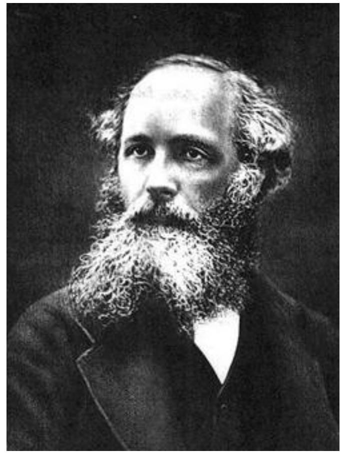
Equazioni Maxwell nel vuoto



$$\vec{\nabla} \cdot \vec{E} = 0 \qquad \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \qquad \vec{\nabla} \times \vec{B} = \mu_o \varepsilon_o \frac{\partial \vec{E}}{\partial t}$$

Equazioni di Helmholtz

$$\nabla^2 \vec{E} = \mu_o \varepsilon_o \frac{\partial^2 \vec{E}}{\partial t^2} = -k^2 \vec{E}$$

$$\nabla^2 \vec{B} = \mu_o \varepsilon_o \frac{\partial^2 \vec{B}}{\partial t^2} = -k^2 \vec{B}$$

Scomposizione in armoniche

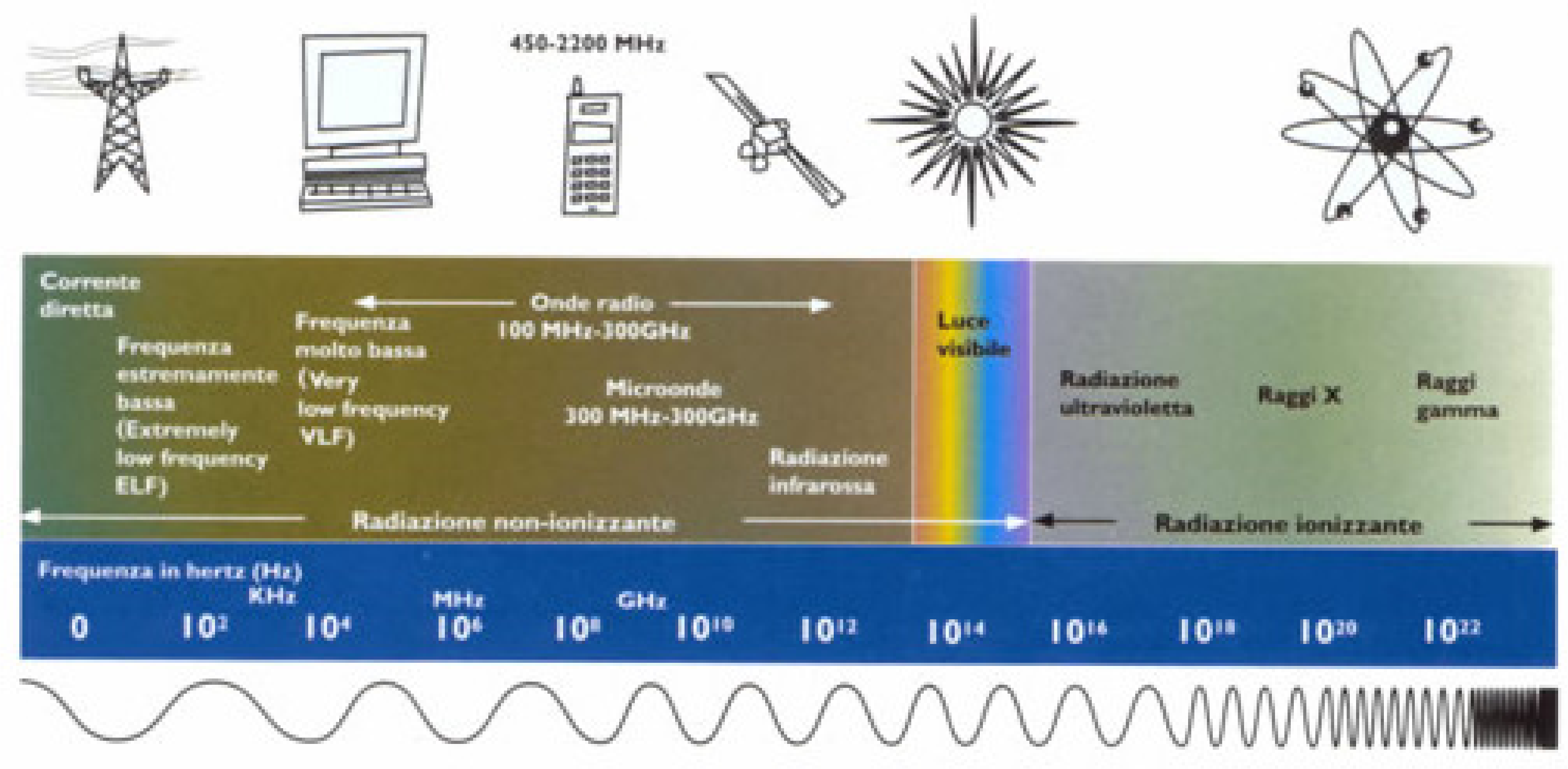
$$k = \frac{\omega}{c}$$

Relazione dispersione

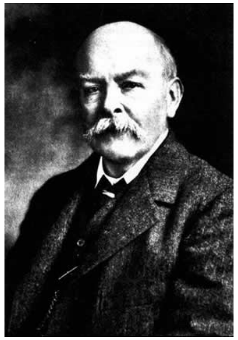
$$\lambda = \frac{c}{\nu} \qquad \lambda = \frac{ch}{h\nu} = \frac{ch}{e}\frac{e}{h\nu} \qquad \lambda(nm) = \frac{1239.8}{h\nu(eV)}$$

