Two-Scale Two-Phase Formation of Charged 3D Continuum Particles - Sphere and Cube From Electrons in a Vacuum0 (Aether). An Example of Scaleportation of Charge from the Sub-Atomic to Continuum Charged Particles, Conventional MD Cannot be Applied

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Abstract:

It is known that the smallest electromagnetic (EM) charges are of the sub-atomic sizes - electron, photon (yes, electromagnetic), proton are the pretty small, but volumetric particles. The larger by volume and strength charges of particles, bodies are usually to be structured (built) from these EM charges along with the added larger electric and/or electromagnetic as well as neutral particles - atoms, molecules, ions, other "particles".

The pure theoretical problem of construction of 3D continuum mechanics size particle consisting of only electrons is an important one for physics. These kind of problems have been formulated in Conventional Orthodox Homogeneous physics (COHP) and chemistry many years ago while not just provided that, of course, any continuum mechanics size particles (or volume with a substance) are do consist of atoms, molecules, ions, electrons and "free" space in between of them. Meanwhile, the methods of physical characteristics transfer between the physics of scales are not correct in COHP. The difficulty or incorrect treatment is connected to the incorrect mathematics and physics of modeling and simulation equations - workers do use the Homogeneous matter mathematics while it is obvious that the continuum mechanics media are Heterogeneous on Atomic and smaller scales. The COH physics can not take this fact into account so, all the methods used in the areas of atomic and continuum mechanics interaction are treated in COHP with great actual simplification because of these issues.

All of this information, knowledge on inadequacy of MD and other atomic and sub-atomic scales physics and chemistry for interscale communication and dependencies are not delivered to students in schools and universities, unfortunately.

In this publication we report on the methods and HSP-VAT techniques that make available the modeling and simulation of the two-scale sub-atomic - continuum mechanics properties of volumes filled with electrons and scaleportation of properties of a singular charge such "elementary" particle as the real physical subject of electron(s) in the aether to the particles (volume filled with electron particles) of continuum scale size.

Key words*: Polyscale physics; Electron; Electrons in Vacuum; Aether; Heterogeneous media; Averaging theories; HSP-VAT; Multiscale; Polyscale modeling; Collective interaction; Electrodynamics; Heterogeneous electrodynamics; Sub-Atomic modeling; Particles model; Elementary particles dynamics; Gauss-Ostrogradsky theorem; WSAM theorem; Scaleportation.*

1. **Introduction**

We would like, for many reasons, to keep referring to the medium that infiltrate all the materials' forms around, in environment, and known to exists and to be believed by physicists in old times as an aether.

For the strictness of exposition of known and coherently explained and modeled within the paradigm of simultaneous Polyscale-Polyphase-Polyphysics (3P) physical entities and modeling them as a set of related concepts, 3P theories has been suggested as the needed one the concept of intermediate medium - an aether. The long range interaction can not be provided, executed via the real emptiness, real nothing.

That is known for centuries that physicists always considered the presence of some intermediate substance and called it an aether.

That is a partial explanation, also because at the beginning of XX century there was no understanding and no of physics and mathematics polyphase, heterogeneous methods. So, physicists couldn't even approach that kind of problems. The vision for heterogeneous media physics need had appeared later in the time of WWII for the tasks related to nuclear weaponry and nuclear power.

Returning back to the many centuries fundamental acceptance of aether existence immediately stands the question that physicists of XX century couldn't approach and solve: Any medium with the aether recognized is being meant having at least of two "phase" medium - one is the aether itself and another is what is put in the problem at the beginning of study (at least one medium for even homogeneous medium).

Meanwhile, since the 80th of XX the two-phase problem began started formulation and solution as the two scale two phase statements - that is the real sense of the two-phase physics [1-18].

Most of these improvements can be referred to the proper, stricter treatment of collective, interactive phenomena while taking heterogeneous matter for study. To this kind of phenomena/changes we can relate almost any action or process more complicated than collision of "mathematical" ball onto the "mathematical" wall, or movement and collisions of two "mathematical" balls, meaning particles, atoms or molecules in MD.

In all other nature prescribed cases the physical matters are of scaled or multiscale character by existence.

There is no substance of physical content in our known universe that is not a heterogeneous one.

Also, in physics there is no action or process that we can name a local one, unless we want to. Otherwise, we have to look into the point and what it means more strictly. Obviously, many actions or processes can be separated from their less important, at the moment or case, surroundings or/and forces. But that is always more or less an artificial choice.

