Interaction Between Masses by Exchange of Information

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Abstract: As physical information a physical value is defined, which characterizes the object and is exchanged during an interaction between two or more physical objects. The exchanged information must determine the changed properties of the objects after interaction. It is the aim of this paper to show, that action described by covariant four dimensional commutators of communication relations included in photons of static Maxwell fields is the physical information in electromagnetic and gravitation interactions.

1 Introduction

It is assumed that the interaction between masses by an exchange of information occurs during an overlap (superposition) of the photon clouds of the interacting objects, a transfer of this information from the photon cloud to the core of masses and processed there under a change of properties of the objects. An example for such an interaction is the interaction between two electrons. The photon cloud of electrons is described by static Maxwell fields; the photons of the static Maxwell fields will interact changing the properties of the photons and the modification of the photons will be the information, which in the core of the electron will change the properties of the electron. For a description of an interaction between masses the representation of masses by the scalar Lagrange density and for the photons static Maxwell fields their representation as energy momentum tensor are used, [1].

Fields characterizing the objects by Lagrange density and describing their quantisation by commutators of communication relations are transformed into the Fourier space, where their products are represented by correlations, [2]. The correlations generate a dependency between the fields in the correlation function. In classic physics the correlations describe the influence of one of the fields (the conjugate field) on the other field. Using this dependence, correlation structures of the quantized objects are constructed. As a construction principle the third law of Newton is used. The correlation structures consists of strings between creators and annihilators of the vector potential. These strings are interpreted as currents flowing form a creator of one sign to an annihilator of the other sign. If the strings ere connected with a positive creator and a negative annihilator this is interpreted as a positive current and if the the string is connected with a negative creator and a positive annihilator this current is negative. The currents can flow in the correlation structure in positive and negative circulation direction.

The obtained correlation structures of objects exists always in two modifications, which are distinguished between each other by their correlation directions and by the signs of the correlations. The structures with opposite correlation directions are considered as two spin directions and are named by O and X. The structures with different correlation directions and of different signs of some of the fields are assumed to be two oscillation states of oscillators. For state Z1 of Maxwell photons it is assumed that the $\mu = 0$ oscillator is positive and for state Z2 negative. It will be shown that using the representation of elementary objects with masses and charges and photons of static Maxwell fields by structures, generated from correlations, the interaction between elementary objects can be described by an exchange of information. As information action of the $\mu = 0$ oscillator embedded in four dimensional structures of photons of static Maxwell field is used.

2 Correlation Structure of Photons of Static Maxwell Fields

The photons of static Maxwell fields consists of O-X-photons. As an example the X-photon of a negative charge in its oscillation state Z2 is depicted in relations (1).

$$
\begin{array}{ccccccccccccc}
B_3 & \rightarrow & {}_{+}\mathbf{A}_1 & \leftarrow & B_1 & & & & E_2 & \rightarrow & {}_{+}A_0 & \leftarrow & E_3 \\
\uparrow & & & & \uparrow & & & & \uparrow & & & & \uparrow \\
{}_{-}A_1 & & LO & & {}_{-}A_1 & & & & {}_{-}\mathbf{A}_0 & & RO & & {}_{-}\mathbf{A}_0 \\
\downarrow & & & & \downarrow & & & & \Downarrow & & & & \downarrow \\
E_2 & \rightarrow & {}_{+}\mathbf{A}_1 & \leftarrow & \partial A_2 & \Leftarrow & {}_{-}\mathbf{A}_2 & \rightarrow & \partial A_0 & \Rightarrow & {}_{+}A_0 & \leftarrow & E_1 \\
 & & & & \Downarrow & & XZ2 & & \downarrow & & & & \\
 & & & & {}_{+}A_2 & & 1/2 & & {}_{+}A_1 & & & & \\
 & & & & \uparrow & & -0123 & & \Uparrow & & & & \\
B_1 & \rightarrow & {}_{+}A_3 & \Leftarrow & \partial A_3 & \leftarrow & {}_{-}\mathbf{A}_1 & \Rightarrow & \partial A_1 & \rightarrow & {}_{+}\mathbf{A}_2 & \leftarrow & B_2 \\
\uparrow & & & & \Uparrow & & & & \uparrow & & & & \uparrow \\
{}_{-}\mathbf{A}_3 & & LU & & {}_{-}\mathbf{A}_3 & & & & {}_{-}A_2 & & RU & & {}_{-}A_2 \\
\downarrow & & & & \downarrow & & & & \downarrow & & & & \downarrow \\
E_3 & \rightarrow & {}_{+}A_3 & \leftarrow & B_2 & & & & E_1 & \rightarrow & {}_{+}\mathbf{A}_2 & \leftarrow & B_3
\end{array}
\tag{1a}
$$

$$
\begin{array}{ccccccccccccc}
B_3 & \rightarrow & {}_{+}\mathbf{A}_2 & \leftarrow & B_1 & & & & E_2 & \rightarrow & {}_{+}\mathbf{A}_3 & \leftarrow & E_3 \\
\uparrow & & & & \uparrow & & & & \uparrow & & & & \uparrow \\
{}_{-}A_2 & & & & {}_{-}A_2 & & & & {}_{-}A_3 & & & & {}_{-}A_3 \\
\downarrow & & & & \Downarrow & & & & \downarrow & & & & \downarrow \\
E_2 & \rightarrow & {}_{+}\mathbf{A}_2 & \Leftarrow & \partial A_2 & \leftarrow & {}_{-}A_0 & \Rightarrow & \partial A_0 & \rightarrow & {}_{+}\mathbf{A}_3 & \leftarrow & E_1 \\
 & & & & \downarrow & & XZ2 & & \Downarrow & & & & \\
 & & & & {}_{+}\mathbf{A}_3 & & 0/3 & & {}_{+}\mathbf{A}_0 & & & & \\
 & & & & \Uparrow & & -0123 & & \uparrow & & & & \\
B_1 & \rightarrow & {}_{+}\mathbf{A}_0 & \leftarrow & \partial A_3 & \Leftarrow & {}_{-}A_3 & \rightarrow & \partial A_1 & \Rightarrow & {}_{+}\mathbf{A}_1 & \leftarrow & B_2 \\
\uparrow & & & & \uparrow & & & & \Uparrow & & & & \uparrow \\
{}_{-}A_0 & & & & {}_{-}A_0 & & & & {}_{-}A_1 & & & & {}_{-}A_1 \\
\downarrow & & & & \downarrow & & & & \downarrow & & & & \downarrow \\
E_3 & \rightarrow & {}_{+}\mathbf{A}_0 & \leftarrow & B_2 & & & & E_1 & \rightarrow & {}_{+}\mathbf{A}_1 & \leftarrow & B_3
\end{array}
\qquad (1b)
$$

