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Review Article

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The Theory of the Photon

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Abbreviations

A-Physics Equations and Formulas
B- Quantum gravity constants
C- Quantum Permittivity constants
D- A quantum current
E- The lifetime equation
F-The lifespan of the electron
G-The lifespan of the universe
H-The lifespan and mass of the photon
I-The photon radius
J- The escape velocity
K- The photon speed
L- The photon acceleration:
M-Product of velocity and acceleration
N-Photon decoupling time
O-The different phases of the radiation eras
P-The lifetime of the photon
Q-The gravitational force (before decoupling)
R-A study in the double slit experiment
S-Other characteristics of photons

Introduction

A photon is a particle of light defined as a discrete bundle (or quantum) of Electromagnetic energy. Photons are always in motion and, in a vacuum (a completely empty space), have a constant speed of light to all observers. Photons travel at the vacuum speed of light (more commonly just called the speed of light) of c = 299792458 m/s.

The concept of the photon led to important developments in experimental and theoretical physics, such as lasers, Bose-Einstein condensers, quantum optics, quantum field theory and the probabilistic interpretation of quantum mechanics. A photon is a spin particle equal to 1, so it is a boson, and its mass will be close to zero.

Problematic

The question that poses itself is does the photon accelerate to the speed of light? Alternatively, would the photon have already traveled at the speed of light c when it was created directly? Is it as if the photon jumped from the speed of zero to the speed of light instantly?

A-Physics Equations and Formulas

$$\mathrm{E} = \mathrm{m}c^2.$$

$$A_{\text{current}} = \frac{c^2 \times \sqrt{m}}{t}.$$

$$V_{\text{tension}} = \sqrt{m}.$$

$$w_{\text{Power}} = \frac{c^2 \times m}{t} = \frac{E}{t}.$$

Elementary charge: e=1.602176634×10^{-19} C

$$e = \sqrt{m} \times c^2$$

G; the gravitational constant = 6.67408×10^{-11}m^3 Kg^{-1} S^{-2}
C; Speed of light

The fine structure constant α =7,2973525646 ×10^{-3}
The correction value sin (β)
The Dirac's constant $\hbar$=1,054571818 ×10^{-34} J.s
Electron mass (m_e) =9.109383×10^{-31} Kg

B- Quantum Gravity Constants

(End of the Triassic era about 199 million years ago)
β=90

$$G_\alpha = \frac{\alpha \times c^4 \times \sqrt{G \times \hbar \times c}}{e^2 \times (2\pi) \times \sin(\beta)}$$

$$=5{,}3253003 \times 10^{50}\ m^3 Kg^{-1} S^{-2}$$

$$G_\beta = \frac{e^2 \times (2\pi) \times \sin(\beta)}{\alpha \times c^4} \times \sqrt{\frac{G^3}{\hbar \times c}} = 8{,}3644755 \times 10^{-72}\ m^3 Kg^{-1} S^{-2}$$

The gravitational constant

$$G = \sqrt{G_\alpha \times G_\beta} = 6.67408 \times 10^{-11}\ m^3 Kg^{-1} S^{-2}$$

C- Quantum Permittivity constants (End of the Triassic era about 199 million years ago)

β=90°

$$\varepsilon_\alpha = \frac{\alpha \times c^4 \times \varepsilon_0}{e^2 \times (2\pi) \times \sin(\beta)} \times \sqrt{\frac{\hbar \times c}{G}} = 7{,}0648253 \times 10^{49} Kg^{-1} m^{-3} s^4 A^2$$

$$\varepsilon_\beta = \frac{e^2 \times (2\pi) \times \varepsilon_0 \times \sin(\beta)}{\alpha \times c^4} \times \sqrt{\frac{G}{\hbar \times c}} = 1{,}\ 109675 \times 10^{-72} Kg^{-1} m^{-3} s^4 A^2$$

