Physical Information Theory, an Oscillator Approach to Elementary Objects

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Short description of the content

A physical information theory (PIT) is presented. Elementary objects are characterized by physical information and the interaction between elementary objects is described by an exchange of information. The physical information is a four dimensional oscillator, which contains action and can be described by oscillators of static Maxwell fields in electromagnetic effects and in gravitation. Properties and interactions uniformly are described by the Hamilton principle, which in the presented formalism is active as minimization of action.

PIT is based on classic physics (Lagrange density) and on quantum mechanics (communication relations), describes elementary objects (masses, charges, Maxwell photons, gravitons, vacuum) by structures with oscillator properties and the interaction between the objects by an exchange of information. PIT is an adequate representation of physical effects, because it delivers a new consistent explanation for those effects on the basis of the Hamilton principle, which up to now are not explained in classic physics and quantum mechanics. Using the PIT the following effects in between others are obtain a new interpretation: mechanism of interaction of objects by an exchange of physical information, the law of causality and the time arrow, the structure of the vacuum, mechanism of propagation of light in vacuum, wave-particle dualism of light and material waves, double slit experiments, “which way” experiments, Lorentz force, Aharonov-Bohm effect, EPR experiments, quantum eraser, delayed choice experiments, interaction of masses in gravitation, equality of weight and inert mass, deflection of light in gravitational gradient, red shift of spectral lines in gravitation.

The structures of elementary objects are formed under the assumption that the fields, which describe the density of an object in one space-time point, depend from each other and that this dependence can be described by the laws of Newton. The dependence of the fields from each other is described by correlations, which are defined on Fourier space; the correlations in structures of oscillators describe oscillating currents. The structures are characterized by physical information and the interaction between objects is described by an information exchange. The physical information is action, contained in four dimensional structures of scalar oscillators, of Maxwell photons, of gravitons and of photons of vacuum. Formation and interaction between structures of objects occurs by superposition of structures and by induction. The PIT is considered to be a contribution to the fundamental descriptions of physical nature, which consists of a characterization of elementary objects by physical information and an exchange of physical information during interaction under the general principle of minimization of action.

Extended content

Goal of a twenty years project, which was leading to the presented report, was the development of a method for a characterization of elementary objects by physical information and the description of the interaction between objects by an exchange of physical information. As physical information action is postulated, which is included in a four dimensional structure. In following the formalism will be called the Physical Information Theory, abbreviated by PIT.

Chapter 1: Starting out in the first chapter from the Lagrange density and from commutators of communication relations of quantum mechanics and applying the Principle of Simultaneous Contrary Oscillation (PSCO), scalar oscillators are constructed, which are characterized by action, described by four dimensional commutators of communication relations. The PSCO demands that for each current in an oscillator in a rest frame, which flow in one direction, there must be at the same time another residual current with the same amount, the same sign and of opposite circulation direction. The PSCO represents the third

law of Newton for an oscillator in a rest frame and describes the simultaneity of movement of all currents in such an oscillator. To the scalar oscillators “photons” of a photon cloud are related, which in this chapter are also described by four dimensional scalar commutators of communication relations. In frame of the considerations of the scalar theory the scalar commutators are considered to be the physical information. The sign of action in the commutators of communication relations is characterizing the sign of the charge; this will be confirmed in the following chapters by the description of the photons of static Maxwell fields. The oscillators of particle, anti-particle and neutral particle are expressed by four scalar correlation structures, one for each coordinate $\mu = 0,1,2,3$. The construction of the scalar oscillators occurs by a transformation of the products of the Lagrange density and of the commutators of communication relations into the Fourier space, where the factors of the products are forming correlations. The interaction between the fields in correlations is described by currents under conditions of the PSCO. It is shown that the oscillators oscillate between two oscillation states (between correlation directions: current directions), if they in one of their two oscillation states exchange information with their photon cloud. This allows the description of the interaction between two objects in the following form: the photons of the photon clouds of two objects interact by superposition (overlap) under conditions of action minimization, this results in the formation of two photons with the same change of action; the change of action is described by a delta of commutators of communication relations (delta of action), the deltas are absorbed by the scalar oscillators of an object in its exchange state and processed in the following particle state, under formation of a change of four dimensional canonical momenta. The interaction in the photon cloud between two objects describes the third law of Newton. The processing of action in particle state of the oscillator, under formation of a change of canonical momenta, describes the second law of Newton. If no interaction takes place, the object remains in its rest frame, which describes the first law of Newton. The description of interaction by oscillation of scalar oscillators between an exchange state and a particle state represents the causality, which relay on the three laws of Newton and defines the time arrow. All in the PIT considered oscillations and interactions contain a time arrow; all processes in the PIT are in time directed, there is no time-symmetry. It is shown that the time arrow is lost by transforming the oscillators into space-time; the time arrow is generated in all elementary objects by a change of action.

