Photon is kinetic energy of electron

Ichiro Nakayama
Yazucho Yazugun Tottoriken Japan

Abstract

It is confirmed that a photon is the kinetic energy detached from an electron, and, the kinetic energy of an electron is undulation created in space, because of the wave length of bright line spectrum of light.

The wavelength of the bright line spectrum of light from a hydrogen atom is explained by Niels Henrik David Bohr's hydrogen atom model. But, I assumed that "the energy and momentum of a photon " were equal to "electronic kinetic energy", in the unique way from Bohr's hydrogen atom model, and it was confirmed that the wavelengths of the bright line spectrums of light from a hydrogen atom were calculated correctly. This thing means that electronic kinetic energy becomes a photon separated from an electron. Moreover, it means that the direction and velocity of a traveling photon is different from well-known ones of light which is generally admitted.

1. Introduction

By electronic transition, the bright line spectrums with specific wavelength are observed. This wavelength is formulated in mathematical expression by Niels Henrik David Bohr's hydrogen atom model. (1)

$$\frac{1}{\lambda}=\frac{m_e e^4}{8\varepsilon_0^2 c h^3}\left(\frac{1}{n'^2}-\frac{1}{n^2}\right) \qquad (1)$$

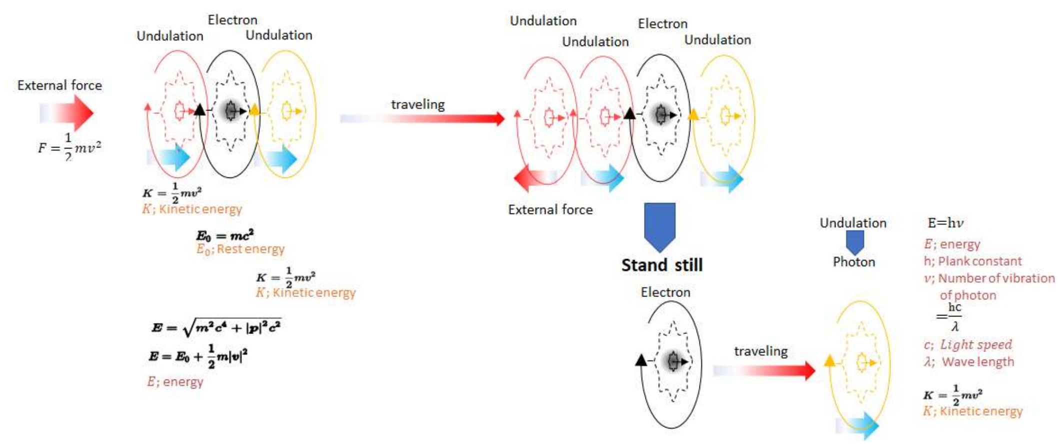
λ ：Wavelength of line spectrum from hydrogen atom
n^2, n'^2 ：　Quantum number　but、$n > n'$
m_e ：Electronic mass
e ：Electronic electrical charge
ε_0 ：Dielectric constant
c ：Light speed
h ：　Plank constant

This time, I introduced a new formula by giving a new interpretation to a photon, and succeeded in calculating the wave lengths of this line spectrums.

It is explained by energy body theory that increased energy as undulation is created in the rear and front space of a moving elementary particle. When the elementary particle is an electron, and the electronic posture or its moving direction changes, the undulation in front space of a moving electron is detached from it. It is an electromagnetic wave (a photon). Then, the kinetic energy of an electron is equal to the energy and kinetic energy of a photon emitted from an electron. (Fig 1)

By this thinking, I made the next equations, and calculated them to get the wavelength of the bright line spectrums of a hydrogen. And all results were right.

