物質機能科学IIb

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知覚情報科学

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(10)

後期２００９年

THE VISION, What is light ?

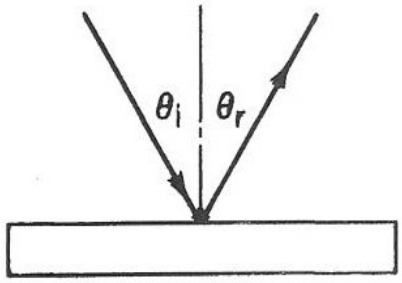


Fig. 26–1. The angle of incidence is equal to the angle of reflection.

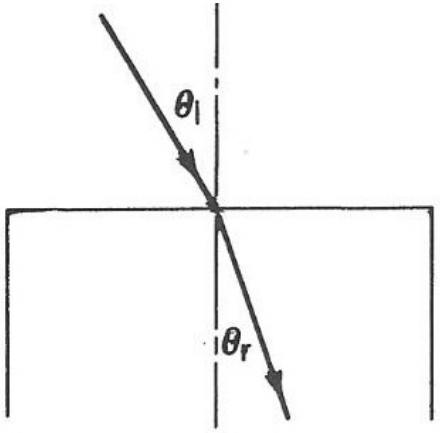


Fig. 26–2. A light ray is refracted when it passes from one medium into another.

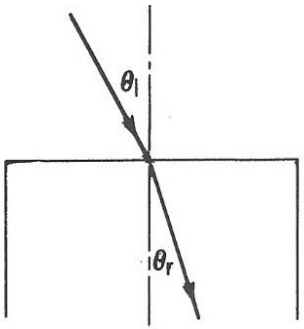


Table 26–1

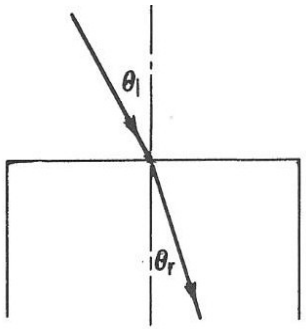
Angle in air	Angle in water
10°	8°
20°	15-1/2°
30°	22-1/2°
40°	29°
50°	35°
60°	40-1/2°
70°	45-1/2°
80°	50°

140 A.D., Claudius Ptolemy

Table 26–2

Angle in air	Angle in water
10°	7-1/2°
20°	15°
30°	22°
40°	29°
50°	35°
60°	40-1/2°
70°	45°
80°	48°

$$\sin \theta_i = n \sin \theta_r.$$



Snell law (1621)

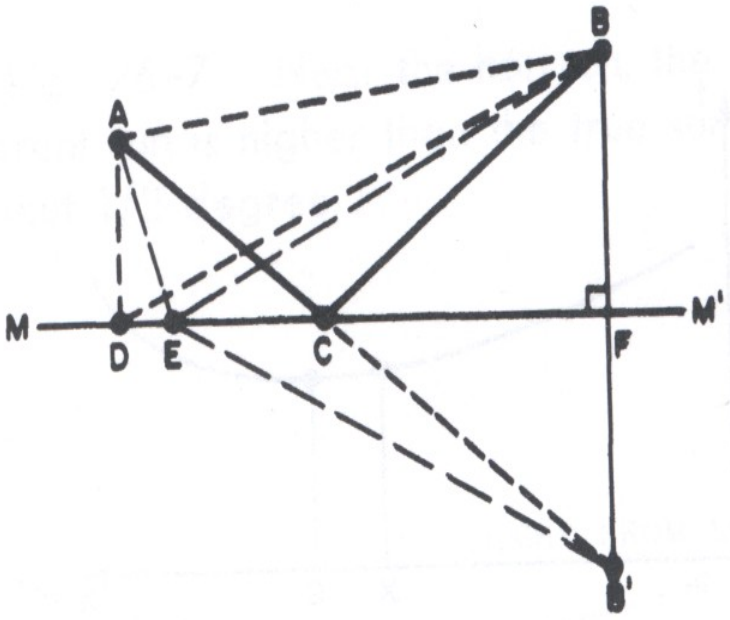
Principle of Fermat (1650, Snell+29 years!)

