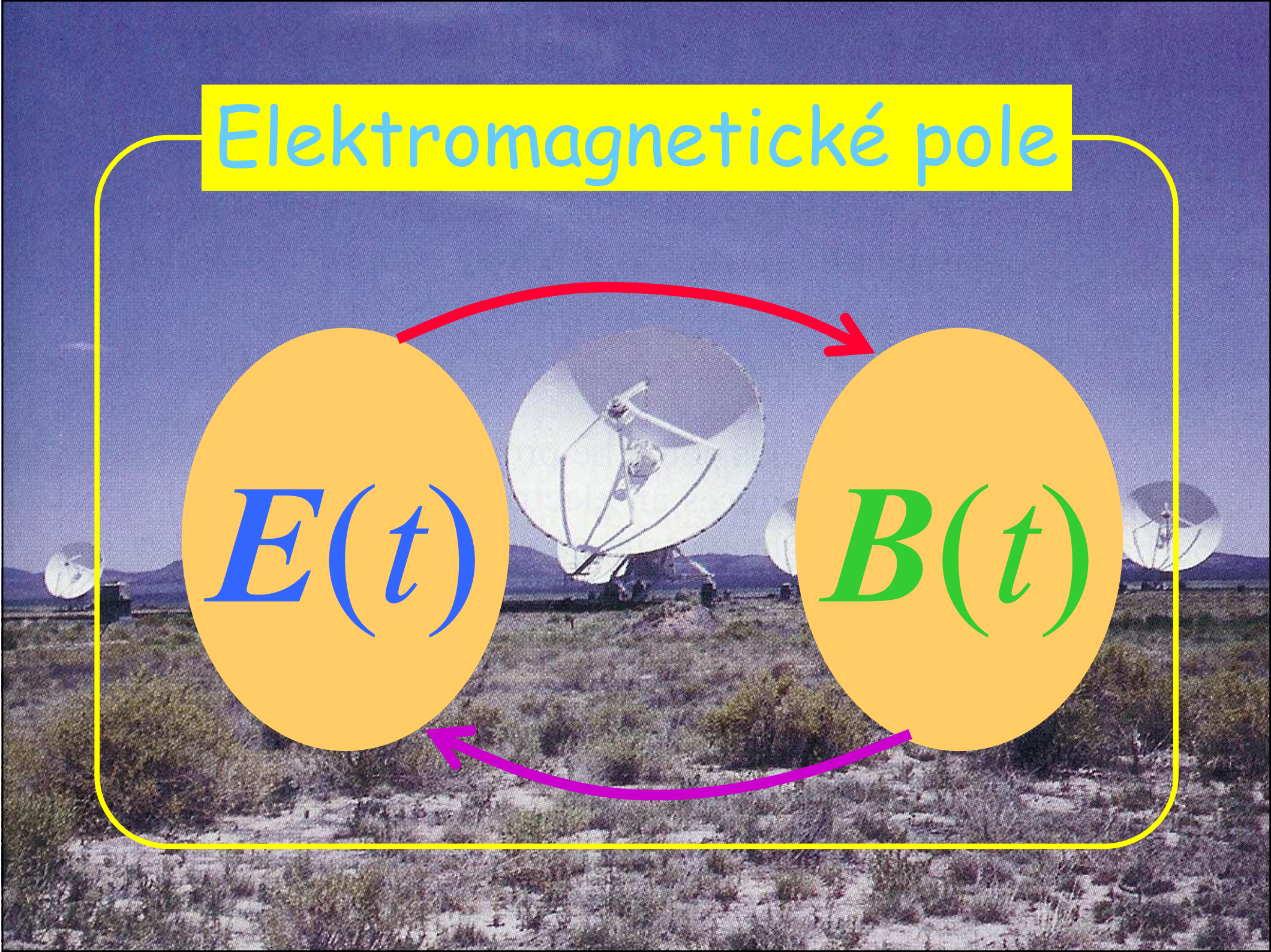
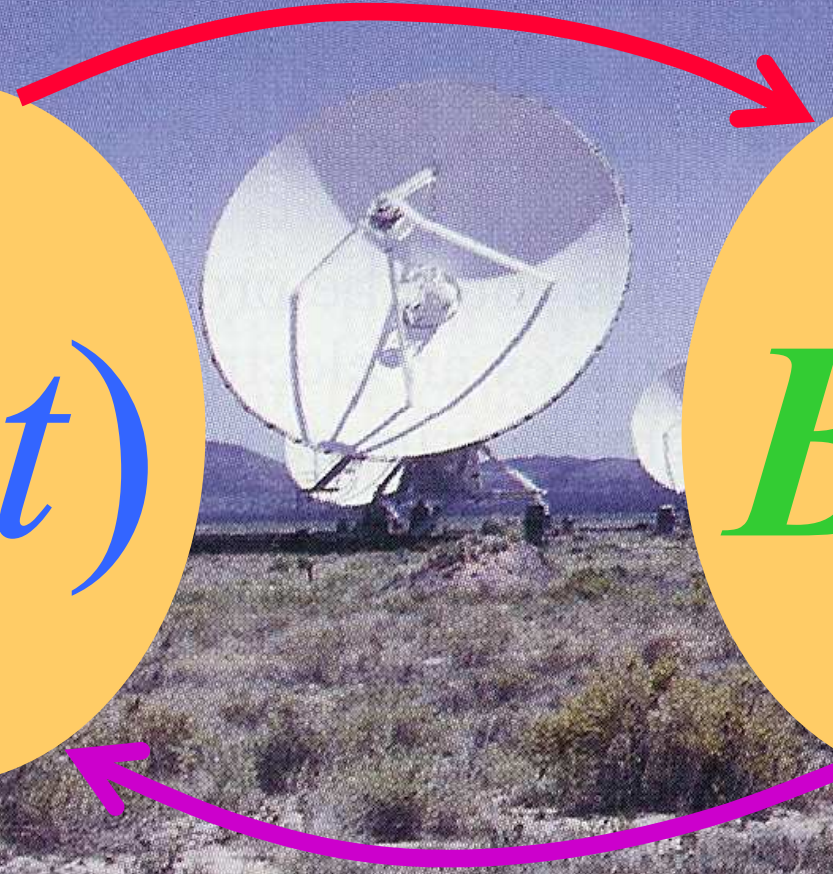
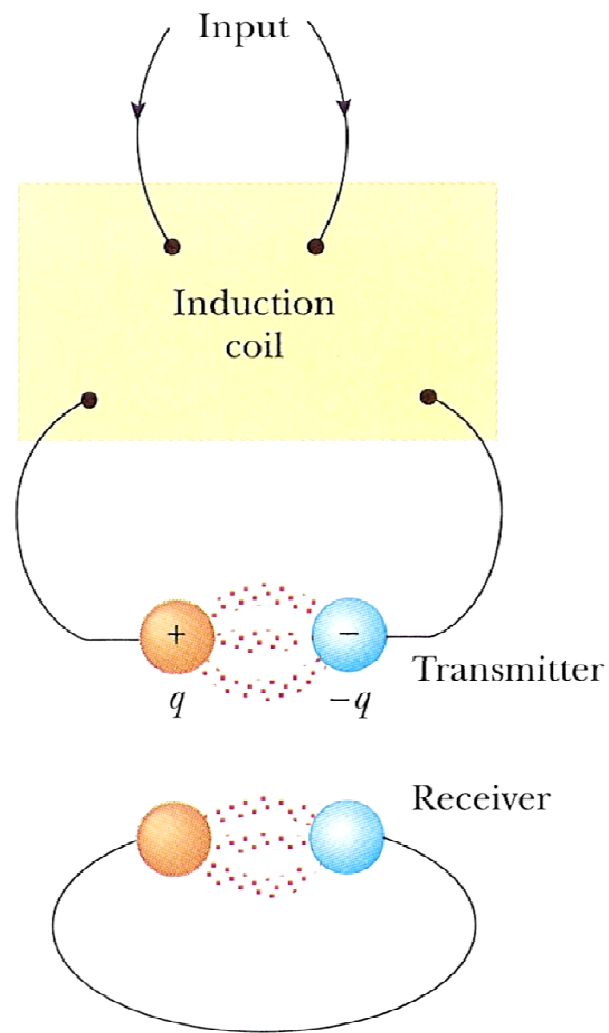


