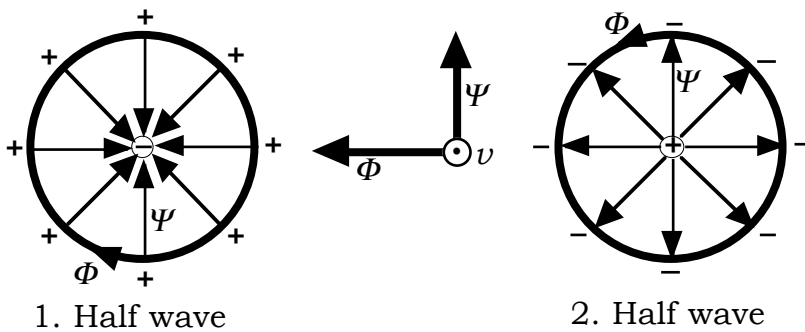


**FUNDAMENTAL FACTS ABOUT PHOTONS**

Based on the Finnish original "Perustietoa fotonista" in Sähkö & Tele (2007)/6 pp. 47...49.

According to Max Planck, the energy of a photon can be derived from the equation  $E = hf$ , in which  $h$  is Planck's constant and  $f$  the oscillation frequency of a photon. The photon also has a spin  $L_f = h/(2\pi)$ , discovered by Niels Bohr. In addition, we shall assume that Planck's constant fulfills the equation  $h = \Psi\Phi$ , in which  $\Psi$  is the electric flux and  $\Phi$  the magnetic flux of a photon. Using this information, this article explores the structure of photons and some of their attributes.



**Graph 1.** Flux vectors and dissections of the half waves of a photon in an electromagnetic state, as the photon approaches the spectator at speed  $v$ .

**Photon fluxes and the moment of inertia**

In graph 1, the photon's magnetic flux  $\Phi$  consists of circular strands and its electric flux  $\Psi$  of strands contained within and perpendicular to the magnetic flux.

If the direction of the electric flux vector  $\Psi$  is described as upwards, as the photon approaches the spectator, must the direction of the magnetic flux vector  $\Phi$  be from right to left, as in graph 1, because according to electromagnetic theory  $\Psi = \epsilon\Phi \times v$  and  $\Phi = -\mu\Psi \times v$ , where  $\epsilon$  is the permittivity and  $\mu$  the permeability of the medium.

The oscillation frequency of a photon can be derived from the equation  $f = v/\lambda$ , in which  $\lambda$  is the wavelength of the photon. A photon can also rotate around its traveling axis, in which case its spin can be calculated using the moment of inertia from the equation  $L_f = 2\pi nJ$ , in which  $J$  is the photon's moment of inertia and  $n$  its spinning frequency around its traveling axis.

To calculate a photon's moment of inertia, the following line of equations can be used:  $2\pi nJ = h/(2\pi) = \Psi\Phi/(2\pi)$ . From this follows that  $J = h/(4\pi^2 n) = \Psi\Phi/(4\pi^2 n)$ , from which we see that a photon's moment of inertia is inversely proportional to its spinning frequency  $n$ . The greater a photon's spinning frequency, the smaller is its moment of inertia, and vice versa.

The energy of a photon's spinning movement can be derived from the following line of equations:  $E_s = 0,5\omega^2 J = 2\pi^2 n^2 J$ . The subscript  $s$  refers to the photon's spin and  $\omega = 2\pi n$  is the angular speed of a spinning photon.

**The energy of a spinning photon**

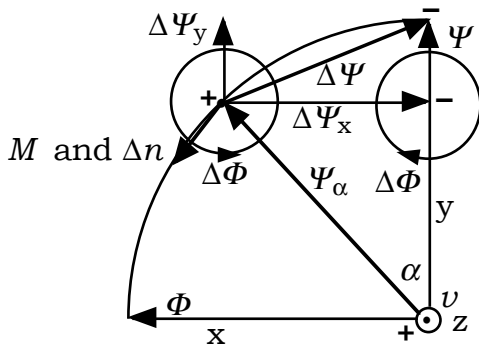
According to Planck’s law, the entire energy of a spinning photon can be derived from the following line of equations:  $E = hf = 4\pi^2 nJf$ . If  $n = f$  we arrive at  $E = 4\pi^2 nJn = 4\pi^2 fJf$ . The spin of the photon accounts for half of this energy,  $E_s = 2\pi^2 nJn$ , therefore the photon’s forward movement is left with exactly another half of the entire energy of the spinning photon.