Each O-and X-photon consists of two parts (1/2) and (0/3) which must be overlapped to determine their properties. The O-X-photon of static Maxwell fields is generated by an overlap of the two photons O and X. The correlations in this correlation structure are described by arrows pointing from the creator to the annihilator of the components of the vector potential. The letters E_i and B_i describe three dimensional cubes generated on correlation space by the derivative of the components of the vector potential and the ∂A_μ are unity cubes for the four dimensions $\mu = 0, 1, 2, 3$; the cubes are obtained from the Fourier transformation of the trace of the energy momentum tensor of Maxwell fields in Lorentz gauge. Each O-X-photon of static Maxwell fields consists of ten sets of components of the vector potential $\{A_\mu, \mu = 0, 1, 2, 3\}$, five positive and five negatives. A positive and a negative set is common to both photons O and X and connect the two photons O and X. In (1) the positive components of the vector potential are described by bold letters, the others are negative. The three dimensional structure (1) contain all four μ = 0,1,2,3 coordinates and all B_i and B_i fields.

3 Correlation Structure of Scalar Fields

The scalar correlation structure is obtained from the scalar Lagrange density and from the covariant four dimensional scalar commutators of communication relations of quantum mechanics (μ-commutators consisting of μ-correlations). As an example the structure of the μ= 3 scalar oscillator of a particle in oscillation state Z1 is shown in relations (2).

state Z1 of the μ= 3 scalar oscillator of a particle:

$$
\begin{array}{cccccccccccccc}
{}_{+}\varphi & \Leftarrow & \partial_{\mu-}\varphi^\dagger & \rightarrow & \partial_{\mu+}\varphi & \leftarrow & {}_{-}\varphi^\dagger & {}_{-}\varphi^\dagger & \Rightarrow & \partial_{\mu-}\varphi & \Leftarrow & \partial_{\mu-}\varphi^\dagger & \rightarrow & {}_{-}\varphi \\
\uparrow & LO & & \mu 1 & & & \downarrow & \Downarrow & & & \mu 1 & & RO & \Uparrow \\
{}_{-}\varphi^\dagger & \rightarrow & \partial_{\mu-}\varphi & \leftarrow & \partial_{\mu-}\varphi^\dagger & \Rightarrow & {}_{-}\varphi & {}_{-}\varphi & \leftarrow & \partial_{\mu+}\varphi^\dagger & \Rightarrow & \partial_{\mu-}\varphi & \Leftarrow & {}_{+}\varphi^\dagger \\
{}_{+}\varphi^\dagger & \rightarrow & \partial_{\mu+}\varphi & \leftarrow & \partial_{\mu+}\varphi^\dagger & \Rightarrow & {}_{+}\varphi & {}_{+}\varphi & \leftarrow & \partial_{\mu-}\varphi^\dagger & \Rightarrow & \partial_{\mu+}\varphi & \Leftarrow & {}_{-}\varphi^\dagger \\
\downarrow & LU & & \mu 2 & & & \uparrow & \Uparrow & & & \mu 2 & & RU & \Downarrow \\
{}_{-}\varphi & \Leftarrow & \partial_{\mu+}\varphi^\dagger & \rightarrow & \partial_{\mu-}\varphi & \leftarrow & {}_{+}\varphi^\dagger & {}_{+}\varphi^\dagger & \Rightarrow & \partial_{\mu+}\varphi & \Leftarrow & \partial_{\mu+}\varphi^\dagger & \rightarrow & {}_{+}\varphi
\end{array}
$$

(2)

Each scalar oscillator consists of four closed paths μ1LO μ1RO μ2LU and μ2RU. The scalar oscillators are constructed from two scalar Lagrange densities and from two co-variant four dimensional scalar commutators of communication relations. The two commutators of communication relations we call also the photons O and X, because as it will be shown, they can be identified by the commutators of absorbed O and X photons of static Maxwell fields. In following the scalar correlation structure will be used in the following representation:

Particle, $\mu = 3$ oscillator, state Z1.2:

O1: Z1.2LS			RS			O2: Z1.2LS			RS		
$_{-}\Phi$	$\Leftarrow -$	$_{+}\varphi^{\dagger}$	$_{+}\Phi^{\dagger}$	$+ \Rightarrow$	$_{+}\varphi$	$_{-}\varphi^{\dagger}$	$- \Rightarrow$	$_{+}\Phi$	$_{+}\varphi$	$\Leftarrow +$	$_{+}\Phi^{\dagger}$
$\uparrow$	$\mu1$	$\downarrow$	$\downarrow$	$\mu1$	$\uparrow$	$\downarrow$	$\mu1$	$\uparrow$	$\uparrow$	$\mu1$	$\downarrow$
$_{+}\varphi^{\dagger}$	$- \Rightarrow$	$_{+}\Phi$	$_{+}\varphi$	$\Leftarrow +$	$_{-}\Phi^{\dagger}$	$_{+}\Phi$	$\Leftarrow -$	$_{+}\varphi^{\dagger}$	$_{+}\Phi^{\dagger}$	$+ \Rightarrow$	$_{-}\varphi$
A	$X(1/2)$			$X(0/3)$		**C**	$X(1/2)$			$X(0/3)$	
$_{-}\varphi$	$\Leftarrow +$	$_{-}\Phi^{\dagger}$	$_{-}\varphi^{\dagger}$	$- \Rightarrow$	$_{+}\Phi$	$_{-}\Phi^{\dagger}$	$+ \Rightarrow$	$_{-}\varphi$	$_{-}\Phi$	$\Leftarrow -$	$_{+}\varphi^{\dagger}$
$\uparrow$	$\mu2$	$\downarrow$	$\downarrow$	$\mu2$	$\uparrow$	$\downarrow$	$\mu2$	$\uparrow$	$\uparrow$	$\mu2$	$\downarrow$
$_{+}\Phi^{\dagger}$	$+ \Rightarrow$	$_{-}\varphi$	$_{-}\Phi$	$\Leftarrow -$	$_{-}\varphi^{\dagger}$	$_{+}\varphi$	$\Leftarrow +$	$_{-}\Phi^{\dagger}$	$_{-}\varphi^{\dagger}$	$- \Rightarrow$	$_{-}\Phi$
(3)											
o **B**	O(1/2)			O(0/3)		**D**	O(1/2)			O(0/3)	
Z1.2 = O(−)-X(+)						Z1.2 = O(+)-X(−)					