Fig 1 Kinetic energy and Photon



2. Derivation

The whole energy of a transiting electron is expressed as the next equation (2-1) by Special relativity.

$$E_e = E_{e0} + \frac{1}{2}m_e|v_e|^2 \qquad (2-1)$$

E_e : Whole energy of an electron

E_{e0}: Rest energy of an electron

E_{ek} : Kinetic energy of an electron

m_e: mass of an electron

v_e: Traveling speed of an electron

If the rest energy E_{e0} is subtracted from the equation (2-1) of the whole energy E_e of a moving electron, the kinetic energy E_{ek} of a transiting electron is gotten as the next equation (2-2).

$$E_{ek} = \frac{1}{2}m_e v_e^2 \qquad (2-2)$$

The kinetic energy E_{ek} of a transiting electron is the same as the energy level difference $|E_{n'} - E_n|$.

$$E_{ek} = |E_{n'} - E_n| \qquad (2-3)$$

The kinetic energy E_{ek} of a transiting electron is equal to the photon's energy E_p.detached from the electron.

Because, kinetic energy which generated in front of an electron is undulation, and the undulation becomes a photon after being detached from an electron.

In quantum theory, it is explained "that a photon is one of elementary particles, and is a force carrier of quantum state and all kinds of electromagnetic waves including photons" (Wikipedia Photon).

$$E_{ek} = E_p \qquad (3)$$

And, the energy and kinetic energy E_p of a photon is (4-1) and (4-2), by Planck's Energy quantum hypothesis.

$$E_p = |E_{n'} - E_n| = \mathrm{h}\nu_p \qquad (4-1)$$

$$\mathrm{c} = \lambda_p \nu_p \qquad \therefore E_p = \frac{hc}{\lambda_p} \qquad (4-2)$$

E_n: Energy level at quantum number n

$E_{n'}$: Energy level at quantum number n'

E_p: Photon's whole energy

h: Plank constant

ν_p : Photon's frequency

λ_p : Photon's wavelength

c: Light speed

Kinetic energy of an electron E_{ek}(2-2) is equal to energy and kinetic energy of a photon E_p(4-1), so, equation (5-1) is gotten.

$$\frac{m_e v_e^2}{2} = \mathrm{h}\nu_p \qquad (5-1)$$

If equation (5-1) is transformed, electronic transition speed v_e(5-1)' is gotten.

$$v_e = \sqrt{\frac{2\mathrm{h}\nu_p}{m_e}} \qquad (5-1)'$$

In the same way, equation (5-2) is gotten from equation (2-2) and equation (4-2).

$$\frac{m_e v_e^2}{2} = \frac{hc}{\lambda_p} \qquad (5-2)$$

If equation (5-2) is transformed, electronic transition speed λ_p (5-2)' is gotten.

$$\lambda_p = 2 \times \frac{hc}{m_e v_e^2} \qquad (5-2)'$$

If equation (5-1)' is substituted for (5-2)', equation (6) is gotten. And wavelength is not calculated.

$$\lambda_p = \frac{c}{\nu_p} \qquad (6)$$

The reason is conceivable that velocity and frequency are different between a photon (6)' which is emphasized a particle character and light (6)" which is emphasized a wave character.

$$\lambda_p = \frac{v_p}{\nu_p} \qquad (6)'$$

$$\lambda_l = \frac{c}{\nu_l} \qquad (6)''$$

Then, first, the value of v_e must be worked out, after that, must be substituted for equation (5-2)'.

By the way, the traveling speed v_p of a photon is generally not well known except energy body theory.

3. Calculating wavelength of photon

The calculating results of the bright line spectrums from a hydrogen atom per three spectrum series, Lyman series, Balmer series, and Paschen series are as follows.

All calculation results coincide with the established values in fig 2.

The next values are substituted into equations (5-1)' and (5-2)'.

