The Sagnac Experiment analyzed with the "Emission & Regeneration" UFT

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Last revision December 2015

(This paper is an extract of [10] listed in section Bibliography.)

Abstract

The results of the Sagnac experiment analyzed with the Standard Model (SM) are not compatible with Special Relativity and are easily explained with non relativistic equations assuming that light moves with light speed independent of its source.

The Sagnac results analyzed with the "Emission & Regeneration" UFT [10] present no incompatibilities within the theory. The theory is based on an approach where subatomic particles such as electrons and positrons are modeled as focal points in space where continuously fundamental particles are emitted and absorbed, fundamental particles where the energy of the electron or positron is stored as rotations defining longitudinal and transversal angular momenta (fields). Interaction laws between angular momenta of fundamental particles are postulated in that way, that the basic laws of physics (Coulomb, Ampere, Lorentz, Maxwell, Gravitation, bending of particles and interference of photons, Bragg, etc.) can be derived from the postulates. This methodology makes sure, that the approach is in accordance with the basic laws of physics, in other words, with well proven experimental data.

The "Emission & Regeneration" UFT postulates that light is emitted with light speed relative to the emitting source and that light is absorbed by lenses and electric antennas of the measuring instruments and subsequently emitted with light speed, explaining the constancy of light speed in all inertial frames.

Special Relativity derived in the frame of the "E & R" UFT has absolute time and absolute space resulting in a theory without paradoxes.

1 Emission Theory.

The assumption of our standard model that light moves with light speed c independent of the emitting source induces the existence of an absolute reference frame or ether, but at the same time the model is not compatible with such absolute frames.

The objections made by Willem de Sitter in 1913 about Emission Theories based on a star in a double star system, is based on a representation of light as a continuous wave and not as bursts of sequences of FPs with opposed transversal angular momenta with equal length L . The concept is shown in Fig 1.

In the quantized representation photons with speeds $c+v$ and $c-v$ may arrive simultaneously at the measuring equipment placed at C showing the two Doppler spectral lines corresponding to the red and blue shifts in accordance with Kepler's laws of motion. No bizarre effects, as predicted by Willem de Sitter, will be seen because photons of equal length L and λ with speeds $c+v$ and $c-v$ are detected independently by the measuring instrument giving well defined lines corresponding to the Doppler effect.