Elektromagnetické pole

$E(t)$

$B(t)$

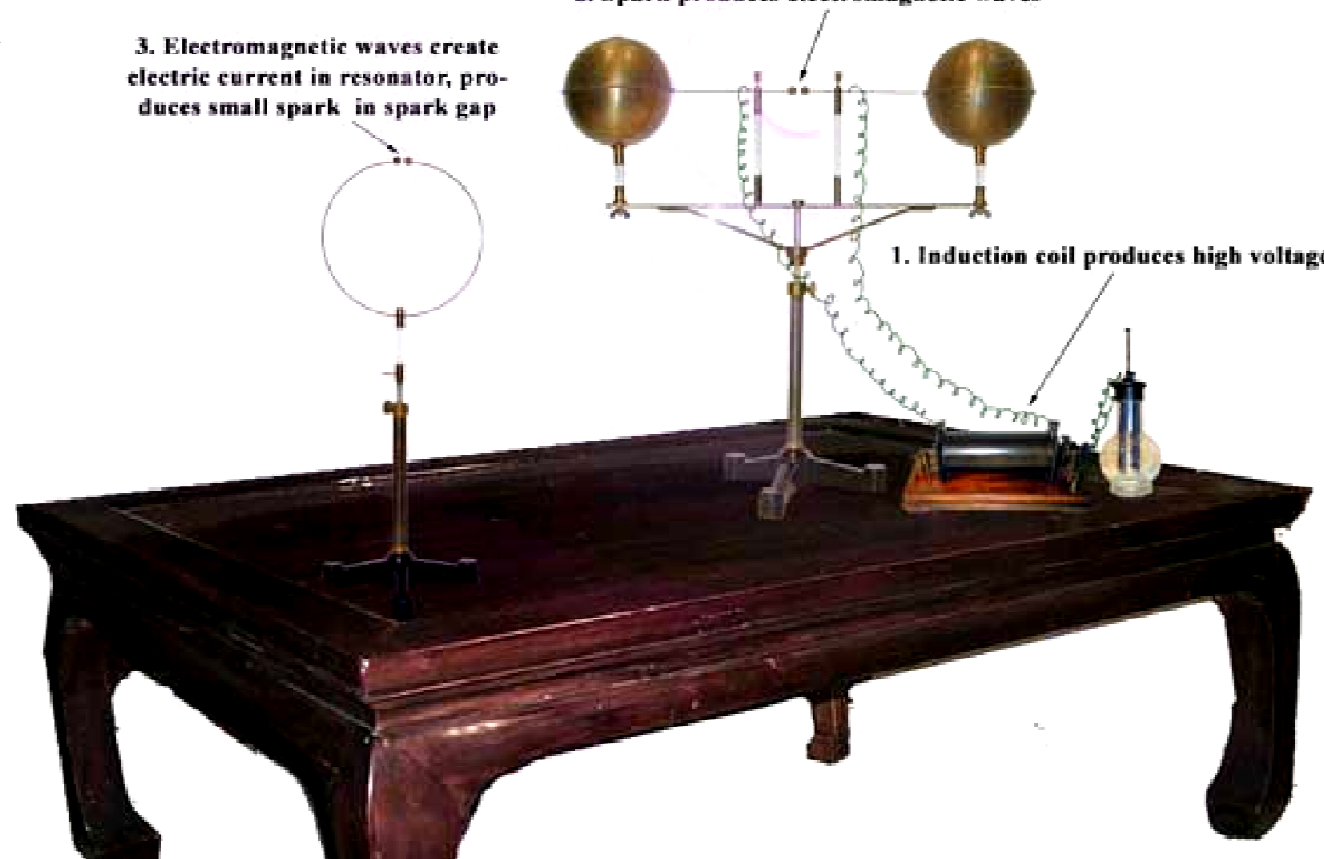




3. Electromagnetic waves create electric current in resonator, produces small spark in spark gap

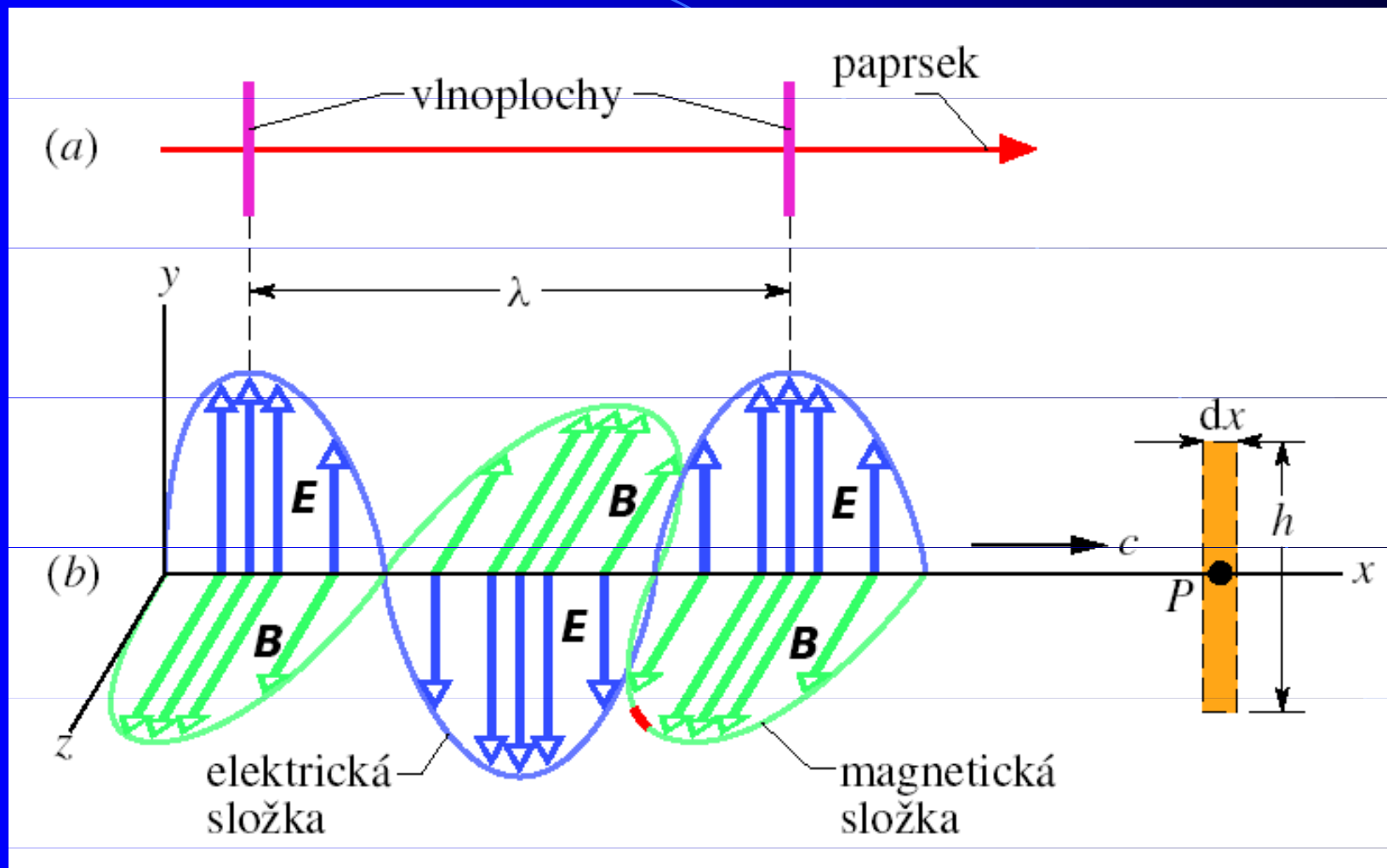
2. Spark produces electromagnetic waves

1. Induction coil produces high voltage



1888

Rovinná elektromagnetická vlna



$$E = E_m \sin(kx - \omega t)$$

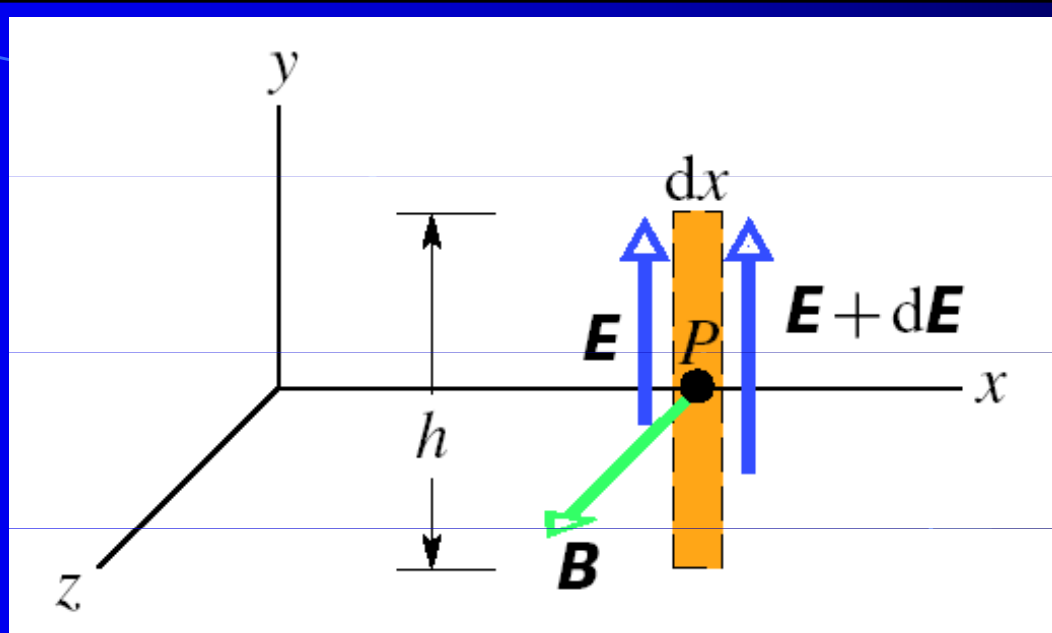
$$B = B_m \sin(kx - \omega t)$$

$$\oiint_S \vec{E} \cdot d\vec{S} = \frac{1}{\epsilon_0} \sum Q$$

$$\oint_C \vec{B} \cdot d\vec{s} = \mu_0 \sum I + \mu_0 \epsilon_0 \frac{d}{dt} \iint_{S(C)} \vec{E} \cdot d\vec{S}$$

$$\oiint_S \vec{B} \cdot d\vec{S} = 0$$

$$\oint_C \vec{E} \cdot d\vec{s} = - \frac{d}{dt} \iint_{S(C)} \vec{B} \cdot d\vec{S}$$

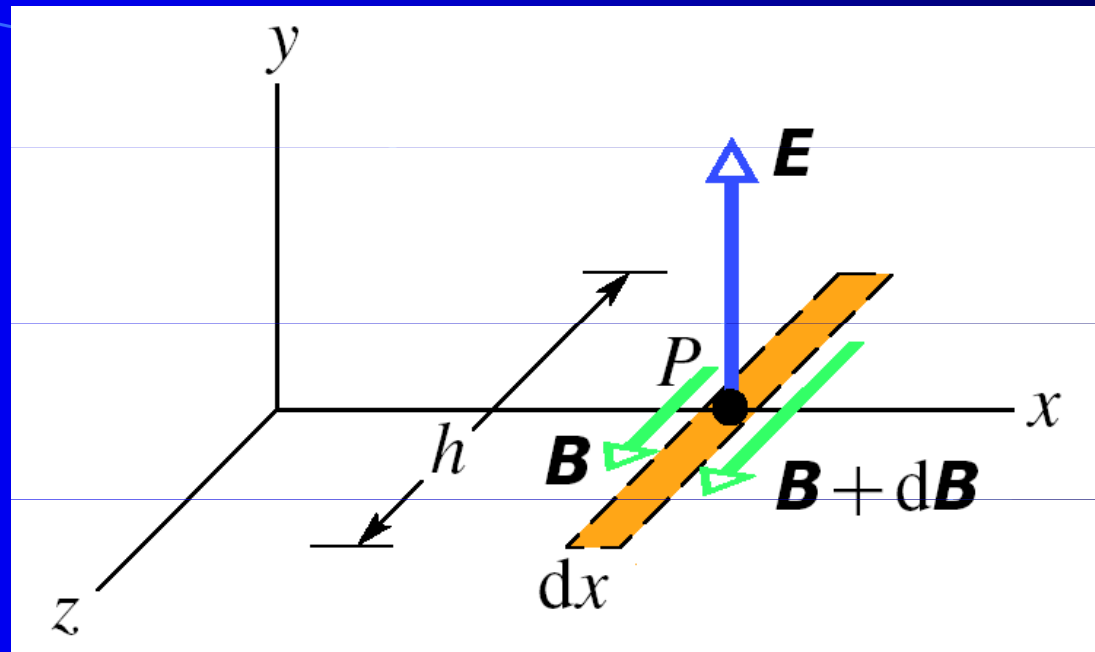


$$\oint \mathbf{E} \cdot d\mathbf{s} = (E + dE)h - Eh = h dE$$

$$\Phi_B = (B)(h dx) \cos 0$$

$$\oint \mathbf{E} \cdot d\mathbf{s} = -\frac{d\Phi_B}{dt}$$

$$\frac{\partial E}{\partial x} = -\frac{\partial B}{\partial t}$$



$$\oint \mathbf{B} \cdot d\mathbf{s} = -(B + dB)h + Bh = -h dB$$

$$\Phi_E = (E)(h dx) \cos 0$$

$$\oint \mathbf{B} \cdot d\mathbf{s} = \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$$

$$-\frac{\partial B}{\partial x} = \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$$

$$\frac{\partial E_y}{\partial x} = -\frac{\partial B_z}{\partial t}$$
$$-\frac{\partial B_z}{\partial x} = \mu_0 \epsilon_0 \frac{\partial E_y}{\partial t}$$

$$\frac{\partial^2 E_y}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 E_y}{\partial t^2}$$