This forward movement energy comes from the following line of equations:  $E_f = 2\pi^2 nJf = 2\pi^2 fJf = hf/2 = mc^2/2$ , where  $m = hf/c^2 = \Psi \Phi f/c^2$ , because also Einstein’s equation  $E = mc^2$  must apply. It follows from above that a photon’s energy is in all mediums dependent on its oscillation frequency  $f$  or spinning frequency  $n$ .

The spinning movement of a photon does not impede its progress at a light speed. But it is well-known that a photon cannot "survive" unless it always proceeds at light speed,  $v = \pm 1/(\epsilon\mu)^{0,5}$ , in which the largest value is,  $c = \pm 1/(\epsilon_0\mu_0)^{0,5}$ , where  $\epsilon_0$  is the permittivity and  $\mu_0$  the permeability of a vacuum.

**During a single spin, a photon travels the distance  $\lambda = v/f$**

Based on the above assumption and the law of the conservation of the spin, the following balance equation can be created for a spinning photon  $\Psi\Phi/(2\pi) = 2\pi nJ$ , from which follows  $\Psi\Phi = 4\pi^2 nJ$ . The law of the conservation of energy gives exactly the same result as the law of the conservation of the spin, if  $f = n = v/\lambda$ . In other words, if the absolute values of a photon’s oscillation and spinning frequency are equal, and if the photon travels exactly one wavelength during a single spin.



**Graph 2.** An external interference creates a torque.

In graph 2 the electric flux vector  $\Psi$  has turned counterclockwise for the amount of angle  $\alpha$  due to external interference. Vector  $\Delta\Psi$  and its components describe the consequences of this interference. The vector  $\Delta\Psi$  moves at speed  $v$  along with the photon at the direction of the  $z$  axis towards the spectator. Its point of origin can be imagined to have a positive charge, and its point of apex a negative charge. Around the point of origin a magnetic flux ring  $\Delta\Phi$  is created, which reinforces the magnetic field convergent with the original magnetic flux above the point of origin of vector  $\Delta\Psi$ , and decreases the original magnetic flux below the point of origin. Hereby a counterclockwise torque  $M$  is created.

A magnetic flux ring is also formed around the point of apex of vector  $\Delta\Psi_x$ . It also creates a counterclockwise torque. Should the flux vector  $\Psi$  have

swung clockwise at first, the spinning would have begun and continued clockwise.

The above leads to the conclusion that due to the spinning of the electric flux  $\Psi$ , both original fluxes of the electromagnetic state  $\Psi$  and  $\Phi$  will begin to decrease. At the same time, energy begins to flow from the "photon's electromagnetic energy reserve" to rotate the photon's moment of inertia around its traveling axis, because due to the external interference the photon has "decided to move" from a state of electromagnetic equilibrium to a state of electromechanical equilibrium, in which the spinning movement can completely cancel the photon's original fluxes  $\Psi$  and  $\Phi$ .

### **How to define the counter-fluxes created by spinning movement**

Based on what has been stated so far, the following applies  $\Phi\Psi = 4\pi^2 nJ$ . Because the photon's wave impedance can be derived from the equation  $Z = \Phi / \Psi$ , this impedance can be used to find the following equations  $\Phi_s = \pm 2\pi(nJZ)^{0,5}$  and  $\Psi_s = \pm 2\pi(nJ/Z)^{0,5}$ . In addition, it is true that  $\Phi_s \Psi_s = 4\pi^2 nJ$ , where  $\Phi_s$  is the magnetic counter flux and  $\Psi_s$  the electric counter flux caused by a photon's spinning movement.

When a spinning photon has ended up in an electromechanical equilibrium, this state can be described by  $\Phi - 2\pi(nJZ)^{0,5} = 0$  and  $\Psi - 2\pi(nJ/Z)^{0,5} = 0$ . Because  $Z = \Phi / \Psi = (L/C)^{0,5}$  and  $n = (1/LC)^{0,5}$ , also the following line of equations are valid:

$$\Phi_s = \pm 2\pi(nJZ)^{0,5} = \pm 2\pi n(LJ)^{0,5} = \pm 2\pi(J/C)^{0,5} \text{ and}$$

$$\Psi_s = \pm 2\pi(nJ/Z)^{0,5} = \pm 2\pi n(CJ)^{0,5} = \pm 2\pi(J/L)^{0,5},$$

where  $L$  is photon's inductance and  $C$  its capacitance.