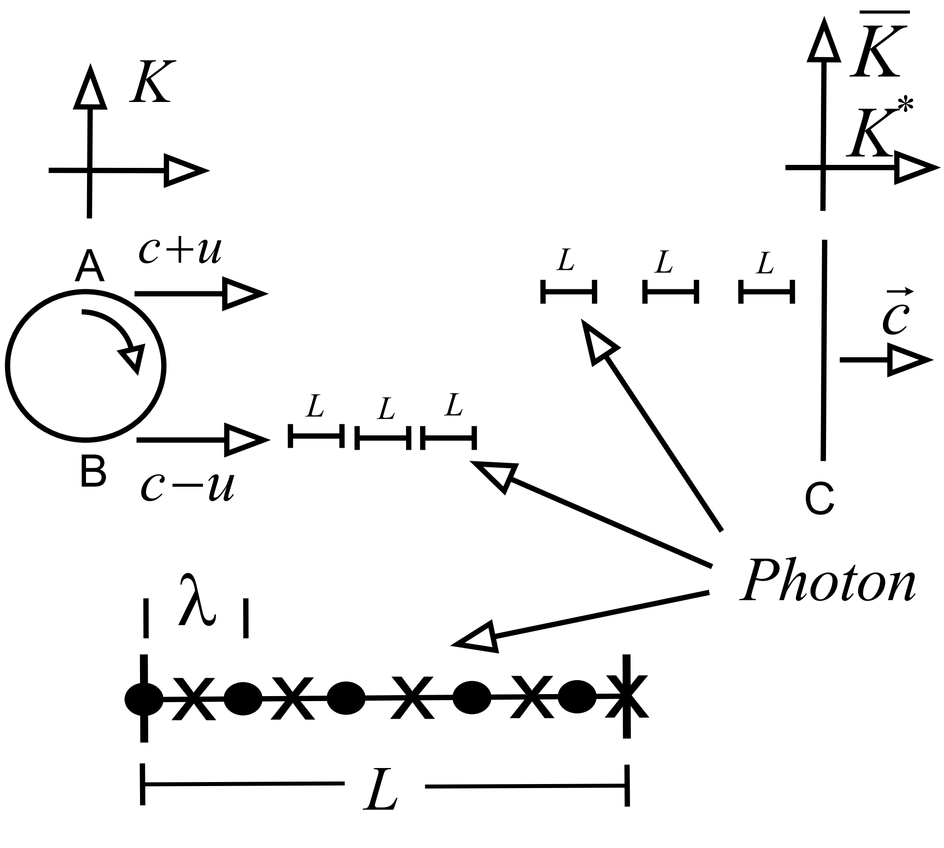

Figure 1: Emission Theory.

Fig 1 shows how bursts of Fundamental Particles (FPs) with opposed angular momenta (photons) emitted with light speed c by a star in a double star system, travel from frame K to frames $\bar{K}$ and K^* with speeds $c+u$ from A and $c-u$ from B. When they arrive at the measuring instruments at C, the transformations to the frames $\bar{K}$ and K^* take place and the photons are emitted with the speed of light c relative to these frames explaining the constancy of the light speed in inertial frames.

The emission time of photons from **isolated** atoms is approximately $\tau = 10^{-8}\ s$ what gives a length for the wave train of $L = c\ \tau = 3\ m$. The total energy of the emitted photon is $E_t = h\ \nu_t$ and the wavelength is $\lambda_t = c/\nu_t$. We have defined that the photon is composed of a train of FPs with alternated angular momenta where the distance between two consecutive FPs is equal $\lambda_t/2$. The number of FPs that build the photon is therefore $L/(\lambda_t/2)$ and we get for the energy of one FP

$$E_{FP} = \frac{E_t\ \lambda_t}{2\ L} = \frac{h}{2\ \tau} = 3.313 \cdot 10^{-26}\ J = 2.068 \cdot 10^{-7}\ eV \tag{1}$$

and for the angular frequency of the angular momentum h

$$\nu_{FP} = \frac{E_{FP}}{h} = \frac{1}{2\ \tau} = 5 \cdot 10^{7}\ s^{-1} \tag{2}$$

The "Emission & Regeneration" UFT is based on a modern physical description of nature postulating that

- photons are emitted with light speed c relative to their source
- photons emitted with c in one frame that moves with the speed v relative to a second frame, arrive to the second frame with speed $c \pm v$.
- photons with speed $c \pm v$ are reflected with c relative to the reflecting surface
- photons refracted into a medium with $n = 1$ move with speed c independent of the speed they had in the first medium with $n \neq 1$.

The concept is shown in Fig. 2

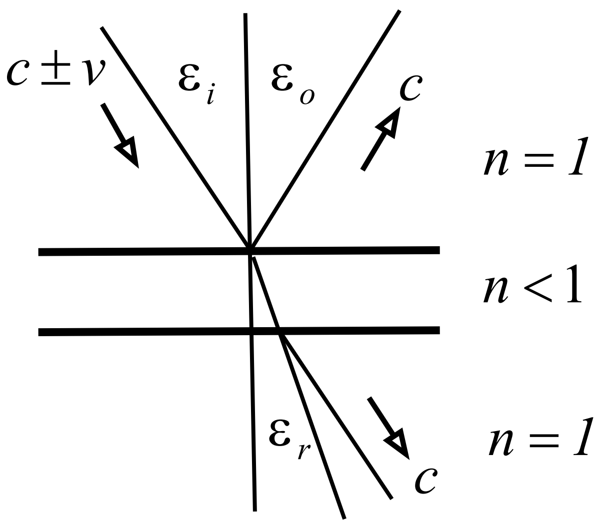

Figure 2: Light speed at reflections and refractions

2 Special Relativity based on absolute time and space.

Space and time are variables of our physical world that are intrinsically linked together. Laws that are mathematically described as independent of time, like the Coulomb and gravitation laws, are the result of repetitive actions of the time variations of linear momenta [10].