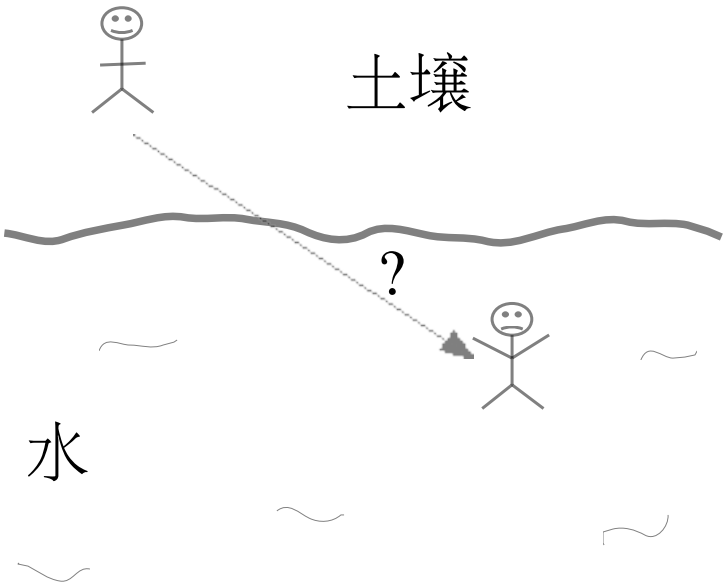
フェルマット原則

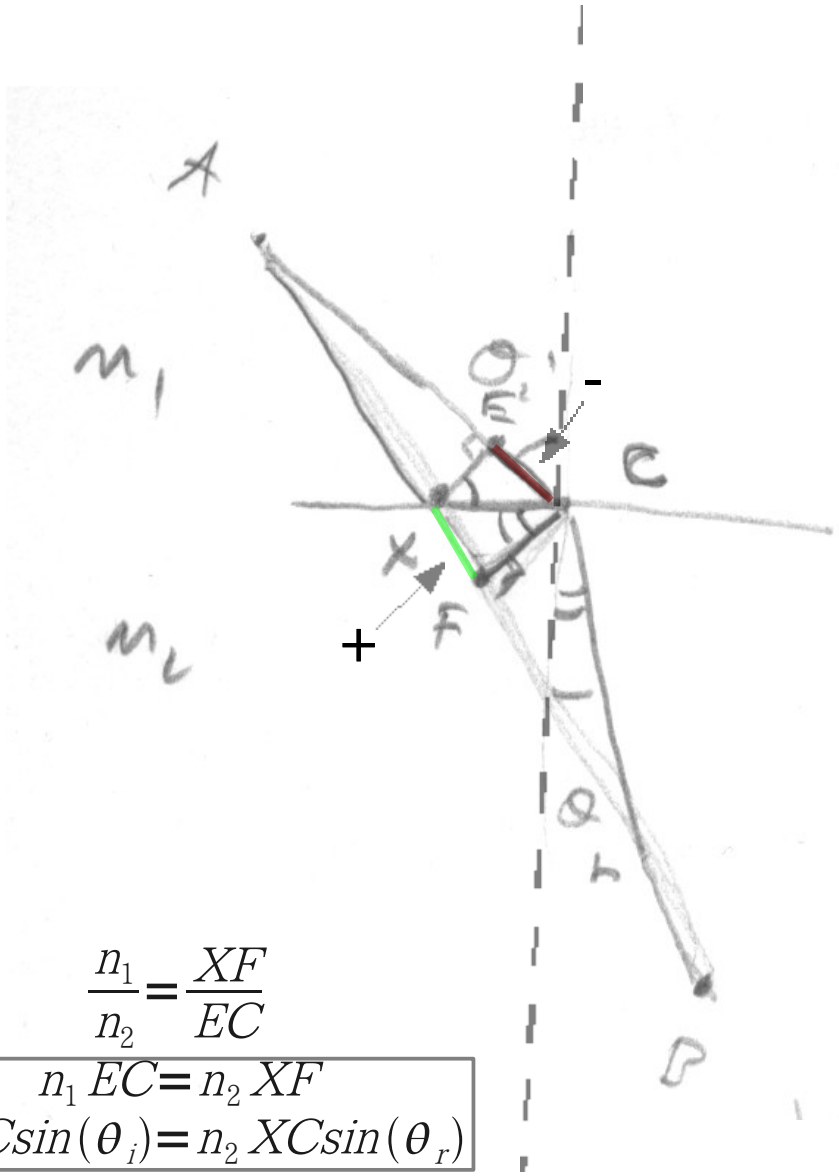
Out of all possible paths, light takes the path which requires the *less time*

