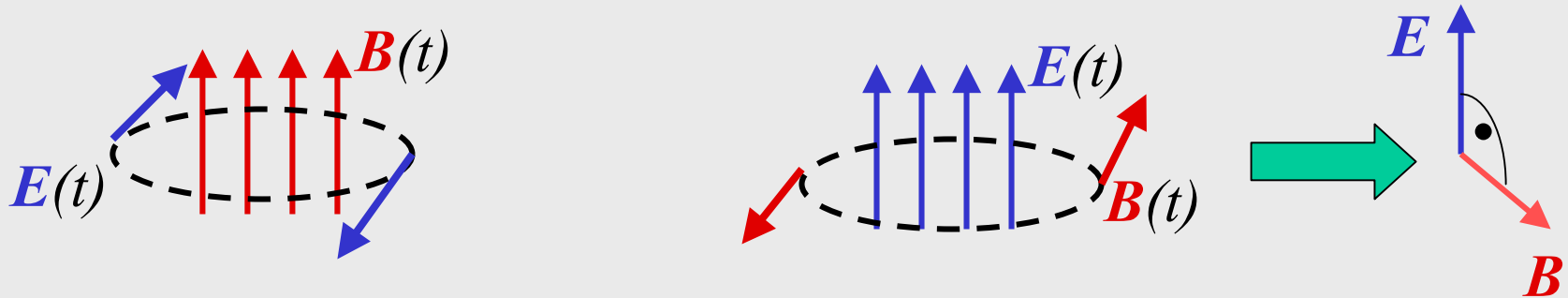


Lainefunktsioon $x_P(z, t) = x_0 \sin(2\pi f(t - z/v))$

Elektromagnetlaine - nii E kui ka B peavad muutuma samasuguse seaduspärasuse järgi

E ja B orientatsioon ning seos??



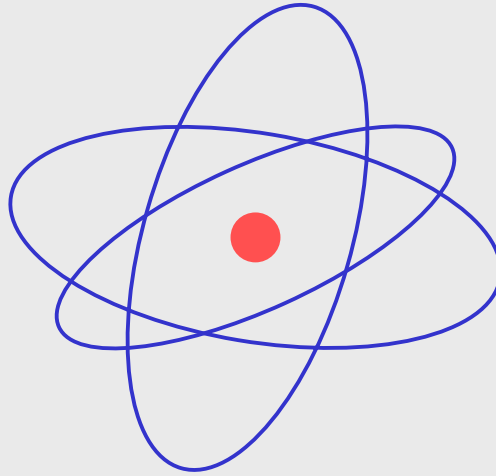
Saab näidata, et vaakumis $|\vec{E}| = c|\vec{B}|$ kus

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} = 2,99792458 \times 10^8 \text{ ms}^{-1}$$

Leviku seisukohalt vaakumis on $\vec{E}$ ja $\vec{B}$ võrdväärised

Mõju ainele

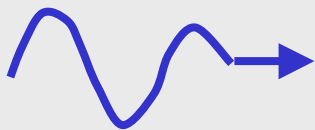
$$|\vec{E}| = c|\vec{B}|$$



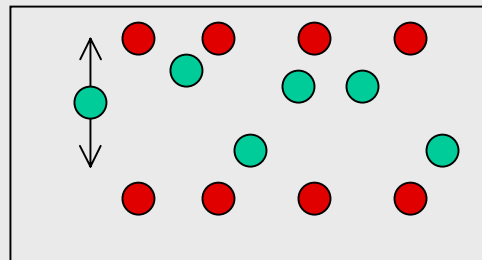
$$\vec{F} = e(\vec{E} + \vec{v} \times \vec{B})$$