Vacuum permittivity

$$\varepsilon_0 = \sqrt{\varepsilon_\alpha \times \varepsilon_\beta} = 8.85418781762039 \times 10^{-12}\ Kg^{-1} m^{-3} s^4 A^2$$

D- A Quantum Current

The quantum current it is, in the unit of quantum black hole measurement system, the unit of electric current,

$$\text{Quantum Current} = \sqrt{\frac{c^6 \times 4 \times \pi \times \varepsilon_\beta}{G_\alpha}}$$

$$= \frac{2 \times \pi \times e^2}{\alpha} \times \sqrt{\frac{4 \times \pi \times \varepsilon_0}{c^3 \times \hbar}} = 4{,}\ 3691269 \times 10^{-36} \text{A}$$

E- The Lifetime Equation

$$the\ lifetime = \frac{c^2}{\text{quantum current}} \times \sqrt{\frac{mass}{(2\pi)}}$$

F-The Lifespan of the Electron

An electron is the subatomic particle that carries a negative electric charge. It has no known components, which is why it's considered to be a basic building block of the universe, or an elementary particle. The best measurement yet of the lifetime of the electron suggests that a particle present today will probably still be around in 66,000 yottayears (6.6×10^{28} yr) , which is about five-quintillion times the current age of the universe.

$$the\ electron\ lifetime = \frac{c^2}{\text{quantum current}} \times \sqrt{\frac{mass_{electron}}{(2\pi)}}$$

$$\frac{c^2}{4{,}3691269 \times 10^{-36}} \times \sqrt{\frac{\text{m}_\text{e}}{(2\pi)}} = 7{,}8433645 \times 10^{36}\ s$$

$$\approx \left(\left(\frac{\alpha^2 \times c^2}{8 \times \pi^2 \times e^2 \times m_e} \right) \times \sqrt{\frac{\hbar^3 \times c}{G}} \right) = 5{,}9600905 \times 10^{36}\ s$$

$$\approx \left(\left(\frac{c^2 \times m_e}{e^2} \right)^2 \times \left(\frac{\alpha \times c}{(2\pi)} \right) \times \sqrt{\hbar \times G \times c} \right) = 5{,}1644312 \times 10^{36}\ s$$

G-The Lifespan of the Universe

According to the theory, the Big Rip to the End of the Universe is more immutable than the rest. At least to me, the energy density is expected to increase out of control over time. Eventually, it will cause everything from galaxies to the smallest things to disintegrate and turn them into its constituent particles or radiation. The entire universe would essentially be torn apart into its constituent particles. However, when it can be expected to occur remains a mystery that can be solved with mathematical equations [1].

$$Mass = \frac{\alpha \times c^5 \times \hbar}{e^2 \times (2\pi) \times G} = 1{,}7367754 \times 10^{53} Kg = (Planck\ tension)^2 / 2\pi.$$

Quantum Gravity Constants

$$the\ universe\ lifetime = \frac{c^2}{\text{quantum current}} \times \sqrt{\frac{mass_{universe}}{(2\pi)}}$$

$$= \frac{c^2}{4{,}3691269 \times 10^{-36}} \times \sqrt{\frac{1{,}7367754 \times 10^{53}}{(2\pi)}} = 3.4247569 \times 10^{78}\ s.$$

$$\left(\frac{\alpha \times c^3}{e^2 \times (2\pi)} \right)^2 \times \sqrt{\frac{c \times \hbar^3}{G}} = 3.4263841 \times 10^{78}\ s.$$

H-The Lifespan and Mass of the Photon

The idea that photons have a finite lifespan, and therefore mass, is difficult to imagine. Indeed, astronomers looking at distant cosmic objects regularly detect photons that are billions of years old. But some theories suggest that photons could have a non-zero rest mass, albeit a small one the upper limit for the mass of the photon is constrained to thanks to experiments with electric and magnetic fields. And with this small mass, a photon could decay into other lighter elementary particles, such as a pair of the lightest neutrino and an antineutrino, or even particles that are currently unknown and beyond the Standard Model of particle physics [2].