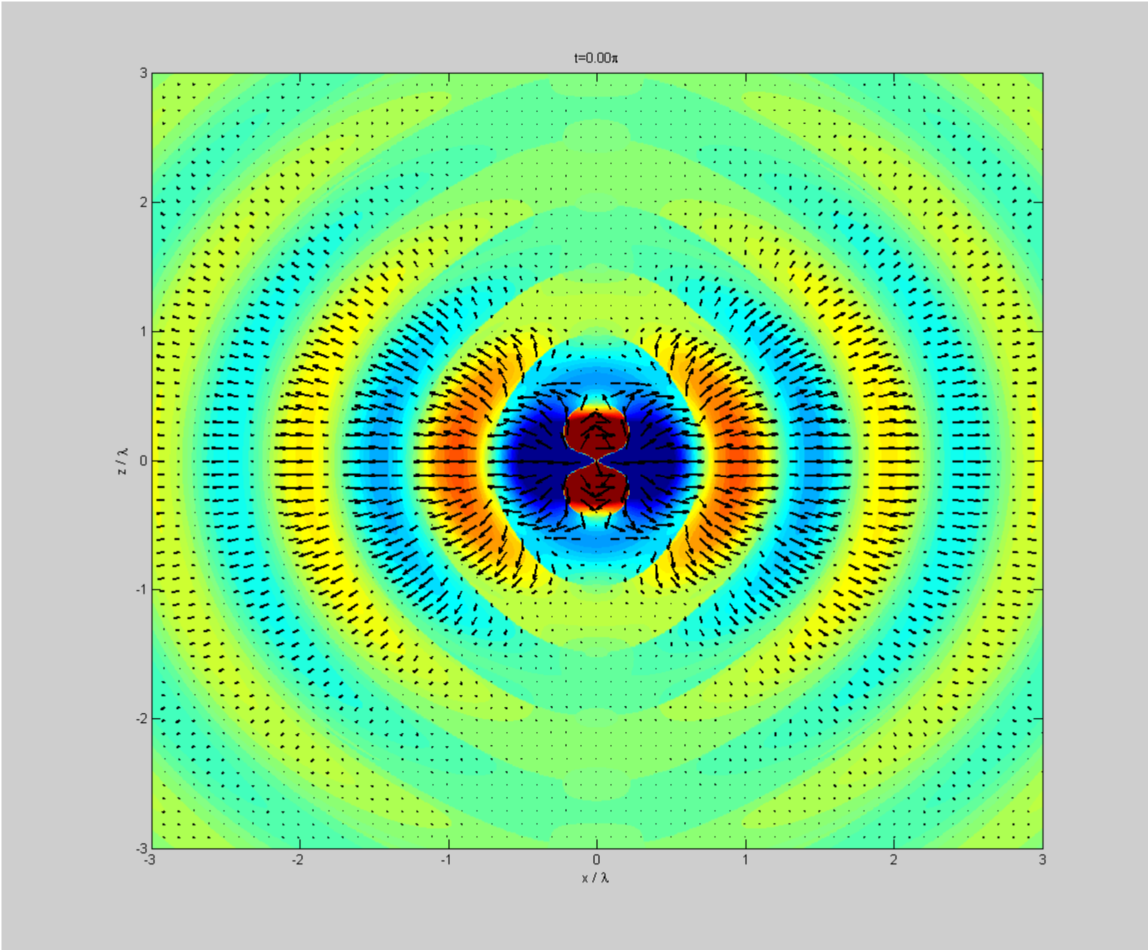
Onde elettromagnetiche

∃ ∀ ω



Vettore di Poynting $\vec{S} = \frac{\vec{E} \times \vec{B}}{\mu_o} = \varepsilon_o E^2 c \hat{k}$

