Light radiation

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- The **space energy** (vacuum space) spreads only in the $2\mu_0$ width in the hidden dimension. (μ_0: radius of a quantum particle)
- The single energy circulation in **hidden-space** dimensions (iS) can move continuously in the 3D space but not in the hidden dimension.
- iS can rotate around a hidden dimensional axis in a space-space dimensional plane like an electron circulation in an atom.
- iS **cannot rotate** around a **space axis** to a mixed direction of hidden and space dimensions.
- A rotation of iS around a space axis **radiates the light** instead of rotate to a hidden-space mixed direction.

< Rotation of iS in a space-space plane >

Take a hidden-space single circulation iS in H-X.

$$E_{(iS)}[X \quad H] = E_{(iS)}\,\mu_0(\cos\omega_0 t + i\sin\omega_0 t)$$

$$E_{(iS)} = m_0{\mu_0}^2{\omega_0}^2$$

Axis orthogonal to a space(X)-space(Y) plane:

One in 3D (X,Y,Z) space; Z

Two in 4D (X,Y,Z,H) space; Z and H

Rotation of iS around a space (Z) axis:

Three rotations; in X-Y and **H-X** (also H-Y: automatically given)

Rotation in **H-X**:

In order to keep quantized in a spacia, the frequency should be $\omega = n\omega_0$.

If $\omega < \omega_0$, iS cannot rotate in H-X but the energy is released in X.

< Rotate iS around a space axis >

Add an energy ΔE and rotate iS around a space axis Z by $\omega < \omega_0$.

$$\Delta E = m_0 {\mu_0}^2 \omega^2$$

$$[\mathrm{X} \quad \mathrm{H}] = \mu_0(\cos\omega t + i\sin\omega t) \;\; , \;\; [\mathrm{X} \quad \mathrm{Y}] = \mu_0(\cos\omega t + j\sin\omega t)$$

ΔE circulates in H-X and in X-Y → circulation breaks → energy vibrations in **Y** and **H** propagate to +X and -X.

Light radiations $\Delta E \rightarrow 2\gamma$

Energy release: at phases $\theta = -\pi/2$ (-X direction) and $\theta = \pi/2$ (+X)

Let us see one radiation to +X direction.

$$E_\gamma = \frac{\Delta E}{2} = \frac{E_{(iS)}}{2{\omega_0}^2}\omega^2 = \frac{m_0 {\mu_0}^2}{2}\omega^2 \text{ (energy of light)}$$

Spacias (medium) transport the vibrations in H and Y to X. The propagation speed is equal to the circulating velocity of the spacia, which is the light speed.

$$v_x = \mu_0 \omega_0 = c$$

Wavelength: expanded from the circumference $2\pi\mu_0$ by ω_0/ω times

$$\lambda = 2\pi\mu_0\frac{\omega_0}{\omega} = \frac{\mu_0\omega_0}{\nu} = \frac{c}{\nu}$$

Location of the half-circle energy in X:

$$\mathbf{X} = (-\mu_0\omega_0 t + \mu_0)\mathbf{e_x}\ \ (\approx -\mu_0\omega_0 t\mathbf{e_x} = -ct\mathbf{e_x})$$

Location in **H**: $$\mathbf{H} = \mu_0 \sin\omega t\ \mathbf{e_h}$$

Location in **Y**: The amplitude gets larger due to propagating to surrounding spacias at $\mu_0\omega_0$ while the original rotation was at $\mu_0\omega$.

$$\mathbf{Y} = \frac{\omega_0}{\omega}\mu_0 \sin\omega t\ \mathbf{e_y}$$

Velocities in H and Y:

$$\mathbf{v_h} = \frac{d\mathbf{H}}{dt} = \omega\mu_0 \cos\omega t\ \mathbf{e_h}$$

$$\mathbf{v_y} = \frac{d\mathbf{Y}}{dt} = \omega_0\mu_0 \cos\omega t\ \mathbf{e_y}$$