In this paper we assured to be concerned to the multiscale, heterogeneous, nonlocal and nonlinear properties mostly of the atomic and sub-atomic scales group ~ $(10^{-17} \div 10^{-9})$ m.

For these ~9 orders of decimal magnitude the conventional homogeneous one scale physical theories provide mostly for the approximate or even ad-hoc adjusting mechanisms for the two-scale Bottom-Up scale communication, and that mode is to be re-entered in the current paper from the Bottom-Up and Top-Down interscale transport (communications) point of view. That says the connections of the scale inherited fields are of great significance/importance. We previously studied thoroughly in many sciences (fields) the contemporary homogeneous physics theories for heterogeneous matter and these reviews are referred below.

The strictest definition for the different scale related fields communication - transformation we suggested in 2004 as the Scaleportation.

Scaleportation is the means and procedures of the direct and strict "transformation" of data and processes at one scale to the data and processes of the neighboring Upper or Lower Scale. These interscale communications, scale transformations of data are performed mostly not by formulae using the coefficients as this is customary in homogeneous physics, but via using the interscale governing equations for the phenomena.

Scaleportation has being performed over the all our two-scale solved the HSP problems mentioned in this text and in the website - http://www.travkin-hspt.com, as soon as the simulation methods that have been based on the algorithms of analytical (exact) or numerical methods created for the direct Bottom-Up (BU) or Top-Down (TD) two-scale solutions.

It might help with the understanding of our approach to the more strict physically and mathematically description of many subjects of Heterogeneous, Scaled, and Hierarchical nature, made by nature itself from the atomic, molecular scale that the some knowledge of HSP-VAT (Hierarchical Scaled Physics - Volume Averaging Theory) can be of assistance.

2. Fundamentals of the HSP-VAT Theory in Application to Particle Physics

Some principal provisions, conceptual definitions, concepts of scaling matter related to the subject of Particle Physics collective interaction of the arrays of Sub-atomic particles and modeling of Heterogeneous particulate media of the two, at least, phase (components) as scaled media we have been placed in a few manuscripts and publications - ones are the easiest to reach at [19-28]. .

2.1. Introductory to Polyphase Description in Particle Physics and Related Technologies

2.1.1 Hierarchical Scaled Volume Averaging Theory (HSVAT) introductory mathematical notions and theorems

The basic idea of hierarchical medium description and modeling is to recognize that the physical phenomena, mathematical presentation of those phenomena, and their models can be very different at even neighboring scales. In most of situations those are different even if phenomena themselves are similar or looking as identical, but the scales are different and the lower scale features should be transported to the upper level of description (or Top-Down). With that action, the useful information from the lower scale physics would be added to the characteristics on the upper scale level.

The following definitions were used in 1980-2010s in heterogeneous media theories as well as at the earlier times for other sciences dealing with the scaled heterogeneous problems.

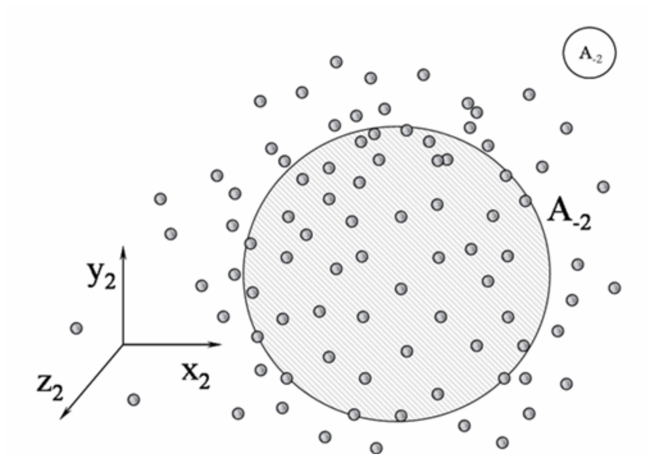

Figure 1. Representative Elementary Volume (REV) in space (heterogeneous medium) with the continuum particles and the aether as intermedium. The shape (volumetric form) of the REVs can be not only of spherical one. Mathematical modeling and simulation are supposed to be performed on both scale spaces with the mathematical statements that complicate formulation and numerical (analytical) simulation (calculation) of the physical field distributions.