$$n = \frac{c}{V_{\text{光のスピード}}}$$

$$c = 300.000\text{Km}/sec$$







$$\frac{n_1}{n_2} = \frac{XF}{EC}$$

Snell Law (1650) →

$$n_1 EC = n_2 XF$$
$$n_1 XC\sin(\theta_i) = n_2 XC\sin(\theta_r)$$

$$n_1 \sin(\theta_i) = n_2 \sin(\theta_r)$$

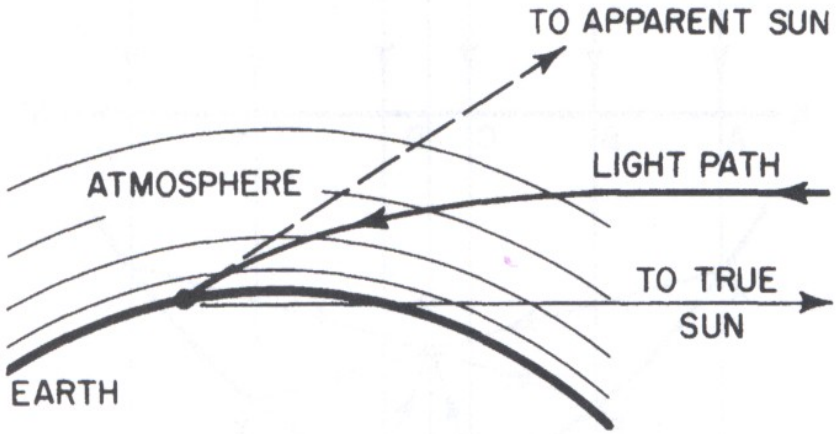


Fig. 26–7. Near the horizon, the apparent sun is higher than the true sun by about 1/2 degree.

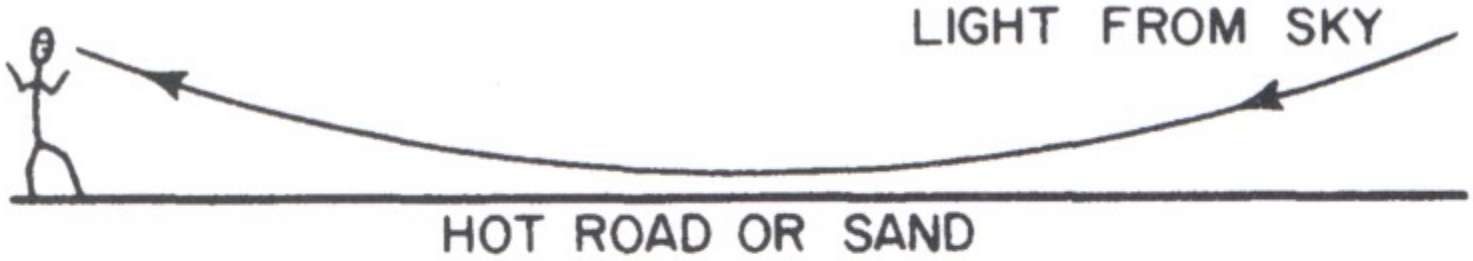
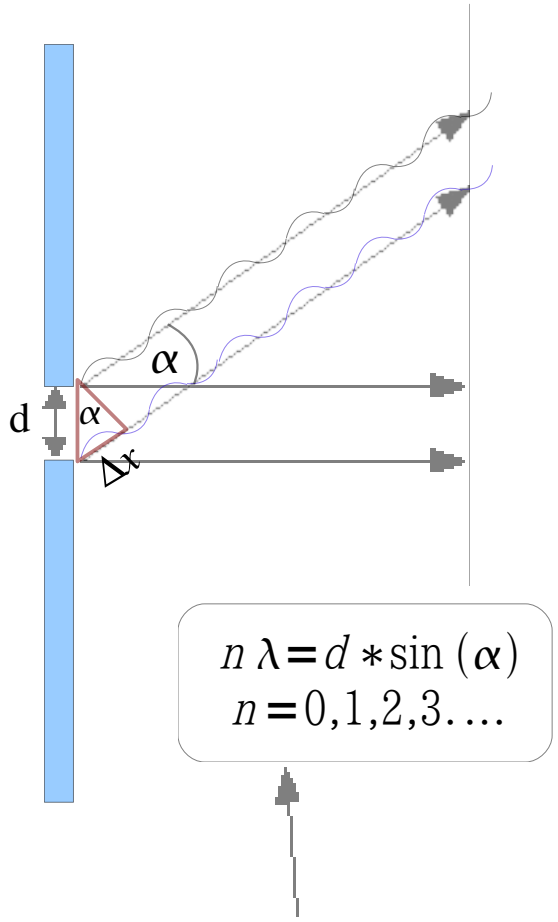