Momentums in H and Y are "**electric charge**" and "**magnetic charge**" (half-circle momentum is the amplitude):

$$e_\gamma = b_\gamma = p_h = \frac{m_0 \mu_0}{2} \omega$$

$$\mathbf{e_\gamma} = e_\gamma \cos \omega t \, \mathbf{e_h}$$

$$\mathbf{b_\gamma} = b_\gamma \cos \omega t \, \mathbf{e_y}$$

If expressed by $\sin$ like the position in Y:

$$\mathbf{e_\gamma} = \frac{m_0 \mu_0}{2} \sin(\omega t + \pi/2) \, \mathbf{e_h}$$

$$\mathbf{b_\gamma} = \frac{m_0 \mu_0}{2} \sin(\omega t + \pi/2) \, \mathbf{e_y}$$

Vibrations of electric charge and magnetic charge are advanced by $\pi/2$ in phase than that of location in Y.

Propagation in X of **electric/magnetic charges** and **energy location in Y** (plane wave, $k = \omega/c$) :

$$\mathbf{e}_{\boldsymbol{\gamma}} = \frac{m_0\mu_0}{2}\omega\cos(kx - \omega t)\,\mathbf{e}_{\mathbf{h}} = \frac{m_0\mu_0}{2}\omega\sin\big(kx - (\omega t + \pi/2)\big)\,\mathbf{e}_{\mathbf{h}}$$

$$\mathbf{b}_{\boldsymbol{\gamma}} = \frac{m_0\mu_0}{2}\omega\cos(kx - \omega t)\,\mathbf{e}_{\mathbf{y}} = \frac{m_0\mu_0}{2}\omega\sin\big(kx - (\omega t + \pi/2)\big)\,\mathbf{e}_{\mathbf{y}}$$

$$\mathbf{Y} = \frac{\omega_0}{\omega}\mu_0\sin(kx - \omega t)\,\mathbf{e}_{\mathbf{y}}$$

Define the **light quantum (photon)** as a single cycle of light.

$$E_q = \frac{E_\gamma}{\nu} = \frac{2\pi}{\omega}\frac{m_0{\mu_0}^2}{2}\omega^2 = \pi m_0{\mu_0}^2\omega == 2\pi^2 m_0{\mu_0}^2\nu$$

$$E_q = \hbar\omega = h\nu \quad (\omega = 2\pi\nu\,,\ \hbar = h/2\pi)$$

Photon energy is **not per common time** but per cycle.

Summary of light

Propagation in X of energy location in H and Y $\Longrightarrow$ that of electric / magnetic charges

$$\mathbf{e}_{\boldsymbol{\gamma}} = \frac{m_0\mu_0}{2}\omega \sin\big(kx - (\omega t + \pi/2)\big)\,\mathbf{e}_{\mathbf{h}} \qquad \text{(electric charge)}$$

$$\mathbf{b}_{\boldsymbol{\gamma}} = \frac{m_0\mu_0}{2}\omega \sin\big(kx - (\omega t + \pi/2)\big)\,\mathbf{e}_{\mathbf{y}} \qquad \text{(magnetic charge)}$$

$$\mathbf{Y} = \frac{\omega_0}{\omega}\mu_0 \sin(kx - \omega t)\,\mathbf{e}_{\mathbf{y}} \quad (k = \omega/c) \qquad \text{(energy location in Y)}$$

$$\mathbf{X} = (-\mu_0\omega_0 t + \mu_0)\mathbf{e}_{\mathbf{x}} \;\; (\approx -ct\mathbf{e}_{\mathbf{x}}) \qquad \text{(energy location in X)}$$

$$c = \mu_0\omega_0 \qquad \text{(light speed)}$$

$$E_\gamma = \frac{\Delta E}{2} = \frac{E_{(iS)}}{2{\omega_0}^2}\omega^2 = \frac{m_0{\mu_0}^2}{2}\omega^2 = 2\pi^2 m_0{\mu_0}^2\nu^2 = h\nu^2 \quad \text{(energy of light)}$$

$$E_q = \frac{E_\gamma}{\nu} = \hbar\omega = h\nu \qquad \text{(energy of light quantum / photon)}$$

$$h = 2\pi^2 m_0{\mu_0}^2 \qquad \text{(Planck constant)}$$

h is **invariant** by the space expansion, while ω_0 decreases.