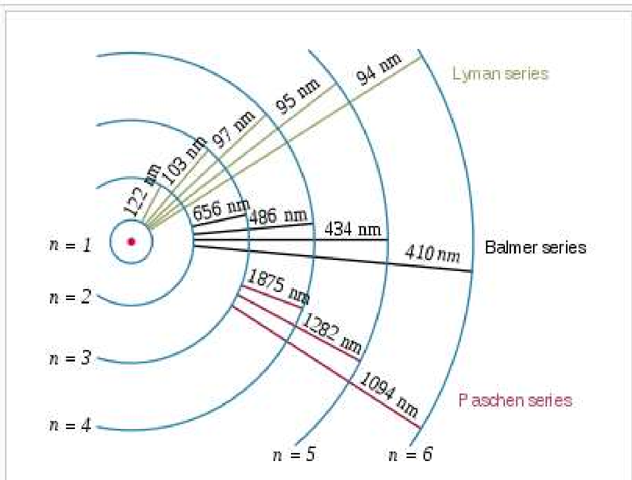
$m_e = 9.10938356 \times 10^{-31}(\mathrm{kg})$: Electronic mass

$\mathrm{h} = 6.626 \times 10^{-34}(js) = 6.626 \times 10^{-34}(kgm^2/s)$: Plank constant

$\mathrm{v} = 1.9 \times 10^5(\mathrm{m/s})$ Photon's traveling speed

E =Energy level difference between atomic orbits

Fig 2 Hydrogen spectral series



Electron transitions and their resulting wavelengths for hydrogen. Energy levels are not to scale.

(Wikipedia; Hydrogen spectral series)

Energy level of hydrogen

※ "hν" in equation (4-2) is energy level difference in the next table.

Energy level	Energy	Energy level difference			
		n1	n2	n3	n4
n1	-13.6 eV				
n2	-3.4 eV	-10.2 eV			
n3	-1.51 eV	-12.09 eV	-1.89 eV		
n4	-0.85eV	-12.75 eV	-2.55 eV	-0.66 eV	
n5	-0.54 eV	-13.06 eV	-2.86 eV	-0.97 eV	-0.31 eV

Lyman series

n2 → n1

$$\lambda = \frac{2 \times 6.626 \times 10^{-34}\left(\frac{kgm^2}{s}\right) \times 3 \times 10^6 \left(\frac{m}{s}\right)}{9.1 \times 10^{-31}(\mathrm{kg}) \times 1.9 \times 10^5 \times 1.9 \times 10^5 \left(\frac{\mathrm{m}}{\mathrm{s}}\right)\left(\frac{\mathrm{m}}{\mathrm{s}}\right)} = 1.21 \times 10^{-7}(m) = 121(nm)$$

$$v = \sqrt{\frac{2 \times 10.2 \times 1.6 \times 10^{-19} j\left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-31} kg}} \cong 1900 km/s$$

n3 → n1

$$\lambda = \frac{2 \times 6.626 \times 10^{-34}\left(\frac{kgm^2}{s}\right) \times 3 \times 10^8 \left(\frac{m}{s}\right)}{9.1 \times 10^{-31}(\mathrm{kg}) \times 2.06 \times 10^6 \times 2.06 \times 10^6 \left(\frac{\mathrm{m}}{\mathrm{s}}\right)\left(\frac{\mathrm{m}}{\mathrm{s}}\right)} = 1.03 \times 10^{-7}(m) = 103(nm)$$

$$v = \sqrt{\frac{2 \times 12.1 \times 1.6 \times 10^{-19} j\left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-31} kg}} \cong 2060 km/s$$

n4 → n1

$$\lambda = \frac{2 \times 6.626 \times 10^{-34}\left(\frac{kgm^2}{s}\right) \times 3 \times 10^8 \left(\frac{m}{s}\right)}{9.1 \times 10^{-31}(\mathrm{kg}) \times 2.13 \times 10^6 \times 2.13 \times 10^6 \left(\frac{\mathrm{m}}{\mathrm{s}}\right)\left(\frac{\mathrm{m}}{\mathrm{s}}\right)} = 0.96 \times 10^{-7}(m) = 96(nm)$$

$$v = \sqrt{\frac{2 \times 12.85 \times 1.6 \times 10^{-19} j\left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-31} kg}} \cong 2130 km/s$$