$$\frac{c^2}{\text{quantum current}} \times \sqrt{\frac{mass_{Photon}}{(2\pi)}} = \frac{2 \times \pi \times \hbar \times c^2}{\alpha \times e^2} = 3.1839973 \times 10^{23}\ seconds =$$

$$1{,}0089755 \times 10^{16} years\ after\ big-bang$$

$$\textbf{Photon mass} = \frac{(64 \times \pi 5 \times \hbar \times \varepsilon_0)}{\alpha^4 \times c^3)} = 2.3885215 \times 10^{-58} \text{Kg}$$

I-The Photon Radius

Photons are continuously distributed around the electron. They can only be at very specific distances which make up photonic projectiles.

Photons revolve stably around the electron only if it occupies well-defined regions that is located at some distance from the nucleus and is characterized by its own energy state.

The introduction of energy (often in the form of radiation) can cause the electron to enter an unstable state called an "excited state" where the photons on the electron's shell are higher. However, if the energy supply stops, the electron ends up returning to its initial state by releasing a photon.

$$r_{ph} = \frac{\alpha^3 \times e^4}{128 \times \pi^5 \times \hbar \times {\varepsilon_0}^2 \times m_e \times c^3} = 3.2147846 \times 10^{-26} m$$

$$r_{ph} = \frac{32 \times \pi^5 \times \varepsilon_0}{\alpha^2 \times e^2} \times \sqrt{\frac{\hbar^3 \times G}{c}} = 3.240007 \times 10^{-26} m$$

$$r_{ph} = \frac{\alpha^2 \times c^2 \times m_{photon}}{2 \times e^2} \times \sqrt{\hbar \times G \times c} = 3.240007 \times 10^{-26} m$$

$$r_{ph} = \frac{e^4}{2 \times \alpha \times \varepsilon_0 \times m_e \times m_{photon} \times c^6} = 3.2147846 \times 10^{-26} m$$

J- The Escape Velocity
The escape velocity is the minimum speed that a photon must impart so that it escapes the pull of the electron's gravitational field and reaches a point at infinity. At this speed, the path of the photon becomes a parabola moving away from the electron towards infinity. Below this speed, the photon remains bound to the electron as it follows an elliptical orbit around the electron.

The Escape Velocity

$$v_1 = \sqrt{\frac{2 \times G \times m_e}{r_{photon}}} = \sqrt{\frac{2 \times (6.67408 \times 10^{-11}) \times m_e}{3.240007 \times 10^{-26}}} = 6.12607358 \times 10^{-8}\ m/s$$

The Photon Velocity

$$v_{ph} \frac{64 \times \pi^5 \times \varepsilon_0}{\alpha^4} \times \sqrt{\frac{G \times \hbar}{c^5}} = m_{photon} \times \sqrt{\frac{G \times c}{\hbar}} = 3.2911479$$

When an electron gains energy, it can jump from its orbit to an orbit with a higher potential energy. An electron in this case is called an excited electron. So the velocity of the photon increases, but it does not reach the escape velocity, so the photon collapse and the distance between them decreases to reach the Planck length. At some point, the electron can return from the excited level to the starting level alone in orbit with low potential.

The electron will release into the environment the photon which has gained a velocity higher than the new escape velocity.

The New Escape Velocity

$$v_2 = \sqrt{\frac{2 \times G \times m_e}{Planck\ length}} = \sqrt{\frac{2 \times (6.67408 \times 10^{-11}) \times m_e}{1.6169756 \times 10^{-35}}} = 1.15534237 \times 10^{-3}\ m/s$$

The new photon velocity

$$\frac{\alpha^3 \times e^2}{32 \times \pi^4 \times \hbar \times \varepsilon_0} = \frac{e^2 \times (2\pi)}{\alpha \times c^3 \times m_{photon}} = 3,4272234 \times 10^{-3}\ m/s$$

K- The Photon Speed
Photons follow a circular path around the electron at quantum speed. As the electron approaches the nucleus, it becomes more and more localized, which means that the photon reaches the escape phase, and therefore its kinetic energy, is more and more uncertain. This increases the total energy.