$$F = e\left(E + \frac{v}{c}E\right)$$

Seni, kui $v \ll c$ tuleb arvestada vaid elektrivälja mõju



Juhid



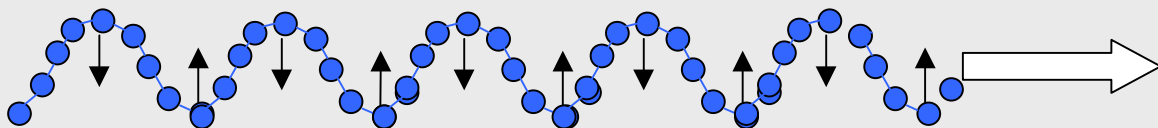
EML neeldub

Pikilained nt

häälelaine

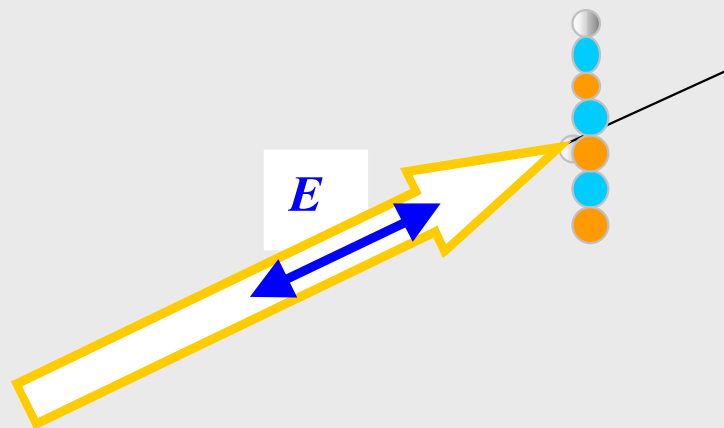


Ristilaine nt laine veepinnal

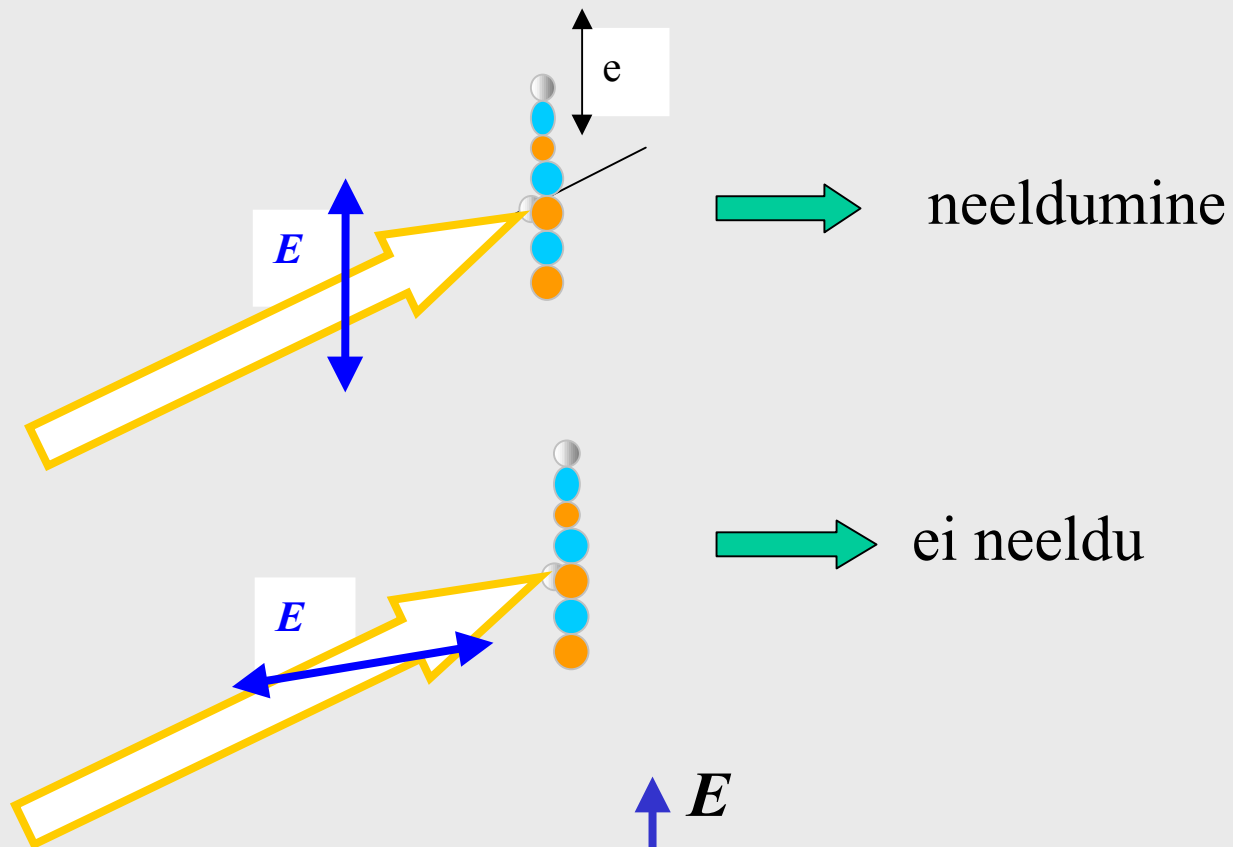


EML ??

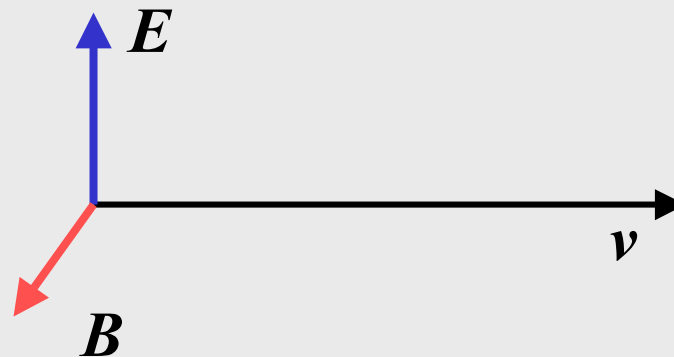
Kui pikilaine:



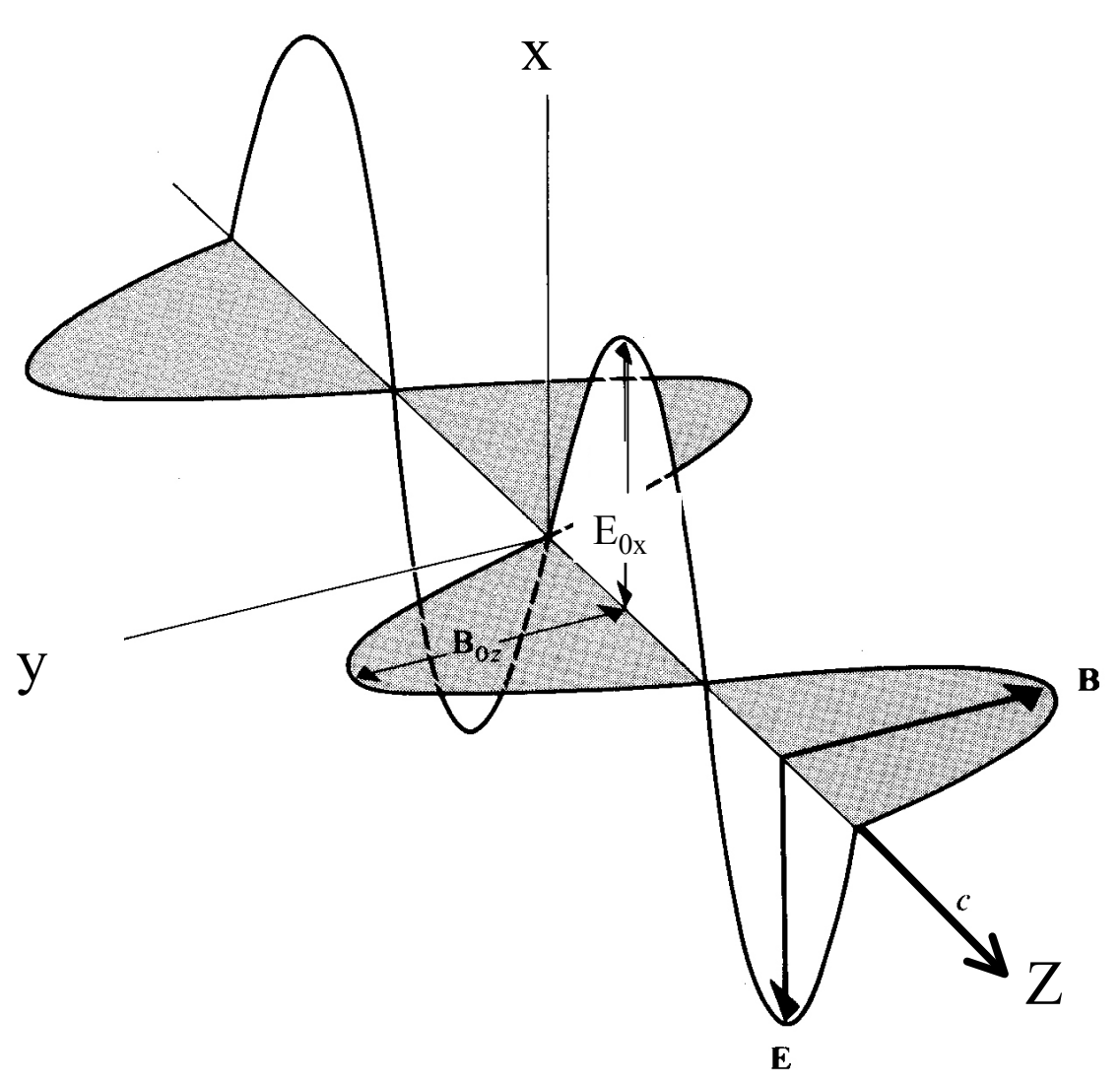
Kui ristilaine:



EML on ristilaine



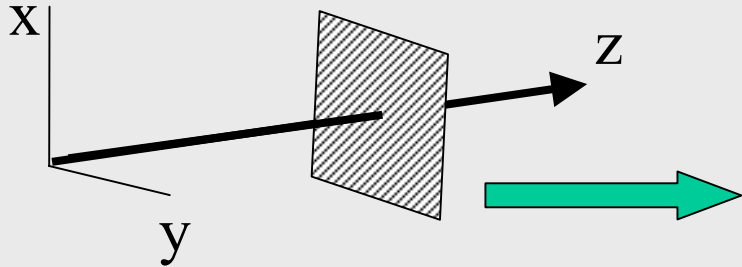
$$E_x(z,t) = E_0 \sin(\omega(t - z/v)) \quad B_y(z,t) = B_0 \sin(\omega(t - z/v))$$



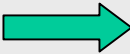
$$\begin{aligned} 2\pi f(t - z/v) &= \\ &= \omega t - 2\pi \frac{z}{vT} \\ &= \omega t - 2\pi \frac{z}{\lambda} \\ &= \omega t - kz \end{aligned}$$