The volume average value of one phase in a two phase medium $\langle s_1(\mathbf{x})\rangle$ in the REV (Representative Elementary Volume) and its fluctuations in various directions, its main physical and mathematical needs, definitions are determined [2-12] at first looking simple

$$s_1(\vec{x}) = \left\langle s_1(\vec{x})\right\rangle + \widehat{s}_1(\vec{x}), \qquad \langle s_1\rangle = \frac{\Delta\Omega_1}{\Delta\Omega}.$$

The three types of two-phase medium averaging over the REV [9-13] function f are defined by the following averaging operators arranged in the order of seniority

$$\langle f\rangle = \langle f\rangle_1 + \langle f\rangle_2 = \langle s_1\rangle\widetilde{f}_1 + (1-\langle s_1\rangle)\widetilde{f}_2,$$

where the phase averages are given by

$$\langle f\rangle_1 = \langle s_1\rangle\frac{1}{\Delta\Omega_1}\int_{\Delta\Omega_1} f\left(t,\vec{x}\right)d\omega = \langle s_1\rangle\widetilde{f}_1,$$

$$\langle f\rangle_2 = \langle s_2\rangle\frac{1}{\Delta\Omega_2}\int_{\Delta\Omega_2} f\left(t,\vec{x}\right)d\omega = \langle s_2\rangle\widetilde{f}_2,$$

and the two internal phase averaged functions are given by

$$\{f\}_1 = \widetilde{f}_1 = \frac{1}{\Delta\Omega_1}\int_{\Delta\Omega_1} f\left(t,\vec{x}\right)d\omega,$$

$$\{f\}_2 = \tilde{f}_2 = \frac{1}{\Delta\Omega_2} \int_{\Delta\Omega_2} f\left(t, \vec{x}\right) d\omega,$$

where $\tilde{f}_1$ is an average over the space of phase one $\Delta\Omega_1$ in the REV, $\tilde{f}_2$ is an average over the second phase volume $\Delta\Omega_2 = \Delta\Omega - \Delta\Omega_1$, and <f> is an average over the whole REV. There are also important averaging theorems for averaging of the spatial ∇ operator - heterogeneous analogs of Gauss-Ostrogradsky theorem. Those are plenty already since 70-80s [1-10,16-19,20-27]. The first few of them needed to average the field equations are the WSAM theorem (after Whitaker-Slattery-Anderson-Marle) and the one is for the intraphase ∇ averaging. The differentiation theorem for the intraphase averaged function reads

$$\{\nabla f\}_1 = \nabla \tilde{f} + \frac{1}{\Delta\Omega_1} \int_{\partial S_w} \hat{f}\, \vec{ds}_1 \ ,$$

$$\hat{f} = f - \tilde{f}, \quad f \forall\ \Delta\Omega_1,$$

where ∂S_w is the inner surface in the REV, $\vec{ds}_1$ is the second-phase, inward-directed differential area in the REV ($\vec{ds}_1 = \vec{n}_1 dS$).

The WSAM theorem sets the averaged operator ∇ in accordance with

$$\langle \nabla f \rangle_1 = \nabla \langle f \rangle_1 + \frac{1}{\Delta\Omega} \int_{\partial S_{12}} f\, \vec{ds}_1 \ .$$

It can be shown that for the invariable morphology (<m>=const) of the medium the operator $\{\nabla f\}_1$ can be presented also as

$$\{\nabla f\}_1 = \nabla \{f\}_1 + \frac{1}{\Delta\Omega_1} \int_{\partial S_w} f\, \overrightarrow{ds}_1,$$

when <m>=const. Meanwhile, the foundation for averaging made, for example, by Nemat-Nasser and Hori [31] (and many others) is based on conventional homogeneous Gauss-Ostrogradsky theorem (see pp.59-60 in [31]), not of its heterogeneous analogs as the WSAM theorem.

The following averaging theorem has been found for the **rot** operator

$$\langle \nabla \times \mathbf{f} \rangle_1 = \nabla \times \langle \mathbf{f} \rangle_1 + \frac{1}{\Delta\Omega} \int_{\partial S_{12}} \vec{ds}_1 \times \mathbf{f},$$

and as a consequence, the theorem for the intraphase average of ($\nabla\times\mathbf{f}$) is found to be

$$\{\nabla \times \mathbf{f}\}_1 = \nabla \times \{\mathbf{f}\}_1 + \frac{1}{\Delta\Omega_1} \int_{\partial S_{12}} \vec{ds}_1 \times \hat{\mathbf{f}}.$$

The averaged time derivative according to transport theorem forms in the heterogeneous medium the following mathematical equation for a phase one, for example, is

$$\left\langle \frac{\partial f}{\partial t} \right\rangle_1 = \frac{\partial}{\partial t}\langle f \rangle_1 - \frac{1}{\Delta\Omega} \int_{\partial S_{12}} (\mathbf{V}_s f) \cdot \vec{ds}_1,$$

where vector $\mathbf{V}_s$ is the velocity of the interface surface ∂S_{12}.