It seems that electromechanical equilibrium is a more "advantageous state" for a photon than electromagnetic equilibrium.

When counter fluxes  $\Phi_s$  and  $\Psi_s$  have canceled the original fluxes  $\Phi$  and  $\Psi$  of a photon's electromagnetic state, the photon has become a neutral but spinning particle of an apparent mass, that proceeds at light speed dependent on the medium.

Electromechanical equilibrium and an electromagnetic state are alternative states for a photon. If a photon ceases to spin, it immediately transforms into the electromagnetic state described in graph 1. Nevertheless, based on what has been stated above, the electromechanical equilibrium seems to be the state that a photon "always seeks, if possible". More in references [1]...[3].

### **Medium and gravity affect also a spinning photon**

A spinning photon appears to be a very stable particle. Electromagnetic fields do not impede its progress. However a photon is always a part of the medium or environment, in which it is moving. For a photon even a vacuum is a medium, and a photon can also be part of a vacuum.

By altering its moment of inertia, a photon can keep its spinning frequency and energy constant, if moving from one medium to another does not cause energy losses. A long time ago people used to wonder, why a lens made out of ice did not melt when it focused sunlight to ignite a stack of gunpowder. The answer is, that the progress of light thorough a lens made out of clean ice did not consume a significant amount of the energy of sunlight photons.

Gravity fields have an effect on photons. If a photon "ascends" in a gravity field in a vacuum, it keeps its velocity at value  $c$ , but decreases its frequency  $f$  and increases its wavelength  $\lambda = c/f$ .

The products  $fc$  and  $nc$  describe the acceleration ability of a photon oscillating or spinning at frequency  $f = n$ , with which it is able to maintain its velocity at value  $c$  during its ascent in vacuum-like conditions.

The acceleration ability of a photon, oscillating or spinning at great frequencies, the product  $fc$  or  $nc$ , always conquers the gravity field's acceleration rate  $GM/r^2$ , where  $G$  is the gravitational constant,  $M$  the mass of a celestial body and  $r$  the distance from the photon to the centre of the celestial body. There is more information on this topic in some of the publications cited in reference [1].

If a photon "descends" in a gravity field, its frequency increases and wavelength decreases. By decreasing its wavelength, a "descending" photon can in turn obtain energy from a gravity field.

Photons in a spinning particle format can transport energy to distances up to several millions of light years. A gravity field cannot capture a photon, if its frequency is great enough. But a photon will reflect back to its original direction, if its acceleration ability, the product  $fc$  or  $nc$ , is smaller than required for the gravity acceleration rate  $GM/r^2$  to conquer it. In this case the photon will be too large to ascend to an upper level within the gravity field. Therefore, us humans seem to be living inside an enormous "black bubble".

### **Can an exploding graviton create matter**

As descending and ascending photons collide, the collisions may create gravitons, whose spin is double that of a photon. Gravitons do not require traveling velocity in order to "survive", unlike photons that always do.

Photons and gravitons can "descend" in a gravity field. As they descend, their energies increase. Simultaneously, both increase their spinning frequencies. If the spinning frequency of a photon or a graviton becomes too great, they explode. An exploding photon may be divided into two parts. These partial photons oscillate or spin at half the frequency of the exploded photon.

However, it seems possible that as a graviton explodes, two protons and two electrons may be created - in other words the building blocks for two hydrogen atoms. If this is the case, the basis of the "Big Bang" theory collapses. This topic is also dealt with in more detail in some publications cited in reference [1].

### **References**

[1] [www.osmo.hassi.net/Publications](http://www.osmo.hassi.net/Publications)

[2] Hassi, O. : Fotonin malli, Tampereen teknillisen yliopiston erikoisjulkaisu, ISBN 952-15-1004-8, Tampere 2003, 114 pages. (Photon model, a special publication of Tampere University of Technology. A model of the structure, behavior and energy of a photon).

[3] Hassi, O. : Palapeliä fotoneilla (Puzzle with photons), Tampere University of Technology. Publications 1994. 30 pages.