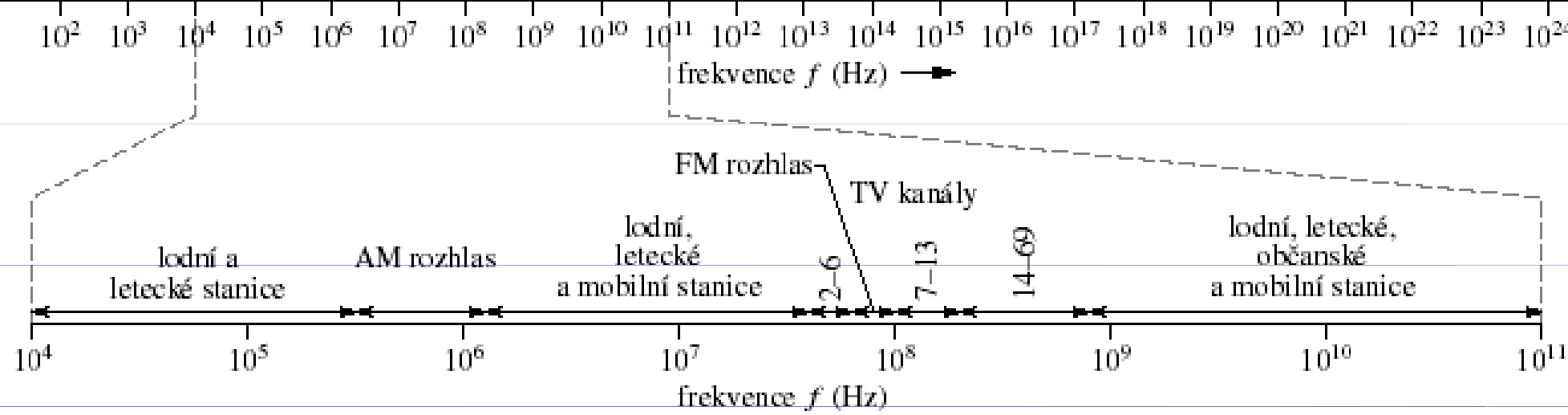
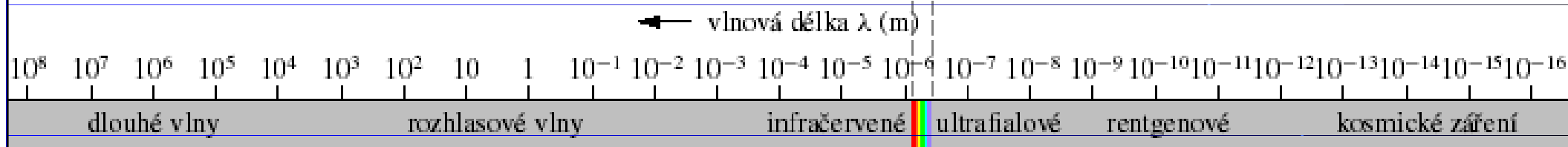
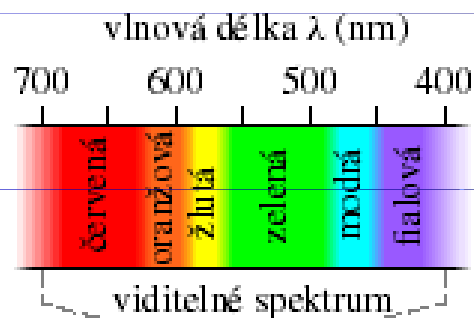
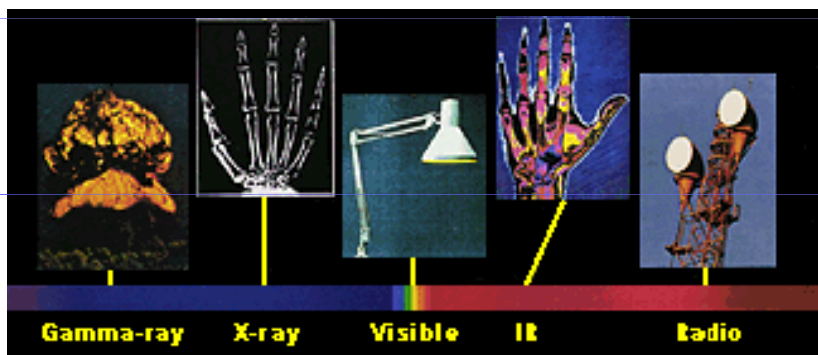
$$\frac{\partial^2 B_z}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 B_z}{\partial t^2}$$