To arrive to the transformation equations Einstein made abstraction of the physical cause that makes that light speed is the same in all inertial frames. The transformation rules show time dilation and length contraction.

The Lorenz transformation applied on speed variables, as shown in the proposed approach, is formulated with absolute time and space for all frames and takes account of the physical cause of constancy of light speed in all inertial frames.

To show the difference between Einstein's approach and the proposed, we start with the formulation of the general Lorentz equation with space and time variables as shown in Fig. 3.

$$x^2 + y^2 + z^2 + (ic_o\, t)^2 = \bar{x}^2 + \bar{y}^2 + \bar{z}^2 + (ic_o\, \bar{t})^2 \tag{3}$$

For distances between two points eq. (3) writes now

$$(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 + (ic_o\, \Delta t)^2 = (\Delta \bar{x})^2 + (\Delta \bar{y})^2 + (\Delta \bar{z})^2 + (ic_o\, \Delta \bar{t})^2 \tag{4}$$

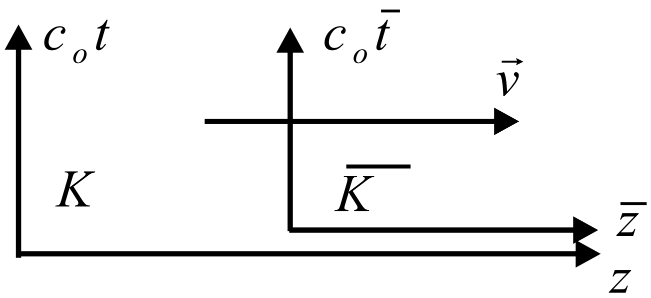

Figure 3: Transformation frames for **space-time** variables

The fact of equal light speed in all inertial frames is basically a speed problem and not a space or time problem. Therefor, in the proposed approach, the Lorentz equation is formulated with speed variables and absolut time and space dividing eq. (4) through the **absolute time** $(\Delta t)^2$ and introducing the forth speed v_c.

$$v_x^2 + v_y^2 + v_z^2 + (iv_c)^2 = \bar{v}_x^2 + \bar{v}_y^2 + \bar{v}_z^2 + (i\bar{v}_c)^2 \tag{5}$$

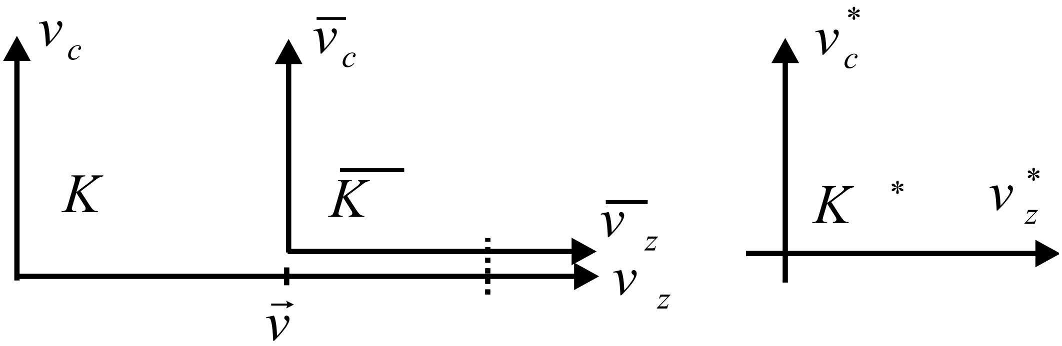

Figure 4: Transformation frames for **speed** variables

For the special Lorentz transformation with speed variables we get the following transformation rules between the frames K and $\bar{K}$:

a) $\bar{v}_x = v_x \qquad v_x = \bar{v}_x$

b) $\bar{v}_y = v_y \qquad v_y = \bar{v}_y$

c) $$\bar{v}_z = \frac{v_z - v}{\sqrt{1 - v^2/v_c^2}} \qquad v_z = \frac{\bar{v}_z + v}{\sqrt{1 - v^2/\bar{v}_c^2}}$$

d) $$\bar{v}_c = \frac{v_c - \dfrac{v}{v_c}\, v_z}{\sqrt{1 - v^2/v_c^2}} \qquad v_c = \frac{\bar{v}_c + \dfrac{v}{\bar{v}_c}\, \bar{v}_z}{\sqrt{1 - v^2/\bar{v}_c^2}}$$

According to the approach "Emission & Regeneration" Unified Field Theory [10] from the author, electromagnetic waves that arrive from moving frames with speeds different than light speed to measuring instruments like optical lenses or electric antennas, are absorbed by their atoms and subsequently emitted with light speed c_o in their own frames. To take account of the behaviour of light in measuring instruments an additional transformation is necessary.

In Fig 4 the instruments are placed in the frame K^* which is linked rigidly to the *virtual* frame $\bar{K}$ and electromagnetic waves arrive from the frame K with the speed $\bar{v}_z$ in the *virtual* frame $\bar{K}$. The potentiality of the virtual frame $\bar{K}$ consists in that electromagnetic waves can move with all possible speeds in that frame. The frequencies of electromagnetic waves that pass from the virtual frame $\bar{K}$ to the frame K^* are invariant resulting the following transformation rules between the two frames:

$$
\begin{array}{llll}
\text{e)} & v_x^* = \bar{v}_x & \text{f)} & v_y^* = \bar{v}_y \\
\text{g)} & v_z^* = \bar{v}_z & \text{h)} & f_z^* = \bar{f}_z
\end{array}
$$

The link between the frames K and $\bar{K}$ is given by the wavelengths $\lambda = \bar{\lambda}$ which are invariant because there is **no length contraction**.

The links between the frames are:

$$
\begin{array}{ll}
K \to \bar{K} & \bar{K} \to K^* \\
\lambda = \bar{\lambda} & \bar{f} = f^*
\end{array}
$$

Note: All information about events in frame K are passed to the frames $\bar{K}$ and K^* exclusively through the electromagnetic fields E and B that come from frame K. Therefore all transformations between the frames must be described as transformations of these fields, what is achieved through the invariance of the Maxwell wave equations.

3 Sagnac Experiment.

In the frame of our Standard Model (SM) the results of the Sagnac experiment are not compatible with Special Relativity and easily explained with non relativistic equations, but still assuming that light moves with light speed independent of its source.

The equations for the Sagnac experiment are now derived based on the emission, reflection and refraction postulates of the "E & R" UFT.

The concept is shown in Fig. 5

Fig. 1 of Fig. 5 shows the arrangement with a light source at point "0" and a detector for the two counter-rotating light rays also at point "0'. Mirrors are placed at points "1", "2", ..."n" of the ring. The tangential speed of the rotating arrangement is "v".

Points “0” and “1” are placed in the parallel planes “a” and “b”. For the time a photon of the length L and wavelength λ takes to pass from plane “a” to plane “b” the relative speed between them of $v_r = v(1-\cos\varphi)$ can be assumed constant. If we imagin that plane “a“ moves relative to plane “b” then, according to the emission theory, the speed of the ray that leaves “a” in the direction of “ b “ has the speed $v_{b_i} = c - v_r$ as shown in Fig. 2 of Fig. 5.