n4 → n1 omission

Balmer series

n3 → n2

$$\lambda = \frac{2 \times 6.626 \times 10^{-34} \left(\frac{kgm^2}{s}\right) \times 3 \times 10^8 \left(\frac{m}{s}\right)}{9.1 \times 10^{-31}(\mathrm{kg}) \times 0.815 \times 10^6 \times 0.815 \times 10^6 \left(\frac{\mathrm{m}}{\mathrm{s}}\right)\left(\frac{\mathrm{m}}{\mathrm{s}}\right)} = 6.58 \times 10^{-7}(m) = 658(nm)$$

$$v = \sqrt{\frac{2 \times 1.89 \times 1.6 \times 10^{-19} j \left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-3}\ kg}} \cong 815 km/s$$

n4 $\rightarrow$ n2

$$\lambda = \frac{2 \times 6.626 \times 10^{-34} \left(\frac{kgm^2}{s}\right) \times 3 \times 10^8 \left(\frac{m}{s}\right)}{9.1 \times 10^{-3}\ (\mathrm{kg}) \times 1.003 \times 10^6 \times 1.003 \times 10^6 \left(\frac{\mathrm{m}}{\mathrm{s}}\right)\left(\frac{\mathrm{m}}{\mathrm{s}}\right)} = 4.34 \times 10^{-7}(m) = 434(nm)$$

$$v = \sqrt{\frac{2 \times 2.86 \times 1.6 \times 10^{-19} j \left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-31} kg}} \cong 1003 km/s$$

Paschen series

n4 $\rightarrow$ n3

$$\lambda = \frac{2 \times 6.626 \times 10^{-34} \left(\frac{kgm^2}{s}\right) \times 3 \times 10^8 \left(\frac{m}{s}\right)}{9.1 \times 10^{-31}(\mathrm{kg}) \times 0.482 \times 10^6 \times 0.482 \times 10^6 \left(\frac{\mathrm{m}}{\mathrm{s}}\right)\left(\frac{\mathrm{m}}{\mathrm{s}}\right)} = 18.81 \times 10^{-7}(m) = 1881(nm)$$

$$v = \sqrt{\frac{2 \times 0.66 \times 1.6 \times 10^{-1}\ j \left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-31} kg}} \cong 482 km/s$$

n5 $\rightarrow$ n3

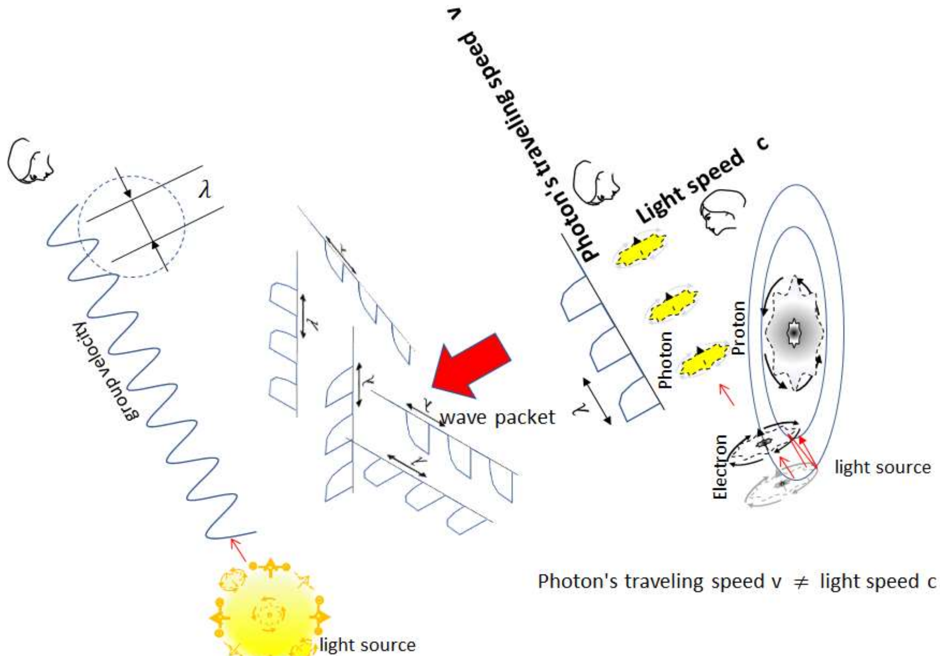
$$\lambda = \frac{2 \times 6.626 \times 10^{-34} \left(\frac{kgm^2}{s}\right) \times 3 \times 10^8 \left(\frac{m}{s}\right)}{9.1 \times 10^{-31}(\mathrm{kg}) \times 0.584 \times 10^6 \times 0.584 \times 10^6 \left(\frac{\mathrm{m}}{\mathrm{s}}\right)\left(\frac{\mathrm{m}}{\mathrm{s}}\right)} = 12.81 \times 10^{-7}(m) = 1281(nm)$$