At present, the models of transport phenomena in heterogeneous media when using the HSP-VAT allow to treat media with the following features: 1) multi-scaled media; 2) media with non-linear physical characteristics; 3) polydisperse morphologies; 4) materials with phase anisotropy; 5) media with non-constant or field dependent phase properties; 6) transient problems; 7) presence of imperfect interface surfaces; 8) presence of internal (mostly at the interface) physical-chemical phenomena, etc.

2.1.2 Hierarchical Scaled Volume Averaging Theory (HSVAT) Operating Lemmas

When the interface is fixed in space the averaged functions for the first and second phase (as liquid *f* and solid *s*, for example, or two-phase solid; here is the more understandable two-phase continuum medium used just for known for a few decades and taught in the universities area of physics. Meanwhile, it doesn't matter what the size of particles is of interest. It just to be the correct physics for those "particles.") within the REV and over the entire REV fulfill the following conditions, namely

$$\{f+g\}_f = \{f\}_f + \{g\}_f, \qquad \{a\}_f = a,$$

for the conditions of steady state phases

$$\left\{\frac{\partial f}{\partial t}\right\}_f = \frac{\partial \{f\}_f}{\partial t}, \qquad \left\{\tilde{f}\, g\right\}_f = \tilde{f}_f\, \tilde{g}_f,$$

where a - a constant, except for the differentiation condition $\{\nabla f\}_1$ and $\langle \nabla f \rangle_1$, that is as written above in the two forms.

There is an important difference in the definitions of averaged and fluctuation values in regards of their meaning and values in the REV comparing to definitions supported by Whitaker and co-authors see, for example, in [6,9-16,29-30]. The treatment and interpretation of the averaged values inside of the REV are supported in the classical interpretation when a value, considered as an averaged inside of the Lower scale REV volume, is still the constant value within the same initial ground scale REV the assigned representation point $\mathbf{x}^u$ for the Upper scale description space. The more detail on that problem are given in [6,9-11]. These methods are supported and verified by the exact two--scale solutions that have been able for performing because of that.

Some clearance to this difficult issue brings the concepts and formulation of the scaled problems in the two or more scales.

The **intrinsic type** of averaging $\{f\}_f$ fulfill all **four** of the above conditions as well as the following **four consequences**

$$\left\{\tilde{f}\right\}_f = \tilde{f}, \quad \left\{\hat{f}\right\}_f = \left\{f - \tilde{f}\right\}_f = 0,$$
$$\left\{\tilde{f}\,\tilde{g}\right\}_f = \tilde{f}_f\,\tilde{g}_f, \quad \left\{\tilde{f}\,\hat{g}\right\}_f = \tilde{f}_f\,\tilde{\hat{g}}_f = 0.$$

At the same time, $\langle f\rangle_f$ and $\langle f\rangle$ do not fulfill neither the second of the averaging conditions for $\{f\}_f$, with equalities

$$\langle f+g\rangle_f = \langle f\rangle_f + \langle g\rangle_f, \qquad \langle a\rangle_f \neq a, \quad \langle a\rangle_f = \langle m\rangle a,$$

while for the stationary morphology spatial volumes

$$\left\langle \frac{\partial f}{\partial t}\right\rangle_f = \frac{\partial\langle f\rangle_f}{\partial t}, \qquad \left\langle \tilde{f}\,g\right\rangle_f = \tilde{f}_f\,\langle g\rangle_f,$$

nor the consequences of the other averaging conditions

$$\left\langle \tilde{f}\right\rangle_f = \langle m\rangle\tilde{f}, \Rightarrow \left\langle \tilde{f}\right\rangle_f \neq \tilde{f}, \quad \left\langle \hat{f}\right\rangle_f = \left\langle f-\tilde{f}\right\rangle_f = 0,$$
$$\left\langle \tilde{f}\,\tilde{g}\right\rangle_f = \langle m\rangle\tilde{f}_f\,\tilde{g}_f, \Rightarrow \left\langle \tilde{f}\,\tilde{g}\right\rangle_f \neq \tilde{f}_f\,\tilde{g}_f,$$
$$\left\langle \tilde{f}\,\hat{g}\right\rangle_f = \tilde{f}_f\,\langle\hat{g}\rangle_f = 0.$$

More detail on the non-local VAT procedures and governing equations for different physical problems modeled in homogeneous media by linear mathematical physics equations can be found in publications [9-18] and many other. Meanwhile, features depicting closure, nonlinear theory, polyphysics applications, polyscale developments, exact solutions, etc. can be found only in the works like [6,9-18,19-28,29-30,35] and in the website http://www.travkin-hspt.com.