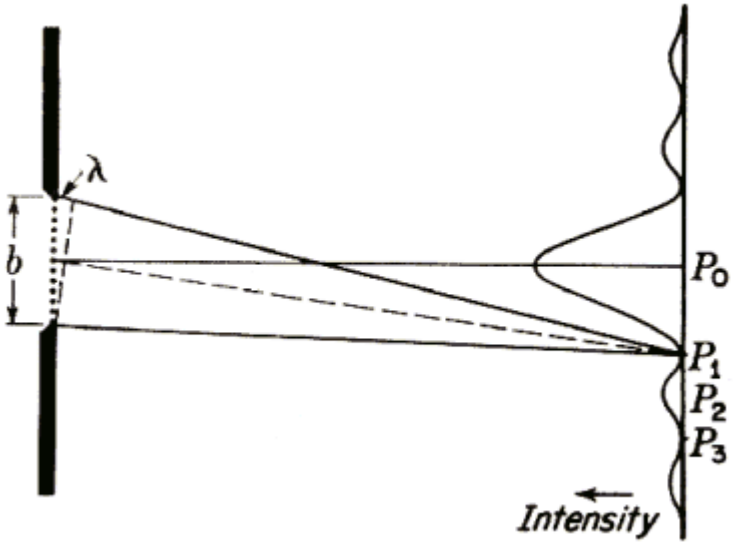
Fig. 26–8. A mirage.

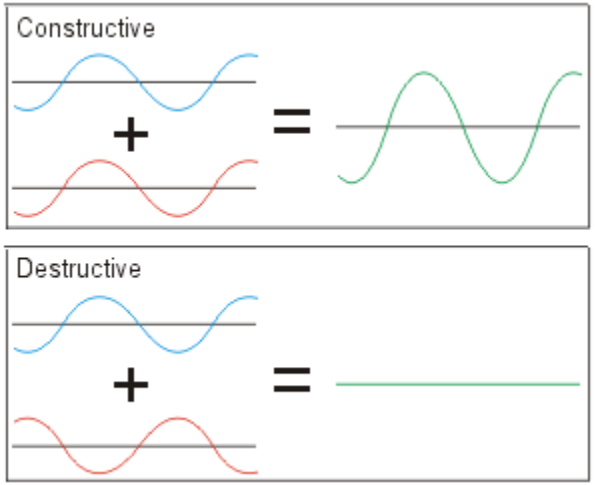
干涉

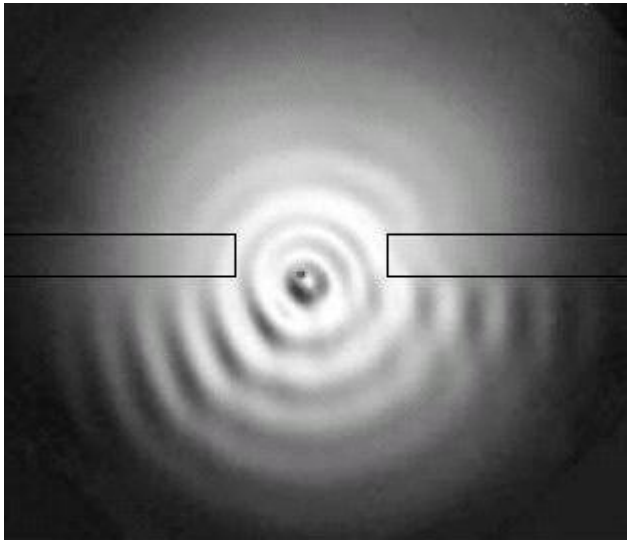


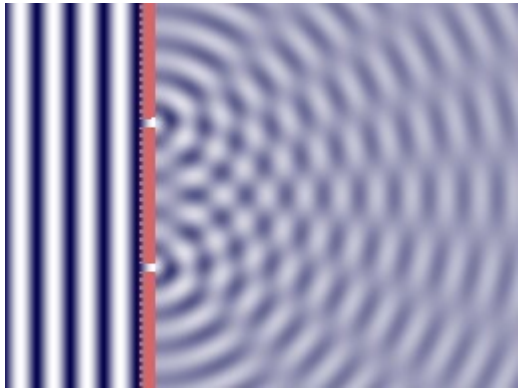
$$n\lambda = d * \sin(\alpha)$$
$$n = 0,1,2,3\ldots.$$