Photon Velocity (The Excited Photon)

$$\frac{\alpha^3 \times e^2}{32 \times \pi^4 \times \hbar \times \varepsilon_0} = 3,4272234 \times 10^{-3}\ m/s$$

Photon Velocity (Moments after Decoupling)

The final velocity of the photon = c

L- The Photon Acceleration
Photon Acceleration (The Excited Photon)

$$\frac{64 \times \pi^5 \times \varepsilon_0}{\alpha^4} = 61,1528568314\ m/s^2$$

Photon Acceleration (Moment after Decoupling)

$$\left(\frac{\sqrt{8} \times e^2 \times \pi}{\hbar \times \alpha^2 \times c}\right) = \left(\frac{\sqrt{128} \times \pi^2}{\alpha \times \mu_0 \times c^2}\right) = 1,35390309 \times 10^{-7}\ m/s^2$$

The Final Acceleration of the Photon

$$\left(\frac{e^2 \times (2\pi)}{\hbar \times \alpha \times c}\right) = \left(\frac{8 \times \pi^2}{\mu_0 \times c^2}\right) = 6,9861501 \times 10^{-10}\ m/s^2$$

M-Product of Velocity and Acceleration

$3,4272234 \times 10^{-3} \times 61,1528568314 =$
$1548002,2449 \times 1,35390309 \times 10^{-7}) =$
$c \times 6,9861501 \times 10^{-10}) =$

$$\left(\frac{e^2 \times (2\pi)}{\hbar \times \alpha}\right) = \left(\frac{8 \times \pi^2}{\mu_0 \times c}\right) = 0,209584503\ m^2/s^3$$

N-Photon Decoupling Time
Photon decoupling is closely related to recombination, which occurred about 378,000 years after the Big Bang, when the universe was hot opaque plasma.

$$\textbf{Decoupling time} = \frac{(1548002,2449)}{(1,35390309 \times 10^{-7})} = 1,1433627 \times 10^{13} s$$

$$\frac{(\alpha^3 \times \hbar \times c^2)}{(4 \times \pi \times e^2)} = 1,1433627 \times 10^{13} s$$

$$\frac{\alpha^2 \times c}{16 \times \pi^2 \times \varepsilon_0} = \frac{4 \times \pi^3 \times \hbar}{\alpha^2 \times c^2 \times m_{photon}} = 1,1425717 \times 10^{13} s$$

≈362319.6 years after big-bang

O-The Different Phases of the Radiation Eras
End of the Triassic era about 199 million years. The Triassic–Jurassic extinction event marks the boundary between the Triassic and Jurassic periods, and is one of the major extinction events of the Phanerozoic eon, profoundly affecting life on land and in the oceans. In the seas, a whole class and 23–34% of marine genera disappeared.

The end-Triassic extinction was the key moment that allowed dinosaurs to become the dominant land animals on Earth.

End of the Triassic era

$$= \frac{c^2}{0,209584503} = \frac{c}{6,9861501 \times 10^{-10}} = \frac{\alpha \times \hbar \times c^2}{2 \times \pi \times e^2} = 4.2942106 \times 10^{17} \text{ seconds}$$

=13607904963.1 years after big-bang (End of the Triassic era about 199 million years ago)

End of the Cretaceous era
Extinction of the Cretaceous and Paleocene era. This most famous global extinction, which is famous for eliminating the dinosaurs. The extinction was the mass extinction that occurred about 66 million years ago during the Mesozoic Era, wiping out up to 75% of plant and animal species on Earth at that time. Extinction events divided the Cretaceous (marking the end of the Mesozoic Era) and the Third Era (marking the beginning of the current Era known as the Cenozoic Era).