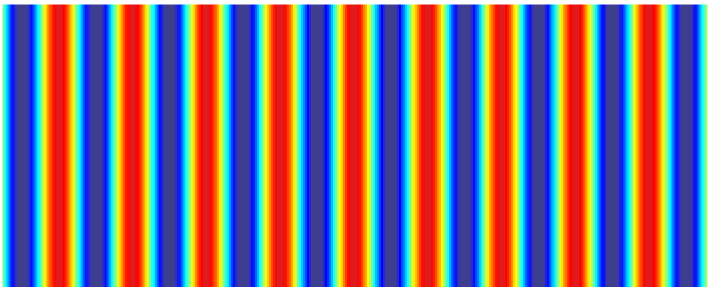


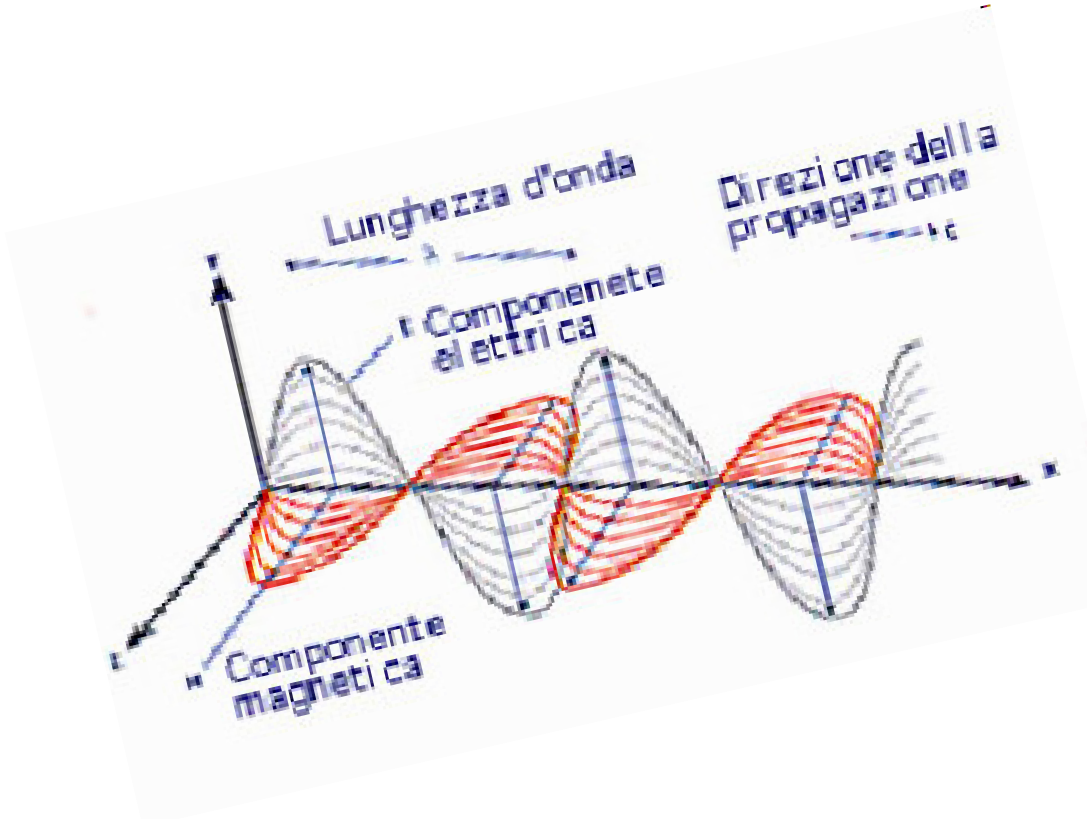


Onde piane

