_{12} \times \left(\vec{E}_1 - \vec{E}_2\right) = 0$$
- Normalna komponenta gostote električnega polja ni (je) zvezna (zakon o električnem pretoku (Gaussov zakon))
$$\left(\vec{D}_2 - \vec{D}_1\right) \cdot \vec{n}_{12} = \sigma_p$$
- Normalna komponenta gostote magnetnega polja je zvezna
$$\left(\vec{B}_2 - \vec{B}_1\right) \cdot \vec{n}_{12} = 0$$
- Tangentna komponenta jakosti magnetnega polja je (ni) zvezna
$$\vec{n}_{12} \times \left(\vec{H}_2 - \vec{H}_1\right) = \vec{J}_p$$

- Meja med dielektriki
  - $\sigma_p = j_p = 0$
  - H in D sta zvezna
- Meja dielektrik-kovina
  - H in D nista (nujno) zvezna

Odboj valovanja na meji

$$k = \frac{2\pi}{\lambda} = \frac{\omega}{c} = \frac{\omega n}{c_0}$$

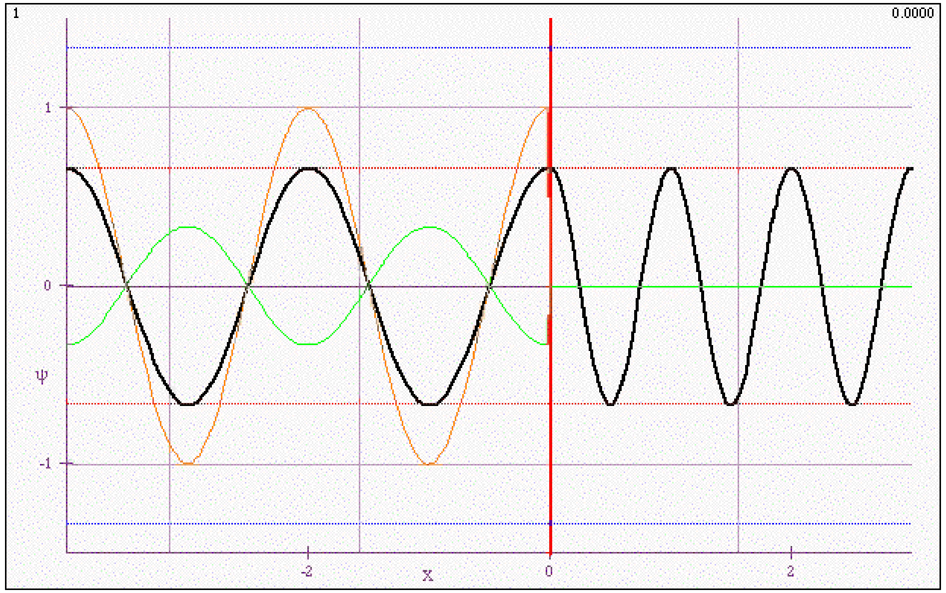


$$k' = \frac{2\pi}{\lambda'} = \frac{\omega}{c'} = \frac{\omega n'}{c_0}$$

Odboj valovanja na meji

$$E_0 = E_{00} \cos(kx - \omega t)$$

$$E_1 = E_{01} \cos(k'x - \omega t)$$

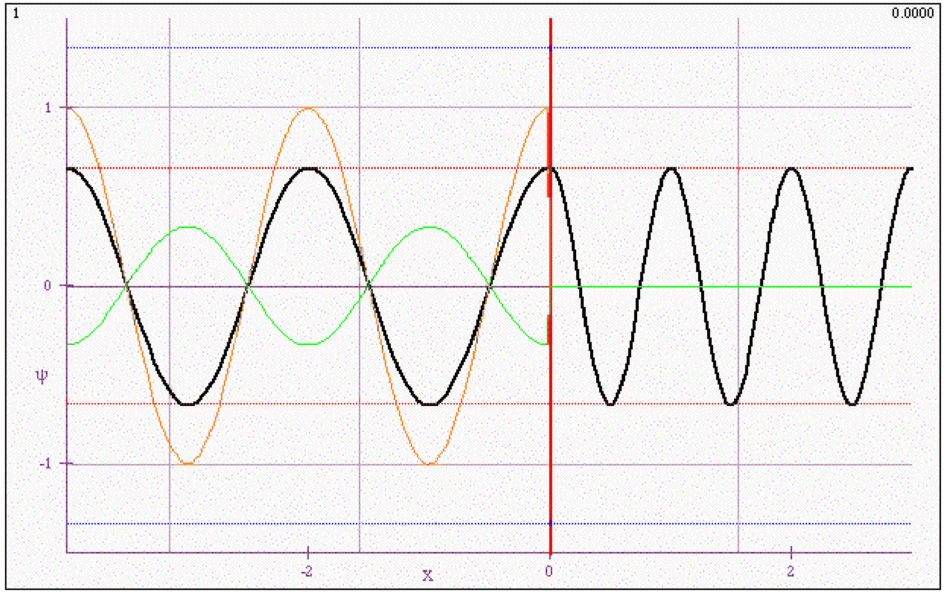


$$E_2 = E_{02} \cos(- kx - \omega t)$$

Odboj valovanja na meji – robni pogoj

$$E_0 = E_{00} \cos(kx - \omega t)$$

$$E_1 = E_{01} \cos(k' x - \omega t)$$



$$E_2 = E_{02} \cos(- kx - \omega t)$$

$$\vec{n}_{12} \times \left(\vec{E}_1 - \vec{E}_2\right) = 0$$

$$\vec{n}_{12} \times \left(\vec{H}_2 - \vec{H}_1\right) = 0$$

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$E_0 + E_2 = E_1$$