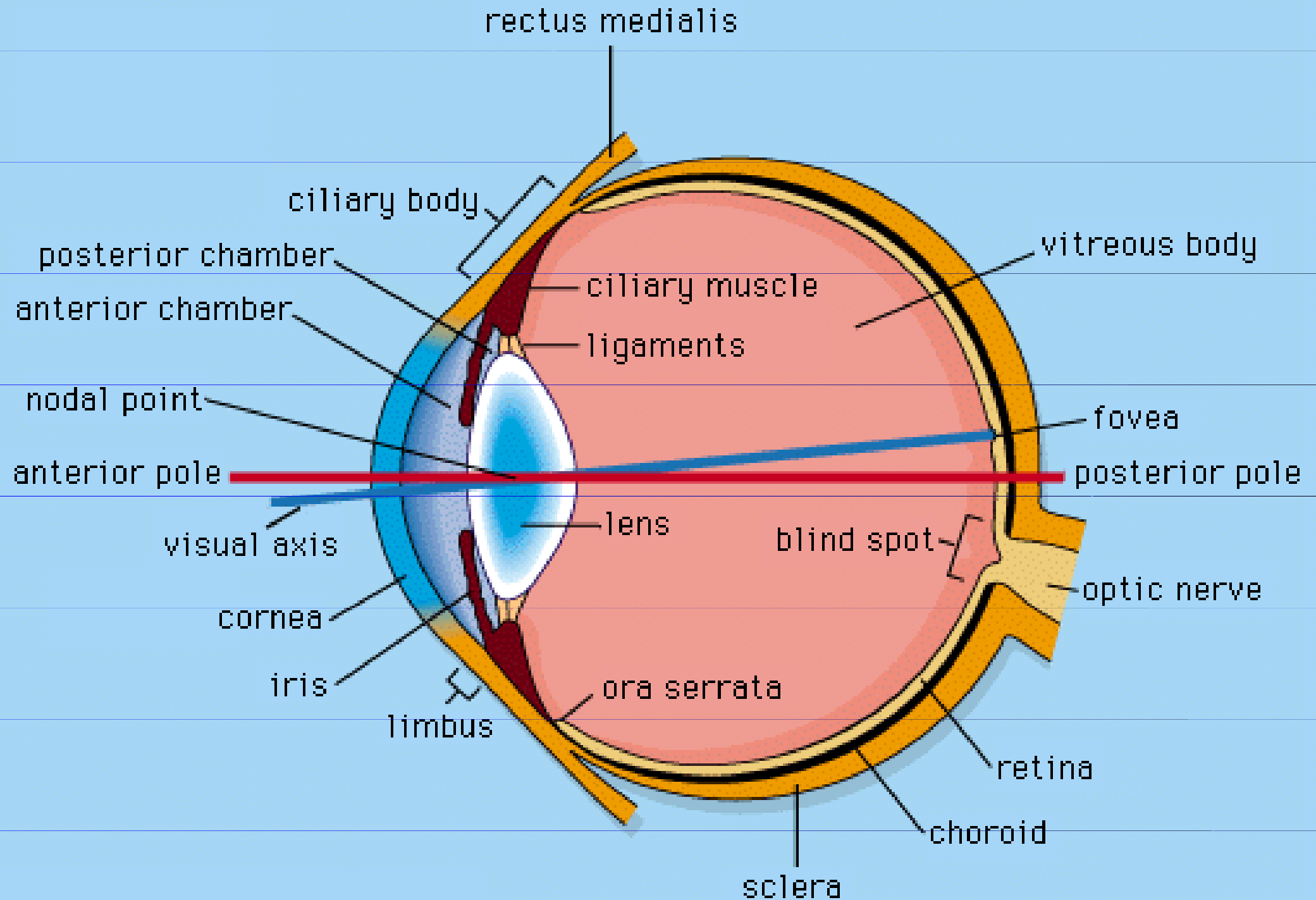
$$E_y = E_{my} \sin(kx - \omega t)$$

$$B_z = B_{mz} \sin(kx - \omega t)$$

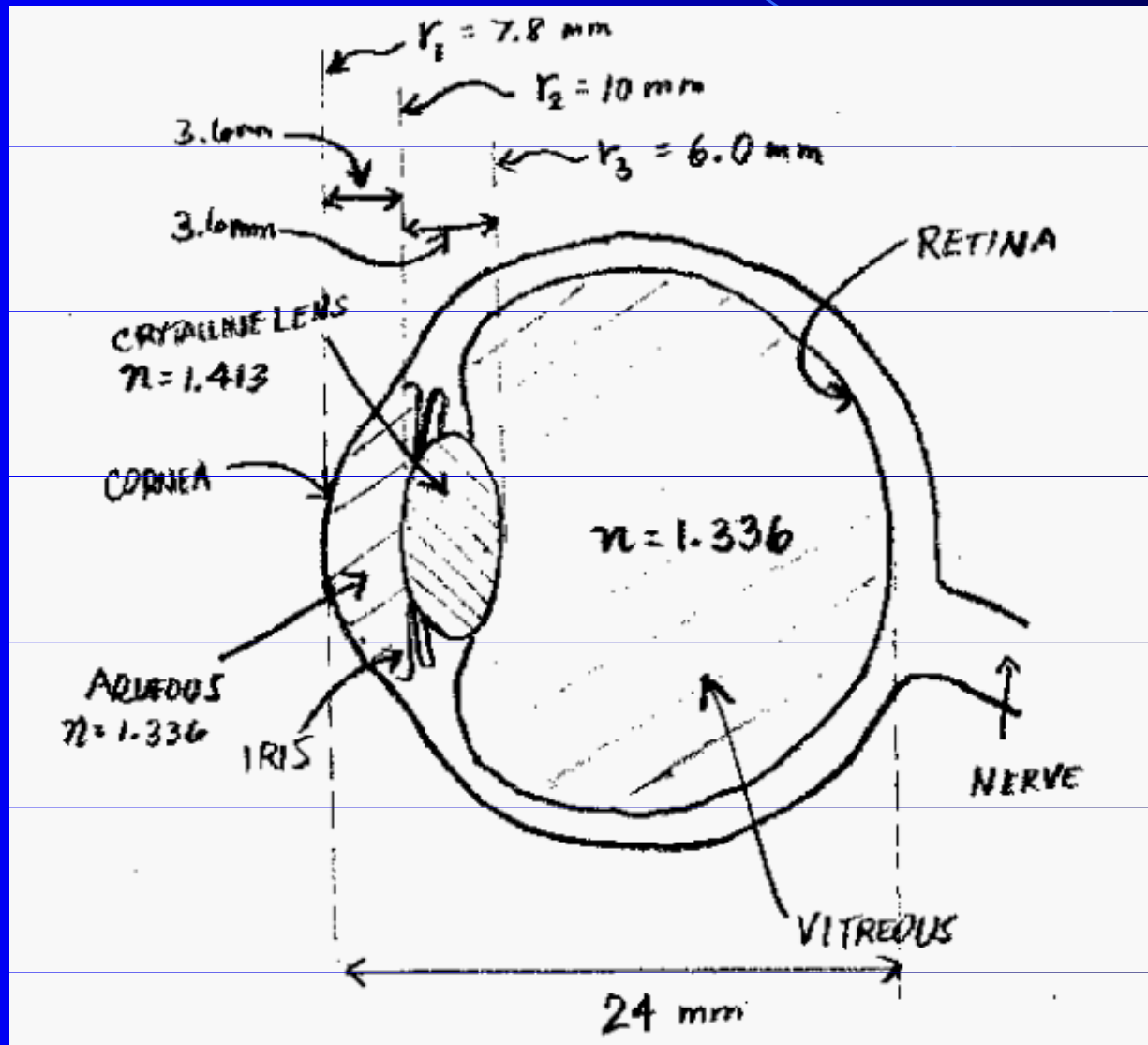
$$E_y / B_z = c$$
$$\omega / k = c$$

Maxwellova duha





Gullstrand's model eye



Approximate wavelength (in vacuum) and frequency ranges for the various colours

Colour	Wavelength (nm)	Frequency (THz) (10^{12} Hz)
Red	780 - 622	384 - 482
Orange	622 - 597	482 - 503
Yellow	597 - 577	503 - 520
Green	577 - 492	520 - 610
Blue	492 - 455	610 - 659
Violet	455 - 390	659 - 769

Přenos energie v elektromagnetickém poli

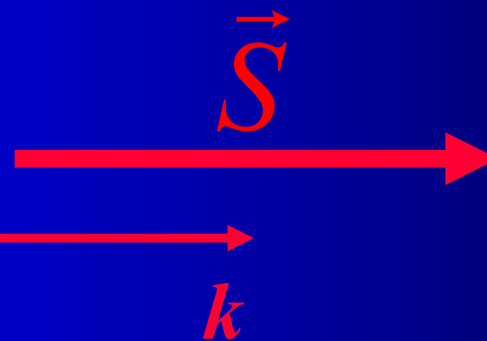