Chapter 2: For a realistic description of interaction between the scalar oscillators of charges and of matter with their photon clouds, in the second chapter the oscillators of the photons of Maxwell fields are constructed. The construction of photons of Maxwell fields is performed under conditions of the PSCO by two different methods: from the trace of the energy momentum tensor, or in an ad-hoc procedure under assumption of the existence of the Maxwell vacuum (chapter 4), the description of the action by commutators of communication relations and under conditions of the PSCO. Formation and interaction of photons of Maxwell fields occurs by superposition (overlap, interference) und by induction. There are two different structures of Maxwell photons, generated on Fourier space: they can be related to the photons of light and to the photons of static Maxwell fields. Similar as in scalar oscillators, the structures of Maxwell photons on Fourier space contain two four dimensional commutators of communication relations, expressed by the components of the vector potential. The structures of the Maxwell photons oscillate between two oscillation states and can be related by their sign of action to particles with positive action, to anti-particles with negative action and to neutral particles with an overlap of positive and negative action. The photons of Maxwell fields are the carriers of physical information. The

photons of light exist in two versions with different spin directions and oscillate in two states, similar as the photons of static Maxwell fields.

Chapter 3: After the construction of Maxwell photons in chapter two, in chapter three the properties of the photons of light and of photons of static Maxwell fields are analyzed. The structures of Maxwell photons consist of correlation strings, which connect creators and annihilators of components of the vector potential in a path crossing cubes. The sixteen three dimensional cubes are obtained from the energy momentum tensor and are formed from derivations of the four dimensional components of the vector potential. The correlation strings correspond to currents, defined in quantum mechanics. The oscillation of Maxwell photons is interpreted by currents, therefore, oscillating between the creators and annihilators in the correlation structure. With the current model the properties of the photons of light and the photons of the static Maxwell fields are interpreted, and compared as they are known from experiments, in their particle, wave and magnetic properties, in their formation of the spin and in the their linear and elliptic polarization. The physical information, contained in photons of static Maxwell fields, determines the properties of the charges: the three properties of static Maxwell fields – the particle-, wave- and magnetic properties – are determined by the sign and circulation direction of currents in unity cubes of the correlation structure of photons.

Chapter 4: In chapter four the different structures of the photons of light and of the photons of the electromagnetic interaction are analyzed in details. The commutators of the communication relations of quantum mechanics in structures of Maxwell photons can be realized in three modifications. Each commutator of communication relations consists in the PIT of two currents, which flow over the unity cubes of derivatives of the vector potential: one current from a positive creator is flowing to a negative annihilator and of one current from a negative creator is flowing to a positive annihilator. If these two currents flow in opposite circulation directions in the structure of the photons, the residual current in negative circulation direction will be different from zero. If this current is positive, the action will be positive and if this current is negative the action will be negative. This will be visible, when the currents are transformed into space-time: the currents form in space-time the commutators of communication relations of quantum mechanics. If the two currents flow in the correlation structure in the same circulation direction, the currents annihilate each other, the residual current is zero and so the action. With the activation of currents in the $\mu = 0$ oscillator also the currents are activated in the whole correlation structure, especially also in the cubes representing the E_i and B_i fields. The sign of action in the correlation structure of the photons determine the signs of the electric and magnetic fields and their particle-, wave- and magnetic- properties. If the action is positive, the structures are related to positive charges, if it is negative to negative charges and if the action is vanishing, the structures describe the photons of vacuum. The structures of the photons of Maxwell vacuum are the same, as the structures of the active photons of light and of electromagnetic fields; the only difference is the different circulation of currents in the photons of vacuum, which results in action equal zero. With vanish of action, all electric and magnetic fields are annihilated by two currents of opposite signs in the photon structure. The properties of the photons of vacuum are of central significance in the following discussion for an explanation of physical effects in frame of the presented formalism.

