Correlation Structure of Maxwell Vacuum

Hans Joachim Dudek, D-53773 Hennef-Rott, Auf dem Komp 19,
e-mail: hjd-djh@t-online.de, tel.: 01638342740

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Abstract: Correlation structures of static and dynamic Maxwell fields, derived from the trace of the energy- momentum tensor, describe the vacuum of these fields, because the incorporated correlations of the commutators of communication relations (μ-commutators) are deactivated. The Maxwell vacuum is characterized by vanishing μ-commutators and by destructive interference of the paths, containing the E- and B-fields. The photons of Maxwell vacuum carry virtual action, however. It is possible to construct correlation structures of Maxwell vacuum, with vanishing μ-commutators, and with activated E- and B- fields. From the dynamic photons of vacuum, vacuum waves are constructed. In analogy to the activated static and dynamic photons of light, the static and dynamic vacuum photons can be entangled.

1 Introduction

Products of conjugate complex fields are represented on Fourier space by correlations, [1, 2]. The correlations describe the dependence of the fields from each other in a correlation product. In expressions describing an object the products of the fields are used for the characterisation of objects by correlations. Because equal fields in the correlations defined in the the same space-time point are identical, from the products characterizing an object a structure can be formed, which describes the object on a "correlation" space. The structure is obtained under conditions of the third law of Newton, which demands that for each current direction simultaneously another residual current must exists with the same amount, the same sign but of opposite direction. We call this construction principle the "Principle of Simultaneous Contrary Oscillation" and abbreviate it by PSCO. Structures obtained in this way from expressions characterizing an object on space time, exists always on correlation space in two different modifications, which are distinguished by their correlation directions. It is assumed that this two structures of an object describe two spin directions, if the signs of the correlations in both configurations are the same, and describes two states of an oscillator, when the signs of the $\mu = 0$ components of the vector potential are different. The two spin directions are distinguished by describing them with an O- and an X-photon and the two oscillation states for example by state

Z1 and Z2. The correlation structure of a Maxwell photon consists always of two parts (1/2) and (0/3); for an interpretation of the photons these two parts must be overlapped (superimposed). The correlation structure of photons of static Maxwell fields consists of O-X-photons, the photons of light are formed by the two different photons O and X with two different spin directions.

Using the trace of the energy momentum tensor of the Maxwell fields in Lorentz gauge and a four dimensional commutator of communication relations, both described by components of the vector potential, in this way correlation structures of quantised photons of Maxwell fields are obtained. The general correlation structure of Maxwell field should describe all properties of electromagnetism, especially the photons of light and the photons of the static electric and magnetic fields. In the present paper only the Maxwell vacuum will be discussed.

The general correlation structure of Maxwell fields can be separated into two parts, which represents the dynamic photons of light and the photons of static Maxwell fields. Because the correlation structure of Maxwell fields is complex, in following the two different structures for the vacuum will be discussed separately. The structures of photons of vacuum are the same, as the structures for the photons of static Maxwell fields and the dynamic photons of vacuum are same as the structures of photons of light. The difference lays in the kind of activation of the $\mu = 0$ oscillator of active photons in relation to vacuum photons; the $\mu = 0$ oscillator is the source of oscillation and the source of action, fig.1.

2 Correlation Structure of Static Maxwell Vacuum

The correlation structure of static Maxwell fields is depicted in relations (1), which describes the state Z1 of the O(+)-photon of static Maxwell fields of vacuum. In this publication the correlations are described by an arrow: the arrow is pointing from the creator to the annihilator. In structure (1) the single arrows describe the spin- correlations and the double arrows the μ- correlations (correlations of the commutators of communication relations). The positive signs of the components of the vector potential are described by bold letters, the other vector potential components are negative. The letters E_i, B_i and ∂A_α represents 16 cubes for the E- and B- fields and for the unity coordinates, respectively; each of the cubes is formed from 12 correlations between the partial derivatives of the components of the vector potential, derived from the trace of the energy- momentum tensor of Maxwell fields, [3]. The correlation structure of the next oscillation state Z2 has all correlation directions and some correlation signs inverted. In our model of the photon, there are two states, which oscillate between their correlations directions, and some of correlations oscillate in addition between the signs (different for static and dynamic photons, see below.). The four μ- correlations of each μ belong to one μ- commutator of communication relations. The μ- correlations of the commutator are connected to the $\mu = \alpha$ of the unity cubes ∂A_α (compare fig.1).

$$
\begin{array}{ccccccccccccc}
B_3 & \rightarrow & {}_+A_1 & \leftarrow & B_1 & & & & E_2 & \rightarrow & {}_+\mathbf{A}_0 & \leftarrow & E_3 \\
\uparrow & & & & \uparrow & & & & \uparrow & & & & \uparrow \\
{}_-\mathbf{A}_1 & & LO & & {}_-\mathbf{A}_1 & & & & {}_-A_0 & & RO & & {}_-A_0 \\
\downarrow & & & & \downarrow & & & & \Downarrow & & & & \downarrow \\
E_2 & \rightarrow & {}_+A_1 & \leftarrow & \partial A_2 & \Rightarrow & {}_+A_2 & \leftarrow & \partial A_0 & \Rightarrow & {}_+\mathbf{A}_0 & \leftarrow & E_1 \\
 & & & & \Uparrow & & OZ1 & & \uparrow & & & & \\
 & & & & {}_-\mathbf{A}_2 & & 1/2 & & {}_-\mathbf{A}_1 & & & & \\
 & & & & \downarrow & & +V & & \Downarrow & & & & \\
B_1 & \rightarrow & {}_+\mathbf{A}_3 & \Leftarrow & \partial A_3 & \rightarrow & {}_+A_1 & \Leftarrow & \partial A_1 & \rightarrow & {}_+A_2 & \leftarrow & B_2 \\
\uparrow & & & & \Uparrow & & & & \uparrow & & & & \uparrow \\
{}_-A_3 & & LU & & {}_-A_3 & & & & {}_-\mathbf{A}_2 & & RU & & {}_-\mathbf{A}_2 \\
\downarrow & & & & \downarrow & & & & \downarrow & & & & \downarrow \\
E_3 & \rightarrow & {}_+\mathbf{A}_3 & \leftarrow & B_2 & & & & E_1 & \rightarrow & {}_+A_2 & \leftarrow & B_3
\end{array}
\tag{1a}
$$

$$
\begin{array}{ccccccccccccc}
B_3 & \rightarrow & {}_+\mathbf{A}_2 & \leftarrow & B_1 & & & & E_2 & \rightarrow & {}_+A_3 & \leftarrow & E_3 \\
\uparrow & & & & \uparrow & & & & \uparrow & & & & \uparrow \\
{}_-A_2 & & & & {}_-A_2 & & & & {}_-\mathbf{A}_3 & & & & {}_-\mathbf{A}_3 \\
\downarrow & & & & \Downarrow & & & & \downarrow & & & & \downarrow \\
E_2 & \rightarrow & {}_+\mathbf{A}_2 & \Leftarrow & \partial A_2 & \rightarrow & {}_+A_0 & \Leftarrow & \partial A_0 & \rightarrow & {}_+A_3 & \leftarrow & E_1 \\
 & & & & \uparrow & & OZ1 & & \Uparrow & & & & \\
 & & & & {}_-\mathbf{A}_3 & & 0/3 & & {}_-\mathbf{A}_0 & & & & \\
 & & & & \Downarrow & & -V & & \downarrow & & & & \\
B_1 & \rightarrow & {}_+A_0 & \leftarrow & \partial A_3 & \Rightarrow & {}_+A_3 & \leftarrow & \partial A_1 & \Rightarrow & {}_+\mathbf{A}_1 & \leftarrow & B_2 \\
\uparrow & & & & \uparrow & & & & \Uparrow & & & & \uparrow \\
{}_-\mathbf{A}_0 & & & & {}_-\mathbf{A}_0 & & & & {}_-A_1 & & & & {}_-A_1 \\
\downarrow & & & & \downarrow & & & & \downarrow & & & & \downarrow \\
E_3 & \rightarrow & {}_+A_0 & \leftarrow & B_2 & & & & E_1 & \rightarrow & {}_+\mathbf{A}_1 & \leftarrow & B_3
\end{array}
\tag{1b}
$$

Reading the μ- correlations in the paths of the above correlation structure in the agreed negative direction of reading (clockwise), one obtains the following correlations