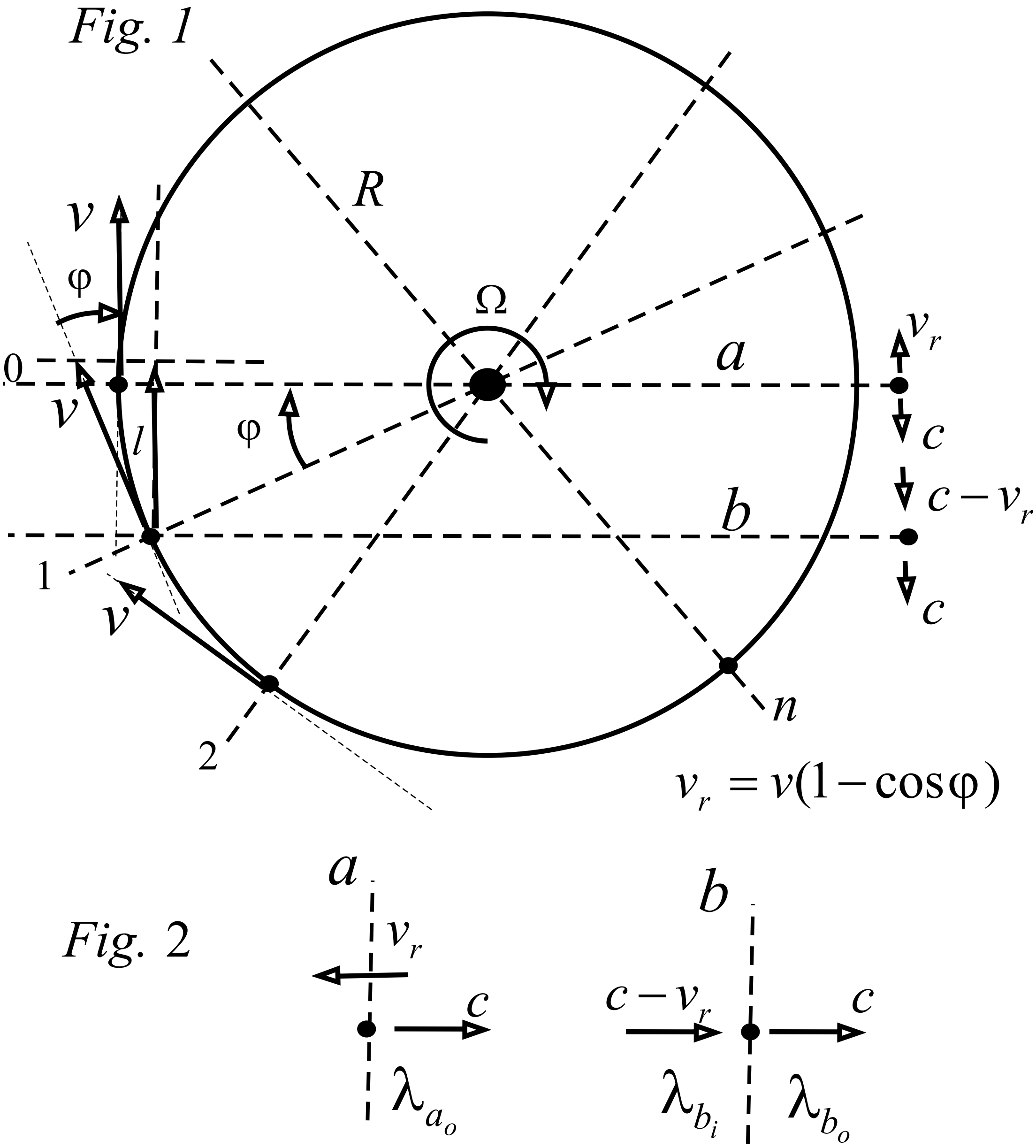

Figure 5: Sagnac experiment

Also according to the emission theory the output wavelength λ_{a_o} at “a” must be equal to the input wavelength λ_{b_i}. We get for the frequancies ν

$$\lambda_{b_i} = \frac{c - v_r}{\nu_{b_i}} = \lambda_{a_o} \qquad \rightarrow \qquad \nu_{b_i} = \frac{c - v_r}{\lambda_{a_o}} \tag{6}$$