$\mu = 0$ oscillator, state Z1.2

O1: Z1.2-LS			RS			O2: Z1.2-LS			RS		
$_{-}\varphi$	$\Leftarrow +$	$_{+}\Phi^{\dagger}$	$_{+}\varphi^{\dagger}$	$- \Rightarrow$	$_{+}\Phi$	$_{-}\Phi^{\dagger}$	$+ \Rightarrow$	$_{+}\varphi$	$_{+}\Phi$	$\Leftarrow -$	$_{+}\varphi^{\dagger}$
$\uparrow$	$\mu1$	$\downarrow$	$\downarrow$	$\mu1$	$\uparrow$	$\downarrow$	$\mu1$	$\uparrow$	$\uparrow$	$\mu1$	$\downarrow$
$_{+}\Phi^{\dagger}$	$+ \Rightarrow$	$_{+}\varphi$	$_{+}\Phi$	$\Leftarrow -$	$_{-}\varphi^{\dagger}$	$_{+}\varphi$	$\Leftarrow +$	$_{+}\Phi^{\dagger}$	$_{+}\varphi^{\dagger}$	$- \Rightarrow$	$_{-}\Phi$
A	$X(1/2)$			$X(0/3)$		**C**	$X(1/2)$			$X(0/3)$	
$_{-}\Phi$	$\Leftarrow -$	$_{-}\varphi^{\dagger}$	$_{-}\Phi^{\dagger}$	$+ \Rightarrow$	$_{+}\varphi$	$_{-}\varphi^{\dagger}$	$- \Rightarrow$	$_{-}\Phi$	$_{-}\varphi$	$\Leftarrow +$	$_{+}\Phi^{\dagger}$
$\uparrow$	$\mu2$	$\downarrow$	$\downarrow$	$\mu2$	$\uparrow$	$\downarrow$	$\mu2$	$\uparrow$	$\uparrow$	$\mu2$	$\downarrow$
$_{+}\varphi$	$- \Rightarrow$	$_{-}\Phi$	$_{-}\varphi$	$\Leftarrow +$	$_{-}\Phi^{\dagger}$	$_{+}\Phi$	$\Leftarrow -$	$_{-}\varphi^{\dagger}$	$_{-}\Phi^{\dagger}$	$+ \Rightarrow$	$_{-}\varphi$
o **B**	O(1/2)			O(0/3)		**D**	O(1/2)			O(0/3)	
Z1.2 = O(+)-X(−)						Z1.2 = O(−)-X(+)					

(3)

The interaction between the O-X-photons of the photon cloud and the scalar oscillators occurs by an overlap between the O and X photons of the photon cloud and the O and X photons absorbed in the scalar oscillators. In particle properties this interaction occurs in four states: in two exchange states, in which the information of the photons of the photon cloud is exchange with the absorbed photons and in two particle states, in which the absorbed new information is processed in the scalar oscillator. For the particle the exchange states are the states Z1.1 and Z1.2 and the particle states are Z2.1 and Z2.2. For the anti-particle the exchange and particle states are exchanged between Z1 and Z2.

For the description of the interaction between the photons of the photon cloud and the absorbed photons two scalar oscillators O1 and O2 are needed. The two oscillators O1 and O2 are conjugate to each other; this is a precondition for the interaction in particle properties, in which in one oscillation state the O photons of the O-X-photons in photon cloud interact with the O-photon in the O1 oscillator and the X-photon of the photon cloud is interacting with the X-photon in the O2 oscillator. In the following interaction process the O-photon of the O-X-photon is interacting with the O-photon of the O2 oscillator and the X photon with the X-photon of the O1 oscillator. This kind of interaction is ruled by the condition of action minimization (Hamilton principle).

The representation (3) is obtained from the representation (2) by introducing the characteristic properties of the μ-oscillators of the photons of static Maxwell fields into the scalar oscillators under the assumption that μ-correlations of the static photons are parallel and equally directed with the μ-correlations of the scalar oscillators. The products between the derivatives of the scalar oscillators, like $\partial_\mu\varphi\partial_\mu\varphi^\dagger$ are identified with the same products in the unity cubes of the static photons between the derivatives of the vector components. As a result of the introduction of the oscillators of the static photons into the scalar oscillators each scalar oscillator O1 and O2 consists of two product between the scalar components $\varphi\varphi^\dagger$ and $\varphi^\dagger\varphi$ and of an O-X-photon. The position of the two parts (1/2) and (0/3) of the O and X photons and their sign of action is shown in representation (3). In (3) the arrows $\Leftarrow -$ describe for example a negative current in positive circulation direction and an arrow $+\Rightarrow$ a positive current in negative circulation direction in one of the four paths of the scalar oscillator. The large letter of the scalar fields, for example $_{-}\Phi$, describe a positive annihilator of the scalar fields and the small letters, for example $_{+}\varphi^\dagger$, a negative creator of the scalar fields. The photons of the static Maxwell fields determine the properties of the scalar oscillators, especially their description as a particle or anti-particle.

In our model of gravitational and electrostatically interaction the structure of all scalar μ- oscillators is the same; the formation of masses or charges occur in an interaction between the scalar oscillators and between the photons or gravitons under the condition of minimization of action, which leads to a common structure of oscillators with a radial distribution of action of an object in a rest frame.