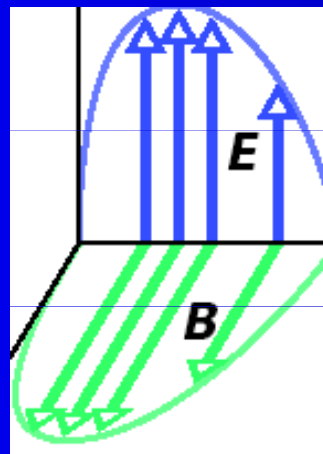
$\frac{1}{2} \epsilon_0 E^2$ (blue oval) and $\frac{B^2}{2\mu_0}$ (yellow oval) are shown. A blue arrow points from the first term and a yellow arrow from the second to a box containing:

$$w = w_{el} + w_{mg}$$

$$= \frac{1}{2} \epsilon_0 E^2 + \frac{1}{2} \epsilon_0 E^2$$

$$= \frac{1}{c\mu_0} EB$$

$$J \cdot m^{-3}$$

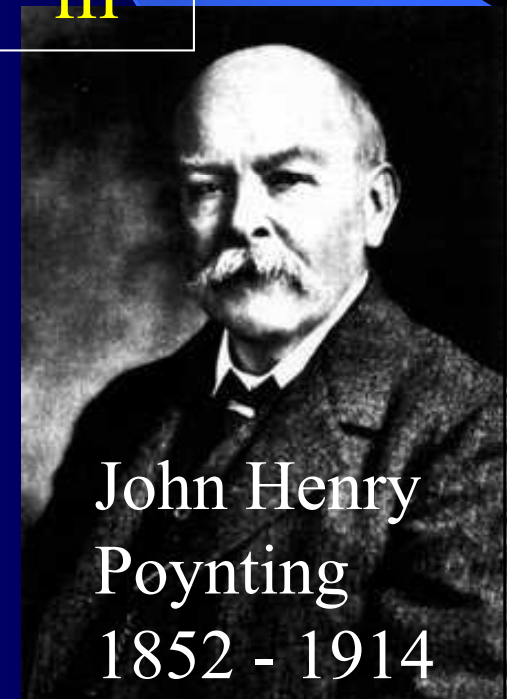


Poyntingův vektor

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

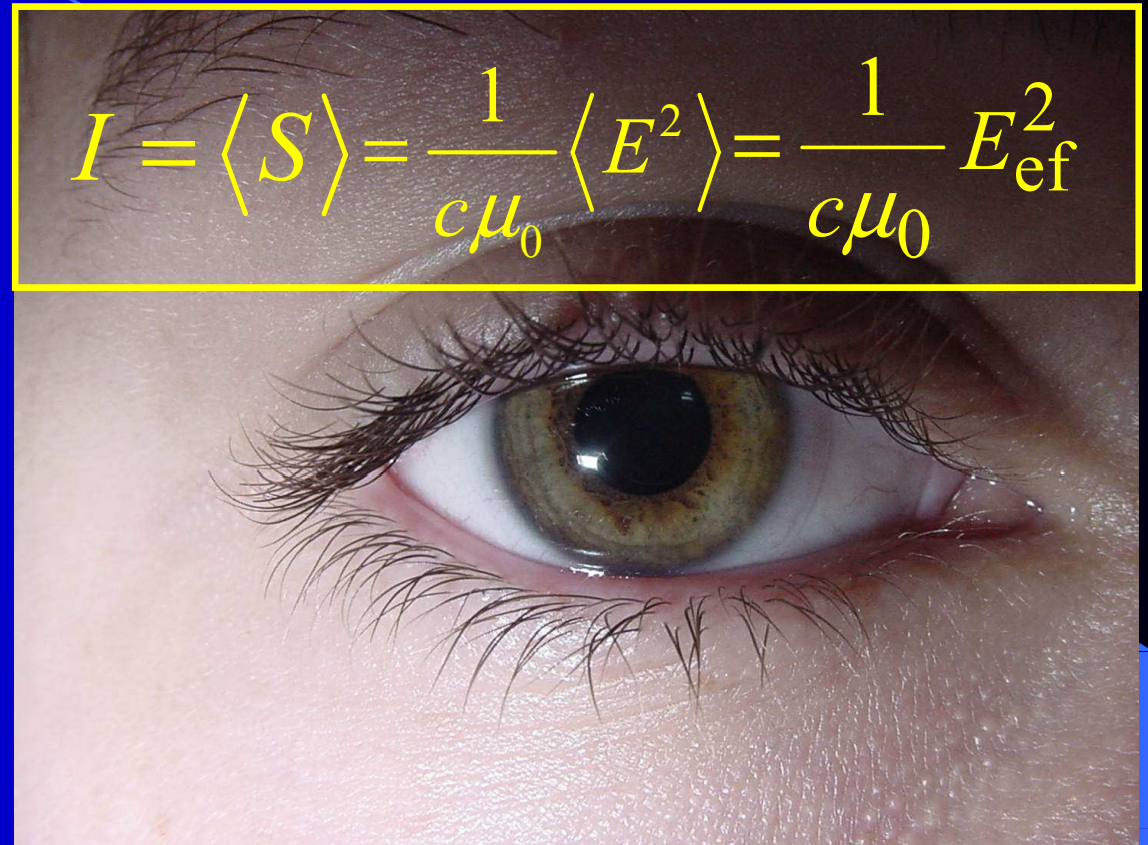
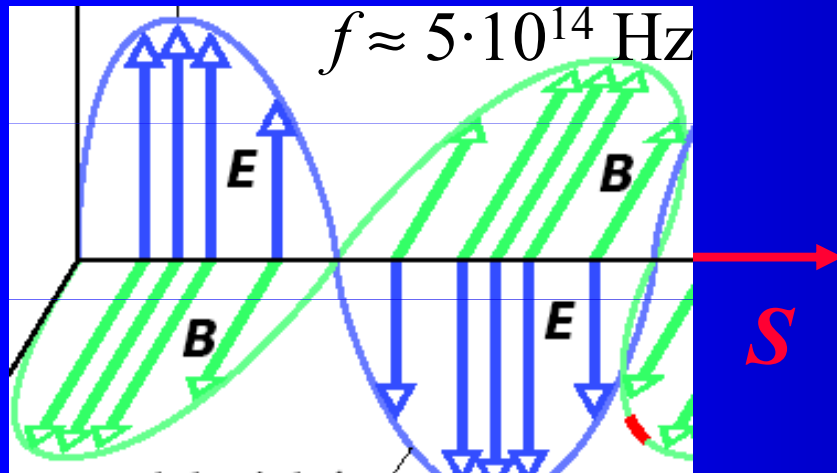
$$S = \frac{1}{\mu_0} EB = cW$$