V-Z1(1/2):
$$
\begin{array}{ll}
{}_+A_0 \Leftarrow \partial_{0-}A_0 - \partial_{0+}A_0 \Leftarrow_- A_0 & {}_+A_3 \Leftarrow \partial_{3-}A_3 - \partial_{3+}A_3 \Leftarrow_- A_3 \\
{}_-A_1 \Rightarrow \partial_{1+}A_1 - \partial_{1-}A_1 \Rightarrow_+ A_1 & {}_+A_2 \Rightarrow \partial_{2+}A_2 - \partial_{2+}A_2 \Rightarrow_+ A_2
\end{array}
$$

V-Z1(0/3):
$$
\begin{array}{ll}
-{}_+A_0 \Leftarrow \partial_{0-}A_0 + \partial_{0+}A_0 \Leftarrow_- A_0 & -{}_+A_3 \Leftarrow \partial_{3-}A_3 + \partial_{3+}A_3 \Leftarrow_- A_3 \\
-{}_-A_1 \Rightarrow \partial_{1+}A_1 + \partial_{1-}A_1 \Rightarrow_+ A_1 & -{}_+A_2 \Rightarrow \partial_{2+}A_2 + \partial_{2+}A_2 \Rightarrow_+ A_2
\end{array}
$$

Adding the correlations of both parts of the correlation structure, all correlations reduce to zero. The vanishing of the μ- correlations is connected with the relative circulation direction of the μ- correlations in both parts (1/2) and (0/3) of the photon. If the μ- commutator is deactivated, the circulation direction of μ- correlations in both parts (1/2) and (0/3) has the same sign. The correlation structure derived from the energy- momentum tensor of Maxwell fields has in this form no commutators different from zero. The correlation structure has no action; the action is deactivated. If the circulation directions in the two parts (0/3) and (1/2) have different signs, each O- or X- photon contains a four dimensional commutator $[A_\mu, \partial_\mu A_\mu]$, μ = 0,1,2,3, which describes a positive action, and

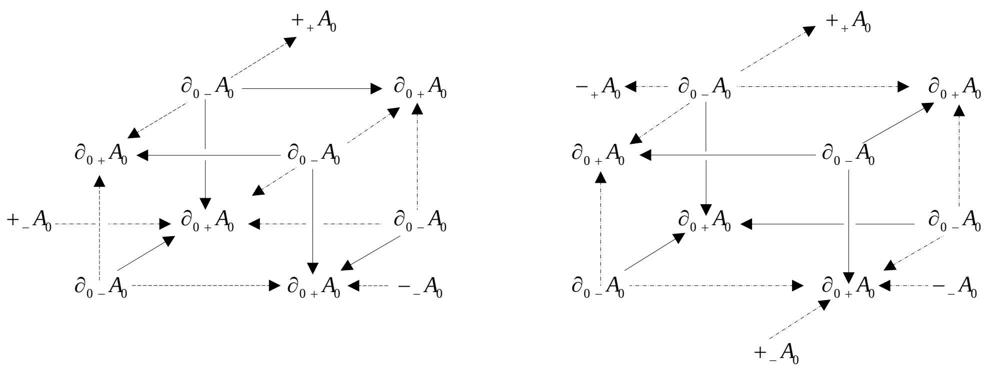

Figure 1: Two modifications of the $\mu = 0$ oscillator. (a) describes the $\mu = 0$ oscillator of vacuum which is the source of deactivated virtual action and (b) the $\mu = 0$ oscillator generating real action.

with the opposite sign a negative action. Because the action characterizes the activity of a physical object in space time, [4], the above structure describes the Maxwell vacuum. As will be discussed below, in general the correlation structure of the Maxwell vacuum has also all E- and B- fields deactivated.

Besides of the above structure of a static photon of the Maxwell vacuum, another correlation structure can be derived, if all correlation directions in the structure are changed, without changing the signs of the correlations. The same procedure is performed to obtain the second oscillation state Z2 of the photon, by changing in addition the signs of the $\mu = 0$ vector potential components. To distinguish both structures with opposite correlation directions, we will call them the O- and the X- photons. The photons O and X have the same properties, and are distinguished by the directions of their correlations. The photons O and X of static Maxwell fields form an O-X- pair, because to both photons a positive and a negative set of vector potential components $\{A_\mu, \mu = 0, 1, 2, 3\}$ are common. The O-X- photon is formed by overlapping the four parts O(1/2), O(0/3), X(1/2) and X(0/3) and by determining the result by superposition of equally directed correlations. Each state of an O-X- photon of vacuum contains two virtual four dimensional commutators.

3 The $\mu = 0$ Oscillator

In fig.1 two different properties of the $\mu = 0$ oscillator are depicted. The $\mu = 0$ oscillator in fig.1b generates positive action with two currents

(1/2): ${}_{+}A_0 \Leftarrow \partial_{0-}A_0 - \partial_{0+}A_0 \Leftarrow_{-} A_0$
(0/3): $-{}_{+}A_0 \Rightarrow \partial_{0-}A_0 + \partial_{0+}A_0 \Rightarrow_{-} A_0$

Adding the two currents the commutator $[A_0, \partial_0 A_0]$ is obtained (), while as discussed for the structure (a) in fig.1 and represented for the relations (Products of two creators or of two annihilators are not forming on Fourier space correlations, they form convolutions, which describe the internal interactions of fields.), this leads to a residual current equal zero. All photons of deactivated Maxwell vacuum contain μ- oscillators as shown in fig.1(a).

4 Oscillation of Photons of Static Maxwell Vacuum

From the correlation structure follows that the photons of static Maxwell fields of vacuum oscillate by changing the direction of correlations between the states. The four variations of the structure of the static Maxwell fields leads to two different photons of static vacuum with two oscillation states:

V1$_\alpha$ = OZ1$_v$(+)-XZ1$_v$(+) and V2$_\alpha$ = OZ2$_v$(−)-XZ2$_v$(−)
V1$_\beta$ = OZ1$_v$(−)-XZ1$_v$(−) and V2$_\beta$ = OZ2$_v$(+)-XZ2$_v$(+)

with the following properties:

V1$_\alpha$ = OZ1$_v$(+)-XZ1$_v$(+) $\leftrightarrow$ V2$_\alpha$ = OZ2$_v$(−)-XZ2$_v$(−)

	μ=3	μ=0		μ=3	μ=0
OZ1$_v$(+):	(−−)/(+−)	(−−)/(+−)	OZ2$_v$(−):	(−+)/(++)	(−+)/(++)
XZ1$_v$(+):	(−+)/(++)	(++)/(−+)	XZ2$_v$(−):	(−−)/(+−)	(+−)/(−−)

V1$_\beta$ = OZ1$_v$(−)-XZ1$_v$(−) $\leftrightarrow$ V2$_\beta$ = OZ2$_v$(+)-XZ2$_v$(+)

	μ=3	μ=0		μ=3	μ=0
OZ1$_v$(−):	(+−)/(−−)	(−−)/(+−)	OZ2$_v$(+):	(++)/(−+)	(−+)/(++)
XZ1$_v$(−):	(++)/(−+)	(++)/(−+)	XZ2$_v$(+):	(+−)/(−−)	(+−)/(−−)

The first sign in brackets describes the current sign and the second sign the circulation direction of the current (in relation to the negative circulation direction; clockwise) in the paths of the correlation structure. The ratio of two currents describes the currents in the two parts of the photon: (1/2)/(0/3). There are four possible sign combinations for the currents in Maxwell photons of vacuum: (−−)/(+−), (++)/(−+), (+−)/(−−) and (−+)/(++), in which the circulation direction of currents in the two photon parts (1/2) and (0/3) is the same and the current signs are different. These static Maxwell photons of vacuum are able to interact with photons of particle and anti-particle and with the photons of light, [4]. The photons of vacuum are a part of the interaction process between objects and is the background for the propagation of photons of light in vacuum.

5 E- and B- Fields of Static Maxwell Vacuum

The correlation structure of the O(+)- Photon in (1) will be compared with that of the O(−)- photon. For save of space this photon is not reproduced; it is obtained from the O(+) photon by reversing all signs of the $\mu = \mathrm{i}$ vector potential components. Our aim is to explain the behaviour and interaction of photons by means of interference (superposition) and induction. The interference takes place, when the overlapping correlations in the same path (e.g. LO or RU etc.) have the same direction. The elementary step of induction consists of two parts: (a) the simultaneous formation of vacuum photons with the formation of a state of an active photon under conditions of the PSCO and (b) a flow of current during the following oscillation state into the locally formed state of the vacuum photon (see fig.4a), [4]. The two parts of a photon: (0/3) and (1/2) always overlap. When we overlap the two parts of the photons O-X-(+) and O-X-(−) all correlations in each path have in pairs the same direction, the components of the vector potential have different signs. The paths interfere destructive. It is the destructive interference of two or more currents, which make the residual current to zero. Because the static Maxwell vacuum is built of both photons O-X-(+) and O-X-(−), all paths of the vacuum with the included E_i and B_i fields interfere in mean destructive. In mean the Maxwell vacuum has no activated commutators and no activated E- and B- fields.