Chapter 5: According to our aim to characterize elementary objects by physical information and to describe their interaction by an exchange of physical information, in chapter five the interaction of scalar oscillators, representing objects with a charge and a mass, with the photons of the static Maxwell fields, is analyzed. This chapter leads to the following results: For an interaction of the photons of static Maxell fields together with scalar oscillators representing charges and masses, two scalar oscillators with different properties must be activated. The two scalar oscillators must be conjugate to each other, that is, they must have different circulation directions of currents and the absorbed photons must have different signs of action. In this configuration they are able to oscillate together with photons of the photon cloud in three different oscillation modes: with particle-, with wave- and with magnetic properties. A self-stabilization effect exits in wave properties, which is based on an overlap of two different static photons with wave properties, containing different signs of action; by superposition the difference of action is virtually stored. A second important result of this chapter is that the exchanged information in an interaction between two objects, under conditions of action minimization, is always virtually stored by different signs in different memories of the oscillation system. By this in this chapter is shown that the physical information is a value in elementary objects, which characterize these objects, that their different interactions occur under an exchange of physical information and the modification of objects after an interaction can be expressed by the modification of the content of physical information. In addition it is shown that the physical information determines the three fundamental properties of the elementary objects: the particle-, the wave- and the magnetic properties. In the following chapters the photons of static Maxwell fields together with scalar oscillators are used for the description of properties of elementary objects.

Chapter 6: While in the first five chapters the formalism for a description of nature by physical information was developed, in the following five chapters this method is applied to different effects of classic physics and of quantum mechanics, with the aim to prove the developed method for an interpretation of nature. In chapter six the significance of physical information is analyzed for the mechanism of formation of wave properties. For this charges consisting of scalar oscillators and of a photon cloud are considered in a rest frame and in a homogeneous potential gradient. In both situations the formation of wave properties from particle properties occurs under existence of a rest frame, in which the physical information is under conditions of minimization of action. Under conditions of minimization of action all charges in a rest frame convert into wave properties. Physical information must be distinguished for elastic and in-elastic interactions. In elastic interactions, only the transversal oscillators are changing, without a change of action in the oscillator; the objects change only their direction of movement. In an in-elastic interaction action is changing in the longitudinal oscillators ($\mu = 0$ and $\mu = 3$), which is connected with a change of the rest frame (energy). If an in-elastic interaction under a supply of action takes place, the oscillator is converting from wave into particle properties: the particle state is activated and a change of canonical momenta occurs. If the supply of action fail to appear, the action is not changing, the oscillator remains again in a rest frame and under conditions of action minimization the oscillator oscillate in two exchange states, omitting the particle state, which is a condition for wave properties. It is shown that in a homogeneous potential gradient the charge, moving though a homogeneous gradient is in a local rest frame, in which action is not changing, so that the conditions of wave properties are fulfilled. From this considerations follows that the principle of equivalence of Einstein can be generalized on electromagnetic interactions and

that the conditions for the validity of the principle of equivalence is the minimization of action (on space time the Hamilton principle). It is postulated that the principle of equivalence is of general validity in local rest frames. The static photons of positive and negative action are forming the wave properties on atom orbitals: the photons form a rest frame, without a change of action, which is the reason for the stability of atom orbitals.