4 Action Contained in Static Photons as Physical Information

The sixteen cubes E_i, B_i and ∂A_μ in relations (1) are a representation of the trace of the energy-momentum tensor on correlation space. The oscillation of photons like (1) and of scalar oscillators, like (3) is interpreted by a current flow between creators and annihilators during a change of states. The properties of the $\mu = 0$ cube together with the μ-correlations of the $\mu = 0$ commutator are depicted in fig.1. We consider the currents

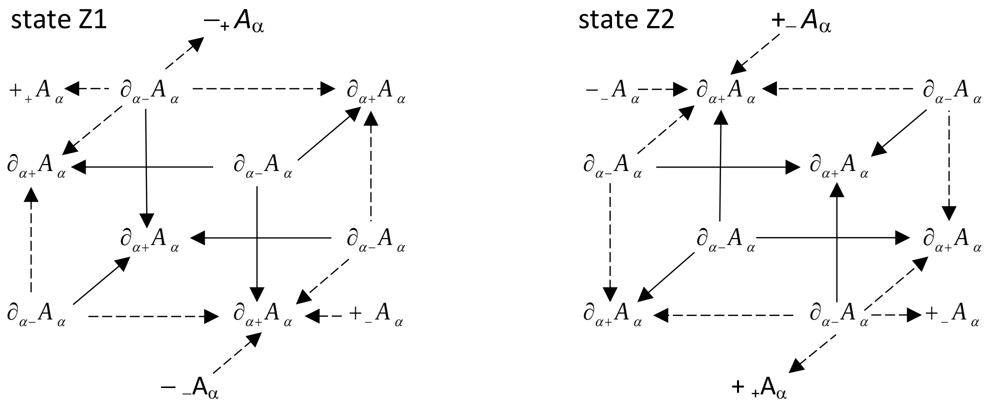


Figure 1: Two oscillation states of the α- unity cube of the X-photon. Arrows describe correlations.

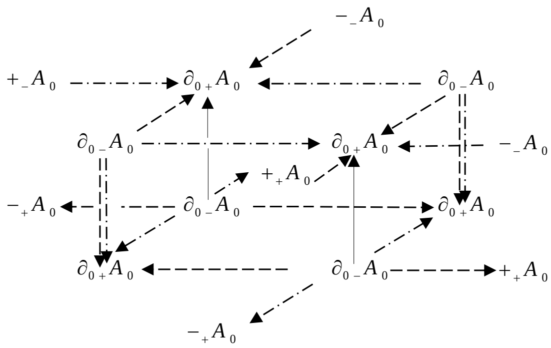
of the O-Photon in fig.1 generated between the two creators $-_{-}A_0$ and $+_{-}A_0$ and two annihilators $+_{+}A_0$ and $-_{+}A_0$ for state Z1 and state Z2. Reading in negative circulation direction (clockwise) in the path of the photon is used. The following currents are obtained:

Z1, X: (1/2)/(0/3): $+_{-}A_0 \Rightarrow \partial A_0 \Rightarrow -_{+}A_0$ and $+_{+}A_0 \Leftarrow \partial A_0 \Leftarrow -_{-}A_0$

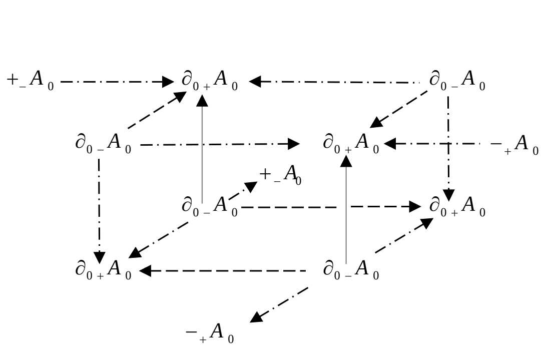
Z2, X: (1/2)/(0/3): $+_{+}A_0 \Leftarrow \partial A_0 \Leftarrow -_{-}A_0$ and $-_{-}A_0 \Rightarrow \partial A_0 \Rightarrow -_{+}A_0$

In state Z1 they form a positive commutator $[A_0, \partial_0 A_0]$ and in state Z2 a negative commutator $[\partial_0 A_0, A_0]$ (Products between two creators or between two annihilators are forming on Fourier space convolutions). The vertical correlations in the cubes of relation (1) describe the products between the derivatives of fields in the Lagrange density. As the source of physical information in an interaction between oscillators of matter the $\mu = 0$ commutator is considered. In a four dimensional photon (1) the $\mu = 0$ commutator is forming positive action in oscillation state Z1 and negative action in state Z2. The photons of static Maxwell fields are the carrier of this information in an interaction between mass- and between charge- oscillators.

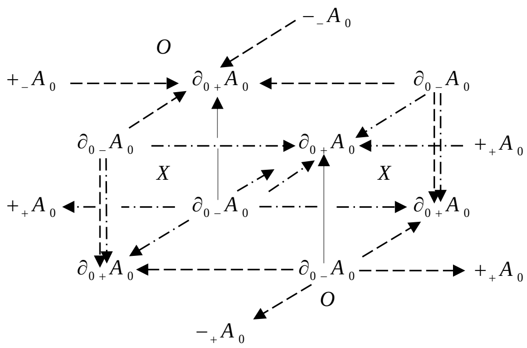
The source of action in O-X-photons of static Maxwell fields (and in dynamic photons of light) occurs in three different modifications: as real action, as activated virtual action and as deactivated virtual action. The three modifications will be discussed at the example of the $\mu = 0$ oscillator, represented in fig.2 and for the the $\mu = 3$ commutator in fig.3. In fig.2a the $\mu = 0$ oscillator of the O-X-photon of vacuum is shown. The μ