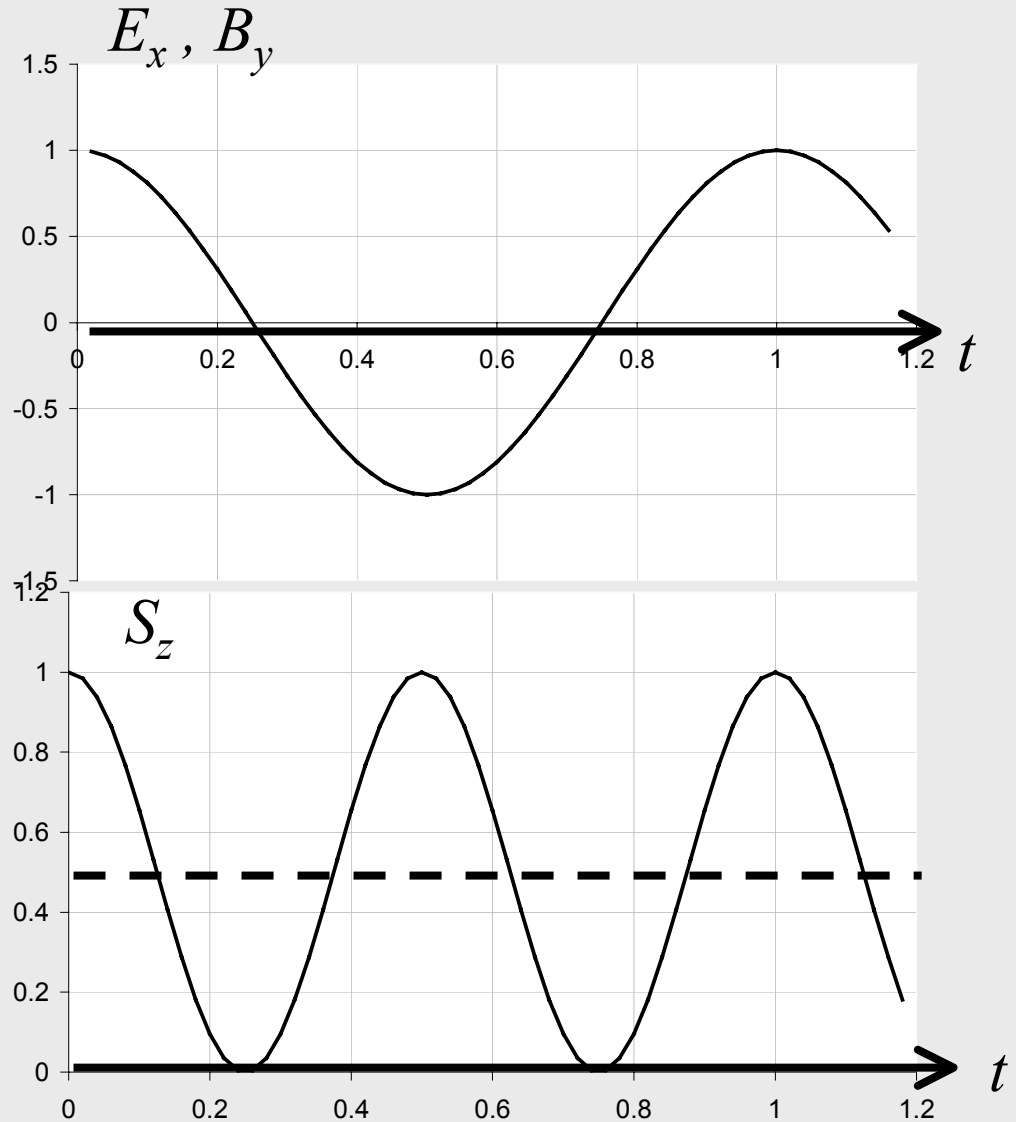
$$E_x(z,t) = E_o \sin(\omega t - kz) \quad B_y(z,t) = B_o \sin(\omega t - kz)$$