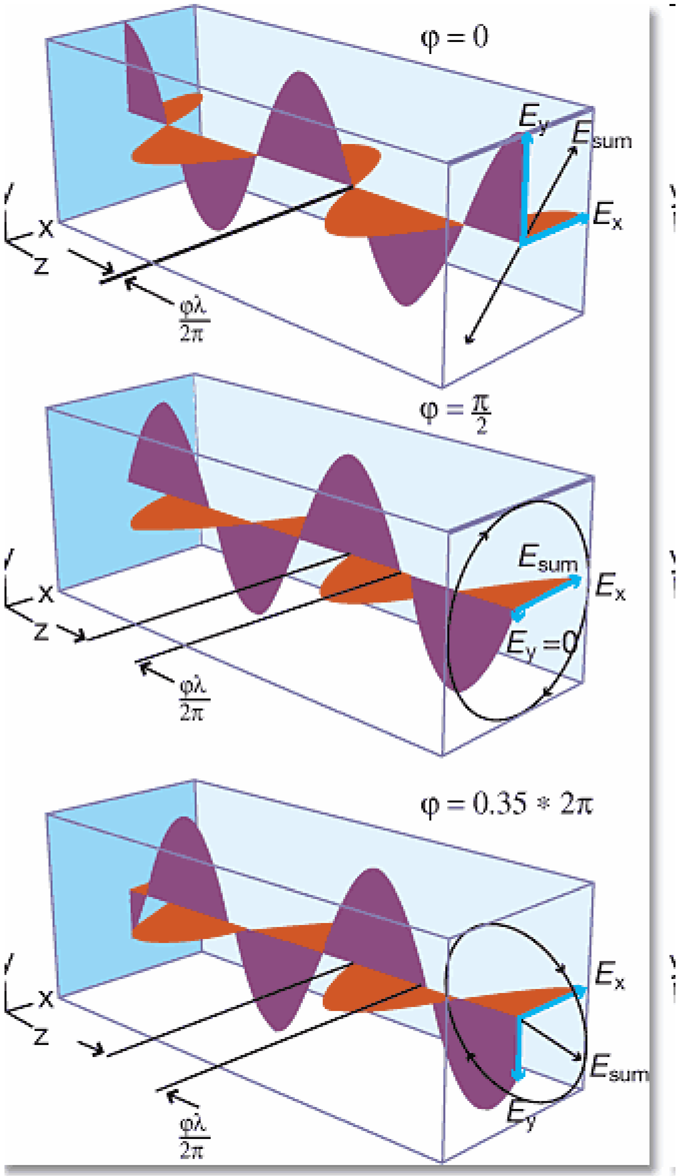
$$\vec{E} = \vec{E}_o e^{i(\vec{k}\cdot\vec{r}-\omega t)}$$

