Research article
Photon: a first model that describes it.

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I am the author of the following textbooks:

1. “Verso la Fisica”, published by Arianna Edition: text intended for the two-year period of the
scientific high school, of which the link is the following link
https://www.amazon.it/s?k=verso+la+fisica&__mk_it_IT=AMAŽON&ref=nb_sb_noss
2. “Con me stanno buoni”, a book that presents a realistic presentation of today's school,
going beyond the facade that hides it.
https://www.amazon.it/s?k=con+me+stanno+buoni+francesco+ferrara&__mk_it_IT=AMAŽON&ref=nb_sb_noss

3. **Il danzatore cosmico**, Aracne edizioni, divulgation physics text
https://www.youtube.com/watch?v=gTgkX2K1RFE

1. Introduction

My name is Francesco Ferrara, I am a physics teacher and an independent researcher.
I have always shown a keen interest in science, favoring a type of holistic approach: my interests range from physics to electronics to medicine to philosophy.

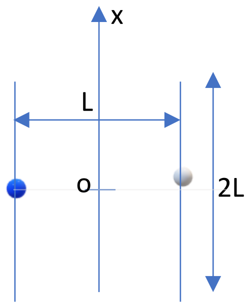
My research mainly makes use of unofficial sources, coming mainly from the network world, which tend to promote content other than officially accepted. I believe that the contribution that independent researchers have given to science, in the most disparate sectors, is noteworthy, these scientific researchers were motivated exclusively by a healthy curiosity, devoid of economic interests.

1.1 Nomenclature

Physical dimension.	***Symbol***	***Unit of measure***
Duration of pulse	τ	s
Maximum intensity of the current generated by the positive sphere.	i_p	A
Maximum intensity of the current generated by the negative sphere.	i_n	A
Period of the waveform of the current through a generic section	T	s
Length of the two strings of current	2L	m
Charge of the positive sphere	$q_+ = q_p$	C
	$q_p = 1.60217733 \times 10^{-19}\ C$	
Sphere speed positively charged	$v_p(t)$	m/s
Sphere speed negatively charged	$v_n(t)$	m/s
Average speed, on a period, for the negatively charged, sphere	v_{nm}	m/s

Average speed, on a period, for the positively charged sphere.	v_{pm}	m/s
Angular pulsation of the two spheres	ω	s^{-1}

2. Presentation of model

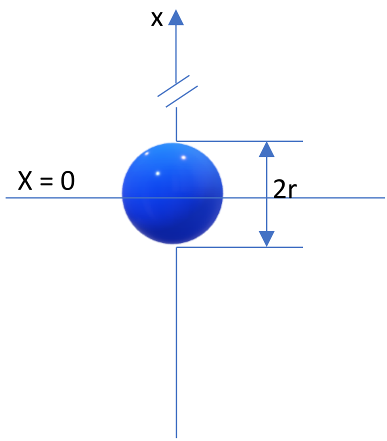


The model of photon, implemented by me, is composed of two parallel strings, with a length equal to 2L, (L≃7,424791147·10−15m), the distance between the strings is, also, equal to 2L.
Two spheres, without mass, one positively charged and one negatively charged, having both radii, equal to the classic radius of the electron, they move, with harmonic motion, at one speed equal to the speed of the light.
Each of the spheres describes a current string.
One of two sphere has a positive charge, the other sphere has a negative charge. The two spheres have the same radius go in the same direction.
Since the two spheres have opposite charge and they go in the same direction, the currents generated by the two spheres have opposite direction.

The speed of the spheres has a sinusoidal waveform, it reaches a maximum value for x = 0, on the contrary, is zero when x =L and x = -L

We refer, now, to the section corresponding to x = 0. In this section the speed will be maximum and equal to that of the light c.
We indicate with τ, the time interval required for the charged sphere to pass through the abscissa section x = 0, it is possible to write:

$$\tau = \frac{2r}{c} \quad \text{Relation 1}$$



We calculate the current that passes through the section having abscissa x = 0, we have:

Relation 2

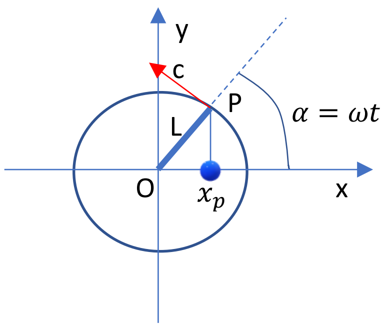
$$\frac{ec}{2r}$$

When a time, equal to half period, is elapsed, the sphere will pass again through the abscissa section x = 0,

proceeding downwards. Therefore, a current pulse of equal amplitude, $\frac{ec}{2r}$, but negative will be generated.

To calculate the duration of a period, i.e. the time taken by the sphere to make a complete oscillation, is possible to consider the harmonic motion of the sphere, along the string, such as the projection, along a diameter, of a point that moves with circular motion and uniform along a circumference of radius L, at a speed equal to that of light.