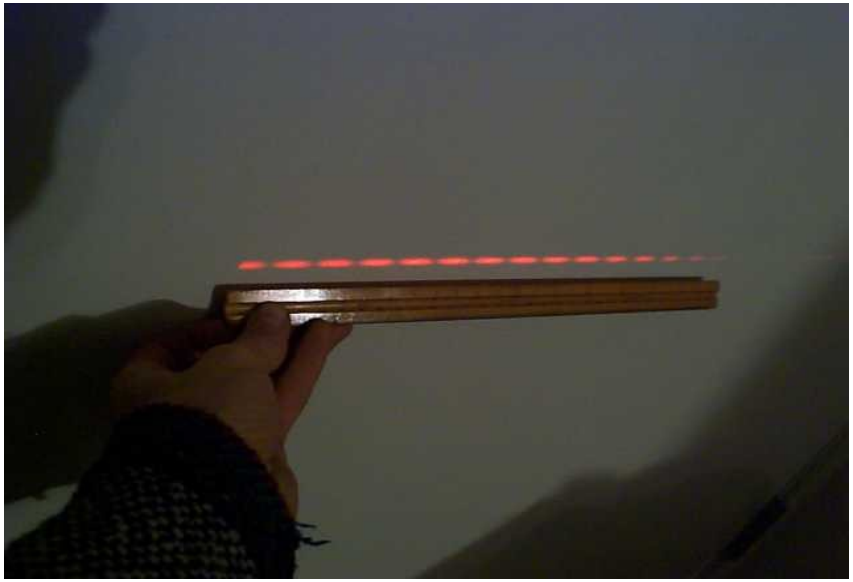
Interference: **Max** condition



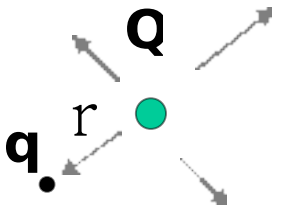








チャージを存在



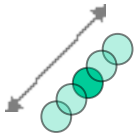
静電場

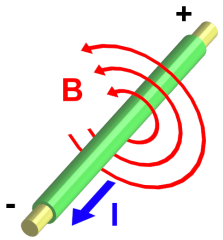
Coulomb法:

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{\mathbf{r}}$$

$$\mathbf{F} = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}\hat{\mathbf{r}} = q\mathbf{E}$$

チャージを動くと



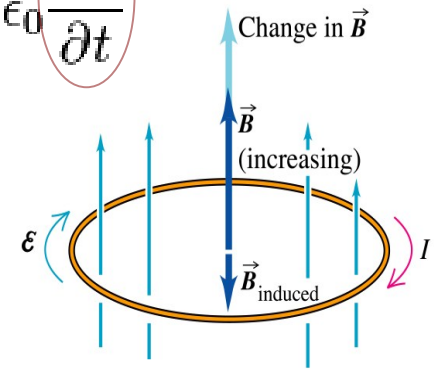


Ampere法

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

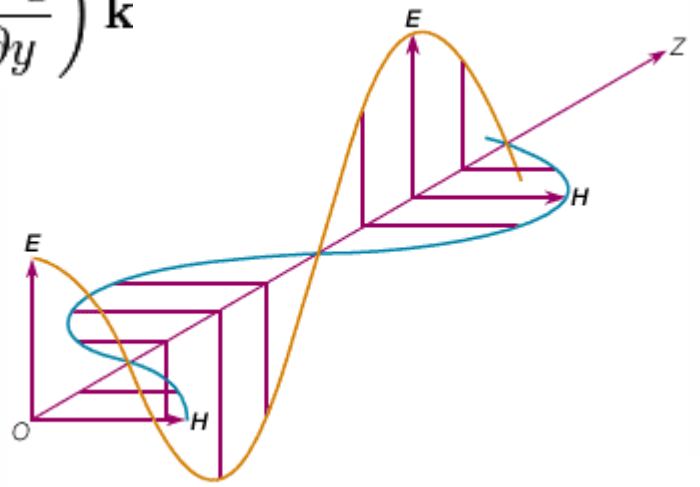
$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

Faraday法



$$\nabla \times \mathbf{F}$$

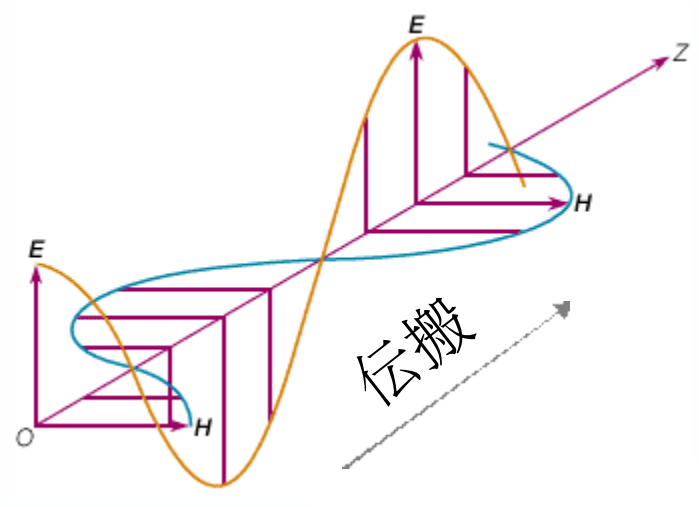
$$\left(\frac{\partial F_z}{\partial y} - \frac{\partial F_y}{\partial z}\right)\mathbf{i} + \left(\frac{\partial F_x}{\partial z} - \frac{\partial F_z}{\partial x}\right)\mathbf{j} + \left(\frac{\partial F_y}{\partial x} - \frac{\partial F_x}{\partial y}\right)\mathbf{k}$$