$$\vec{k}\cdot\vec{E} = 0 \qquad \vec{k}\times\vec{B} = \omega\vec{E}$$





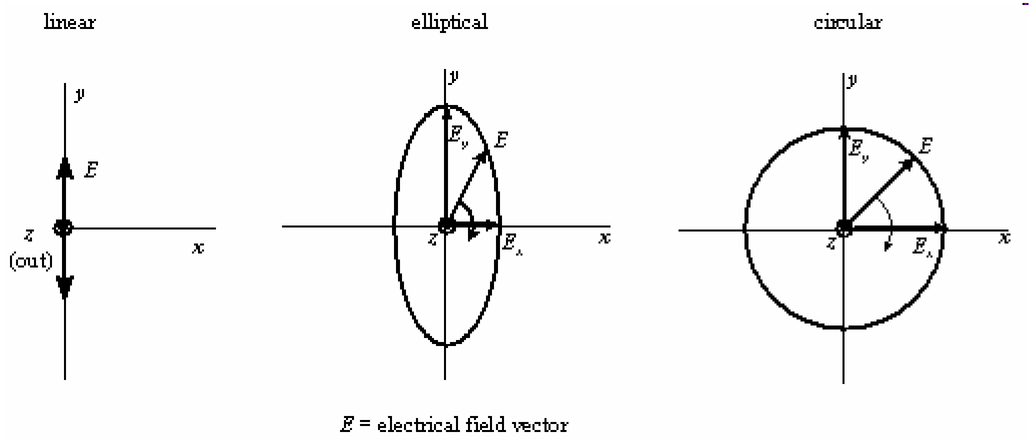
Onde piane: polarizzazione



$$\vec{E} = \vec{E}_o e^{i(\vec{k}\cdot\vec{r}-\omega t)} + c.c.$$

$$\vec{k} = k\hat{e}_z$$

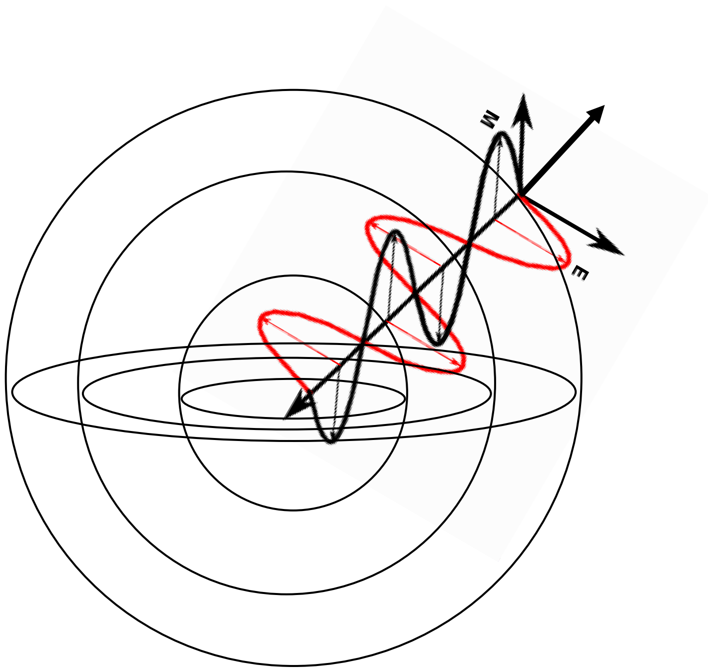
$$E_{o,x} = E_o \qquad E_{o,y} = E_o e^{i\varphi}$$