$$cE_0 - cE_2 = c' E_1$$

Odboj valovanja na meji

$$E_0 + E_2 = E_1$$

$$cE_0 - cE_2 = c'E_1$$

Odboj valovanja na meji

$$E_0 + E_2 = E_1$$

$$cE_0 - cE_2 = c'E_1$$

$$cE_0 - cE_2 = c'(E_0 + E_2)$$

Odboj valovanja na meji

$$E_0 + E_2 = E_1$$

$$cE_0 - cE_2 = c'E_1$$

$$cE_0 - cE_2 = c'(E_0 + E_2)$$

$$\frac{E_0}{E_2} - 1 = \frac{c'}{c}\left(\frac{E_0}{E_2} + 1\right)$$

$$\frac{E_0}{E_2}\left(1 - \frac{c'}{c}\right) = 1 + \frac{c'}{c}$$

$$\frac{E_2}{E_0} = \frac{1 - \frac{c'}{c}}{1 + \frac{c'}{c}} = \frac{n - n'}{n + n'}$$

Odboj valovanja na meji

$$E_0 + E_2 = E_1$$

$$cE_0 - cE_2 = c'E_1$$

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$$\frac{E_2}{E_0} = \frac{1 - \frac{c'}{c}}{1 + \frac{c'}{c}} = \frac{n - n'}{n + n'}$$

$$\frac{E_2}{E_0} = \frac{1 - 1{,}5}{1 + 1{,}5} = \frac{0{,}5}{2{,}5} = 0{,}2$$

Odboj valovanja na meji

$$E_0 + E_2 = E_1$$

$$cE_0 - cE_2 = c'E_1$$

$$cE_0 - cE_2 = c'(E_0 + E_2)$$

$$\frac{E_0}{E_2} - 1 = \frac{c'}{c}\left(\frac{E_0}{E_2} + 1\right)$$

$$\frac{E_0}{E_2}\left(1 - \frac{c'}{c}\right) = 1 + \frac{c'}{c}$$

$$\frac{E_2}{E_0} = \frac{1 - \frac{c'}{c}}{1 + \frac{c'}{c}} = \frac{n - n'}{n + n'}$$

$$\frac{E_2}{E_0} = \frac{1 - 1{,}5}{1 + 1{,}5} = \frac{0{,}5}{2{,}5} = 0{,}2$$

$$\frac{j_2}{j_0} = \left(\frac{E_2}{E_0}\right)^2 = 0{,}04$$