The analysis of wave properties formation in a homogeneous potential gradient leads to the discussion of the behavior of masses in a gradient of gravitation. It is shown that the wave properties formation of charges in a homogeneous potential gradient has its equivalence in the propagation of masses in a gradient of gravitation: the principle of equivalence is in both effects realized due to the same kind of exchanged physical information. While in an interaction between two masses or between two charges real action is exchanged, in an interaction of charges or masses in a homogeneous gradient the local rest frame is realized by an exchange of activated virtual action.

Chapter 7: In chapter seven the significance of physical information for the formation and activation of magnetic photons is analyzed. The magnetic photons are derived from photons of electric interactions. Two kinds of magnetic photons are obtained: magnetic photons, which are able to interact only with their longitudinal oscillators and which interact with the photons of the applied potential in a current leading conductor and magnetic photons, which are activated only in the transversal direction. The two kinds of magnetic photons have in each oscillation state between each other parallel activated currents. If a constant current flow in a conductor, both kinds of photons are generated by the positive and negative charges; the only longitudinal active photons interact with the photons of the applied potential, generating the propagation of charges in the conductor. Because the currents of longitudinal activated photons overlap with the currents of transversal activated photons with the same current directions, the magnetic photons with activated transversal oscillators obtain the same currents, as the longitudinal activated photons and are emitted perpendicular to the current direction, forming the magnetic field lines. It is shown that the magnetic photons explain the Lorentz force. At the example of the Hertz oscillator the formation of the electromagnetic waves is discussed and is shown that the electromagnetic wave propagate into a transversal direction of the photon structure, oscillating between the other transversal direction and the longitudinal direction. The oscillation of the electromagnetic wave occurs under minimization of action; the structure of the electromagnetic wave is determined by the photons of static Maxwell fields and is completely different to the structure of photons of light. If the electromagnetic waves interact in high frequency, they form photons of light, which explains the transition from emission of electromagnetic waves at low temperatures to emission of photons of light at high temperatures.

Chapter 8: In chapter eight the typical quantum mechanical effects are analyzed. The propagation of light in vacuum is explained by the elementary step of induction, in which during formation of one state of a structure of the photon, simultaneously locally the following states in vacuum are formed; the action of vacuum photons is determined by the virtual action of the vacuum. The described mechanism of light propagation results in a constant speed of light in each rest frame. For diffraction of light- or material- waves at a double slit it is shown that at the potential distribution of the double slit the interaction of the wave is elastic, changing only the phase (propagation direction) of the photons. On their

way to the detector the waves interfere and the interference properties are determining the propagation direction of the charge. At detector screen the interaction is in-elastic, resulting in particle properties formation. The interpretation of the “which way” experiments is based on the wave-particle dualism or on the mechanism of propagation of light in vacuum. For photons of light it is shown that for a change from wave to particle properties at the double slit no change of action is needed. The “which way” results at the Mach- Zehnder interferometer can be interpreted by the inductive formation of wave trains in vacuum. The Aharonov-Bohm effect is explained by the formation of transversal photons; these photons are always emitted perpendicular to the solenoid, independently from the dimensions of the solenoid. The interpretation of EPR experiments is based on the formation of photons of vacuum under conditions of the third law of Newton (PSCO); it is shown that entangled photons are connected with an information channel, which is formed in vacuum with photons of vacuum, locally connected to the entangled photons; the photons of vacuum have the same structure and the same properties, as the active photons, but are containing only virtual action of the vacuum. In an additional section of this chapter, the formalism of the PIT is proposed to be applied for an explanation of the effects in particle physics. The interpretation of the effects of classic physics and quantum mechanics in this chapter suggest that the discussed effects can be explained by causality and locality.