$$J \cdot m^{-2} \cdot s^{-1} = W \cdot m^{-2}$$



John Henry Poynting
1852 - 1914

Intenzita záření, intenzita světla



$$I = \langle S \rangle = \frac{1}{c\mu_0} \langle E^2 \rangle = \frac{1}{c\mu_0} E_{\text{ef}}^2$$

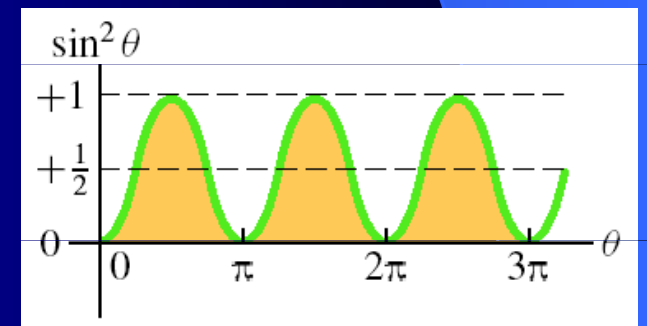
$$\vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B}$$

$$E/c$$

$$\langle S \rangle = \frac{1}{\mu_0} \langle EB \rangle = \frac{1}{c\mu_0} \langle E^2 \rangle$$

$$E = E_m \sin(kx - \omega t)$$

$$\langle E^2 \rangle = \frac{1}{T} \int_0^T E_m^2 \sin^2(kx - \omega t) dt = \frac{E_m^2}{2} = E_{\text{ef}}^2$$



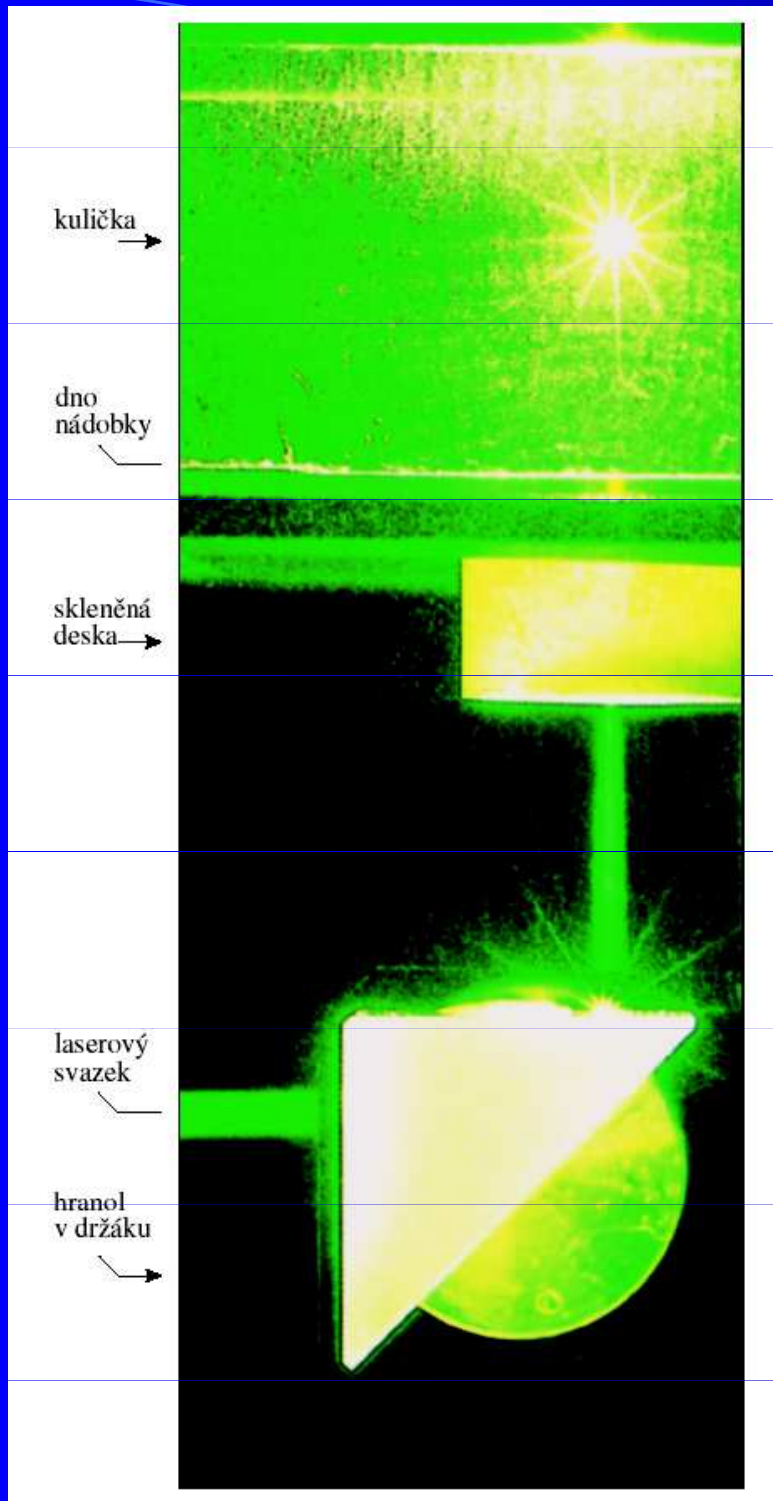
Hybnost elektromagnetického pole a tlak záření