6 Formation of Gravitons

In literature the representation of gravity by the Maxwell theory is discussed early in time, [5, 6]. In frame of the presented formalism the interaction of static Maxwell photons with matter oscillators can be simulated. The matter oscillators are described by scalar fields, which are constructed in a same way as the photons of Maxwell fields, by transforming the products of the scalar Lagrange density into the Fourier space and by forming correlation structures for the scalar oscillators, [4]. Two different kinds of interactions between oscillators of matter with Maxwell photons are discussed: the interaction of static photons of positive and negative charges and the interaction of matter oscillators with photons of vacuum, which are describing the gravitons. The structure and the properties of the gravitons, constructed under application of the Maxwell fields will be shortly discussed.

Two kinds of vacuum O-X-photons can be identified, fig.2; photons consisting of structures as shown in fig.1a, in which the μ- correlations have the same circulation direction and different signs of currents: these photons form vacuum photons with deactivated virtual action. The photons of deactivated virtual action of vacuum are those, which form the background of interactions on vacuum. The second kind of photons of vacuum are O-X-photons, which are formed by a superposition of O and X photons with the same amount but in O and X with different signs of real action. O and X photons in O-X-photons have in general the same amount of action, because they are formed under conditions of minimization of action (Principle of Hamilton).

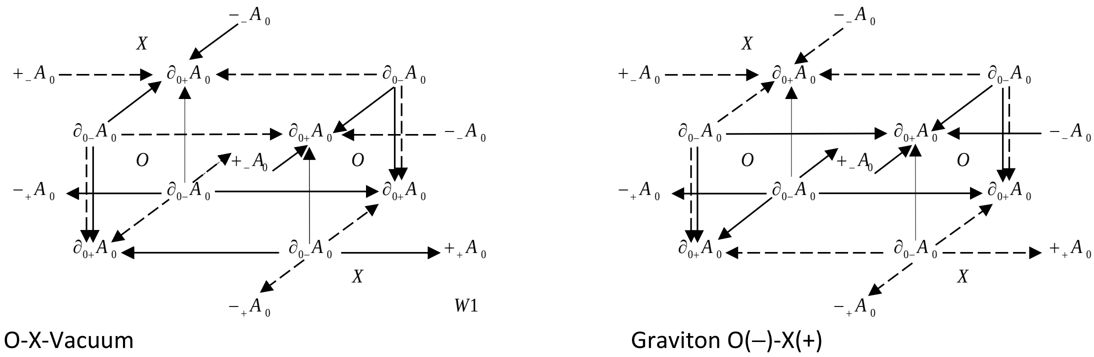

Figure 2: The $\mu = 0$ oscillators of O-X-photons of deactivated and of activated virtual action have an identical correlation structure. The O and X photons are virtual active in gravitons, in deactivated vacuum they are virtual deactivated.

In a O-X-combination these photons form activated virtual action: this action can be exchanged between oscillators of matter under a change of their properties. The O-X-photons with activated virtual action have an identical structure in comparison to the photons of deactivated virtual action, and in the $\mu = 0$ oscillator the signs of currents are the same, as the photons with deactivated action, fig.2, the gravitons are superimposed on the photons of vacuum with deactivated action, together the two vacuum photons form the Maxwell vacuum.

In an interaction with matter oscillators the photons with activated virtual action behave differently in comparison to the photons with deactivated virtual action. The O-X-photons with activated virtual action split in an interaction with photons of matter-oscillators in O and X photons with positive and negative action. In an interaction with photons of the matter oscillators the separated photons O and X with real are absorbed in matter oscillators changing the rest frame of objects, while the photons with deactivated action do not change the properties of matter oscillators, because their action is deactivated.

7 Dynamic Maxwell Vacuum

The correlation structure of photons of the dynamic Maxwell vacuum is the same, as the structure of the photons of light. An example of the dynamic O- photon of vacuum in oscillation state Z1 is shown in relations (2).

$$
\begin{array}{ccccccccccccc}
 & & & & B_1 & \leftarrow & {}_-A_2 & \rightarrow & E_2 & & & & \\
 & & & & \downarrow & & & & \downarrow & & & & \\
 & & & & {}_+\mathbf{A}_2 & & bo & & {}_+\mathbf{A}_2 & & & & \\
 & & & & \Uparrow & & & & \uparrow & & & & \\
E_2 & \leftarrow & {}_-A_3 & \rightarrow & \partial A_2 & \Leftarrow & {}_-A_2 & \rightarrow & \partial A_0 & \Leftarrow & {}_-A_0 & \rightarrow & E_1 \\
\downarrow & & & & \downarrow & & OZ1 & & \Downarrow & & & & \downarrow \\
{}_+\mathbf{A}_3 & & gl & & {}_+\mathbf{A}_3 & & 0/3 & & {}_+\mathbf{A}_0 & & gr & & {}_+\mathbf{A}_0 \\
\uparrow & & & & \Uparrow & & V & & \uparrow & & & & \uparrow \\
B_1 & \leftarrow & {}_-A_3 & \Rightarrow & \partial A_3 & \leftarrow & {}_-A_1 & \Rightarrow & \partial A_1 & \leftarrow & {}_-A_0 & \rightarrow & B_2 \\
 & & & & \downarrow & & & & \Downarrow & & & & \\
 & & & & {}_+\mathbf{A}_1 & & bu & & {}_+\mathbf{A}_1 & & & & \\
 & & & & \uparrow & & & & \uparrow & & & & \\
 & & & & B_2 & \leftarrow & {}_-A_1 & \rightarrow & E_1 & & & &
\end{array} \tag{2a}
$$

$$
\begin{array}{ccccccccccccc}
 & & & & B_1 & \leftarrow & {}_-\mathbf{A}_0 & \rightarrow & E_2 & & & & \\
 & & & & \downarrow & & & & \downarrow & & & & \\
 & & & & {}_+A_0 & & & & {}_+A_0 & & & & \\
 & & & & \uparrow & & & & \Uparrow & & & & \\
E_2 & \leftarrow & {}_-\mathbf{A}_2 & \Rightarrow & \partial A_2 & \leftarrow & {}_-\mathbf{A}_0 & \Rightarrow & \partial A_0 & \leftarrow & {}_-\mathbf{A}_1 & \rightarrow & E_1 \\
\downarrow & & & & \Downarrow & & OZ1 & & \downarrow & & & & \downarrow \\
{}_+A_2 & & & & {}_+A_2 & & 1/2 & & {}_+A_1 & & & & {}_+A_1 \\
\uparrow & & & & \uparrow & & V & & \Uparrow & & & & \uparrow \\
B_1 & \leftarrow & {}_-\mathbf{A}_2 & \rightarrow & \partial A_3 & \Leftarrow & {}_-\mathbf{A}_3 & \rightarrow & \partial A_1 & \Leftarrow & {}_-\mathbf{A}_1 & \rightarrow & B_2 \\
 & & & & \Downarrow & & & & \downarrow & & & & \\
 & & & & {}_+A_3 & & & & {}_+A_3 & & & & \\
 & & & & \uparrow & & & & \uparrow & & & & \\
 & & & & B_2 & \leftarrow & {}_-\mathbf{A}_3 & \rightarrow & E_1 & & & &
\end{array} \tag{2b}
$$

The spin correlations are again described by single and the μ- correlations by double arrows. In the part (0/3) the μ- correlations of the paths *bo* and *bu* have a negative, and in the paths *gl* and *gr* a positive circulation direction. The opposite is for the (1/2) part of the photon. To each μ are belonging four μ- correlations, two of them are in the *gl* and *gr* paths of part (0/3) and two in the *bo* and *bu* paths of part (1/2). All four μ- correlations of a special μ have the same circulation direction. Similar to the static photons, reading the correlation in the agreed negative circulation direction, results in four μ-correlations for each μ, which added gives zero. The correlation structure describes the vacuum, now for the dynamic Maxwell photons of light. Similar to the static photons, from the above correlation structure the second state Z2 is obtained, by changing all correlation directions, and for dynamic vacuum also of all signs of the vector potential components. From the above dynamic O-photon of the vacuum, we obtain the dynamic X- photon of vacuum, exchanging all correlation directions, without changing the signs of the correlations. The activated dynamic O and X photons of light describe the two spin directions of quantum mechanics.

