Wavelength of bright line spectrum from hydrogen

Ichiro Nakayama
Yazucho Yazugun Tottoriken Japan

abstract: 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 being 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 Wavelength of bright line spectrum

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)

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 the all results were right.

If the rest energy E_0 is subtracted from the equation (2-1) of the whole energy E of a moving electron, the equation (2-2) of the kinetic energy E_k is gotten. And, the energy and kinetic energy E_p of a photon by Planck's Energy quantum hypothesis is (3-1) and (3-2). The equation (4-1) expresses that the kinetic energy E_k of an electron is equal to the energy and kinetic energy E_p of a photon. By this, the equation (4-2) of the traveling speed υ of photon which is the same as an electronic one and the equation (4-3) of the wave length λ the bright line spectrums are gotten.

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

1.1 Calculating wavelength

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.

The all calculation results coincide with the established values in fig 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

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

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

$$v = \sqrt{\frac{2 \times 12.1 \times 1.6 \times 10^{-19} j \left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-3}\ \ kg}} \cong 2060 km/s$$

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　略

Balmer series

n3 → n2

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

$$v = \sqrt{\frac{2 \times 1.89 \times 1.6 \times 10^{-19} j \left(\frac{kg \cdot m^2}{s^2}\right)}{9.1 \times 10^{-31} kg}} \cong 815 km/s$$

n4 → n2

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

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

Paschen series

n4 → n3

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

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

n5 → n3

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

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

1.2 Interpretation of wavelength calculation

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.

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.

2 Equations

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

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

$$\mathrm{E} = \mathrm{h\nu} \qquad (2-1)$$

$$\therefore \mathrm{E} = \frac{hc}{\lambda} \qquad (2-2)$$

ν ：Frequency of photon

λ ：Wavelength of photon

$$E = E_0 + \frac{1}{2} m_e |v|^2 \qquad (3-1)$$

$$E_k = \frac{1}{2} m_e v^2 \qquad (3-2)$$

E ：Whole energy of electron

E_k ：Electronic kinetic energy

$$\frac{mv^2}{2} = \mathrm{h}\nu = \frac{hc}{\lambda} \qquad (4-1)$$

$$v = \sqrt{\frac{2\mathrm{h}\nu}{m}} \qquad (4-2)$$

$$\lambda = 2 \times \frac{hc}{m_e v^2} \qquad (4-3)$$

3 Figures & Tables

Fig 1 Kinetic energy and Photon

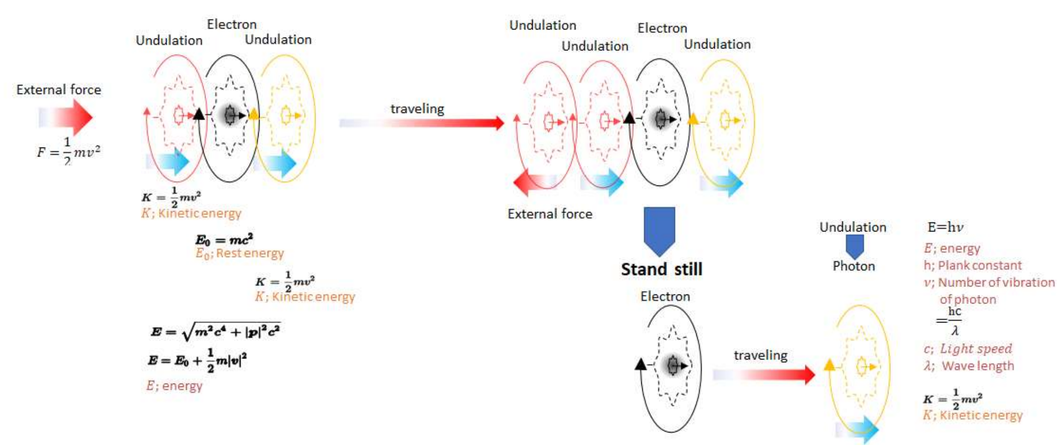
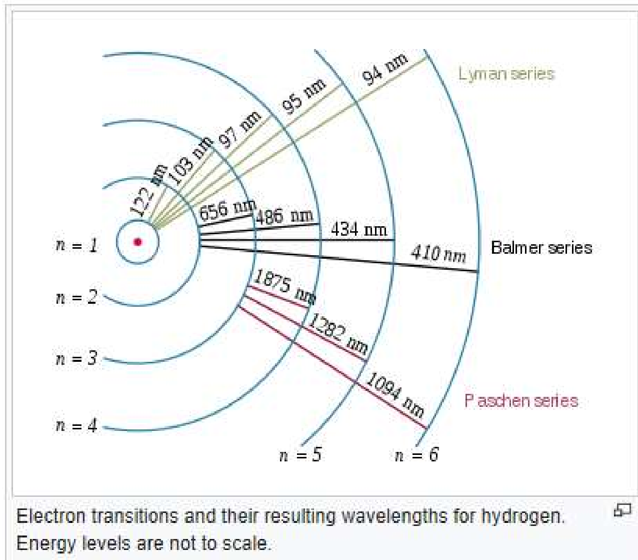