Chapter 9: In chapter nine a general comparison of the statements of the PIT with those of the classic physics and quantum mechanics is performed. Related to classic physics in between others the differences in the interpretation of the charge, the interpretation of relative movement of objects, the formation of the electric and magnetic fields and the comparison of the Maxwell vacuum with the ether, the vacuum fluctuations, vacuum energy, the principle of causality and the time arrow and the dynamic equation of motion, are discussed. For a comparison of the PIT with the quantum mechanics, the following subjects are compared: the quantum mechanical causality, abolition of determinism and probability interpretation, tunnel effect, photo effect, Compton effect, de Broglie-Bohm theory, principle of correspondence, communication relations, Schrödinger equation, delta function, properties of the wave function, uncertainty principle, harmonic oscillator, first and second reduction of the wave function, box paradox of de Broglie, Schrödinger’s cat and others. A part of this chapter is devoted to gravitation: in between others the following effects are discussed: the interaction of photons of vacuum with the photons of charges under formation of gravitons, the deflection of light in a gravitation gradient, red shift of spectral lines in gravitation, dark matter formed without contribution of charges, interpretation of dark energy by the Maxwell vacuum; the Mach principle is explained by the PSCO. An additional subject is the significance of wave trains, which is investigated at the examples of quantum eraser and the delayed choice experiment. From view of the PIT these experiments can be explained by the PSCO: the simultaneous formation of photons of vacuum, which propagate in vacuum under conditions of simultaneity and they are not transporting action but only structure information. The measurement problem of quantum mechanics is discussed and it is shown that from the perspective of the PIT there are existing three different channels of information transfer; the most important is the one, which occurs under the third law of Newton. At example of measurement of properties of a single charge it is shown, that there is not only a wave-particle dualism, but also a similar dualism between wave and magnetic properties.

Chapter 10: The formalism of the PIT was developed with the aim to characterize elementary objects by physical information and for a description of the interaction of objects by an exchange of physical information. The chapter ten is devoted to this subject; the properties of physical information are discussed in more details. More details of the mechanism of action formation in interactions between objects in particle, in wave and in magnetic properties are discussed. The formation of action in the $\mu = 0$ oscillator is of basic importance for the formation and interaction in these three properties. It is in PIT the formation of action in the unity oscillators, which is responsible for the main properties of the photons and of the mass and charge oscillators. The formation of action, as described by commutators of quantum mechanics is responsible for the oscillation of elementary objects, for their stay in a rest frame, for the relative movement and for the change of movement. From the view of the PIT the action and the condition of action minimization on correlation space are responsible for the generation of the space time, for causality and the time arrow. The interaction of the photons of static Maxwell fields by superposition is investigated and it is shown that the formation of a delta of action in particle state, generates virtual action and the action in exchange state is real and as real is absorbed and processed in scalar oscillators in particle state, under formation of a change of canonical momenta of the oscillator. (The mechanism of absorption and processing of the information of gravitons is discussed in appendix J.7). The oscillation schema of scalar oscillators consists, in dependence of the supply of action, of two oscillation phases. The two phases are separated by a non-relativistic limit: in the region of low supply of changes of action the change of action changes the canonical momenta that is the relative speed to a rest frame. Above the non-relativistic limit with the change of action in addition the mass is changing; this is proved by the change of the generation of gravitons. Differences of the structure of photons of static Maxwell fields and of the structure of gravitons are discussed and the difference of interaction in gravitation and for electromagnetic interaction is analyzed. In the last section of this chapter the PIT is comparted with quantum gravity.

The chapter ten shows that physical information, in contradiction to the Shannon information and in contradiction to the quantum mechanical information is independent from the observer and is not simple digital coded information, but has a four dimensional structure, characterizing the four dimensional structures of elementary objects and is exchanged as a four dimensional structure between interacting objects, characterizing the fundamental properties of elementary objects. The introduction of physical information into the description of the physical nature of objects allows an explanation of their nature on the basis of causality and locality. From view of the presented formalism the description of the nature should be possible by a uniform principle: the characterization of elementary objects by physical information and their interaction by an exchange of physical information under conditions of minimization of action (Hamilton Principle on space-time).

The ten **appendices** deliver details for proves of statements in the main text and some additional results for special effects, as for axion like particles, dark photons, interaction conditions between static photons and photons of light, and structures and properties of gravitons.