The photons of dynamic vacuum are much simpler constructed than that of the static vacuum: they consist of eight paths, *gl* and *gr* and *bo* and *bu* in each part (0/3) and (1/2). Each dynamic photon contains four sets of components of the vector potential

$\{A_\mu\}$, two of them are positive and two are negative. The two dynamic photons O and X exists separate (except for entanglement, see below). Contrary to the static photons, the dynamic photons change not only their correlation directions, but also all their signs between the two oscillation states. The two states of the dynamic O-V-Photon are shown for the state Z1 in relation (2), and for the state Z2 in relations (3).

$$
\begin{array}{ccccccccccccc}
 & & & & B_1 & \rightarrow & {}_{+}\mathbf{A}_2 & \leftarrow & E_2 & & & & \\
 & & & & \uparrow & & & & \uparrow & & & & \\
 & & & & {}_{-}A_2 & & & & {}_{-}A_2 & & & & \\
 & & & & \Downarrow & & & & \downarrow & & & & \\
E_2 & \rightarrow & {}_{+}\mathbf{A}_3 & \leftarrow & \partial A_2 & \Rightarrow & {}_{+}\mathbf{A}_2 & \leftarrow & \partial A_0 & \Rightarrow & {}_{+}\mathbf{A}_0 & \leftarrow & E_1 \\
\uparrow & & & & \uparrow & & OZ2 & & \Uparrow & & & & \uparrow \\
{}_{-}A_3 & & & & {}_{-}A_3 & & 0/3 & & {}_{-}A_0 & & & & {}_{-}A_0 \\
\downarrow & & & & \Downarrow & & & & \downarrow & & & & \downarrow \\
B_1 & \rightarrow & {}_{+}\mathbf{A}_3 & \Leftarrow & \partial A_3 & \rightarrow & {}_{+}\mathbf{A}_1 & \Leftarrow & \partial A_1 & \rightarrow & {}_{+}\mathbf{A}_0 & \leftarrow & B_2 \\
 & & & & \uparrow & & & & \Uparrow & & & & \\
 & & & & {}_{-}A_1 & & & & {}_{-}A_1 & & & & \\
 & & & & \downarrow & & & & \downarrow & & & & \\
 & & & & B_2 & \rightarrow & {}_{+}\mathbf{A}_1 & \leftarrow & E_1 & & & &
\end{array}
\tag{3a}
$$

$$
\begin{array}{ccccccccccccc}
 & & & & B_1 & \rightarrow & {}_{+}A_0 & \leftarrow & E_2 & & & & \\
 & & & & \uparrow & & & & \uparrow & & & & \\
 & & & & {}_{-}\mathbf{A}_0 & & & & {}_{-}\mathbf{A}_0 & & & & \\
 & & & & \downarrow & & & & \Downarrow & & & & \\
E_2 & \rightarrow & {}_{+}A_2 & \Leftarrow & \partial A_2 & \rightarrow & {}_{+}A_0 & \Leftarrow & \partial A_0 & \rightarrow & {}_{+}A_1 & \leftarrow & E_1 \\
\uparrow & & & & \Uparrow & & OZ2 & & \uparrow & & & & \uparrow \\
{}_{-}\mathbf{A}_2 & & & & {}_{-}\mathbf{A}_2 & & 1/2 & & {}_{-}\mathbf{A}_1 & & & & {}_{-}\mathbf{A}_1 \\
\downarrow & & & & \downarrow & & & & \Downarrow & & & & \downarrow \\
B_1 & \rightarrow & {}_{+}A_2 & \leftarrow & \partial A_3 & \Rightarrow & {}_{+}A_3 & \leftarrow & \partial A_1 & \Rightarrow & {}_{+}A_1 & \leftarrow & B_2 \\
 & & & & \Uparrow & & & & \uparrow & & & & \\
 & & & & {}_{-}\mathbf{A}_3 & & & & {}_{-}\mathbf{A}_3 & & & & \\
 & & & & \downarrow & & & & \downarrow & & & & \\
 & & & & B_2 & \rightarrow & {}_{+}A_3 & \leftarrow & E_1 & & & &
\end{array}
\tag{3b}
$$

All correlations in the overlapping paths of the two parts of the photons have for the vacuum the same direction, and different signs of the components of the vector potential: there is no interaction between the two states, because the correlations have different directions. The particular property of these dynamic vacuum photons is that contrary to the dynamic active photons of light, the currents are not interfering by superposition of both states; overlapping both oscillation states, the residual current remains zero. These dynamic photons of vacuum have particle properties, in the next section the dynamic photons of vacuum with wave properties are discussed.

Similar to the static vacuum, the dynamic photons of the vacuum contain no commutators different from zero. From the structure of the dynamic vacuum the active dynamic photons are obtained, by exchanging directions and signs of correlations in one of the parts (1/2) or (0/3). Adding the correlations of the dynamic photons of vacuum and transforming them to space time, they only reduce to zero, when we overlap both photons O and X.

8 Dynamic Vacuum Waves

The propagation of activated dynamic photons in vacuum can be simulated, using for a description of the properties of the photons a current model, and under the assumption that the vacuum exists in the form, described in the present paper. Because the dynamic vacuum photons have a similar structure as the activated dynamic photons of light, one can also simulate the propagation of dynamic vacuum photons in vacuum. Basis of the formation of photons of vacuum and of the propagation of photons is the formation of a neighbour state of the photon in vacuum by induction, which occurs under the conditions of simultaneity, following from the PSCO.

The propagation of dynamic photons of vacuum occurs similar as the propagation of photons of light in vacuum under interaction with the photons of deactivated photons of vacuum. This is demonstrated in fig.3 for the $\mu = 0$ oscillator for the two photons O and X, which currents are together introduced into the $\mu = 0$ oscillator. At left in fig.3 the $\mu = 0$ oscillator of the dynamic O and X photons of vacuum are shown and at right the O-X-photon of deactivated static vacuum. Both structures are overlapping, for clarity they are depicted separately. In row A-B the oscillation state Z1/W2 is depicted. The photon move from up to down, which is visible in the structure A by the double arrows connecting the creator plane of the photon with the annihilator plane. The structure of the static photon of the vacuum in state W2 support the movement of the dynamic vacuum photon, because the currents in the structure of the static vacuum are at the same position directed into the same direction.

Due to formation of the oscillation state Z1 of the dynamic vacuum photon together with the state W2 of the static photon of vacuum, the following oscillation state Z1a of the dynamic photon together with the state W1 of the static photons is formed under conditions of the PSCO. This state is formed from correlations of the vacuum with deactivated virtual action of vacuum. As soon as the the next oscillation state is formed the situation E-F is generated and the currents forming action in state Z1/W2 are flowing into the following structure E-F. The structure E-F have the same current directions, as the states A-B, but, because of the sign oscillation of the μ-oscillators, different current signs, and the propagation of the photon is continuing into the direction from up to down.

For the demonstration of the propagation of a vacuum wave in space, similar to the propagation of photons of light, a part of the E_2/B_1- O- photon (2) is represented in fig.4a. The μ- correlations of the commutator $\mu = 0$ have for each unite cube the same circulation direction, the action is equal to zero. Two consecutive states Z1 and Z2 of the cube ∂A_0 are shown. The μ- correlations of the commutator $\mu = 0$ and the connecting strings in the cubes are marked by discontinuous and dot- dashed arrows. The photon is moving from up to down from the state Z1 to the state Z2. The development of the wave can be followed, applying the current model and assuming the existence of the vacuum. A positive and a negative current start in state Z1 from a positive and a negative creator of the vector potential component $+_{-}A_0$ and $-_{-}A_0$ (sources), passes the strings in the cube and the whole state and is leaded in a negative and positive annihilator $-_{+}A_0$ and $+_{+}A_0$ (drains), respectively. As a consequence the drain changes sign and converts into a source and the new state Z2 is generated. In state Z2 the same process in the same direction occurs. In fig.4a the two currents with different signs flow in each state in the same circulation direction: in state Z1 in the positive and in the state Z2 in the negative circulation direction: in each state the residual current is zero. The transported action is vanishing, therefore. The currents rise from different sources, flow along different paths, and limit into different drains. The correlation structure of the static and dynamic Maxwell photons consists always of two planes: a creator plan and an annihilator plane. From all creators of the creator plane the currents are flowing between two states simultaneously to the annihilators of the annihilator plane. In the annihilator plane the drains convert into sources, which are origins of new currents, flowing along analogous paths in the same directions into new drains of the following annihilator plane. This description of propagation of a vacuum wave is similar to the propagation of active photons.

In a formation of vacuum waves by induction in front of active photons under the conditions of the PSCO the second oscillation state is formed and in the following state action is flowing into a similar structure as the fist oscillation state but with opposite signs of currents. The different signs of currents are generated by the $\mu = 0$ oscillator. Currents of photons flow only between the states from the sources – the creators – to the drains – the annihilators. Current starting to flow at beginning of a state is inducing under conditions of the PSCO in the whole system of surrounding coherent vacuum structure the same current, which after finishing the state are again in the whole activated system equal zero. The annihilators convert into creators and the current again is inducing a current flow to the new in vacuum formed annihilators. While action is propagating by forming new oscillation states, the formed current is enclosed in the whole surrounding coherent vacuum system.

