The size of a parton

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Summary. A new theoretical approach is proposed for estimation of linear dimensions of pointlike elements of a nucleon structure. It is based on a hypothesis of existence of the "absolute oscillator", appearing to be the basic element of a physical vacuum. Observing the absolute oscillator as a nil member in the aggregate of the fundamental oscillators, the correlate dependency was obtained, connecting the parameters of fundamental interactions and properties of physical vacuum. Analysis of this dependency allows a conclusion about the existence of a fifth fundamental interaction and a fundamental object, characterized by a mean square radius of $7{,}2 \cdot 10^{-17}$ m. This object is a parton - a particle, comprising a nucleon structure.

Introduction

Pointlike quasifree charged particles in structure of nucleon have been experimentally found in end of sixties 20-th century. They have been called partons [1]. These results have been obtained by examining dispersion of electrons and muons on nucleons.

With small momentum transfer, in the order of hundreds of MeV, proton transits into excited resonance conditions and with momentum transfer, in the order of 1 BeV fragments. Part of an elastic scattering is negligibly small.

According to experimental data partons practically do not interact among themselves on small distances. A parton, accepting projectile lepton, leaving proton boundaries unobstructed. When this happens, quantum-mechanical coherence of a parton structure initial condition is disturbed insomuch that it leads to deeply inelastic scattering.

In accordance with preliminary estimations, the size of a parton should not exceed ~1/50 of the size of a proton.

With the development of the quark theory a hypothesis arose, that partons appear as quarks of three types. In accordance with existing theoretical representations, quarks are pointlike fractionally charged particles, a structure of whose do not show itself on the distances up to 10^{-18} m.

Therefore it could be stated that the nature and dimensional characteristics of a parton are not finally determined presently.

A new theoretical approach is presented in this talk for estimation of the size of pointlike elements of a nucleon structure. This approach is based on a hypothesis of existence of “absolute oscillator”, appearing as basic element of a physical vacuum structure and determining its properties. Considering the “absolute oscillator” as a nil element in the aggregation of fundamental oscillators, a correlation dependency was obtained, connecting parameters of fundamental interactions and properties of physical vacuum. Analysis of this dependency allows a conclusion about the existence of a fundamental object, determining sub nucleon fundamental interaction. This object in our opinion is parton – a particle comprising a nucleon structure.

Present talk is part of the research works, accomplished in consort with our Russian colleagues [2, 3].

1. Hypothesis about existence of absolute oscillator.

1.1. Thesis of universality of wavelike motion.

Analysis of different forms of movement shows, that motion of any object appears as wavelike, oscillating process [4]. This process touches all sides and boundaries of an object and its external appearance is oscillating change of all features and parameters, characterizing the object. In every material system, independently on its nature and size, at all times continuously occur spontaneous deviations of quantitative characteristics of all properties around mean level, defining stability of a given system. Such deviations are common and necessary quality of any real system.

1.2. Thesis about discretion of a physical vacuum.

From the universalism of the wavelike motion a necessary conclusion follows about discretization of a physical vacuum. A scheme of reasoning leading into this conclusion is presented below.

Wavelike motion intrinsically belongs to any part of the material continuum; hence any part of a physical vacuum oscillates. A source of any wavelike motion is a given oscillator. Therefore physical vacuum is aggregate of oscillators.

Oscillation of a physical vacuum, similarly to any other motion of a matter, is self-motion. In such a manner in any part of a physical vacuum continuously happen regularly repeating changes with respect to the properties, characterizing oscillators. The changes of such properties happen within certain limit, which is determined by interrelations of basic properties of a matter.

Forasmuch as properties changes characterizing oscillators limited within certain limits, these oscillators appear to be objects of finite size. Any part of a physical vacuum can not contain endless number of objects of finite size, hence a physical vacuum is discrete.

1.3. Absolute oscillator as "prime-atom" of the material continuum.

Accepting thesis of universalism of wavelike motion and discretization of the material continuum, we arrive at a conclusion that material world appears to be an aggregate of interrelated quantum oscillators. These oscillators physically real, spherically symmetrical and each of them appears to be a source of specific radiation [2, 3, 5].

It is logical to conclude, that a least quantum oscillator exists, which appears to be ultimate (elementary) oscillating cell – "prime-atom" of a physical vacuum and comprises its structural base. Following the author of [5], we call this ultimate cell "absolute oscillator". As a basic element of the structure of a matter, appearing to be bearer of its fundamental properties, the absolute oscillator has to determine the properties of a physical vacuum and a character of self-motion of a matter. The absolute oscillator can be considered as a nil member in the aggregate of fundamental oscillators, determining certain fundamental interactions. Such approach allows considering all fundamental interactions, including gravitational within the frame of one model.

