The space energy (vacuum space) spreads only in the $2\mu_0$ width in the hidden dimension. ($\mu_0$: 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.

$$[\mathbf{E} \quad \mu] = [E_{(iS)} \quad \mu_0] \exp(i\omega_0 t) = [E_{(iS)} \quad \mu_0](\cos(\omega_0 t) + i \sin(\omega_0 t))$$

$$\mu = [\mathbf{X} \quad \mathbf{H}] = \mu_0 \exp(i\omega_0 t)[1 \quad -i]$$

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

$$E_{(iS)} = m_0\mu_0^2\omega_0^2, \quad \Delta E = m_0\mu_0^2\omega^2$$

$$[X \ H] = \mu_0 \exp(i\omega t)[1 \ -i], \quad [X \ Y] = \mu_0 \exp(j\omega t)[1 \ -j]$$

$\Delta E$ circulates in $H$-$X$ and in $X$-$Y \to$ circulation breaks $\to$ energy vibrations in $Y$ and $H$ propagate to $+X$ and $-X$.

**Light radiations** $\Delta E \to 2\gamma$

Energy release: at phases $\theta = -\pi/2$ and $\theta = \pi/2$

Let us see one radiation to $+X$ direction.

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

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.

$$v_X = \mu_0\omega_0 = c$$
Location of the half-circle energy in X:

\[ X = v_x \left( t - \frac{\pi}{2\omega_0} \right) = \mu_0 \left( \omega_0 t - \frac{\pi}{2} \right) \]

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

\[ Y = \frac{\omega_0}{\omega} \mu_0 (\sin \omega t - j \cos \omega t) \]

Location and velocity in H:

\[ H = \mu_0 (\sin \omega t - i \cos \omega t) \]

\[ v_H = \frac{dH}{dt} = \omega \mu_0 (\cos \omega t + i \sin \omega t) \]

Half-circle momentum in H equal to electric charge:

\[ p_h = p_h (\cos \omega t + i \sin \omega t) \]

\[ e_\gamma = e_\gamma (\cos \omega t + i \sin \omega t) \]

\[ e_\gamma = p_h = \frac{E_\gamma}{\mu_0 \omega} = \frac{E_{(iS)} \omega^2}{2 \mu_0 \omega_0^2} = \frac{E_{(iS)}}{2c\omega_0} \omega \quad (c = v_x = \mu_0 \omega_0) \]
Let $\pi/2$ be the initial phase $\omega t \rightarrow \omega t + \pi/2$. Energy distribution of the light:

$$X = ct = \mu_0 \omega_0 t$$

$$Y = \frac{\omega_0}{\omega} \mu_0 (\cos \omega t + j \sin \omega t) = \frac{\omega_0}{\omega} \mu_0 \exp(j\omega t)$$

$$e_y = e_y \exp(i(\omega t + \pi/2))$$

**Propagation in X** of vibrations of **electric charge** and **energy location in Y**:

$$e_y \varphi_e = e_y \exp(i(kx - (\omega t + \pi/2)))$$

$$Y \varphi_y = \frac{\omega_0}{\omega} \mu_0 \exp(j(kx - \omega t))$$

$$k = \omega/c$$

Define the **photon** as a single cycle of light. Energy of photon:

$$E_p = \frac{E_y}{\nu} = \frac{2\pi E_{(is)}}{\omega} \frac{\omega_0^2}{2\omega_0^2} \omega^2 = \frac{\pi E_{(is)}}{\omega_0^2} \omega = \frac{2\pi^2 E_{(is)}}{\omega_0^2} \nu$$

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

Photon energy is **not per common time** but per cycle.
Summary of light

Light speed:

\[ c = \mu_0 \omega_0 \]

Energy of light:

\[ E_\gamma = \frac{E_{(iS)}}{2\omega_0^2} \omega^2 = \frac{\hbar}{2\pi} \omega^2 = h\nu^2 \]

Energy of photon:

\[ E_p = \frac{E_\gamma}{\nu} = \hbar \omega = h\nu \]

Planck constant:

\[ h = \frac{2\pi^2 E_{(iS)}}{\omega_0^2} = \frac{2\pi^2 m_0 \mu_0^2 \omega_0^2}{\omega_0^2} = 2\pi^2 m_0 \mu_0^2 \]

\( h \) is **invariant** by the space expansion, while \( \omega_0 \) decreases.

Amplitude of electric charge:

\[ e_\gamma = \frac{E_\gamma}{\mu_0 \omega} = \frac{E_{(iS)}}{2c \omega_0} \omega \]