These vacuum waves have interference properties, because the currents in both states have the same direction but different current signs. It is assumed that the fields of the photons are polarizing the vacuum, creating simultaneously with the formation of a state of a photon a continuous system of vacuum photons; they have the same structure, as the active photons, but are not containing action. The whole system consisting of the active photon and of vacuum photons, propagate in vacuum continuously, forming in front new vacuum photons. Because the action of this vacuum wave is vanishing, the propagation speed is ruled by the simultaneity of the PSCO and should not be limited by the rules of special relativity (SRT). The vacuum wave is transporting structural information, and is able to interact with active dynamic photons. The mechanism of interference between an active photon and a vacuum photon, being with the active photon coherent, is based

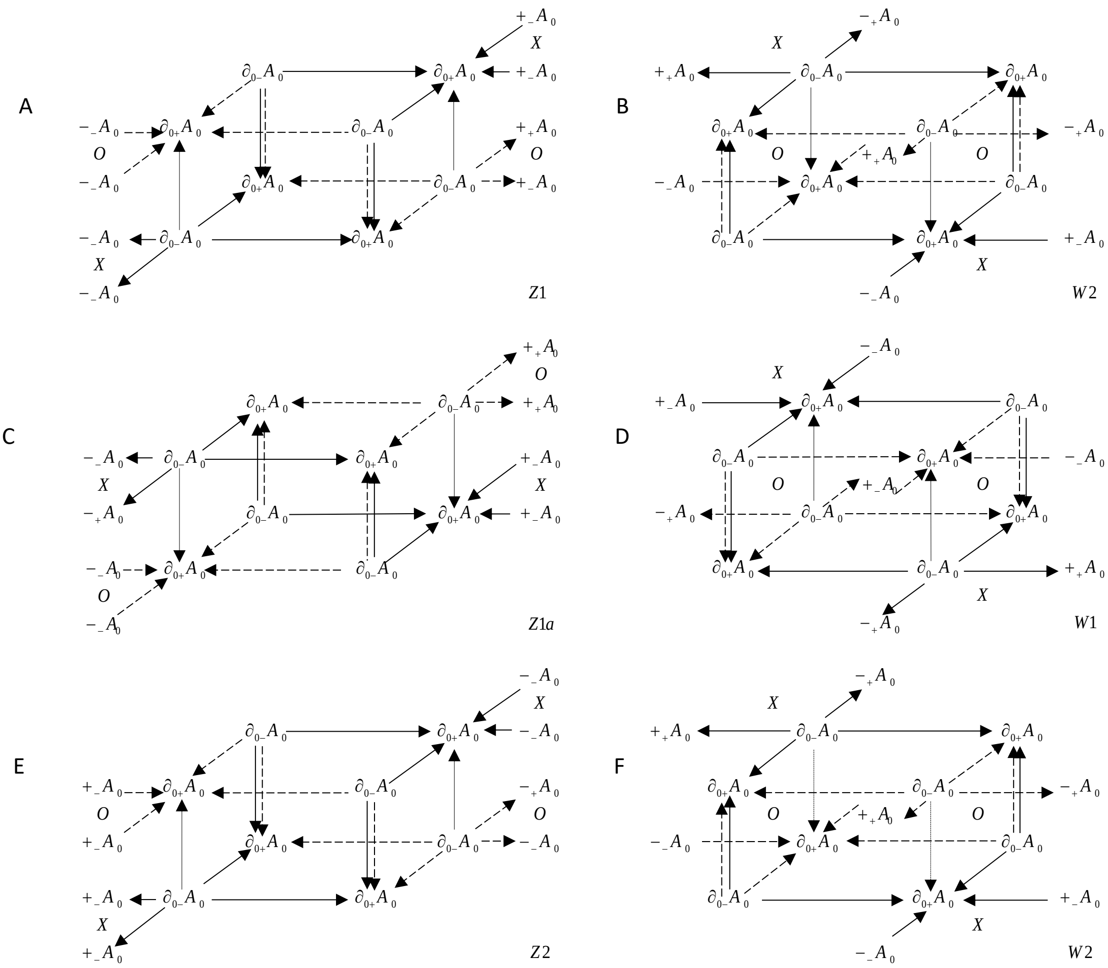

Figure 3: Propagation of dynamic O and X photons of vacuum under contribution of photons of static vacuum at the example of the $\mu = 0$ oscillator. Left side the $\mu = 0$ oscillator of dynamic vacuum, right side the $\mu = 0$ oscillator of static vacuum.

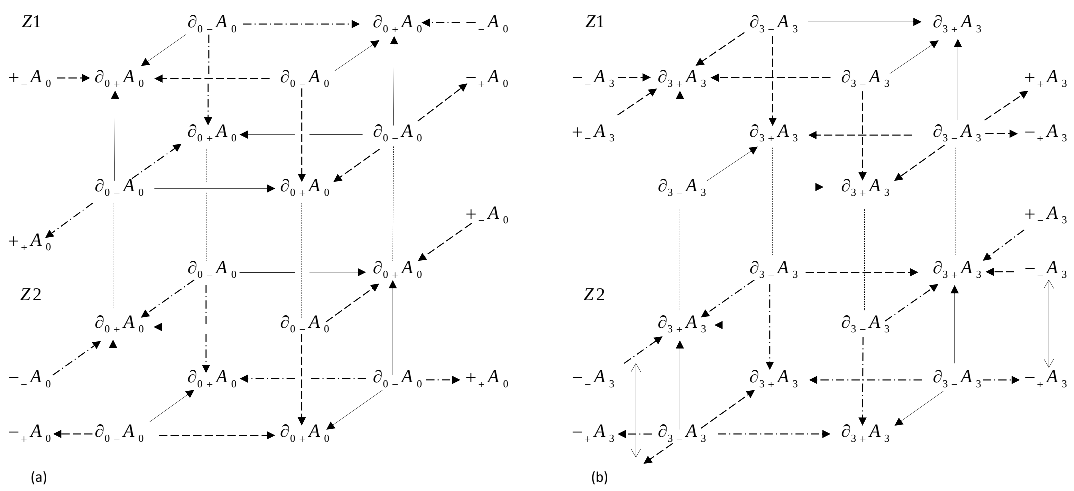

Figure 4: In fig. 4a the propagation of a vacuum wave, at the example of the two oscillation states of the ∂A_0 unite cube of a E_2/B_1- vacuum photon is shown. Propagation from up to down. Fig.4b illustrates the fluctuation of vacuum photons at the example of the ∂A_3 cube. The discontinuous and chain- dotted arrows describe the current flow between creator and annihilator. Arrows describe correlations.

on the superposition of the longitudinal and transversal correlations in the dynamic photons. If an active photon is overlapped by a coherent vacuum photon, the currents are transmitted from the active photon to the vacuum photon; if the phase of both photons is different, destructive interference take place, if the phase is the same, the interference is constructive.

9 Entangled Dynamic Vacuum Photons

In frame of the presented method for the description of elementary objects on correlation space three different interaction forms can be distinguished: induction, superposition (overlap) and entanglement. All three interaction forms occur under conditions of minimization of action. Induction and superposition was already discussed. While in superposition in an overlap of the two photons the structures of these photons remain the same, in entanglement the currents of the two superimposed photons algebraically are added, so that they form a common structure. The change of currents results in a change of properties, [3].