The frequencies at the input and output of plane “b” must be equal

$$\nu_{b_i} = \frac{c - v_r}{\lambda_{a_o}} = \nu_{b_o} = \frac{c}{\lambda_{b_o}} \qquad \rightarrow \qquad \lambda_{b_o} = \frac{c}{c - v_r}\lambda_{a_o} \tag{7}$$

Writing the last equation with the nomenclature used for the points “0” and “1” we get

$$\lambda_{1_o} = \frac{c}{c - v_r}\lambda_{0_o} \tag{8}$$

and for the points “1” and “2” we get

$$\lambda_{2_o} = \frac{c}{c - v_r}\lambda_{1_o} = \left(\frac{c}{c - v_r}\right)^2 \lambda_{0_o} \tag{9}$$

Generalising for “n” we get for the ray in counter clock direction

$$\lambda_{n_o} = \left(\frac{c}{c - v_r}\right)^n \lambda_{0_o} = \frac{1}{(1 - v_r/c)^n}\,\lambda_{0_o} \tag{10}$$

and for the ray in clock direction

$$\lambda'_{n_o} = \left(\frac{c}{c + v_r}\right)^n \lambda_{0_o} = \frac{1}{(1 + v_r/c)^n}\,\lambda_{0_o} \tag{11}$$

With

$$(1 \pm v_r/c)^{-n} = 1 \mp n(v_r/c) + \frac{n(n+1)}{2!}(v_r/c)^2 \mp ...... \qquad for \;\; |v_r/c| < 1 \tag{12}$$

neglecting all non linear terms we get for the wavelength

$$\lambda_{detect} = 1 + n(v_r/c)\lambda_{0_o} \qquad\qquad \lambda'_{detect} = 1 - n(v_r/c)\lambda_{0_o} \tag{13}$$

and for the difference

$$\Delta\lambda_{detect} = \lambda_{detect} - \lambda'_{detect} = 2\,n(v_r/c)\lambda_{0_o} \tag{14}$$

With R the radius of the ring we have that $\Omega = v/R$ and with $v_r = v(1 - \cos\varphi)$ we get

$$\Delta\lambda_{detect} = 2\,n\,\frac{R(1 - \cos\varphi)\lambda_{0_o}}{c}\,\Omega \tag{15}$$

For $n >> 1$ and with l the length of the arc on the ring between two consecutive mirrors, we can write that $2\pi\ R\ m \approx n\ l$ with m the number of windings of the fibre coil. We also have that $\cos\varphi \approx 1 - \varphi^2/2$ and that $\varphi = l/R$. We get

$$\Delta\lambda_{detect} = 2\ \pi\ m\ \frac{l}{c}\ \lambda_{0_o}\ \Omega \tag{16}$$

The wavelength difference between the clock and anticlockwise waves that arrive at the detector at "0" is proportional to the angular speed Ω of the arrangement.

The interference of two sinusoidal waves with nearly the same frequencies ν and wavelengths λ is given with

$$F(r,t) = 2\cos\left[2\pi\ \left(\frac{r}{\lambda_{mod}}\ -\ \Delta\nu\ t\right)\right]\ \sin\left[2\pi\ \left(\frac{r}{\lambda}\ -\ \nu\ t\right)\right] \qquad \lambda_{mod} \approx \frac{\lambda^2}{\Delta\lambda} \tag{17}$$

For our case it is $\Delta\nu = 0$ and $\Delta\lambda = \Delta\lambda_{detect}$ and we get

$$F(r,t) = 2\cos\left[4\pi^2\ m\ \frac{l}{\lambda_0\ c}\ r\ \Omega\right]\ \sin\left[2\pi\ \left(\frac{r}{\lambda_0}\ -\ \nu_0\ t\right)\right] \tag{18}$$

For a given arrangement the argument of the sinus wave varies with r for a given Ω following a cosinus function.