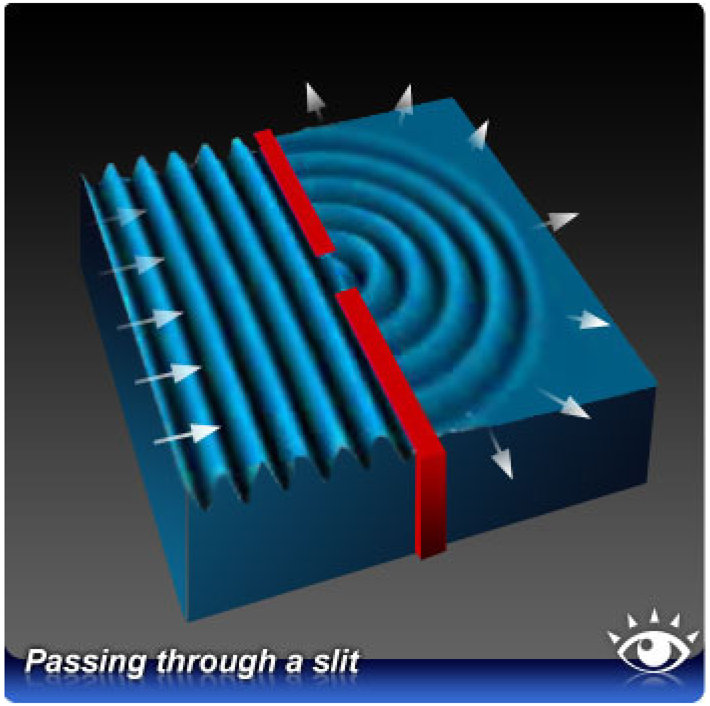


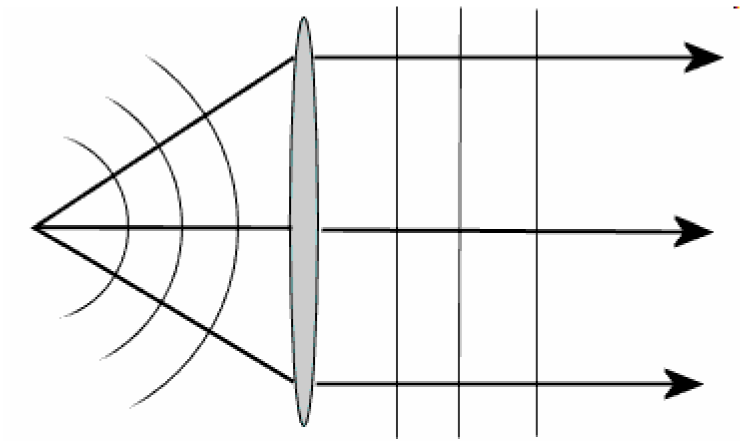
Onde sferiche

$$\vec{E} = \vec{E}_o \frac{e^{i(kr - \omega t)}}{kr}$$

$$\vec{k} \cdot \vec{E} = 0 \qquad \vec{k} \times \vec{B} = \omega \vec{E}$$




Passing through a slit



Equazioni Maxwel nella materia

$$\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\varepsilon_o} \qquad \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \qquad \vec{\nabla} \times \vec{B} = \mu_o \vec{J} + \mu_o \varepsilon_o \frac{\partial \vec{E}}{\partial t}$$

Equazioni Maxwell nella materia

$$\vec{D} = \varepsilon_o \vec{E} + \vec{P} \qquad \vec{H} = \frac{\vec{B}}{\mu_o} - \vec{M}$$

$$\vec{\nabla} \cdot \vec{D} = \rho \qquad \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \qquad \vec{\nabla} \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$$

Equazioni Maxwell semplificate nella materia

$$\vec{\nabla} \cdot \vec{D} = 0 \qquad \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

Non metalli

$$\vec{\nabla} \cdot \vec{B} = 0 \qquad \vec{\nabla} \times \vec{H} = \frac{\partial \vec{D}}{\partial t}$$

$$\vec{D} = \varepsilon_o \vec{E} + \vec{P} = \varepsilon \vec{E}$$

Mezzi lineari

$$\vec{H} = \frac{\vec{B}}{\mu_o} - \vec{M} = \frac{\vec{B}}{\mu}$$

Equazioni Maxwell risemplificate nella materia

$$\vec{D} = \varepsilon_o \vec{E} + \vec{P} = \varepsilon \vec{E}$$

$$\vec{H} = \frac{\vec{B}}{\mu_o} - \vec{M} = \frac{\vec{B}}{\mu}$$

Mezzi omogenei e isotropi

$$\vec{\nabla} \cdot \vec{E} = 0$$

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

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

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

Equazioni Maxwell risemplificate nella materia

$$\vec{\nabla} \cdot \vec{E} = 0 \qquad \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \qquad \vec{\nabla} \times \vec{B} = \mu\varepsilon \frac{\partial \vec{E}}{\partial t}$$