In the above considerations it is shown that the photons of vacuum have all μ- correlations needed to form a four dimensional μ- commutator, but the sum of these correlations is equal to zero. Normally in photons of vacuum the interference of the correlations between the two parts of the photon (0/3) and (1/2) is destructive, the E_i and B_i fields are zero, therefore. One can construct vacuum photons, however, – with all vanishing commutators – which have activated E- and B- fields. (The paths are activated, when the residual currents are different from zero.) This will be shown by the following example. We consider first a single dynamic O-Photon of the vacuum in the relations (4), which is changed in comparison to the O- photon of relations (3), to activate the paths by a constructive interference. (The second state is not displayed.) If we analyse the currents in this correlation structure, they are zero in the unity cubes, but they have not vanishing currents in the E- and B- cubes.

$$\begin{array}{ccccccccccccc}
 & & & & B_1 & \leftarrow & {}_{-}A_2 & \rightarrow & E_2 & & & & \\
 & & & & \downarrow & & & & \downarrow & & & & \\
 & & & & {}_{+}\mathbf{A}_2 & & & & {}_{+}\mathbf{A}_2 & & & & \\
 & & & & \Uparrow & & & & \uparrow & & & & \\
E_2 & \leftarrow & {}_{-}\mathbf{A}_3 & \rightarrow & \partial A_2 & \Leftarrow & {}_{-}A_2 & \rightarrow & \partial A_0 & \Leftarrow & {}_{-}\mathbf{A}_0 & \rightarrow & E_1 \\
\downarrow & & & & \downarrow & & OZ1 & & \Downarrow & & & & \downarrow \\
{}_{+}A_3 & & & & {}_{+}A_3 & & 0/3 & & {}_{+}A_0 & & & & {}_{+}A_0 \\
\uparrow & & & & \Uparrow & & V & & \uparrow & & & & \uparrow \\
B_1 & \leftarrow & {}_{-}\mathbf{A}_3 & \Rightarrow & \partial A_3 & \leftarrow & {}_{-}A_1 & \Rightarrow & \partial A_1 & \leftarrow & {}_{-}\mathbf{A}_0 & \rightarrow & B_2 \\
 & & & & \downarrow & & & & \Downarrow & & & & \\
 & & & & {}_{+}\mathbf{A}_1 & & & & {}_{+}\mathbf{A}_1 & & & & \\
 & & & & \uparrow & & & & \uparrow & & & & \\
 & & & & B_2 & \leftarrow & {}_{-}A_1 & \rightarrow & E_1 & & & &
\end{array} \tag{4a}$$

$$\begin{array}{ccccccccccccc}
 & & & & B_1 & \leftarrow & {}_{-}A_0 & \rightarrow & E_2 & & & & \\
 & & & & \downarrow & & & & \downarrow & & & & \\
 & & & & {}_{+}\mathbf{A}_0 & & & & {}_{+}\mathbf{A}_0 & & & & \\
 & & & & \uparrow & & & & \Uparrow & & & & \\
E_2 & \leftarrow & {}_{-}\mathbf{A}_2 & \Rightarrow & \partial A_2 & \leftarrow & {}_{-}A_0 & \Rightarrow & \partial A_0 & \leftarrow & {}_{-}\mathbf{A}_1 & \rightarrow & E_1 \\
\downarrow & & & & \Downarrow & & OZ1 & & \downarrow & & & & \downarrow \\
{}_{+}A_2 & & & & {}_{+}A_2 & & 1/2 & & {}_{+}A_1 & & & & {}_{+}A_1 \\
\uparrow & & & & \uparrow & & V & & \Uparrow & & & & \uparrow \\
B_1 & \leftarrow & {}_{-}\mathbf{A}_2 & \rightarrow & \partial A_3 & \Leftarrow & {}_{-}A_3 & \rightarrow & \partial A_1 & \Leftarrow & {}_{-}\mathbf{A}_1 & \rightarrow & B_2 \\
 & & & & \Downarrow & & & & \downarrow & & & & \\
 & & & & {}_{+}\mathbf{A}_3 & & & & {}_{+}\mathbf{A}_3 & & & & \\
 & & & & \uparrow & & & & \uparrow & & & & \\
 & & & & B_2 & \leftarrow & {}_{-}A_3 & \rightarrow & E_1 & & & &
\end{array} \tag{4b}$$

Overlapping both photon parts (0/3) and (1/2) of the O- Photon (4), all paths interfere constructive, activating the paths and the fields in the paths. The photon is elliptic polarized and is not able to interfere destructive, when both states are overlapped, because their correlation directions are different in the two oscillation states. The X- Photon with the inverse spin (5) has the same properties. When we overlap both photons (4) and (5), simulating entanglement *in two different oscillation states*, taking the parts with the same correlations directions, for example the photons parts O-Z1(0/3) and X-Z2(1/2), etc., the paths interact destructive, and the currents in the paths cancel each other. The entangled pair has "virtual" commutators, but no action.

$$\begin{array}{ccccccccccccc}
 & & & & B_1 & \rightarrow & {}_{+}A_2 & \leftarrow & E_2 & & & & \\
 & & & & \uparrow & & & & \uparrow & & & & \\
 & & & & {}_{-}\mathbf{A}_2 & & & & {}_{-}\mathbf{A}_2 & & & & \\
 & & & & \Downarrow & & & & \downarrow & & & & \\
E_2 & \rightarrow & {}_{+}\mathbf{A}_3 & \leftarrow & \partial A_2 & \Rightarrow & {}_{+}A_2 & \leftarrow & \partial A_0 & \Rightarrow & {}_{+}\mathbf{A}_0 & \leftarrow & E_1 \\
\uparrow & & & & \uparrow & & XZ1 & & \Uparrow & & & & \uparrow \\
{}_{-}A_3 & & & & {}_{-}A_3 & & 0/3 & & {}_{-}A_0 & & & & {}_{-}A_0 \\
\downarrow & & & & \Downarrow & & V & & \downarrow & & & & \downarrow \\
B_1 & \rightarrow & {}_{+}\mathbf{A}_3 & \Leftarrow & \partial A_3 & \rightarrow & {}_{+}A_1 & \Leftarrow & \partial A_1 & \rightarrow & {}_{+}\mathbf{A}_0 & \leftarrow & B_2 \\
 & & & & \uparrow & & & & \Uparrow & & & & \\
 & & & & {}_{-}\mathbf{A}_1 & & & & {}_{-}\mathbf{A}_1 & & & & \\
 & & & & \downarrow & & & & \downarrow & & & & \\
 & & & & B_2 & \rightarrow & {}_{+}A_1 & \leftarrow & E_1 & & & &
\end{array} \qquad (5a)$$

$$\begin{array}{ccccccccccccc}
 & & & & B_1 & \rightarrow & {}_{+}A_0 & \leftarrow & E_2 & & & & \\
 & & & & \uparrow & & & & \uparrow & & & & \\
 & & & & {}_{-}\mathbf{A}_0 & & & & {}_{-}\mathbf{A}_0 & & & & \\
 & & & & \downarrow & & & & \Downarrow & & & & \\
E_2 & \rightarrow & {}_{+}\mathbf{A}_2 & \Leftarrow & \partial A_2 & \rightarrow & {}_{+}A_0 & \Leftarrow & \partial A_0 & \rightarrow & {}_{+}\mathbf{A}_1 & \leftarrow & E_1 \\
\uparrow & & & & \Uparrow & & XZ1 & & \uparrow & & & & \uparrow \\
{}_{-}A_2 & & & & {}_{-}A_2 & & 1/2 & & {}_{-}A_1 & & & & {}_{-}A_1 \\
\downarrow & & & & \downarrow & & V & & \Downarrow & & & & \downarrow \\
B_1 & \rightarrow & {}_{+}\mathbf{A}_2 & \leftarrow & \partial A_3 & \Rightarrow & {}_{+}A_3 & \leftarrow & \partial A_1 & \Rightarrow & {}_{+}\mathbf{A}_1 & \leftarrow & B_2 \\
 & & & & \Uparrow & & & & \uparrow & & & & \\
 & & & & {}_{-}\mathbf{A}_3 & & & & {}_{-}\mathbf{A}_3 & & & & \\
 & & & & \downarrow & & & & \downarrow & & & & \\
 & & & & B_2 & \rightarrow & {}_{+}A_3 & \leftarrow & E_1 & & & &
\end{array} \qquad (5b)$$

10 Entangled Static Vacuum Photons

Similar to the dynamic vacuum photons of light, also the photons of static Maxwell fields of the vacuum can be entangled. As discussed above, static photons consists always of O-X- pairs. An example of entanglement of static photons of vacuum is given in the relations (6), where the two static vacuum pairs O-X-Z2(−V) and O-X-Z1(+V) are shown (Only the central part of the correlation structure is shown. The activated μ- correlations are marked by circles.) All four μ- commutators in both photon pairs are vanishing, because they have the same circulation directions of the two photon parts (0/3) and (1/2), but different circulation direction of the μ- correlations between the two photon pairs. For an entanglement of both photon pairs the parts of the photons OZ2(1/2)&XZ1(1/2), OZ2(0/3)&XZ1(0/3), XZ2(1/2)&OZ1(1/2) and XZ2(0/3)&OZ1(0/3) must be overlapped; these pairs carry the same correlation directions. After overlap, the currents in these paths cannot be distinguished any more; the entanglement is effectuated by a reduction of currents in paths with the same current direction and currents of different signs. The entangled static photon system of the relations (6) carries four "virtual" four dimensional commutators, two of each with opposite sign: their action is virtual.