Figure 1

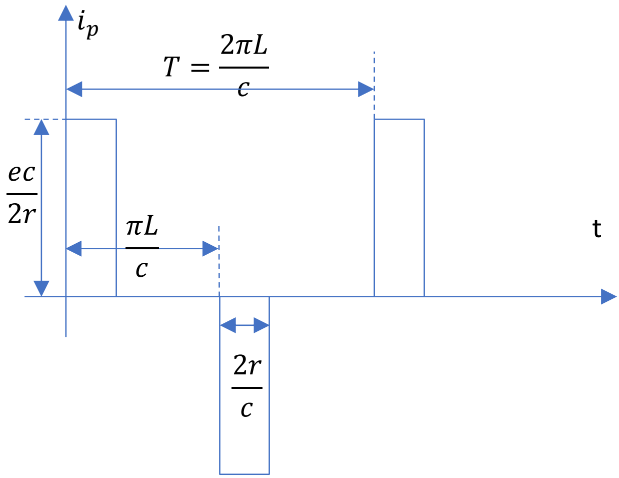


The period, that means, the time elapsed to complete an oscillation, has the following analytic expression:

Relation 3

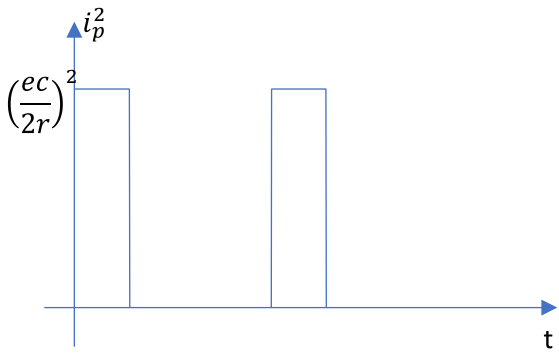
$$T = \frac{2\pi L}{c}$$

Elapsed a time equal to half period, the sphere transits again through the section x = 0, but, this time, however, it will proceed in the opposite direction.



The sphere generates a pulse of current that have equal intensity with respect the previous pulse, but negative.

The power engaged is proportional to the square of the current. We consider, now, a graphic that have, the time as variable, on the abscissas axis and that have the square of the current as variable on the ordinate axis. The graphic following regards the abscissa x = 0 of the string of current.



In a time, equal to half a period, the sphere will have crossed the entire string. The intensity of the current, however, will vary in the different sections of the string, in fact, the speed of the sphere will have a sinusoidal trend as a function of the variable x. The current will be maximum at the abscissa x = 0 and will be zero at the abscissa x = L and x = -L (Look at the figure 1)

Looking at the figure 1, we can write the following expression for the abscissa x_p and for the speed of the sphere in function of the time.

Relation 4

$$x_p = L\, cos\, \omega t$$

Relation 5

$$\dot{x}_p = v = -L\omega\, sin\, \omega t$$

Looking at the relation 2, we can write an expression of the current, on function of the time, substituting in place of the quantity c, the relation 5. We have:

Relation 6

$$i_P(t) = -\frac{e}{2r}\omega L\, sin\, \omega t$$

The string formed by the negative sphere generates a current equal to that of the string formed by the positive sphere, but of opposite sign.

Relation 7

$$i_n(t) = \frac{e}{2r}\omega L\, sin\, \omega t$$

The electric power generated from the positive string will be equal to the electric power generated to the negative string. To calculate the electric power, we can square the expression of the current and to multiply the value obtained, for the characteristic impedance of the vacuum. We have:

Relation 8

$$p(t) = \frac{e^2\omega^2L^2z_0}{4r^2} \cdot sen^2\omega t$$

The relation 8 represents the trend of the physical quantity, "power", with the variation of the time, only for one of the strings.

To calculate the overall power, both strings must be considered, so you need to multiply the relationship 8, by two. We have:

Relation 9

$$p_{totale}(t) = \frac{e^2\omega^2L^2z_0}{2r^2} \cdot sen^2\omega t$$

Let us now calculate the integral of the relationship 8 over time, integrating precisely for the duration of the entire period. In this way, we will obtain the energy engaged in the whole period.

The energy of the system in a period will be given by the following relation:

Relation 10

$$E_{totale} = \int_0^T p_{totale}(t)dt = \int_0^T \frac{e^2\omega^2L^2z_0}{2r^2} \cdot sen^2\omega t dt$$

Calculating we have:

Relation 11

$$\boldsymbol{E_{totale} = \frac{e^2 L^2 z_0^2 \pi}{2r^2} \cdot \omega}$$

The relationship obtained is very significant, since it testifies that, the object we have implemented has behavior, like that of a photon.

In fact, the expression of energy, is the product between two quantities: one of this quantity is the angular pulsation, the other, is a quantity that contains some constants, the length of the two strings, the radius classic of electron, the vacuum's impedance, the electron's charge.

The relation’s structure 8, is like to the Planck's relation's structure:

Relation 12

$$E = \hbar\omega$$

We impose that the second members of relations 11 and 12 are equal. We have:

$$\boldsymbol{\frac{e^2 L^2 z_0^2 \pi}{2r^2}} = \hbar$$

We have:

$$\frac{L}{r} = \sqrt{\frac{2\hbar}{e^2 \pi z_0}}$$

Substituting the numerical values, we have:

$$\frac{L}{r} = \sqrt{\frac{2\hbar}{e^2 \pi z_0}}$$

$$= \sqrt{\frac{2 \times 1.05457266 \ \cdot 10^{-34}}{(1.60217733 \times 10^{-19})^2 \times \pi \times \cdot\ 376.730313461}}$$

$$= 2{,}63482909$$

The quantity r is the classic radius of electron. We know the ratio L/r, we can calculate the string's length. We have:

$L = r \cdot 2{,}63482909 \simeq$

$2{,}817940326727 \cdot 10^{-15} \cdot 2{,}63482909 \simeq 7{,}424791147 \cdot 10^{-15}$ m