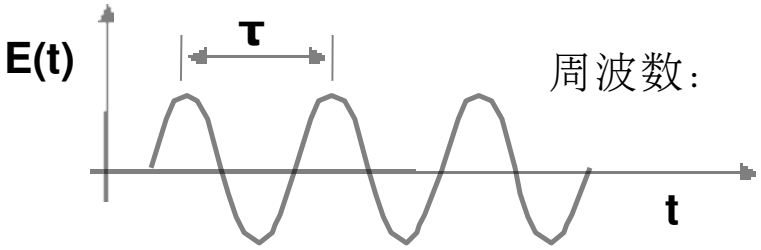


チャージを存在 → 静電場
（Coulomb法）

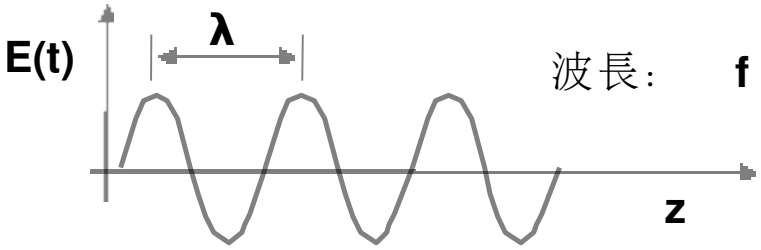
チャージを動く → 動磁場 → 変動電場
(Ampere法)　(Faraday法)

$$\begin{cases} \mathbf{E}(\mathbf{r},t) = \mathbf{E}_0 \cos(\omega t - \mathbf{k}\cdot\mathbf{r} + \phi_0) \\ \mathbf{B}(\mathbf{r},t) = \mathbf{B}_0 \cos(\omega t - \mathbf{k}\cdot\mathbf{r} + \phi_0) \end{cases}$$