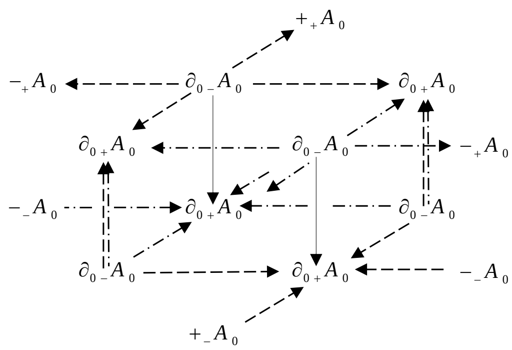
state Z1
(a) ∂A_0- Vacuum for O-X-Photon



state Z1
(b) ∂A_0- Vacuum for O-Photon

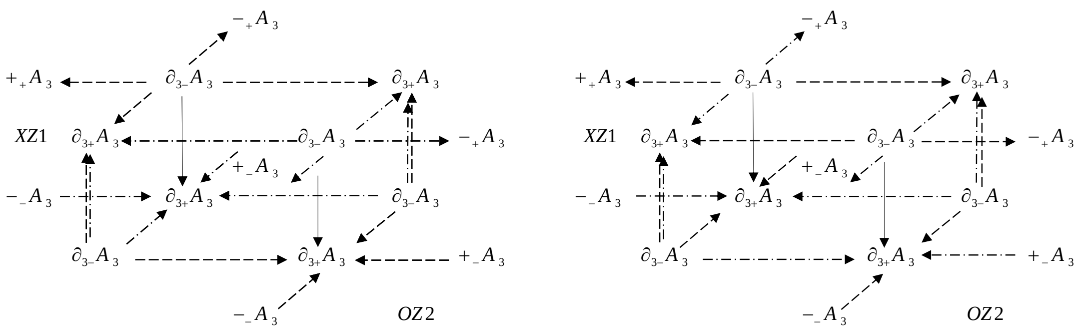


state Z1
(c) μ = 0 of an O-X-photon positive



state Z2
(d) μ = 0 of O-X-photon negative

Figure 2: Different modifications of the $\mu = 0$ oscillator in O-X-photons of static Maxwell fields. (a) O-X-photon of vacuum, (b) O-photon of vacuum, (c) state Z1 of the $\mu = 0$ oscillator, action positive, (d) state Z2 of the $\mu = 0$ oscillator, action negative



(a) O(+)-X(−) photon

O-X-photon of vacuum with deactivated action

Figure 3: Overlap of a negative X-photon with its state Z1 with the positive O-photon in its state Z2 (a) and O-X-photon with deactivates action of vacuum (b) at example of the $\mu = 3$ oscillator. Flow of currents is different in (a) and (b)

$= 0$ oscillator of the two photons O and X of the deactivated vacuum are formed by two currents with different current signs and the same circulation direction. If these two currents are added in relation to the negative circulation direction, they cancel to zero. This is visualized for one of the two photons in fig.2b. In fig.2c and 2d the two oscillation states of the $\mu = 0$ oscillator of O-X-photons with real action of each of the photons O and X for the states Z1 and Z2 are shown. The structure of the active $\mu = 0$ oscillator is the same as that of the vacuum, but the currents forming action are entering at different positions into the cube or exiting from the cube. In fig.2c the oscillation state of the $\mu = 0$ oscillator generates for each of the two photons O and X a positive real action and in state Z2 of fig.2d two times a negative action by the photons O and X is generated.

5 Formation of Static Photons of Charges and of Gravitons

The sign of the charge is determined in the static O-X-photons by the sign of the $\mu = 3$ oscillator. The $\mu = 3$ oscillator has the same amount of currents as the $\mu = 0$ oscillator; the signs of action generated in the $\mu = 3$ oscillator are in both photons O and X and in both oscillation states the same: for particles the $\mu = 3$ oscillator is in both states positive and for anti-particle negative. If we choose for one of the photons O or X a positive $\mu = 3$ oscillator and for the other a negative $\mu = 3$ oscillator, the O-X-photons receive for equal action amounts the annihilation of action. In following it will be shown that these O-X-photons interact with matter oscillators without charges, that is they can be applied as gravitons, [4]. The gravitons represent the third kind of action in Maxwell photons: real action in O-X-photons describe the positive and negative charges, activated virtual action characterizes gravitons and deactivated virtual action the photons of the vacuum.

In fig.3a the characteristic properties of the $\mu = 3$ oscillator of gravitons are depicted and in fig.3b this is compared with the $\mu = 3$ oscillator of the deactivated photons of vacuum. The graviton in fig.3a is constructed by an overlap with a X-photon in its active particle state Z1 with negative real action and with an O-photon with its positive real action in the particle state Z2. The photons O and X must overlap with the same directions of currents. In a similar way another graviton can be constructed by overlapping the O-photon with its negative real action in particle state Z1 with the X-photon with positive real action in the particle state Z2. For equal amounts of action in these photons the currents and the action is cancelling to zero. The formation of O-X-photons with the same amount of action occurs under conditions of action minimization. In O-X-photons of charges with particle properties in particle state the action is real, in gravitons the action is virtual in both oscillation states.

The gravitons are characterized by a special property: the correlation structure of the gravitons is identical with the correlation structure of the photons of vacuum with deactivated action, which enable them to completely overlap with the photons of the deactivated vacuum. This is visible by comparing the structure of fig.3a with the structure in fig.3b. Nevertheless the gravitons are distinguished from the photons of vacuum by their activated virtual action in contradiction to the deactivated virtual action of vacuum. The difference of properties appear during the interaction of the gravitons with matter oscillators. As will be discussed below in an interaction with matter oscillators the O-X-gravitons must separate in O and X-photons with active real action of positive and negative signs; such a separation of the O-X-photons with deactivated virtual action of vacuum leads to deactivated O and X photons, which are not able to interact with matter oscillators under a change of properties.

6 Interaction between Static Photons of Charges and Gravitons

The mechanism of interaction between two charges, or between charges and gravitons is different to the interaction of charges or masses in a homogeneous potential gradient. In the present report only the interaction between photons of a charge and a graviton is discussed, while the interactions of charges and masses in a homogeneous potential gradient are discussed in [7].