$$\frac{\alpha\times\hbar\times c^2}{2\times\pi\times e^2\times sin(82^\circ)}=\frac{c^2}{0{,}209584503\times sin(82^\circ)}=\frac{c^2}{0{,}207542}=\mathbf{4.3364717\times10^{17}}\ \boldsymbol{seconds}=$$

13741743299.1 years after big-bang (End of the Cretaceous era about 65 million years ago)

(82°=photon magnetic tilt)

P-The Lifetime of the Photon

$$\frac{2\times\pi\times\hbar\times c^2}{\alpha\times e^2}=\frac{\alpha^3\times c^5\times m_{photon}}{32\times\pi^3\times\varepsilon_0\times e^2}=\mathbf{3.1839973\times10^{23}}\ \boldsymbol{seconds}=\mathbf{1{,}0089755}\times$$

10^{16} years after big-bang.

Q-The Gravitational Force (Before Decoupling)

The gravitational force is a force that attracts any two objects with mass. We call the gravitational force attractive because it always tries to pull masses together, it never pushes them apart. This is called Newton's Universal Law of Gravitation.

The force between the electron and photon, given the mass of electron, is $9{,}109383\times10^{-31}$ kg and the mass of the photon is

2.3885215×10^{-58} kg. The distance between the electron and the photon is

3.240007×10^{-26}m.

$$F=\frac{G\times m_e\times m_{photon}}{r^2}=1{,}3832458\times10^{-47}N$$

$$\frac{64\times e^2\times\pi^6\times\varepsilon_0}{\alpha^4\times c^4\times m_e}\times\sqrt{\frac{\hbar\times c}{G}}=\frac{e^2\times\pi\times m_{photon}}{\sqrt{\hbar\times c\times G}\ \times m_e}=1{,}4551752\times10^{-47}N$$

R-A Study in the Double Slit Experiment

One of the most famous experiments in physics is the double slit experiment. It demonstrates, that little particles of matter have something of a wave about them, and suggests that the very act of observing a particle has a dramatic effect on its behavior.

Imagine firing electrons at our wall with the two slits, we'd expect two rectangular strips on the second wall, as with the tennis balls, but what we actually see is very different: the spots where electrons hit build up to replicate the interference pattern from a wave.

One possibility might be that the electrons somehow interfere with each other, so they don't arrive in the same places they would if they were alone. However, the interference pattern remains even when you fire the electrons one by one, so that they have no chance of interfering. Strangely, each individual electron contributes one dot to an overall pattern that looks like the interference pattern of a wave. Individual electron contributes one dot to an overall pattern that looks like the interference pattern of a wave. To find out, we might place a detector by the slits, to see which slit an electron passes through. And that's the really weird bit. If we do that, then the pattern on the detector screen turns into the particle pattern of two strips, the interference pattern disappears. Somehow, the very act of looking makes sure that the electrons travel like well-behaved little tennis balls. It's as if they knew they were being spied on and decided not to be caught in the act of performing weird quantum shenanigans.

What does the experiment tell us? It suggests that what we call "particles", such as electrons, somehow combine characteristics of particles and characteristics of waves. That's the famous wave particle duality of quantum mechanics. It also suggests that the act of observing, of measuring, a quantum system has a profound effect on the system. The question of exactly how that happens constitutes the measurement problem of quantum mechanics.

What does experience tell us? He suggests that what we call "inactive photons," somehow orbit around the stable electrons in a special orbit(The photon radius) . Where the release of electrons is like shooting a ball of photons. It also indicates that the act of observing and measuring the quantum system has a profound effect on the electron system.

It can cause the electron to enter an unstable state called an "excited state" where the photons on the electron shell are lower (Planck length) where the electron release is more like a particle release. This is the famous wave-particle duality of quantum mechanics [3,4].