$$\nabla^2 \vec{E} = -\mu\varepsilon \frac{\partial^2 \vec{E}}{\partial t^2}$$

$$\nabla^2 \vec{B} = -\mu\varepsilon \frac{\partial^2 \vec{B}}{\partial t^2}$$

Equazione delle onde

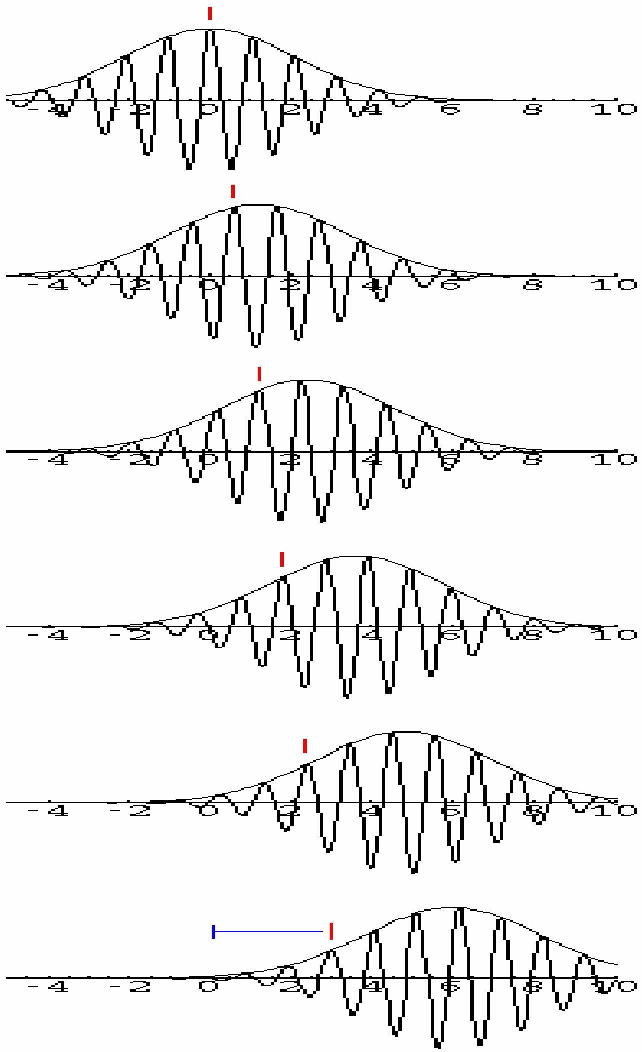
Equazioni di Helmholtz

$$\nabla^2 \vec{E} = \mu_o \varepsilon_o \frac{\partial^2 \vec{E}}{\partial t^2} = -k^2 \vec{E}$$

$$\nabla^2 \vec{B} = \mu \varepsilon \frac{\partial^2 \vec{B}}{\partial t^2} = -k^2 \vec{B}$$

$$k^2 = \frac{\omega^2 n^2}{c^2}$$ Relazione dispersione

Velocità di gruppo

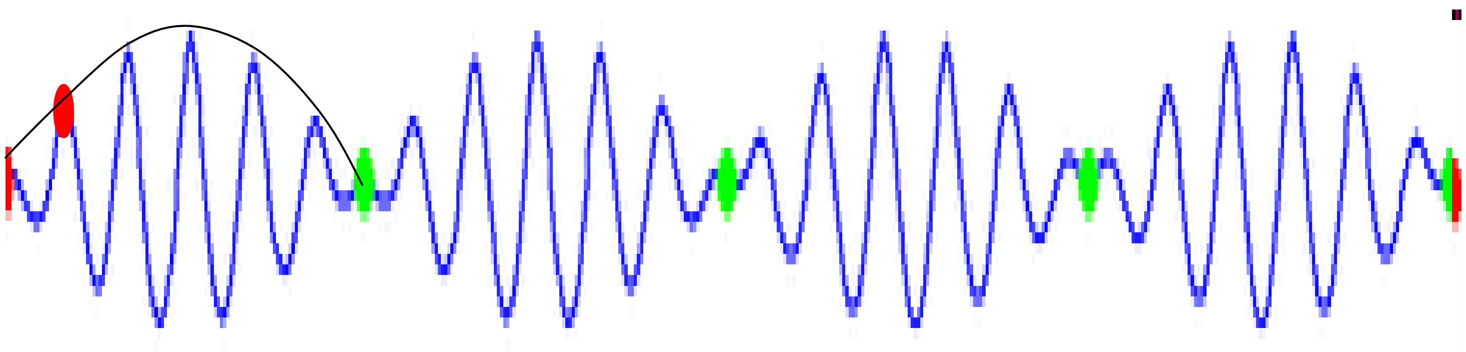


$$k = \frac{\omega n(\omega)}{c}$$

$$v_g = \frac{d\omega}{dk}$$

$$v_g = \frac{c}{n + \omega \dfrac{dn}{d\omega}}$$

Velocità di gruppo



Velocità di gruppo