The interaction between the photons in the photon cloud of two charges occurs only between two different oscillation states, in which the currents of interacting photons in the correlation structures are parallel and equally directed and the sign of action in the $\mu = 0$ oscillator is different. The interaction is an overlap of the interacting two O-X-photons followed with a separation, which can be described by the following relation:

$$\text{O-X \& O}+\Delta\text{-X}+\Delta \rightarrow \text{O}+\Delta\text{-X \& O - X}+\Delta \quad (4)$$

It is assumed that the two interacting photons are distinguished by the four dimensional delta Δ of action: after separation the two photons have the same amount of action. The separation between the two photons occurs under conditions of minimization of action and is the basis of the third law of Newton. The photons with the modified action are interacting by superposition with the mass/charge oscillators under transfer of the delta of action to the absorbed O and X photons and a change of canonical momenta of the object results.

The interaction between the photons of different charges and the interaction of photons of charges with gravitons and the interaction between gravitons of different masses occurs according to the same law (4). As an example the interaction between the photons of an anti-particle and the gravitons is shown in table 1. Only the $\mu = 0$ part of the static photons and gravitons are reproduced. Similar interactions occur between photons of charges under formation of deltas of action and the processing of the information in scalar oscillators under a change of the rest frame. All other kinds of interactions are compiled in appendix J in [3].

In table 1 the interaction of the O- and of the X-photon with the gravitons is depicted separately. In an interaction of the negative O(−)-photon with a graviton, consisting of a contribution of photons of particle and anti-particle, the $\mu = 0$ oscillator interact by superposition with the part of the graviton, which currents are of the same circulation direction and of different current signs. This is for the O(−)-photon the particle-XZ2- part of the graviton with positive action in the $\mu = 3$ oscillator. The interaction result is a delta of action for the $\mu = 0$ oscillator by Δ_g(+OZ1−XZ2); (1/2)/(0/3) = (−+)/(+−)+(++)/(−−). (In brackets the first sign describes the sign of the current and the second sign the sign of circulation direction of currents in the two parts (1/2) and (0/3) of the photon.)

The X(−)-photon of the anti-particle is similar interacting with the OZ2 photon of the graviton OZ2-XZ1 under formation of the delta of action for the $\mu = 0$ oscillator: Δ_g(+XZ1−OZ2); (1/2)/(0/3) = (+−)/(−+)+(−−)/(++). The delta describes the difference of action in the photons of the anti-particle in relation to the gravitons. In a similar interaction of the particles of matter the other of the two components of the gravitons OZ1(−) and XZ1(−) are interacting with the photon cloud of matter/charge oscillators. Because matter exists with equal positive and negative charge, gravitons as a whole are absorbed.

Matter consists usually not only of charges but also of matter oscillators, because different charges have different amounts of specific matter; charges must also contain pure matter oscillators. There must be also an interaction between ae "graviton cloud" with these matter oscillators. Pure matter oscillators are emitting, similar as charges, gravitons. This will occur in a same way as the described interaction between negative charges and the gravitons. An interpretation of dark matter are objects without a charge, containing only mass oscillators, and interacting only with gravitons.

7 Information Processing in Scalar Oscillators

In table 2 the representation of the scalar oscillators O1 and O2 for the two longitudinal oscillators in particle state of an anti-particle in a still more simplified form is given. The scalar fields are neglected and only the two parts of the delta together with the currents of absorbed photons O and X with their directions (to left positive, to right negative circulation direction) and the current signs are introduced. The delta of a commutator consist of two parts with current circulation direction and current signs:

positive delta-μ: $+\Delta_\mu = +\overrightarrow{\Delta} - \overleftarrow{\Delta}$
negative delta-μ: $-\Delta_\mu = -\overrightarrow{\Delta} + \overleftarrow{\Delta}$

The deltas are introduced into the currents of the absorbed photons with the same circulation direction, which is an interaction by superposition. It is assumed that all deltas are introduced during one complete oscillation cycle with equal deltas and the oscillator is again in a new rest frame. The deltas are added to the two longitudinal oscillators with different sign of currents, but the same circulation direction of scalar oscillators.

The addition of the deltas of action is an accumulation of information. Currents of the deltas with the same sign of currents as the currents of the absorbed photons O and X are added to the currents of the absorbed photons, currents with opposite sign of the deltas are subtracted from the currents of the absorbed photons. The information - the delta of action - absorbed after four cycles of interaction under absorption of the deltas with the same amount are added and subtracted with equal numbers: the information is virtually stored. The information storage occurs between the photons O and X, between the oscillators O1 and O2 and between the two longitudinal oscillators. After reaching a new rest frame the whole real action in the scalar oscillator is again equal zero. During the four times interaction cycle the action is different from zero and during that time the object together with its oscillators change the rest frame: the absorption of information is connected with a change of canonical momenta.

The formation of canonical momenta, after a four-time absorption of a delta of action is shown by a representation of the scalar correlation structures (2) by commutators between canonical momenta of the oscillator, [3]. If the canonical momenta are defined by:

$$\pi_\mu = \partial_\mu \varphi + \varphi,\ \hat{\pi}_\mu = \partial_\mu \varphi - \varphi,\ \pi^\dagger_\mu = \partial_\mu \varphi^\dagger + \varphi^\dagger,\ \hat{\pi}^\dagger_\mu = \partial_\mu \varphi^\dagger - \varphi^\dagger.$$

(the fields in this representation are dimensionless) the two oscillation states of the $\mu = 0$ oscillator (2) can be described, for example for the $\mu = 0$ oscillator, by the two commutators $[\pi_0, \hat{\pi}^\dagger_0]$ for Z1 and $[\hat{\pi}^\dagger_0, \pi_0]$ for Z2. Adding four times a delta of action (described by scalar fields) during a four oscillation phase of the scalar oscillators (2), the canonical momenta change to $\bar{\pi}_0 = \pi_0 - \Delta\pi_0$, $\bar{\hat{\pi}}^\dagger_0 = \hat{\pi}^\dagger_0 - \Delta\hat{\pi}^\dagger_0$. This is shown for particle, anti-particle and neutral particle for their four μ-oscillators in [3]. The reaction, as described by scalar oscillators, leads to the same results, as under application of the description with static Maxwell photons: all contributions of the deltas of real action is after a four times acquisition process equal zero, which expresses the virtual storage of action in a new rest frame.