EML:energeetilised karakteristikud

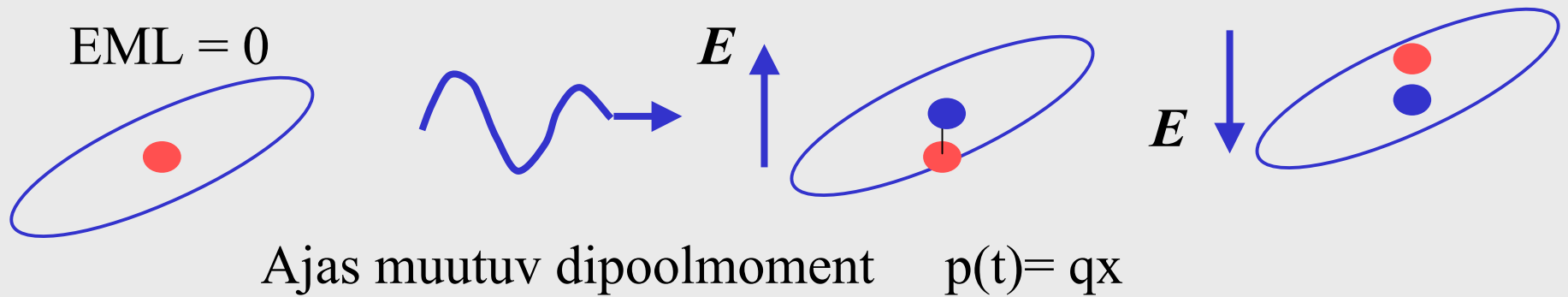


Poyntingi vektor $\vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B}$

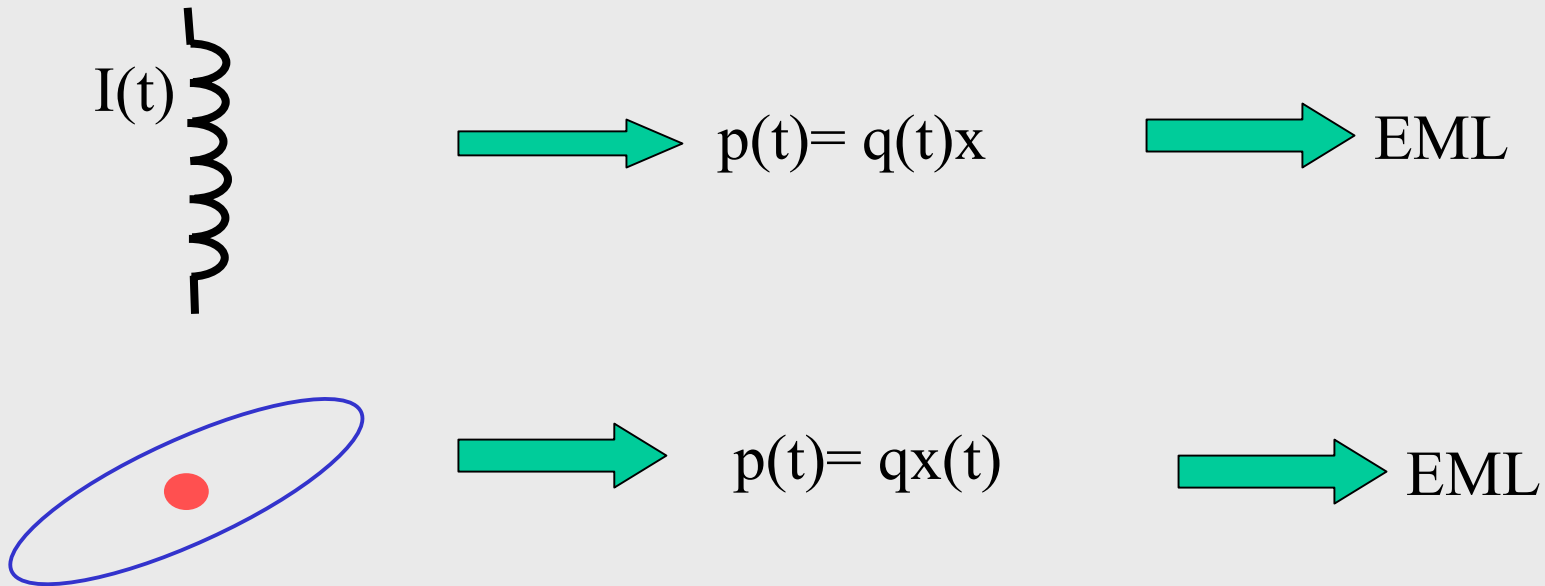
kiiritustihedus $I \propto E_0^2$ 



Elektromagnetlaine dielektrikus

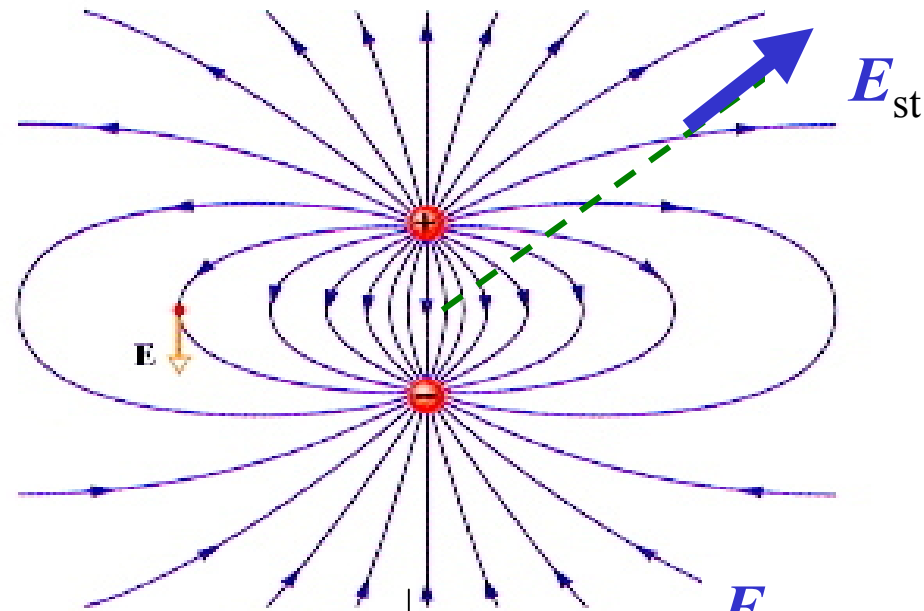