$$v = \sqrt{\frac{2 \times 0.97 \times 1.6 \times 10^{-19} j \left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-31} kg}} \cong 584 km/s$$

4. Interpretation of results

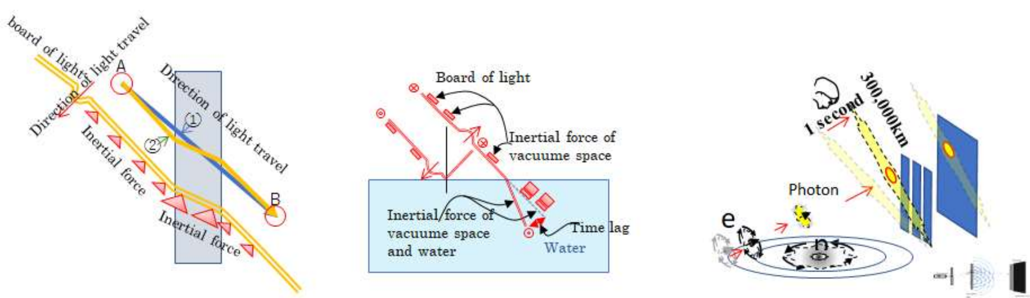
The energy and kinetic energy of a photon emitted by electronic transition is equal to the kinetic energy of an electron. This means that a photon is the same as kinetic energy of an electron. Also, the new way of thinking about light speed is needed, because a photon's traveling speed is the same as electronic speed. After all, photon's traveling direction is different from the direction of light's observation. This is depicted in fig 3.

Fig 3　Photon's traveling speed v and Light speed c



More, "The principle of Fermat", "Reflection and refraction", "Duality of wave and particle", and "Principle of light speed invariable", these phenomena about light came to be understandable rationally. This is depicted in fig 4.

Fig 4.　Fermat's principle, Reflection and Refraction of Light, Duality of particle and wave



5. Conclusion

A photon is the electronic kinetic energy detached from an electron. So, photon's traveling speed is the same as electronic speed just before photon being detached from an electron. This means that light movement is in accordance with the law of inertia.

Also, this explains the principle of light speed invariable including the next interpretation.

Photon's traveling speed is different from light speed widely accepted. After all, photon's traveling direction is different from observational direction of light.

Acknowledgment

While writing this article, I referred to many sites on the internet. I'd like to record thankful intention on Wikipedia here in particular.

References

［1］Web blog「Discovery and inspection of axioms which control from elementary particles to the structure of the universe」in Japanese and in English
(available at: http://energybody.exblog.jp/, date last accessed October 24, 2017)
［2］Web site「Wikipedia」in Japanese
 * Bohr's model (https://ja.wikipedia.org/wiki/)
 * de Broglie waves (https://ja.wikipedia.org/wiki/)
 * Photon (https://ja.wikipedia.org/wiki/)
［3］Web site「Sloan Digital Sky Server」in Japanese
(available at: http://skyserver.sdss.org/edr/jp/, date last accessed October 24, 2017)
［4］Web site「Illustrator Kisokoza」in Japanese
(available at: http://illustrator-ok.com/, date last accessed October 24, 2017)