8 Relativistic Increase of Masses

Looking into details of table 2, during the acquisition process of the same deltas of action, in a potential gradient two different acquisition phases can be distinguished. In both longitudinal oscillators the currents of the delta are in the absorbed photons X in O1 and in O in O2 subtracted and in the absorbed photons O in O1 and X in O2 the currents are added. Addition and subtraction of the currents of deltas is a virtual storage of information.

As long as the currents generated by the absorbed deltas are lower as the currents in the absorbed photons X in O1 and O in O2, this effect will contribute to a balance of positive action and negative action in the oscillators O1&O2. If the contributions of currents of the absorbed deltas are higher as the currents in the scalar fields $\varphi\varphi^\dagger$ and $\varphi^\dagger\varphi$, in all two absorbed O and X photons the current is increasing. Accelerating an object by supplying action above the content of action in the scalar fields $\varphi\varphi^\dagger$ and $\varphi^\dagger\varphi$, the current in the memories of the oscillators are now increasing and are not longer annihilated between the two absorbed O-X-photons and between the two oscillators O1 and O2.

Because the content of masses in the oscillators is related to the content of action, [3], the following explanation of the behaviour of the two acquisition phases of action can be proposed: During the low energy supply of action of the object the acceleration is not relativistic and above it is relativistic; the supply of action in a not relativistic acceleration causes an increase of energy/momentum, in the phase of relativistic acceleration the supply of action causes in addition an increase of the masses. The position of action supply where the supplied action by deltas of interaction is equal to the action of scalar fields $\varphi\varphi^\dagger$ and $\varphi^\dagger\varphi$, we call the not-relativistic limit. This limit determines the number of action units, which are characteristic for the absorbed photons in scalar oscillators and the number of oscillators determine the specific mass of the object.

For the acquisition of action above the not-relativistic limit the results of table 2 can be summarized:

for $\mu = 3$: in O1:X and in O2:O an increase of positive action occurs
for $\mu = 0$: in O1:X and in O2:O an increase of negative action occurs.

This results in
O1&O2: O(+)-X$(+)_\mu = 3$ + O(−)-X$(-)_\mu = 0$ for anti-particle in state Z2

For the similar computations of a particle it follows:

O1&O2: $O(-)\text{-}X(-)_\mu = 3$ + $O(+)\text{-}X(+)_\mu = 0$ for particle in state Z1

For gravitons the interaction occurs always simultaneously for particles and anti-particles. The generated additional action in scalar oscillators generate in the photon cloud the gravitons O(+)-X(−) and O(−)-X(+). Additional gravitons in the photon cloud generates additional gravitation and additional gravitation means additional mass.

9 Summary and Discussion

The application of the Maxwell theory for an explanation of gravitation was already used in the twenties of the last century, [5, 6]. In this paper presented formalism was developed with the aim to describe the interaction between elementary objects by an information exchange. The idea is that elementary objects, such as electrons in classic physics consists of a core and the electrostatic field. An exchange of information during an interaction, for example between electrons, will occur in an interaction between their electrostatic fields. The information exchange occur in space and time; to describe the information exchange, the photons of the electrostatic field must have a structure in interaction by an overlap and must occur in time, for which the structure of the photons must oscillate. This was the motivation to use correlation structures for the description of the core of an object by scalar oscillators and the field generated by the object by oscillators of static Maxwell fields. It is assumed that the interaction between objects will in general occur always by an exchange of information, the obtained formalism suggests that, beside the description of interaction between charges by photons of static Maxwell fields, the structures, called in this paper as gravitons, should describe the interaction between the masses. It reveals that the electromagnetic and the gravitation interaction occurs under the same conditions with the same mechanism: the interaction in the "photon/graviton" cloud and the submission of the information in an oscillation state - the exchange state - to the scalar oscillators and in processing of the information under a change of the rest frame in the particle state in scalar oscillators (The particle state is not occupied in wave properties, [3]).

For the description of scalar oscillators interacting with photons of static Maxwell fields and with gravitons the same correlation structure of scalar oscillators are used. The scalar oscillators follow from the scalar Lagrange density and from scalar commutators of communication relations; their general structure is for the four coordinates the same. The difference between the interaction of charges and the interaction in gravitation will be found in the structures, which the four μ-scalar oscillators are forming for charges and for gravitons. It can be shown that the structure of the photons of static Maxwell fields form the relative relation between the scalar oscillators for different coordinates in the core of the charges, [3]. Similar the structure of the gravitons will form the structure of the four dimensional mass oscillators.

In this paper it is shown that the structures of scalar oscillators and the structures of photons of static Maxwell fields carry action, described by covariant four dimensional commutators of communication relations, which in the presented formalism take the role of oscillators with the $\mu = 0$ oscillator generating the action. The interaction between two elementary objects occurs by an overlap of the photons/gravitons in the photon clouds with a generation of modified photons under conditions of action minimization, the absorption under the same conditions from scalar oscillators and processing the information, which results in a change of canonical momenta. If we define physical information as a physical value which is exchanged between interacting objects under change of properties, caused by the information change, the presented formalism describes the interaction of elementary objects under exchange of physical information. The Physical Information is action carried by four dimensional photons of Maxwell fields.

The presented Physical Information Theory (PIT) is able to explain under new aspects a large number of physical effects, generated during interactions between elementary objects, such as the propagation of photons in vacuum, the wave-particle dualism of light and material objects, the "which way" experiments, the magnetic effects as the Aharonov-Bohm effect, the locality in EPR experiments and for observations in gravity, as the red shift of light in gravitation, light deflection in a gradient of gravity and interpretations of dark matter and dark energy. All effects are explained using the Physical Information in four dimensional Maxwell fields under conditions of the Principle of Hamilton. The discussion of these effects is presented in [3].