EML tekib, kui laeng liigub kiirendusega



Dipooli elektrostaatiline väli

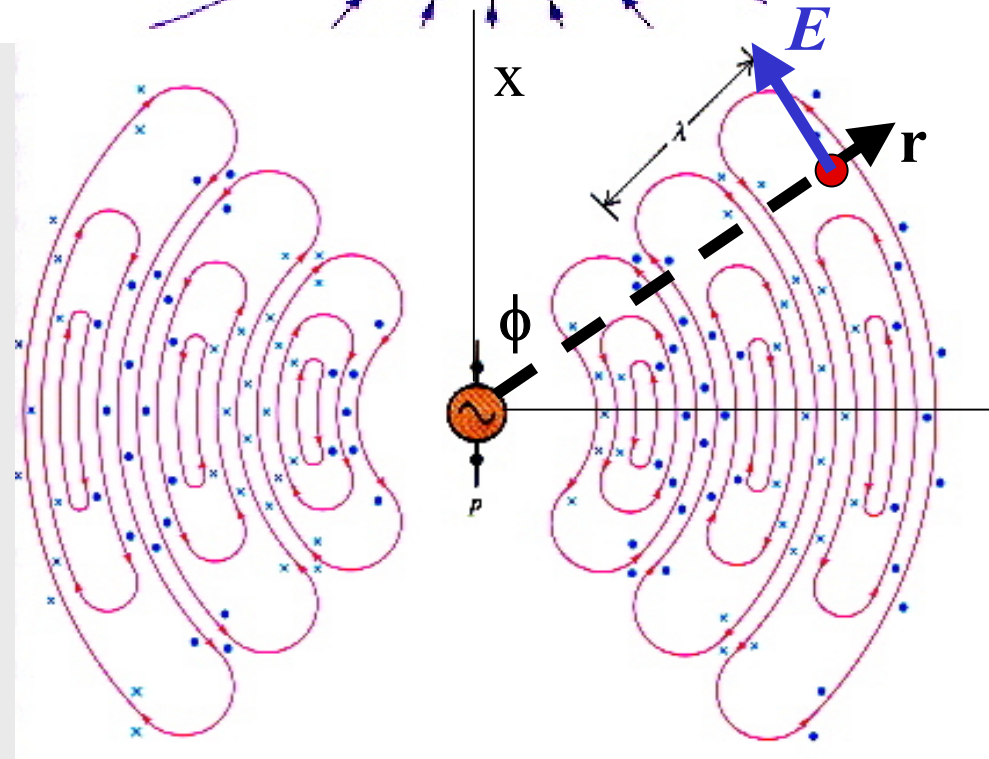
$$\mathbf{E} \parallel \mathbf{r}$$



Dipoolkiirgus

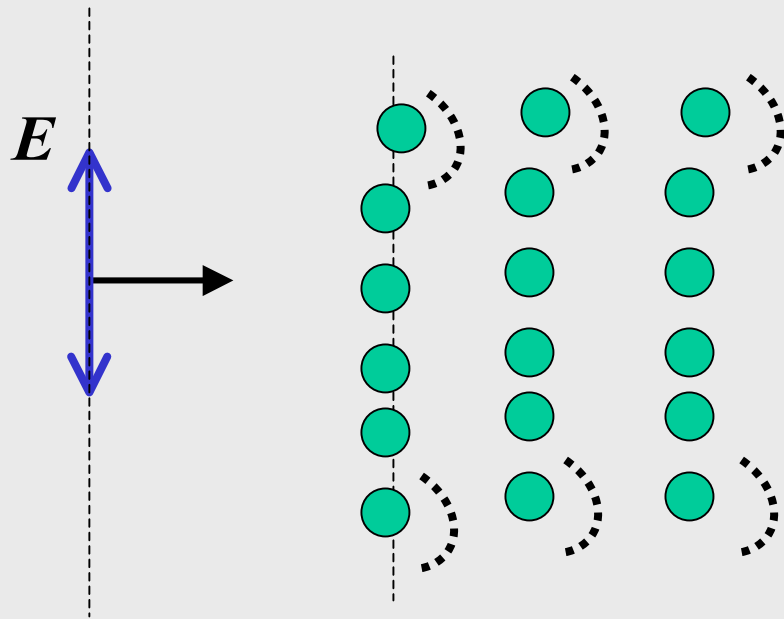
$$\mathbf{E} \perp \mathbf{r} \quad E \propto \frac{1}{r}$$