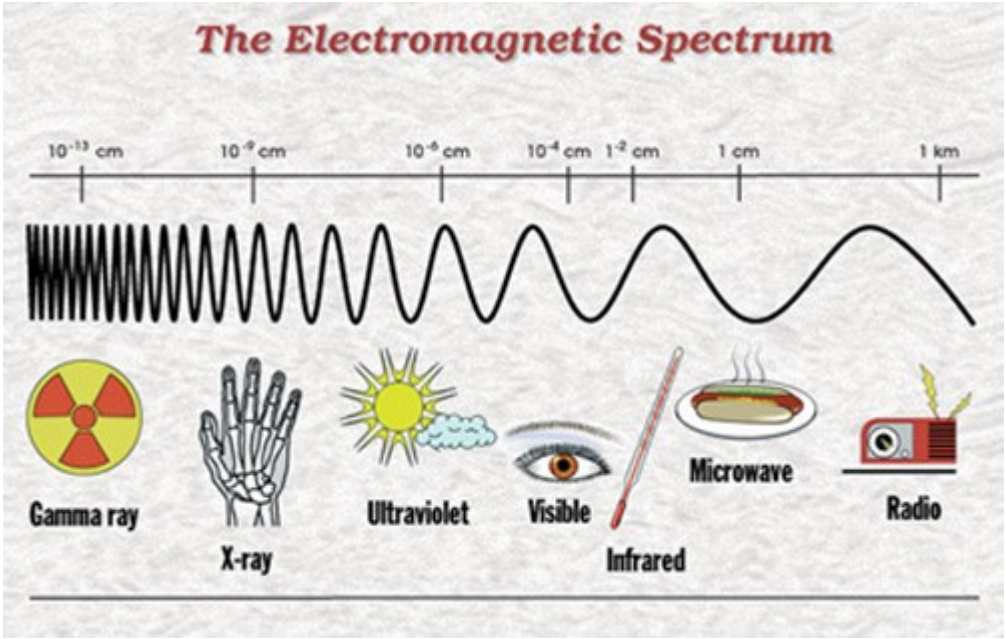


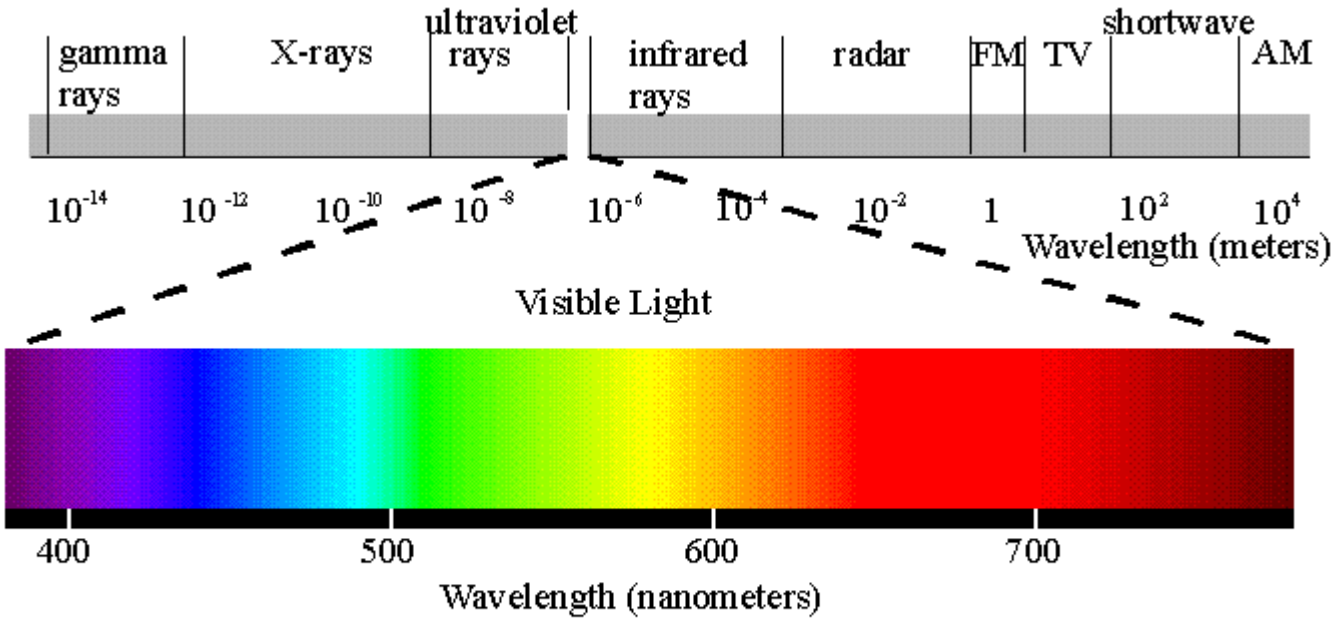


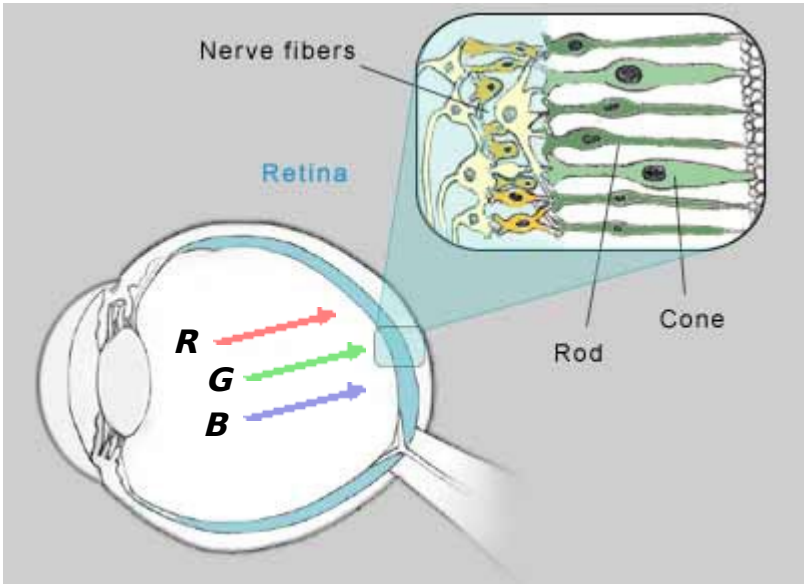
周波数：　**f = 1/τ**

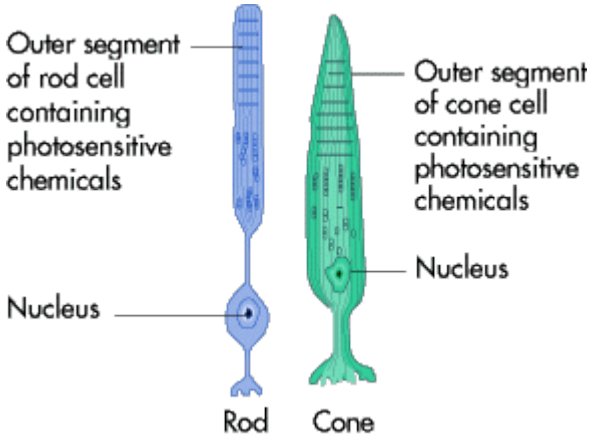


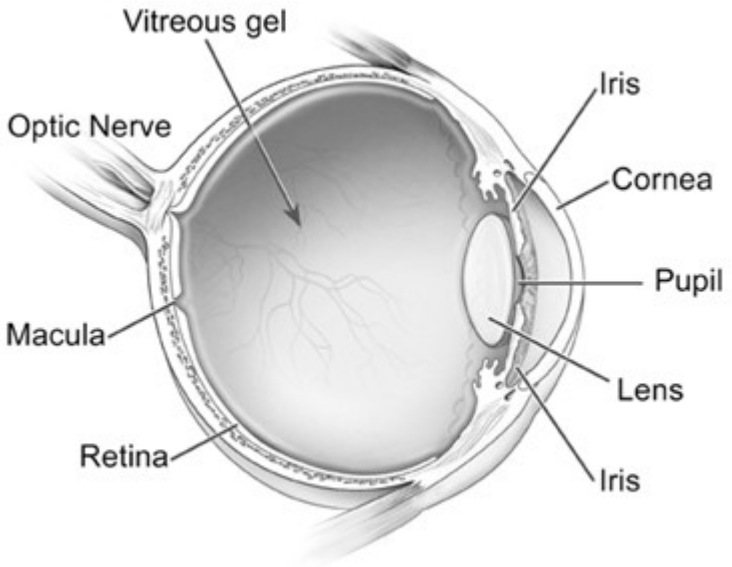
波長：　**f = λ**

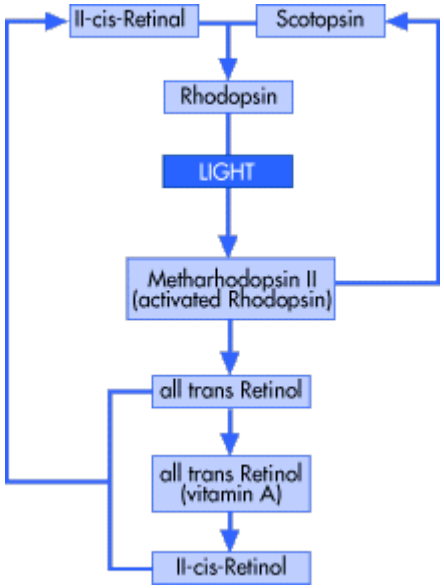


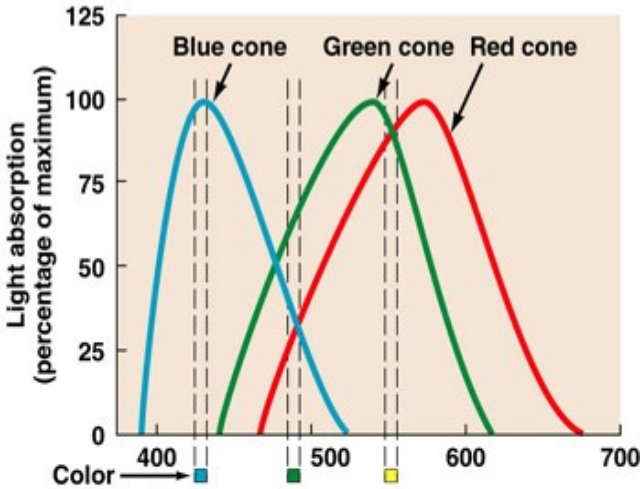

gamma rays
X-rays
ultraviolet rays
infrared rays
radar
FM
TV
shortwave
AM
10^{-14}
10^{-12}
10^{-10}
10^{-8}
10^{-6}
10^{-4}
10^{-2}
1
10^{2}
10^{4}
Wavelength (meters)
Visible Light
400
500
600
700
Wavelength (nanometers)


Nerve fibers
Retina
R
G
B
Cone
Rod


Outer segment of rod cell containing photosensitive chemicals
Nucleus
Outer segment of cone cell containing photosensitive chemicals
Nucleus
Rod
Cone







“RGB”の色で全部の色を作る。この事は光の特性ではない、人間の目の特性です（！）

人間は 「Trichromatic Vision」

動物の世界の中に「Tetrachromacy」「Pentachromats」などがあります