For the intensity of the interference of two light waves with equal frequencies but differing phases we have

$$I(r) = I_1(r) + I_2(r) + 2\ \sqrt{I_1(r)\ I_2(r)}\ \cos[\varphi_1(r) - \varphi_2(r)] \tag{19}$$

The phases are in our case

$$\varphi_1(r) = 2\pi\frac{r}{\lambda_0^2}\ \Delta\lambda_{detect} \qquad \varphi_2(r) =\ -\ 2\pi\frac{r}{\lambda_0^2}\ \Delta\lambda_{detect} \tag{20}$$

The intensity of the interference fringes are given with

$$I(r) = I_1(r) + I_2(r) + 2\ \sqrt{I_1(r)\ I_2(r)}\ \cos\left[4\pi^2\ m\ \frac{l}{\lambda_0\ c}\ r\ \Omega\right] \tag{21}$$

The fringes of the intensity vary with r for a given Ω following a cosinus function .

We have derived the interference patterns for the Sagnac arrangement based on the emission postulates that light is emitted with light speed c relative to its source and that light is refracted or reflected with light speed independent of the input speed. There is no incompatibility with "SR based on absolute time and space".

4 Resume.

The results of the Sagnac experiment analyzed with the Standard Model (SM) are easily explained with non relativistic equations assuming that light moves with light speed independent of its source, but are not compatible with Special Relativity.

The assumption of our standard model that light moves with light speed c independent of the emitting source induces the existence of an absolute reference frame or ether, but at the same time the model is not compatible with such absolute frames.

The objections made by Willem de Sitter in 1913 about Emission Theories based on a star in a double star system, is based on a representation of light as a continuous wave and not as bursts of sequences of FPs with opposed transversal angular momenta with equal length L .

With the quantized representation of photons and the postulates of the "E & R" UFT that photons are emitted with light speed "c" relative to the emitting source and the reflecting and refracting surfaces, the results of the Sagnac experiment are explained in a natural way and without inconsistencies and incompatibilities with "Special Relativity based on absolute time and space".

Bibliography

Note: The present approach is based on the concept that fundamental particles are constantly emitted by electrons and positrons and constantly regenerate them. As the concept is not found in mainstream theory, no existing paper can be used as reference.

1. Günter Lehner. **Elektromagnetische Feldtheorie.** 7. bearbeitete Auflage 2010. Springer Verlag.

2. Hering · Martin · Stohrer. **Physik für Ingenieure.** Vierte, verbesserte Auflage 1992. VDI Verlag.

3. Albrecht Lindner. **Grundkurs Theoretische Physik.** Teubner Verlag, Stuttgart 1994.

4. Georg Joos. **Lehrbuch der Theoretischen Physik.** 15., völlig neu bearbeitete Auflage 1989. AULA-Verlag Wiesbaden.

5. Max Schubert / Gerhard Weber. **Quantentheorie, Grundlagen und Anwendungen.** Spektrum, Akad. Verlag 1993.

6. Harald Klingbeil. **Electromagnetische Feldtheorie.** 2. überarbeitete Auflage 2011, Vieweg + Teubner Verlag.

7. Benenson · Harris · Stocker · Lutz. **Handbook of Physics.** Springer Verlag 2001.

8. B.R. Martin & G. Shaw. **Particle Physics.** John Wiley & Sons 2003.

9. Stephen G. Lipson. **Optik.** Springer Verlag 1997.

10. Osvaldo Domann. **"Emission & Regeneration" Unified Field Theory.** June 2003. www.odomann.com.