$$I \propto \frac{\omega^4 \sin^2(\phi)}{r^2}$$



Dipool ei kiirga oma telje sihis

Elektromagnetlainen levik aines



levikukiirus

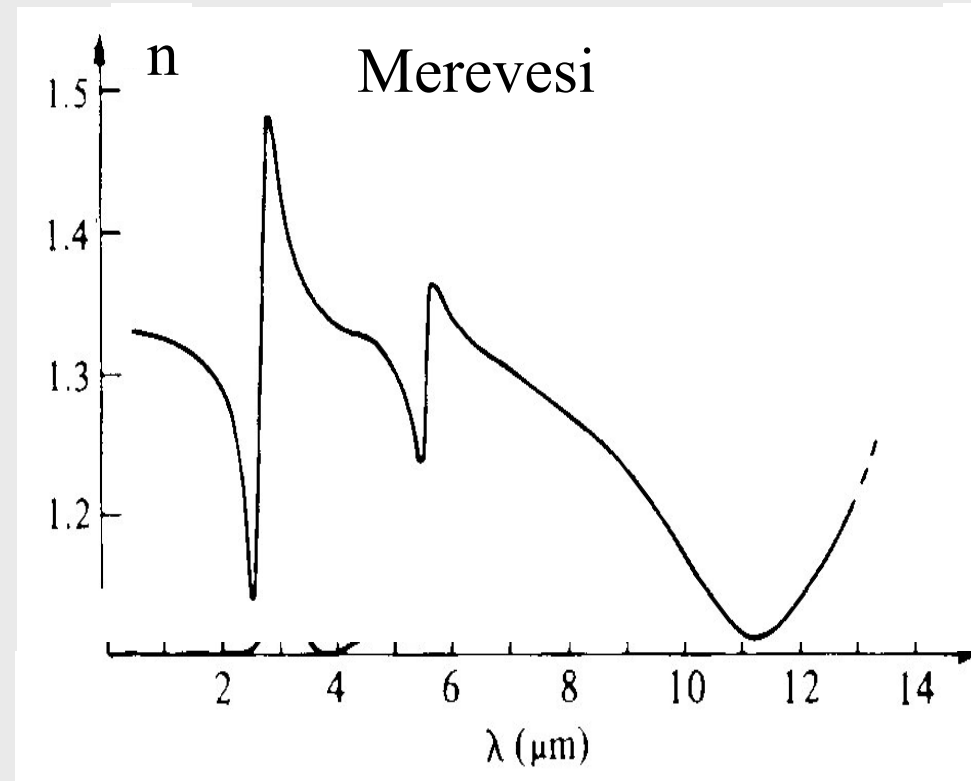
$$v = \frac{c}{n}$$

murdamisnäitaja

$$n = \sqrt{\epsilon\mu}$$

$$n = f(\omega) = F(\lambda)$$

Aine dispersioon



EML skaala

Lainepikkus (m)	Nimetus/rakendus	Sagedus (Hz)
10^7		
10^5	Side merenduses	10^4
10^4		
10^2		
10^1	ULL, televisioon	100 MHz
10^{-1}	mobiiltelefon	1GHz
10^{-2}	Sat TV	10^{10}
10^{-4}	Infrapunane	
10^{-5}		
$10^{-6}=1\ \mu\text{m}$	NÄHTAV VALGUS	$10^{14}\text{-}10^{15}$
10^{-7}		
10^{-8}	Ultraviolet	
$10^{-9}=1\ \text{nm}$	Röntgenkiirus	10^{18}
10^{-10}		
$10^{-12}=1\ \text{pm}$	Gammakiirus	
10^{-13}		10^{22}
10^{-16}		