S-Others Characteristics of Inactive-Photons (Before Decoupling)

$$\mathbf{Energy}=\frac{64\times\pi^5\times\hbar\times\varepsilon_0}{\alpha^4\times c}=m_{photon}\times c^2=2,1496694\times 10^{-41}\ \mathbf{Jouls}$$

$$\boldsymbol{Speed}=\frac{64\times\pi^5\times\varepsilon_0}{\alpha^4}\times\sqrt{\frac{G\times\hbar}{c^5}}=m_{photon}\times\sqrt{\frac{G\times c}{\hbar}}=3.2911479\ \times 10^{-42}\ m/s$$

$$\mathbf{Force}=\frac{64\times\pi^5\times\varepsilon_0}{\alpha^4}\times\sqrt{\frac{\hbar\times c}{G}}=m_{photon}\times c^3\times\sqrt{\frac{c}{\hbar\times G}}=1,33143\times 10^{-6}\ \mathbf{N}.$$

$$\mathbf{Density}=\frac{64\times\pi^5\times e^2\times\varepsilon_0}{\alpha^5\times\hbar\times G\times c^3}=\frac{e^2\times(2\pi)\times m_{photon}}{\alpha\times\hbar^2\times G}=7.112475\times 10^{-15}\ \mathbf{Kg\ m^{-3}}$$

$$\mathbf{Pressure}=\frac{64\times\pi^5\times e^2\times\varepsilon_0}{\alpha^5\times\hbar\times G\times c}=\frac{e^2\times(2\pi)\times m_{photon}\times c^2}{\alpha\times\hbar^2\times G}=640,12275\mathbf{Pa}.$$

$$\mathbf{Current}=\frac{128\times\pi^5\times\times\varepsilon_0}{\alpha^4}\times\sqrt{\frac{\pi\times\hbar\times\varepsilon_0}{c}}=m_{photon}\times c^3\times\sqrt{\frac{4\times\pi\times\varepsilon_0}{c}}=3,8244898\times 10^{-25}\mathbf{A}$$

$$\mathbf{Tension}=\frac{32\times\pi^4}{\alpha^4}\times\sqrt{\frac{\pi\times\varepsilon_0\times\hbar}{c^3}}=\frac{m_{photon}\times c^2}{\sqrt{4\times\pi\times\varepsilon_0\times c\times\hbar}}=1,14576\times 10^{-23}\mathbf{V}$$

$$\boldsymbol{Momentum}=\frac{64\times\pi^5\times\hbar\times\varepsilon_0}{\alpha^4\times c^2}=m_{photon}\times c=7,1655645\times 10^{-50}N.s$$

$$\mathbf{Frequency}=\frac{64\times\pi^5\times\varepsilon_0}{\alpha^4\times c}=m_{photon}\times\frac{c^2}{\hbar}=2,0384286\times 10^{-7}\ Hertz$$

$$\mathbf{Mechanical\ impedance}=$$

$$\frac{64\times\pi^5\times\varepsilon_0}{\alpha^4}\times\sqrt{\frac{\hbar}{c\times G}}=m_{photon}\times c^3\times\sqrt{\frac{1}{G\times\hbar\times c}}$$
$$=4.4381145\times 10^{-15}\ Kg\ s^{-1}$$

$$\boldsymbol{Linear\ density}=\frac{64\times\pi^5\times\varepsilon_0}{\alpha^4}\times\sqrt{\frac{\hbar}{c^3\times G}}=m_{photon}\times c^2\times\sqrt{\frac{1}{G\times\hbar\times c}}$$
$$=1,4793715\ \times 10^{-23}Kg\ m^{-1}$$

Conclusion

Scientists have investigated the nature of light since ancient times; they went back and forth on the answer to one question in particular: Does light behave as a particle or as a wave? After this study, it can be confirmed that the photon has mass. It is traditionally said that photons are massless. This is the form of speech physicists use to describe something about how to describe the particle-like properties of a photon in the language of special relativity. Logic can be constructed in many ways, and this theory is one of them.

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