Fig 2　Hydrogen spectral series



(Wikipedia; Hydrogen spectral series)

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

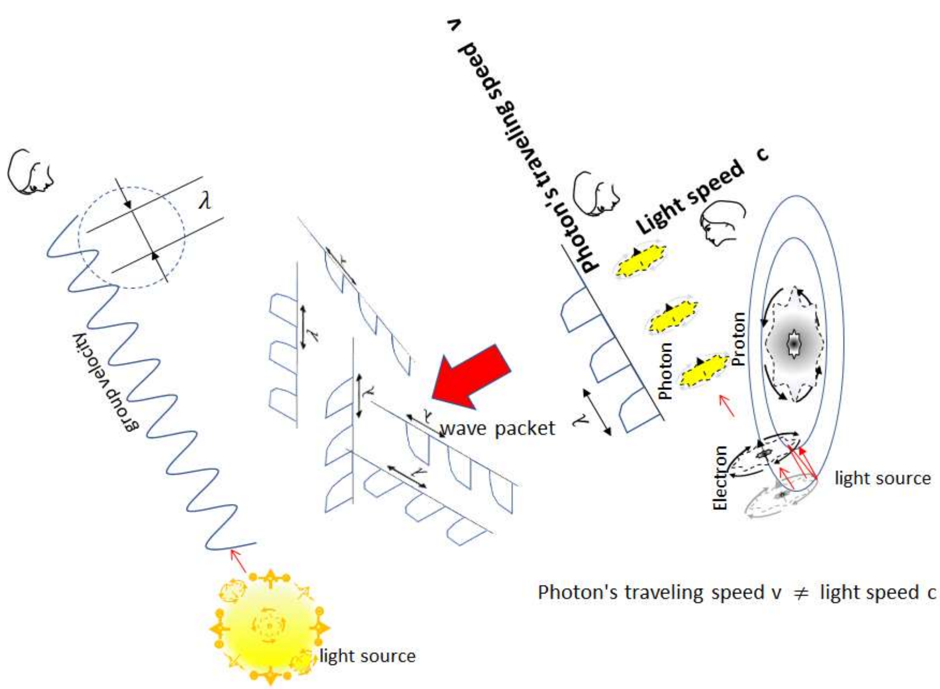
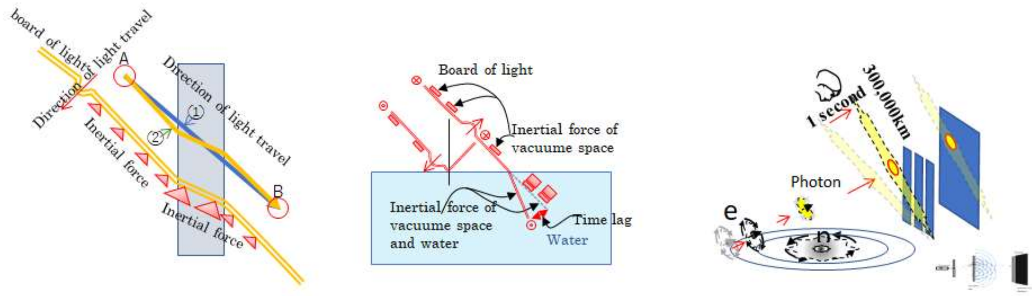


Fig 4. Fermat's principle, Reflection and Refraction of Light, Duality of particle and wave



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 (http://energybody.exblog.jp/)
［2］ Web site「Wikipedia」 in Japanese
［3］ Web site「Sloan Digital Sky Server」 in Japanese (http://skyserver.sdss.org/edr/jp/)
［4］ Web site「Illustrator Kisokoza」 in Japanese (http://illustrator-ok.com/