Lainepikkus

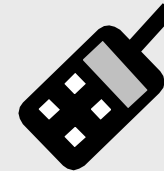
Raadio

3 meetrit



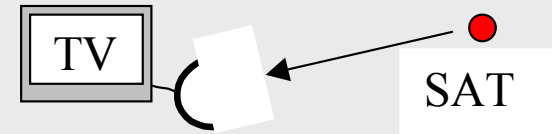
Mobiiltelefon

30 sentimeetrit



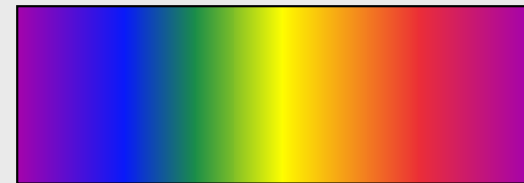
SAT TV

3 sentimeetrit

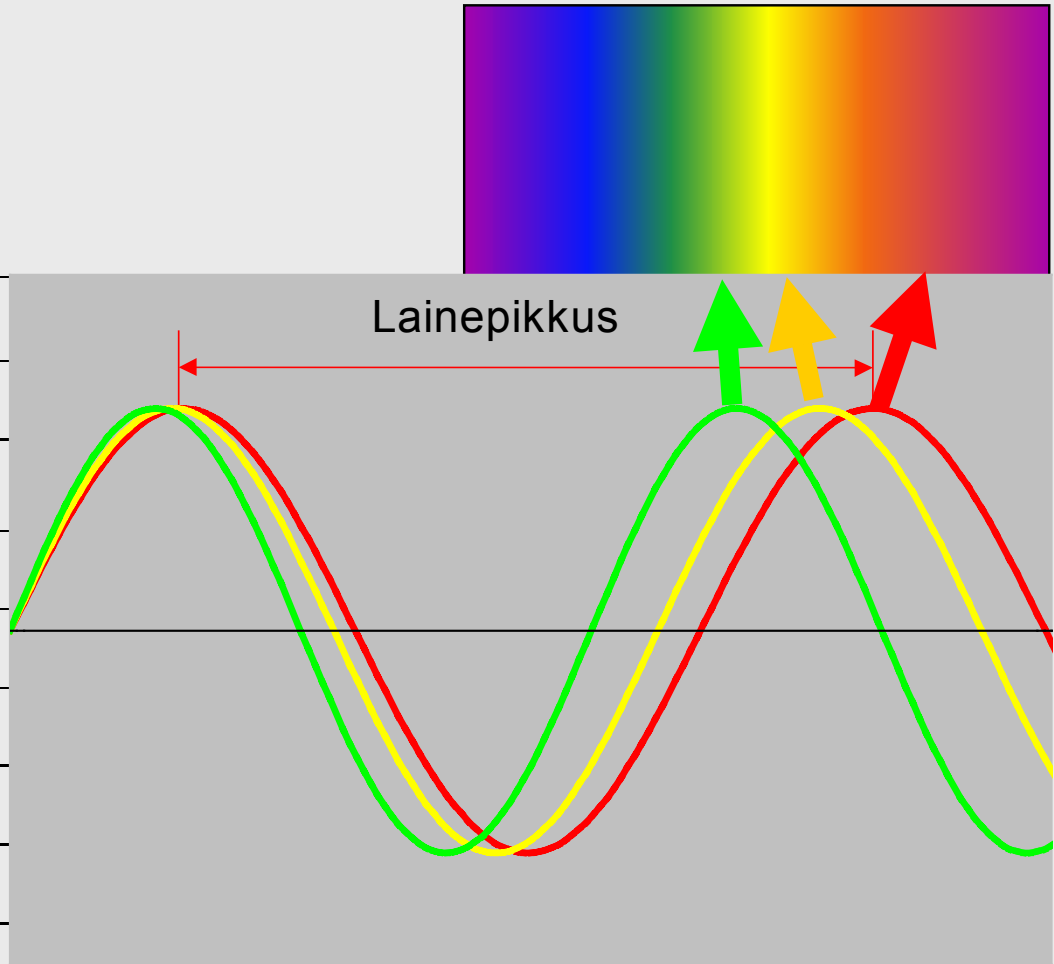


Valgus

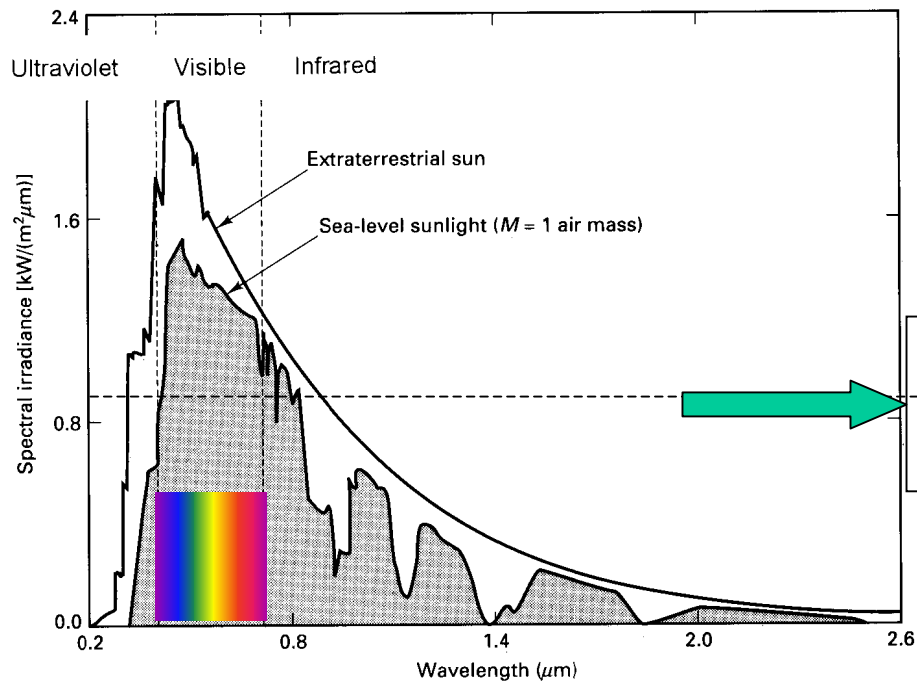
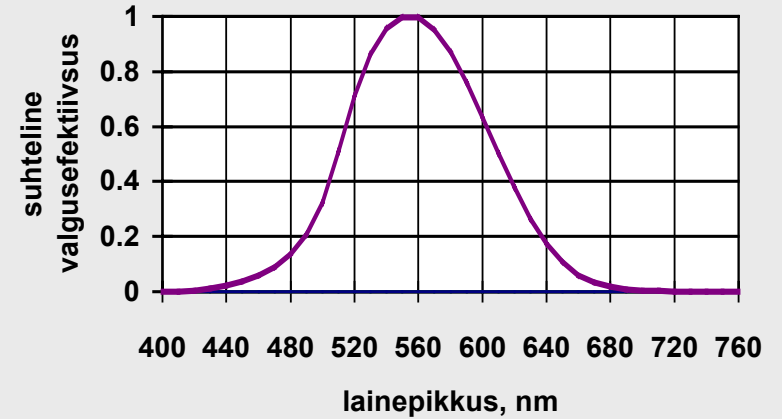
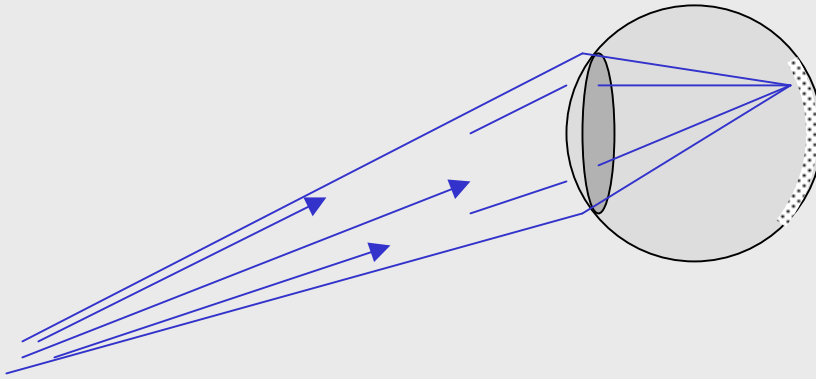
Lainepikkuste vahemikus
380-770 nm e. 0,38-0,77
 μm kutsutakse EML esile
valgusaistingu



Värvus	λ , nm
punane	770-620
oranž	620-590
kollane	590-580
roheline	560-500
helesinine	500-480
sinine	480-450
violetne	450-380



Inimese silm



Üks ja sama kiirgusvoog tekitab erineva valgusaistingu