hustota hybnosti $\pi = \rho c = w/c$

w/c^2

tlak záření při absorpci
odrazu $= \frac{2\pi(S c \Delta t)}{S \Delta t} = 2w$

$= 2I/c$

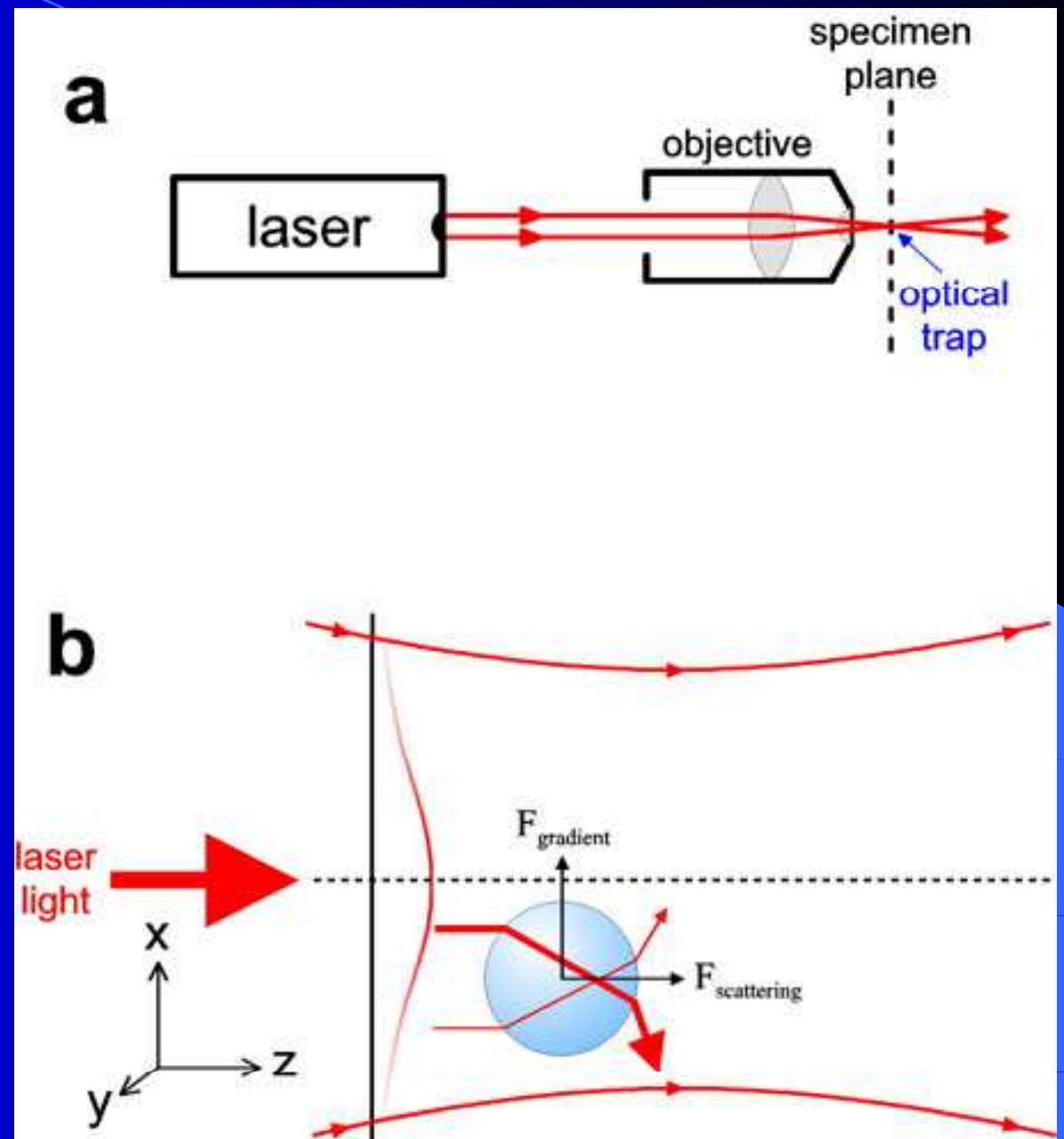
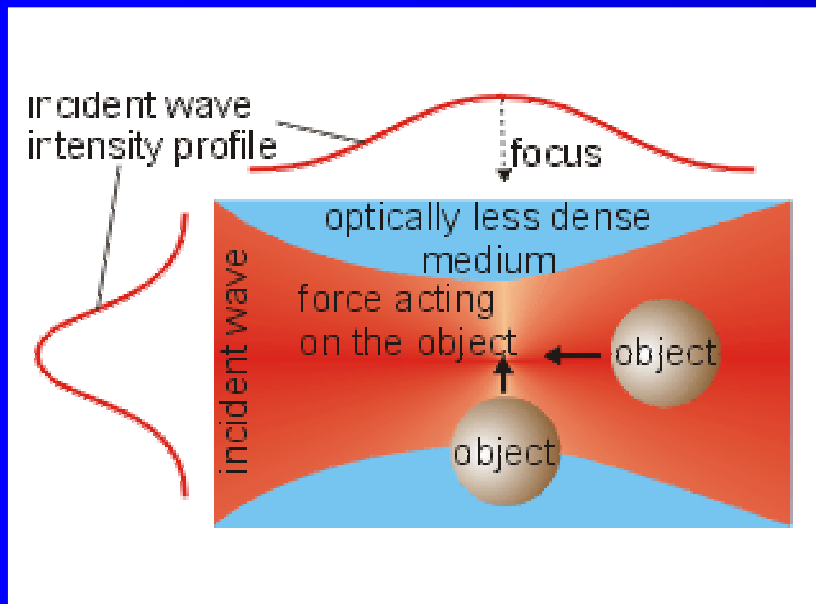


The radiation of the Sun at the Earth has an energy flux density of 1370 W/m^2 , so the radiation pressure is

$$1370 / 299792458 \text{ Pa} = 4.6 \text{ } \mu\text{Pa}$$

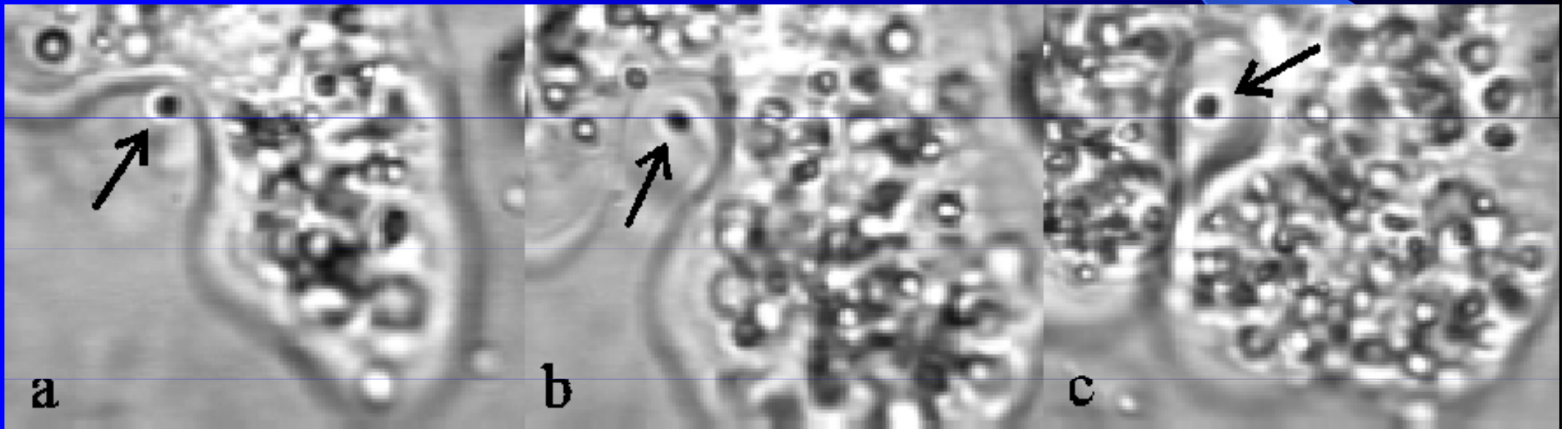
(absorbed)

