RADIATION AMPLITUDE ZERO CONDITION AS A CONSERVATION OF THE STRUCTURAL COMPLEXITY OF THE QUANTUM SYSTEMS, THE FUNDAMENTAL NATURE OF THE CONSERVATION OF THE STRUCTURAL COMPLEXITY

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Radiation amplitude zeros can be considered as a manifestation of the conservation of the structural complexity of the interacting quantum systems. Different aspects of this conguence is analyzed in this work. Through this analysis one can see that the structural complexity incorporates into itself the physical quantities existing before the shift in Standard Model related symmetry and the physical quantities emerging after this event. The long existing questions, twins paradox of special relativity and 'spooky action at a distance' questions are also briefly discussed in the domain of the structural complexity of the system.

Keywords: dependence of the structural complexity on the energy, the connection between the charges and masses of the elementary particles, radiation amplitude zeros, conservation of the structural complexity, structural complexity and shift in the symmetry (spontaneous symmetry breaking), fundamental invariant physical quantities, twins paradox, quantum dualism, 'spooky action at a distance', unobservable variables, electromagnetic waves and the structural complexity.
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INTRODUCTION

The coupling constant – electroweak gauge boson mass relation

$$M_W/g = M_B/g' \qquad (1)$$

enables one to get the Standard Model form of the W and Z bosons in a succinct, natural manner ([1], [2]). This type of relation between the mass and coupling constants holds for all known elementary particles, including all quarks and leptons, but only in an approximate form [3]. Eq. (1) can also be considered as a manifestation of the connection between the energy and the structural complexity of the quantum systems [3]. This approach the analysis of the properties of crystals sheds light to the drastic differences of their latent heat of fusion.This latent heat of fusion difference aspect of the connection between the energy and structural complexity reveals itself in the case of the so called conventional superconductors too [4]. Here the inverse proportionality of the critical temperature and the molecular mass of the substance for the Bose – Einstein condensation plays a key role. This drastic difference in the latent heat of fusion of the crystals tell us that atoms and molecules are not like flamboyant objects moving chaotically within quantum systems, they are more likely follow the certain pattern in their thermal motion: under extreme conditions the whole structure of this pattern breaks down, this phase transition induces the superconducting state in the case of metals.

METHODS

A. Radiation amplitude zeros condition as a manifestation of the conservation of the structural complexity

The tree level scattering amplitude for a source graph V_G, consisting of a single vertex (no internal lines) can be written as

$$M_\gamma(V_G) = \sum_i \frac{Q_i J_i}{p_i q} \qquad (2)$$

Here Q_i and p_i are the charges and momenta of the interacting particles, q is the momentum of the photon ([6], [7]). The vertex currents J_i which depend on the polarizations, but not on the charges of the particles obey the identity

$$\sum J_i = 0 \qquad (3)$$

for all Yang-Mills type vertices, as a result of momentum conservation, Lorentz invariance and the Bianchi identity. This vertex amplitude $M_\gamma(V_G)$ vanishes if

$$\frac{Q_i}{p_i q} = \text{const}, \quad \text{for all i} \qquad (4)$$

In the non – relativistic case Eq. (4) gains the form

$$\frac{Q_i}{m_i} = \text{const}, \quad \text{for all i} \qquad (5)$$

Here m_i are the masses of the interacting particles at the vertex. Eq. (5) is identical to the dipole radiation zero condition. At the same time, according to Eq. (1), Eq. (5) can also be interpreted as the equality of the structural complexity of the particles interacting at the given vertex: when their structural complexities are the same no radiation occurs. In the relativistic limit we can write