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Table 1: Interaction of gravitons OZ1(−)-XZ2(+) and XZ1(−)-OZ2(+) with an O-X-photon of anti-particle in state Z1

O(−)-photon of a negative charge

$$\begin{array}{cccccccccc}
 & & {}_-A_0 & & & & & {}_-A_3 & & \\
 & OZ1 & \Downarrow & & & & OZ1 & \downarrow & & \\
{}_-\mathbf{A}_2 & \rightarrow & \partial A_0 & \Rightarrow & {}_+\mathbf{A}_0 & {}_-\mathbf{A}_0 & \Rightarrow & \partial A_0 & \rightarrow & {}_+\mathbf{A}_3 \\
 & 1/2 & \downarrow & & & & 0/3 & \Downarrow & & \\
 & - & {}_+A_1 & & & & - & {}_+A_0 & &
\end{array}$$

Gravitons:

$$\begin{array}{ccccccccccc}
 & & {}_-A_0 & & & & & {}_-A_3 & & & \\
 & OZ1 & \Downarrow & & & & OZ1 & \downarrow & & & \\
{}_-\mathbf{A}_2 & \rightarrow & \partial A_0 & \Rightarrow & {}_+\mathbf{A}_0 & {}_-\mathbf{A}_0 & \Rightarrow & \partial A_0 & \rightarrow & {}_+\mathbf{A}_3 & \text{anti-particle} \\
 & 1/2 & \downarrow & & & & 0/3 & \Downarrow & & & \\
 & - & {}_+A_1 & & & & - & {}_+A_0 & & &
\end{array}$$

$$\begin{array}{ccccccccccc}
 & & {}_-\mathbf{A}_0 & & & & & {}_-\mathbf{A}_3 & & & \\
 & XZ2 & \Downarrow & & & & XZ2 & \downarrow & & & \\
{}_-A_2 & \rightarrow & \partial A_0 & \Rightarrow & {}_+A_0 & {}_-A_0 & \Rightarrow & \partial A_0 & \rightarrow & {}_+A_3 & \text{particle} \\
 & 1/2 & \downarrow & & & & 0/3 & \Downarrow & & & \\
 & + & {}_+\mathbf{A}_1 & & & & + & {}_+\mathbf{A}_0 & & &
\end{array}$$

O(−)-photon is modified for the $\mu = 0$ oscillator by:
$+\ \Delta_g$(+OZ1−XZ2); (1/2)/(0/3) = (−+)/(+−)+(++)/(−−)

X(−)-photon of a negative charge

$$\begin{array}{cccccccccc}
 & & {}_+A_0 & & & & & {}_+A_3 & & \\
 & XZ1 & \Uparrow & & & & XZ1 & \uparrow & & \\
{}_+\mathbf{A}_2 & \leftarrow & \partial A_0 & \Leftarrow & {}_-\mathbf{A}_0 & {}_+\mathbf{A}_0 & \Leftarrow & \partial A_0 & \leftarrow & {}_-\mathbf{A}_3 \\
 & 1/2 & \uparrow & & & & 0/3 & \Uparrow & & \\
 & - & {}_-A_1 & & & & - & {}_-A_0 & &
\end{array}$$

Gravitons:

$$\begin{array}{ccccccccccc}
 & & {}_+A_0 & & & & & {}_+A_3 & & & \\
 & XZ1 & \Uparrow & & & & XZ1 & \uparrow & & & \\
{}_+\mathbf{A}_2 & \leftarrow & \partial A_0 & \Leftarrow & {}_-\mathbf{A}_0 & {}_+\mathbf{A}_0 & \Leftarrow & \partial A_0 & \leftarrow & {}_-\mathbf{A}_3 & \text{anti-particle} \\
 & 1/2 & \uparrow & & & & 0/3 & \Uparrow & & & \\
 & - & {}_-A_1 & & & & - & {}_-A_0 & & &
\end{array}$$

$$\begin{array}{ccccccccccc}
 & & {}_+\mathbf{A}_0 & & & & & {}_+\mathbf{A}_3 & & & \\
 & OZ2 & \Uparrow & & & & OZ2 & \uparrow & & & \\
{}_+A_2 & \leftarrow & \partial A_0 & \Leftarrow & {}_-A_0 & {}_+A_0 & \Leftarrow & \partial A_0 & \leftarrow & {}_-A_3 & \text{particle} \\
 & 1/2 & \uparrow & & & & 0/3 & \Uparrow & & & \\
 & + & {}_-\mathbf{A}_1 & & & & + & {}_-\mathbf{A}_0 & & &
\end{array}$$

X(−)-photon is modified for the $\mu = 0$ oscillator by:
$+\ \Delta_g$(+XZ1−OZ2); (1/2)/(0/3) = (+−)/(−+)+(−−)/(++)

Table 2: Formation of virtual action in the two longitudinal oscillators $\mu = 3$ and $\mu = 0$ of scalar oscillators O1 and O2, during information exchange between photons of the photon cloud and the scalar anti- particle. The change of action is described by the delta Δ.

particle state of an **anti- particle**

(μ1) addition of action change in $\mu = 3$ oscillator of the X-photon:

O1:Z1-LS	RS	O2:Z1-LS	RS
$+ \Leftarrow -\overleftarrow{\Delta}$	$- \Rightarrow +\overrightarrow{\Delta}$	$+ \Rightarrow +\overrightarrow{\Delta}$	$- \Leftarrow -\overleftarrow{\Delta}$
X(1/2)	X(0/3)	X(1/2)	X(0/3)

(μ2) addition of action change in the O-photon:

$- \Leftarrow -\overleftarrow{\Delta}$	$+ \Rightarrow +\overrightarrow{\Delta}$	$- \Rightarrow +\overrightarrow{\Delta}$	$+ \Leftarrow -\overleftarrow{\Delta}$
O(1/2)	O(0/3)	O(1/2)	O(0/3)

(μ1) subtraction of action change in $\mu = 0$ oscillator of the X-photon:

O1:Z1-LS	RS	O2:Z1-LS	RS
$- \Leftarrow +\overleftarrow{\Delta}$	$+ \Rightarrow -\overrightarrow{\Delta}$	$- \Rightarrow -\overrightarrow{\Delta}$	$+ \Leftarrow +\overleftarrow{\Delta}$
X(1/2)	X(0/3)	X(1/2)	X(0/3)

(μ2) subtraction of action change in the O-photon:

$+ \Leftarrow +\overleftarrow{\Delta}$	$- \Rightarrow -\overrightarrow{\Delta}$	$+ \Rightarrow -\overrightarrow{\Delta}$	$- \Leftarrow +\overleftarrow{\Delta}$
O(1/2)	O(0/3)	O(1/2)	O(0/3)

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