2. Physical model of material continuum.

2.1. Of physical reality of space-time continuum.

After the fundamental works of *H.Minkowski and A.Einstein* [6] the space and time are considered as basically interconnected components of united four-dimensional continuum. The representation of four-dimensional space-time appears nowadays as one of the basic fundamental concept of modern science.

The general relativity theory four-dimensional nature of space-time is accepted as a necessary postulate. The gravity field is considered agreed upon geometry of space-time and all gravitational effects one way or another connected with curvature of space-time [6, 8].

We have analysed the justification of connection of space and time into united diversification – four-dimensional space-time continuum. It is shown that a time, contrary to the space doesn't appear as a basic character of a matter. A time is external character of movement.

With this understanding of a parameter of the time we return to Aristotle, who deemed that the time is nothing else but a number of movements towards past and subsequent and that the time doesn't be a motion, but appears as it insomuch as motion has a number.

Physical parameters time, temperature, entropy have analogy. They all have sequence or reflection of certain properties of a moving matter, but they are not its basic fundamental properties or forms of existence.

In such a way we arrive to fundamental conclusion about iniquity of unification of space and time into single entity – four-dimensional space-time continuum. Such unification means to unite parameter-cause with parameter-consequence, which is incorrect from both logical and physical point of view. Because of this representation of material continuum as four-dimensional space-time can not be considered adequate for a physical reality. Accordingly all conclusions, derived from similar mathematical model and related to physical reality appear to be incorrect and need to be reconsidered.

2.2. Space-electromagnetic model of material continuum.

When developing physical model of a material continuum we proceed from materiality of surrounding world and universality of motion. At that we emphasize that movement of the matter is its self-motion. The natural conclusion is that the character of self-motion of a matter is determined by its basic fundamental properties. In other words, self-regulation lays in the matter and appears as a consequence of its fundamental properties.

One of the fundamental properties of a matter is space or outstretch. However presence of outstretch alone as a property is not capable to cause self-motion of a matter. It is necessary to educe a fundamental property of a matter, which in natural unification with the space compile a source of self-motion of a matter. The time, as we have shown, doesn't appear such a property.

The preliminary research shows that such basic fundamental property of a matter is electromagnetism. Electromagnetism is considered by us as inalienable property of a matter, appearing in both explicit forms – electromagnetic fields and electric charges and hidden forms, inaccessible for direct observation and registration.

If accepting this point of view, material continuum should be considered as space-electromagnetic. A space and electromagnetism appear basic fundamental properties of a matter; they are intrinsic to the matter initially, and appear someway or other in all processes, phenomenon and structures with no exception, interconnected and indivisible.

Space-electromagnetic model of material continuum allows considering all fundamental interactions, including gravitational, within the frame of one physical representation.

Mathematical model of the space-electromagnetic continuum can be represented as fifth-dimensional vector continuum, in which space vector R, having three components (three degrees of freedom), characterizes a space and electromagnetic vector Q, having two components (two degrees of freedom), characterizes electromagnetic properties of a matter [2, 3, 5].

3. Derivation of an equation, connecting parameters of fundamental interactions.

Accepting for simplicity, that space vector R adequately characterizes the radius of oscillator.

Let module of a space vector of an absolute oscillator is equal to $\hat{R}_0$.

Accepting for an upper limit of oscillating space vector expression $R_0 = \hat{R}_0 \cdot K_0$, where $K_0 = f_R / f_Q$ — coefficient, characterizing space-electromagnetic continuum (f_R — number of constituencies of a vector ***R***; f_Q — number of constituencies of a vector **Q**).

Let call oscillators, defining qualitatively different levels of material interactions, fundamental oscillators.

In accordance with the principle of unity of material world, the absolute and fundamental oscillators are interconnected. Therefore the parameters, characterizing properties of these oscillators are also interconnected. For the i-th fundamental oscillator we have

$$R_i = \hat{R}_0 \cdot K_i \tag{3.1}$$

where *i* — number of fundamental oscillator or main quantum number; K_i —function *i*.

Bring in starting condition

$$K_{i=0} = K_0, \tag{3.2}$$

indicating, that absolute oscillator is a nil member in the aggregate of fundamental oscillators. This conditions allows consideration of all fundamental interactions in the frame of one model.

Will search for function K_i in the form of:

$$K_i = K_0^{\Phi_i}, \tag{3.3}$$

where Φ_i — certain function *i*.

To fulfil condition (3.2), function Φ_i must correspond to a condition

$$\Phi_{i=0} = 1. \tag{3.4}$$

Condition (3.4) is fulfilled by a function

$$\Phi_i = \varphi^i, \tag{3.5}$$

where φ — constant, characterizing certain property of space vector..