$$
\begin{array}{cccccccccccccccccc}
 & & {}_{+}\mathbf{A}_1 & & & & {}_{-}A_0 & & & & & {}_{-}A_2 & & & & {}_{+}A_3 & & \\
 & & \uparrow & & & & \Downarrow & \bigcirc & & & & \Downarrow & & & & \uparrow & & \\
{}_{-}A_1 & \rightarrow & \partial A_2 & \Rightarrow & {}_{+}A_2 & \leftarrow & \partial A_0 & \Rightarrow & {}_{+}\mathbf{A}_0 & {}_{+}\mathbf{A}_2 & \Leftarrow & \partial A_2 & \rightarrow & {}_{+}A_0 & \Leftarrow & \partial A_0 & \leftarrow & {}_{-}\mathbf{A}_3 \\
 & & \Uparrow & \bigcirc & OZ1 & & \uparrow & & & & & \uparrow & & OZ1 & & \Uparrow & & \\
 & & {}_{-}\mathbf{A}_2 & & 1/2 & & {}_{-}A_1 & & & & & {}_{-}\mathbf{A}_3 & & 0/3 & & {}_{-}\mathbf{A}_0 & & \\
 & & \downarrow & & -V & & \Downarrow & & & & & \Downarrow & & -V & & \downarrow & & \\
{}_{+}\mathbf{A}_3 & \Leftarrow & \partial A_3 & \rightarrow & {}_{+}\mathbf{A}_1 & \Leftarrow & \partial A_1 & \leftarrow & {}_{-}\mathbf{A}_2 & {}_{-}\mathbf{A}_0 & \rightarrow & \partial A_3 & \Rightarrow & {}_{+}A_3 & \leftarrow & \partial A_1 & \Rightarrow & {}_{+}A_1 \\
 & \bigcirc & \Uparrow & & & & \downarrow & & & & & \downarrow & & & & \Uparrow & & \\
 & & {}_{-}A_3 & & & & {}_{+}A_2 & & & & & {}_{+}A_0 & & & & {}_{-}\mathbf{A}_1 & &
\end{array}
$$

$$
\begin{array}{cccccccccccccccccc}
 & & {}_{-}\mathbf{A}_1 & & & & {}_{+}A_0 & & & & & {}_{+}A_2 & & & & {}_{-}A_3 & & \\
 & & \downarrow & & & & \Uparrow & \bigcirc & & & & \Uparrow & & & & \downarrow & & \\
{}_{+}A_1 & \leftarrow & \partial A_2 & \Leftarrow & {}_{-}A_2 & \rightarrow & \partial A_0 & \Leftarrow & {}_{-}\mathbf{A}_0 & {}_{-}\mathbf{A}_2 & \Rightarrow & \partial A_2 & \leftarrow & {}_{-}A_0 & \Rightarrow & \partial A_0 & \rightarrow & {}_{+}\mathbf{A}_3 \\
 & & \Downarrow & \bigcirc & XZ1 & & \downarrow & & & & & \downarrow & & XZ1 & & \Downarrow & & \\
 & & {}_{+}\mathbf{A}_2 & & 1/2 & & {}_{+}A_1 & & & & & {}_{+}\mathbf{A}_3 & & 0/3 & & {}_{+}\mathbf{A}_0 & & \\
 & & \uparrow & & -V & & \Uparrow & & & & & \Uparrow & & -V & & \uparrow & & \\
{}_{-}\mathbf{A}_3 & \Rightarrow & \partial A_3 & \leftarrow & {}_{-}\mathbf{A}_1 & \Rightarrow & \partial A_1 & \rightarrow & {}_{+}\mathbf{A}_2 & {}_{+}\mathbf{A}_0 & \leftarrow & \partial A_3 & \Leftarrow & {}_{-}A_3 & \rightarrow & \partial A_1 & \Leftarrow & {}_{-}A_1 \\
 & \bigcirc & \Downarrow & & & & \uparrow & & & & & \uparrow & & & & \Downarrow & & \\
 & & {}_{+}A_3 & & & & {}_{-}A_2 & & & & & {}_{-}A_0 & & & & {}_{+}\mathbf{A}_1 & &
\end{array}
$$

$$
\begin{array}{cccccccccccccccccc}
 & & {}_{-}A_1 & & & & {}_{+}\mathbf{A}_0 & & & & & {}_{+}\mathbf{A}_2 & & & & {}_{-}\mathbf{A}_3 & & \\
 & & \downarrow & & & & \Uparrow & \bigcirc & & & & \Uparrow & & & & \downarrow & & \\
{}_{+}\mathbf{A}_1 & \leftarrow & \partial A_2 & \Leftarrow & {}_{-}\mathbf{A}_2 & \rightarrow & \partial A_0 & \Leftarrow & {}_{-}A_0 & {}_{-}A_2 & \Rightarrow & \partial A_2 & \leftarrow & {}_{-}\mathbf{A}_0 & \Rightarrow & \partial A_0 & \rightarrow & {}_{+}A_3 \\
 & & \Downarrow & \bigcirc & OZ2 & & \downarrow & & & & & \downarrow & & OZ2 & & \Downarrow & & \\
 & & {}_{+}A_2 & & 1/2 & & {}_{+}\mathbf{A}_1 & & & & & {}_{+}A_3 & & 0/3 & & {}_{+}A_0 & & \\
 & & \uparrow & & +V & & \Uparrow & & & & & \Uparrow & & +V & & \uparrow & & \\
{}_{-}A_3 & \Rightarrow & \partial A_3 & \leftarrow & {}_{-}A_1 & \Rightarrow & \partial A_1 & \rightarrow & {}_{+}A_2 & {}_{+}A_0 & \leftarrow & \partial A_3 & \Leftarrow & {}_{-}\mathbf{A}_3 & \rightarrow & \partial A_1 & \Leftarrow & {}_{-}\mathbf{A}_1 \\
 & \bigcirc & \Downarrow & & & & \uparrow & & & & & \uparrow & & & & \Downarrow & & \\
 & & {}_{+}\mathbf{A}_3 & & & & {}_{-}\mathbf{A}_2 & & & & & {}_{-}\mathbf{A}_0 & & & & {}_{+}A_1 & &
\end{array}
$$

$$
\begin{array}{cccccccccccccccccc}
 & & {}_{+}A_1 & & & & {}_{+}\mathbf{A}_0 & & & & & {}_{-}\mathbf{A}_2 & & & & {}_{+}\mathbf{A}_3 & & \\
 & & \uparrow & & & & \Downarrow & \bigcirc & & & & \Downarrow & & & & \uparrow & & \\
{}_{-}\mathbf{A}_1 & \rightarrow & \partial A_2 & \Rightarrow & {}_{+}\mathbf{A}_2 & \leftarrow & \partial A_0 & \Rightarrow & {}_{+}A_0 & {}_{+}A_2 & \Leftarrow & \partial A_2 & \rightarrow & {}_{+}\mathbf{A}_0 & \Leftarrow & \partial A_0 & \leftarrow & {}_{-}A_3 \\
 & & \Uparrow & \bigcirc & XZ2 & & \uparrow & & & & & \uparrow & & XZ2 & & \Uparrow & & \\
 & & {}_{-}A_2 & & 1/2 & & {}_{-}\mathbf{A}_1 & & & & & {}_{-}A_3 & & 0/3 & & {}_{-}A_0 & & \\
 & & \downarrow & & +V & & \Downarrow & & & & & \Downarrow & & +V & & \downarrow & & \\
{}_{+}A_3 & \Leftarrow & \partial A_3 & \rightarrow & {}_{+}A_1 & \Leftarrow & \partial A_1 & \leftarrow & {}_{-}A_2 & {}_{-}A_0 & \rightarrow & \partial A_3 & \Rightarrow & {}_{+}\mathbf{A}_3 & \leftarrow & \partial A_1 & \Rightarrow & {}_{+}\mathbf{A}_1 \\
 & \bigcirc & \Uparrow & & & & \downarrow & & & & & \downarrow & & & & \Uparrow & & \\
 & & {}_{-}\mathbf{A}_3 & & & & {}_{+}\mathbf{A}_2 & & & & & {}_{+}\mathbf{A}_0 & & & & {}_{-}A_1 & &
\end{array}
$$

(6)

11 Partly Active Photons of Vacuum

If we change the correlation direction and the signs of the components of vector potential in part (1/2) of path RO of the vacuum photon (1a), the $\mu = 0$ oscillator will be activated in the O-photon of vacuum, while there will be no change of the vacuum properties of all other components of the vacuum photon. Changing the current direction and current signs at the same time in a path of a photons, the number of positive and negative components of the vector potential is not changing, but the currents obtain opposite directions. This is demonstrated in the structure (7), which has to be combined with the part (0/3) of structure (1b). A vacuum photon is obtained, which oscillate in action, in state Z1: $[\partial_0 A_0, A_0]$, in state Z2: $[A_0, \partial_0 A_0]$, but is not active in space. The photon carry any possible action and contributes to the action of the vacuum. Vacuum carry not only virtual action, but also active action in the Maxwell photons. Additional "dark photons" are discussed in [4].