Laserová (optická) pinzeta



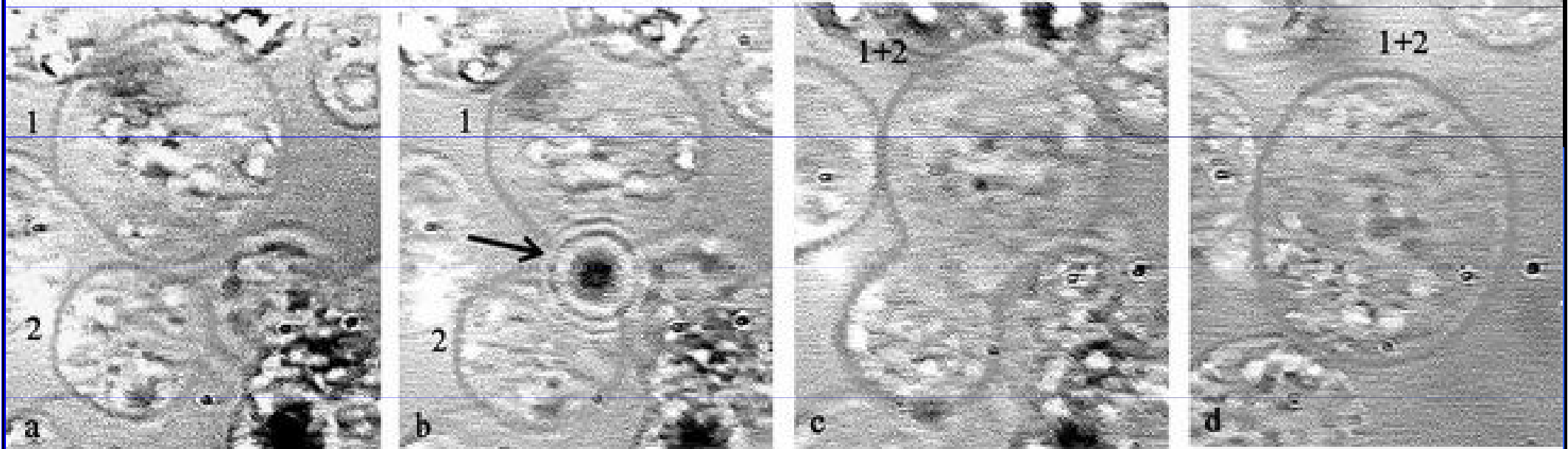
Optická (laserová) pinzeta je zařízení, které využívá mechanického účinku fokusovaného laserového svazku k prostorovému zachycení a přemístování mikroobjektů a nanoobjektů.

„krmení“ améby bakteriální buňkou



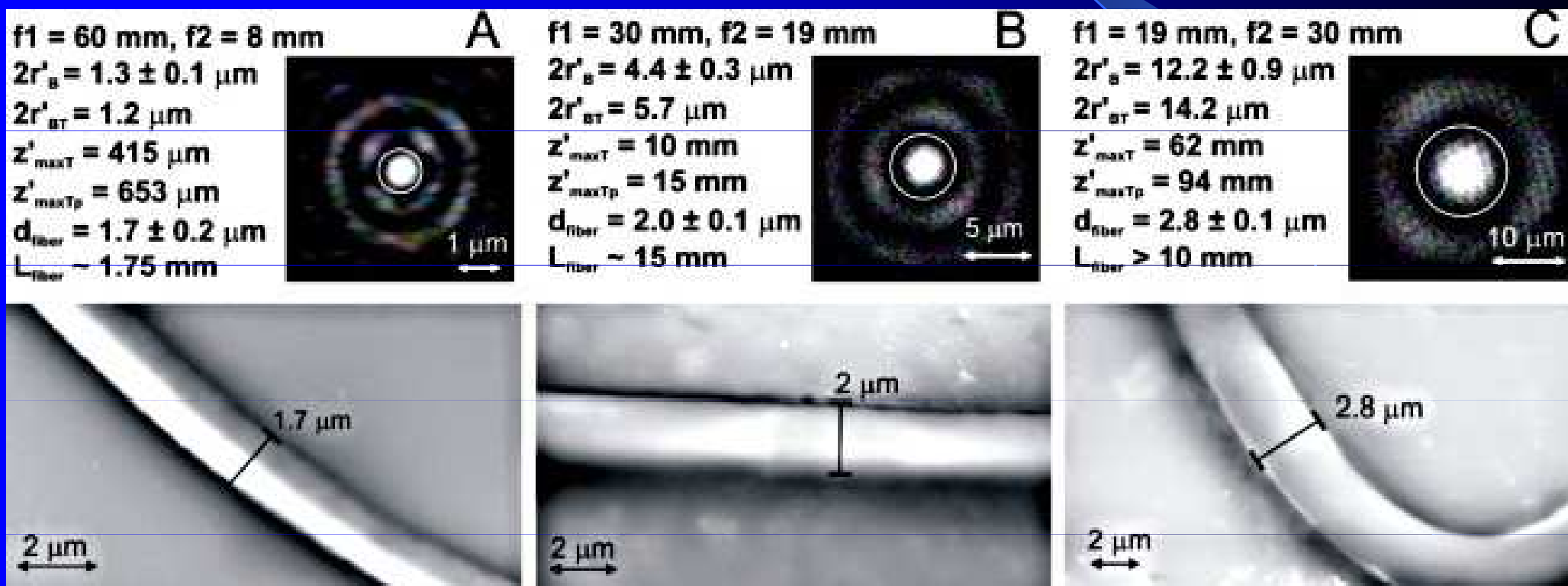
(Tým optických mikromanipulačních technik ÚPT AVČR)

Optický (laserový) skalpel je zařízení, které využívá absorpce fokuzovaného laserového svazku k odpaření velmi malého objemu (cca 1 mikrometr x 1 mikrometr x 1 mikrometr) materiálu na povrchu objektu či uvnitř.



(Tým optických mikromanipulačních technik ÚPT AVČR)

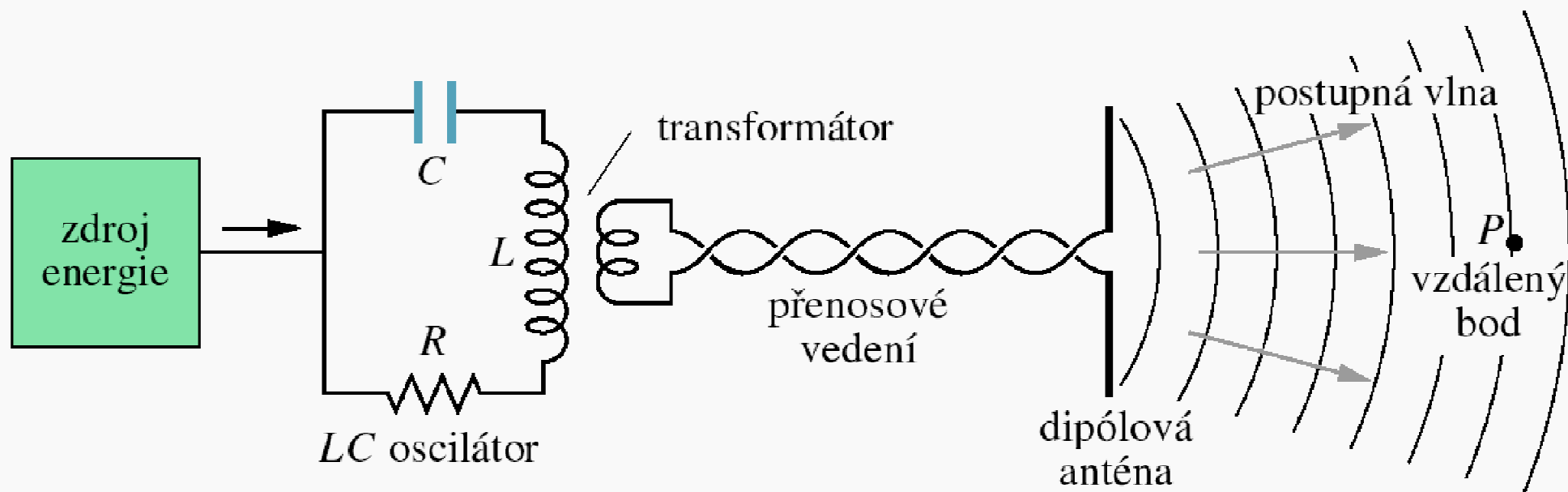
Fotopolymerace se využívá k vytváření mikrostruktur fokusovaným laserovým svazkem. Osvícená oblast ztuhne a stává se součástí vytvářené mikrostruktury.



(Tým optických mikromanipulačních technik ÚPT AVČR)



Generace elektromagnetických vln



Rozhlas a televize