Obviously that the main property of a space vector is a number of degrees of freedom, corresponding to dimensions of space. Therefore we accept that constant φ identically equal f_R. as a result we obtain the following equation, connecting radiuses of absolute and fundamental oscillators.

$$R_i = \hat{R}_0 \cdot K_0^{f_R^i} \tag{3.6}$$

or in the logarithmic form

$$\log R_i = \log \hat{R}_0 + f_R^i \cdot \log K_0, \tag{3.7}$$

where

$$i = 0, 1, 2, \ldots (f_R + f_Q). \tag{3.8}$$

4. Evaluation of parton size

4.1. Conclusion of existence of the fifth fundamental interaction.

With the increase of a quantum number i evolve certain consequence of fundamental oscillators, defining qualitative different levels of material interactions.

Accepting that every fundamental oscillator corresponds certain fundamental interaction and that strong, electromagnetic, weak and gravitational interactions compile in such obtained sequence a continuous row with quantum numbers i respectively 2, 3, 4, 5, we arrive at a conclusion about existence of fifth fundamental interaction, corresponding to a quantum number i = 1. We call this fundamental interaction sub nucleon. According to preliminary evaluation of [5], the intensity of sub nucleon interaction exceeds intensity of the strong interaction 11.4 times.

A fundamental oscillator corresponds to sub nucleon interaction, which in our opinion is material particle, comprising nucleon structure and this particle is to be considered as parton.

4.2. Estimation of a size of absolute oscillator.

From all know fundamental interaction, the most well explored is electromagnetic (i = 3). Its characterizing parameters are measured to the high precision. Therefore let accept electromagnetic interaction as a basis for estimation of a numerical values of a quantity $\hat{R}_0$.

From a condition

$$R_{i=3} = \frac{h}{2mc}, \qquad (4.1)$$

(h — Plank constant; m — mass of electron; c — speed of light) we derive

$$\frac{h}{2mc} = \hat{R}_0 \cdot K_0^{f^3}, \qquad (4.2)$$

hence $\hat{R}_0 = 2{,}135 \cdot 10^{-17}$ m.

Radius of absolute oscillator can be considered as a minimum length. However, since during a process of internal self-motion continuous changes occur in proportion of space and electromagnetic quantities, characterizing absolute oscillator, its radius-vector changes around mean level within certain limits. For this reason numerical numbers of the length, smaller than $\hat{R}_0$, should not be deprived in physical meaning.

4.3. Estimation of sizes of fundamental oscillators, corresponding to sub nucleon, strong, lectromagnetic, weak and gravitational interactions.

Let present in the equation (3.7) numerical numbers of parameters K_0, f_R, $\hat{R}_0$.

When changing the quantum number i from 1 to 5 we obtain numerical numbers of space parameters R_i, considered by us as radiuses of corresponding fundamental oscillators (table 4.1.)

Table 4.1

i	Fundamental oscillator	Corresponding material object	R_i, m
1	Sub nucleon	Parton	$7{,}206 \cdot 10^{-17}$
2	Strong	Nucleon	$8{,}209 \cdot 10^{-16}$
3	Electromagnetic	«Electromagnetic»	$1{,}213 \cdot 10^{-12}$
4	Weak	«Weak»	$3{,}916 \cdot 10^{-3}$
5	Gravitational	Universe	$1{,}317 \cdot 10^{26}$

In accordance with our calculation data mean quadratic radius of a parton equals $7{,}206 \cdot 10^{-17}$ m

The structure and properties of parton can be understood on a basis of developed by us space-electromagnetic model of material continuum.

The question about structure and properties of parton will be presented by us in separate report.

Conclusions

The time, as distinct from space, doesn't appear to be basic property of a matter, therefore representation of material continuum as four-dimensional space-time can not be considered adequate for the physical reality. Correspondingly all conclusions, following such mathematical model and related to physical reality appear to be incorrect and have to be re-considered.

For representation of material continuum is proposed the use of a model, unifying basic fundamental properties of a matter – space and electromagnetism. Mathematical model of the space-electromagnetic continuum is represented as fifth-dimensional vector continuum, in which space vector, having three constituencies (three degree of freedom), characterizes a space and electromagnetic vector, having two constituencies (two degree of freedom), characterizes electromagnetic properties of matter.

Space-electromagnetic model of material continuum allows consideration of all fundamental interactions, including gravitational, in the frame of one physical representation. The equation is obtained, connecting parameters of fundamental interactions. This equation has a predictive power and from its follows conclusion about existence in nature of a new fundamental interaction – sub nucleon. To this sub nucleon interaction corresponds a fundamental object, appearing to be parton – a particle, comprising nucleon structure. Radius of parton is $7{,}206 \cdot 10^{-17}$ m.

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