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$$p_i\, q \;\approx\; \frac{1}{2}(p_i \;+ q)^2 \;=\; \frac{1}{2}M_i^2 \qquad (6)$$

here M_i is a generalized mass of a particle of the mass m_i plus photon system. Radiation amplitude zero condition obtains the form

$$\frac{Q_i}{M_i^2} \;= \text{const}, \qquad \text{for all i} \qquad (7)$$

As it was indicated in [3], the quantity which we call the particle's electric charge does not change as a result of the shift in the symmetry (spontaneous symmetry breaking). The quantity in the denominator of the Eq. (7) (or Eq. (4) for that matter) is a Lorentz invariant (space – time invariant) quantity. Therefore we can say that the structural complexity of a system incorporates into itself invariant quantities relating to the both states of the quantum system, to the states before and after the shift in the symmetry. In the relativistic case, the structural complexity gains a more complex form. Since $\sum Q_i \;=\; 0$, the amplitude M_γ (V_G) will be zero, if

$$\frac{J_i}{p_i\, q} \;= \text{const}, \qquad \text{for all i}$$

or

$$\frac{p_i\, \varepsilon}{p_i\, q} \;= \text{const}, \qquad \text{for all i} \qquad (8)$$

In Eq. (8) form the separation of the physical quantities relating to the state of the system before and after the shift in the symmetry stands out more clearly.

We can interpret the quantum dualism in terms of the above discussion in the following way: the matter reveals itself in a corpuscular form whenever there is an opportunity of the exchange of the structural complexities of the interacting particles. The electroneutral and massless photon manifests its structural complexity in combination with the other particles only as in the case of the equations discussed above.

B. The structural complexity aspects of the twins paradox question in special relativity, 'spooky action at a distance' in quantum mechanics and the electromagnetic waves

In this section we will briefly discuss the structural complexity aspects of the above mentioned cases in physics. We cannot simply attribute the origin of the twins paradox to the difference of the motion with acceleration and without acceleration if the system consists of two objects only. The twin sister who moves with an acceleration does this relative to the larger system, relative to the system with the certain structural complexity. Therefore her motion cannot be 'shifted' to the motion of the twin sister at rest. The second principle of the special relativity also emerges as a result of a similar situation. The speed of light does not depend on the speed of the light source. This is similar to the sound wave in the medium situation. But why does not the speed of light depend on the speed of the observer? The single observer's motion does not change the structural complexity inherent to our universe. The magnitude of the speed of light in vacuum is the reflection of the degree of the space – time structural complexity of our universe. A massless photon, which is essentialy in a pre Big Bang state, does not treat our universe as a point like object, in that case the speed of light would be infinite. The structural complexity approach sheds light on the mystery of the second principle of special relativity, softens the situation with this principle and this can be helpful in understanding the subtleties of the Big Bang processes. In the transparent medium, in the medium with the higher degree of the structural complexity then the average structural complexity belonging to the vacuum (our universe) the speed of light is less then the speed of light in the vacuum. In the case of the diamond and graphite, the substance with higher specific heat capacity, the graphite also has noticeably higher value for the index of refraction - the smaller value for the speed of light. Glass materials with different values for the indices of refraction could also have similar relation for their specific heat capacities. The research on the connection of the latent heat of fusion and the index of refraction for the variety of transparent crystals could also be helpful (it is true that we have only a few transparent crystals of the simple structure).

Quantum entanglement phenomenon can also be attributed to the structural complexity of the system. We have just discussed the conservation of the structural complexity aspect of the quantum systems. Taking measurement in one part of the quantum system affects its structural complexity. The other part's structural complexity will also change in the assumption that the measurement is the structural complexity degree conserving nature. Relevance of the structural complexity to the 'spooky action at a distance' question is an indication that it is purely quantum mechanical aspect of the physical systems.

DISCUSSIONS AND CONCLUSIONS

Radiation amplitude zeros phenomenon offers another good venue for analyzing the structural complexity of the quantum systems. It is shown that this phenomenon can be considered as a result of conservation of the structural complexity of the quantum systems. The quantities involved here tell us about the most fundamental nature of this aspect of the quantum systems, the structural complexity incorporates the charges of the interacting particles, which remain unaltered in the process of shift in the symmetry (spontaneous symmetry breaking) and space – time (Lorentz) invariant quantities. This aspect of the physical systems also brings a simple explanation to the twin paradox question of the special relativity. As one might expect, the stuctural complexity approach may also be helpful with the questions relating to the quantum entanglement.

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