$$\begin{array}{ccccccccccccc}
B_3 & \rightarrow & {}_{+}A_1 & \leftarrow & B_1 & & & & E_2 & \leftarrow & {}_{-}A_0 & \rightarrow & E_3 \\
\uparrow & & & & \uparrow & & & & \downarrow & & & & \downarrow \\
{}_{-}\mathbf{A}_1 & & LO & & {}_{-}\mathbf{A}_1 & & & & {}_{+}\mathbf{A}_0 & & RO & & {}_{+}\mathbf{A}_0 \\
\downarrow & & & & \downarrow & & & & \Uparrow & & & & \downarrow \\
E_2 & \rightarrow & {}_{+}A_1 & \leftarrow & \partial A_2 & \Rightarrow & {}_{+}A_2 & \leftarrow & \partial A_0 & \Leftarrow & {}_{-}A_0 & \rightarrow & E_1 \\
 & & & & \Uparrow & & OZ1 & & \uparrow & & & & \\
 & & & & {}_{-}\mathbf{A}_2 & & 1/2 & & {}_{-}\mathbf{A}_1 & & & & \\
 & & & & \downarrow & & +V & & \Downarrow & & & & \\
B_1 & \rightarrow & {}_{+}\mathbf{A}_3 & \Leftarrow & \partial A_3 & \rightarrow & {}_{+}A_1 & \Leftarrow & \partial A_1 & \rightarrow & {}_{+}A_2 & \leftarrow & B_2 \\
\uparrow & & & & \Uparrow & & & & \uparrow & & & & \uparrow \\
{}_{-}A_3 & & LU & & {}_{-}A_3 & & & & {}_{-}\mathbf{A}_2 & & RU & & {}_{-}\mathbf{A}_2 \\
\downarrow & & & & \downarrow & & & & \downarrow & & & & \downarrow \\
E_3 & \rightarrow & {}_{+}\mathbf{A}_3 & \leftarrow & B_2 & & & & E_1 & \rightarrow & {}_{+}A_2 & \leftarrow & B_3
\end{array} \qquad (7)$$

12 Vacuum Fluctuations

The fluctuation of the vacuum can be described in a similar way, as the propagation of photons in vacuum; fig.4b. The discontinuous arrows show in state Z1 the activation of the ∂A_3 cube: the two currents in the cube have different current sign and different circulation direction, generating action. Chain- dotted arrows describe the vacuum oscillation in state Z2; the two currents of different current sign have the same (negative) circulation direction, this annihilate the action. The double arrows describe the fluctuation of currents between an activation in state Z1 and a deactivation of the action in state Z2 by changing the circulation direction of the current in the ∂A_3 cube.

13 Formation of Vacuum Networks

The correlation structures of static and dynamic Maxwell photons are able to form three dimensional networks in vacuum. As an example in fig.5 the B_3 cube of the LO path of an O-photon of static vacuum is shown. Introduced into the B_3 cube are the four strings characterizing each cube. The string marked by chain dotted arrows is connecting the four paths LO, RO, LU and RU of the vacuum O-photon with each other. The string marked by discontinuous arrows is connecting the B_3 cube with the cubes of neighbouring photons in a network. The continuous strings are entering from neighbouring photons in a network into the O-photons and exiting from the O-photon to the neighbouring vacuum photons. Similar strings can be introduced into the E_3-cubes. In such a network the currents of neighbouring photons oscillate simultaneously.

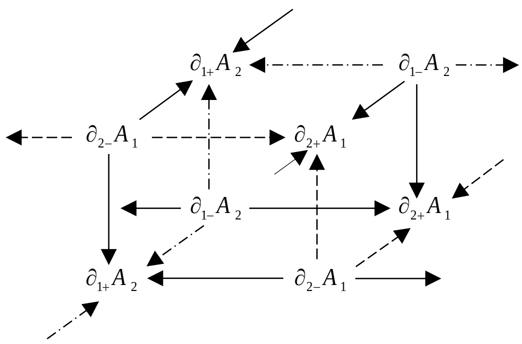

Figure 5: B_3-cube of an O-photon of static vacuum in the path LO; the strings marked by chain-dotted arrows remain inside the photon, the other three strings are able to interact with neighbouring photons.

14 Summary and Discussion

The development of the correlation structure of Maxwell fields on Fourier space was performed under application of the energy-momentum tensor and of four dimensional commutators of communication relations, [7]; in the present report we discuss the vacuum properties of these structures. The photons of static electric and magnetic fields have on correlation space different structures in comparison to the dynamic photons of light (and to the electromagnetic wave); this is so also for the same photons of vacuum. The static and dynamic photons are formed from different correlation strings in the E_i and B_i cubes, [4]. Similar as for active photons in particle, wave and magnetic properties, there are two kinds of O-X-static and two kinds of O and X dynamic photons of vacuum, which oscillate in two oscillation states. This is because the Maxwell fields are formed by two photons O and X with different signs of action, different correlation directions and different signs of the spatial coordinates (There are additional properties of Maxwell fields, not concerning the electromagnetic interaction, discussed in [4].).

Characteristic properties of the Maxwell vacuum are: deactivation of virtual action, deletion of the E and B fields, the same structure, as the active photons of static and dynamic Maxwell fields, formation of active virtual action from deactivates virtual action in fluctuations, formation of particle- and wave properties and the propagation of photons in vacuum, contrary to the photons of light not restricted by the SRT. The propagation of photons of vacuum is different to the propagation of active photons; photons of vacuum propagate under conditions of the PSCO, while active photons of Maxwell fields propagate by a flow of action in space time with the speed of light.

The static photons of vacuum have wave properties, because an overlap of two states results in the formation of positive and negative photons O and X, which cancel each other; the mechanism is the same, as the formation of wave properties by active static photons. It occurs by an interaction between the parts Z1(0/3) and Z2(1/2) and Z1(1/2) with Z2(0/3).

The photons of vacuum are able to interact with active static and dynamic photons, because they have the same structure and the interaction occurs by the same rules under condition of minimization of action, as the interaction of active photons of Maxwell fields among each other. In mean all E- and B- fields in vacuum are cancelled, because the static photons with different signs have nearly the same amount of action and they are able to superimpose, cancelling the currents in the photons.

The interaction between vacuum photons of Maxwell fields among each other and between photons of vacuum and photons of active Maxwell fields occurs under the same conditions, as the interaction between active photons by superposition, entanglement and induction, the action is conserved by a conservation of currents between components of the vector potential and change of action takes place under the rules of Newton.

The photons of vacuum propagate in vacuum under conditions of the PSCO, under application of the deactivated virtual action, contained in the vacuum (quantum fields of vacuum); transport of structure information without transport of active action is not restricted by the conditions of the SRT.

The dynamic photons of vacuum (2) and (3) are not interfering, because the correlation directions of both oscillation states are different. Dynamic vacuum photons of light can be constructed, however, which have deactivated μ-commutators, but activated E_i and B_i cubes; they can form particle, as well as wave properties: If the paths *bo* and *gl* are activated in the vacuum photons, without activation of action, they form wave properties, proved by interference. If for example, the signs of the A_2 components and correlation directions in the part (1/2) of this photon are changed, the dynamic vacuum photon obtains particle properties.

In a fluctuation between the deactivated and activated virtual action in photons of vacuum, the process will immediately return to the properties of deactivation; this is forced by the principle of minimization of action (principle of Hamilton). The active virtual action, formed during fluctuations, can remain active, if active virtual action is absorbed by active photons. This occurs, for example, during an interaction of vacuum photons with the photons of matter oscillators, [4].

Vacuum is not detectable on space time, because the virtual action of vacuum is deactivated; the currents, forming the action, have in the structure of the photons different signs and the same circulation direction. In fluctuations of the vacuum the deactivated virtual action can form activated virtual action and can influence the processes on space time. The objects, described on correlation space are appearing on space time, when the vertical correlations in the correlation structure are activated by a change of action. Processes in vacuum occurring on correlation space, in which the vertical correlations are not activated, will not be visible on space time. The correlation space is connected with the space time by events, [8].

The description of the Maxwell vacuum presented in this paper is incomplete, because it can be expected that additional structures are existing. This follows from the development of the correlation structure. A detailed discussion is contained in [4]. Space and time are to each other connected, because the components of the vector potential, forming the Maxwell vacuum, are four dimensional and their interaction is ruled by the PSCO. The four dimensional space is occupied by quantum fields containing activated and deactivated virtual action.

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