3. Particle Physics and Sub-Atomic Scales Electrodynamics

3.1 The Aether Phase in the Sub-Atomic Scales Electrodynamics

We would like, for many reasons, to keep referring to the medium that infiltrate all the materials' forms around, in environment, and known to exists and to be believed by physicists in old times as an aether.

Many, if not any researcher on aether conclude that the aether has a structure and that it has to be with - "one feature of the aether, one overlooked by Clerk Maxwell and all those who did pursue their 19th century models of aether. The aether conveys electromagnetic waves. Those waves have a lateral oscillation, meaning that they wriggle sideways in their forward progress as does a snake." (Insisted by Aspden, in his "The Heresy of the Aether" [36]).

Meanwhile, what is not known to any devoted educated and even highly qualified researcher of aether is that the structure features of aether demanding recognition that aether is the Heterogeneous medium, and as such needs to have rather different treatment as a physical medium than that these researchers are able to employ for the purpose at the current moment.

The pretty important is the fact that electromagnetic "waves" is actually rather mathematical, but not physical characteristic of electrodynamics in any medium. Electromagnetism is the feature and quality belonging to electromagnetic particles and a medium in which those particles are distributed and/or moving through. There is no so called "electromagnetic" field without charges and a media. Media itself cannot create the "electromagnetic" field.

That means when researchers are saying or treating the "electromagnetic" field - they treat the mathematical implementations of charges that are moving within the media [37-45]. What kind of charges and how they create the "electromagnetic" field, we will discuss below in the text of this manuscript.

Some researchers of aether, for example [46], think that aether is the viscous, compressible fluid-like medium. Nevertheless, other researcher [47] does not agree with this and considers that "....Ether is presented as an all-pervading medium consisting of particles of two equal but opposite in sign, species. Ether has a certain electromagnetic density and elasticity."

In the studies [48,49] profoundly shown inconsistencies in electrical engineering (conventional MHL electrodynamics) without existence of aether. That is, even in practical usage of conventional electrical engineering when experimentally verified rules (laws) - it is obvious the need of an aether as intermediating medium.

We are studying the possible characteristics of aether on the basis of Heterogeneous structure of aether itself.

We rest in this theory on the unspecified mechanical structure of aether and take it as a still medium with electromagnetic and some of continuum mechanics known properties. Nevertheless, we do not support the simplistic definition of electron, other sub-atomic particles as the swirls of an aether itself. We don't have evidences of that; otherwise it's just one of frivolous convenient conjectures.

3.2 Electron as Volumetric Particle

There are many, not only of Conventional Orthodox Homogeneous Physics (COHP) authorship, theories of sub-atomic particles. In this text we are first of all interested in theories where the sub-atomic "elementary" particles are treated as the volumetric objects with the substantiated properties, with their models where the established in physics doubtless features are present in the volumetric particle models.

We found those also. Among them we mostly are interested in theories that have some connection to faultless other areas of physics. For example, when person develops the volumetric theory for an electron and at the same time talking about QM and/or QFT or QED - it is the clear sign that this person is of not enough qualifications in physics, because he supports obsolete or simply approximate or wrong theories in COHP. At the same time he contradicts to the same opinion that volumetric particles stand for.

We will add here some text and basics for including that in models for electron specifically into the details of particle physics. We just want to have ability to simulate our most unusual terms in governing equations on the Upper scale where the continuum electrodynamics is being formulated.

The great reason for seeking the volumetric models of sub-atomic particles is that in this way the tight connection of sub-atomic electrodynamics with the dynamics of particles themselves and with the overall collective Bottom-Up and Top-Down scaleportation of some properties, may be the substantial part of all characteristics is clearly on the table.

The problem with the dynamics of sub-atomic particle is that their momentum equations are insufficient in COHP even at the lower scale governing equations with the short-handed Lorentz force model that is working for more than a century and brought in during this period many problems in particle and general physics. While the COH physics can not average any equation of the sub-atomic phenomena by its own internal inability.

We would start in the current theory with the theory of structured electron, proton, nucleus, hydrogen atom and molecule mostly following the developments by Ph.M. Kanarev in particle and atomic physics those we have found as the most advanced at this time in physics see, for example [37-45].

Then we proceed to physics of electron arrays based on the HSP-VAT methods for Maxwell-Heaviside-Lorentz and Galilean electrodynamics where the electron arrays dynamics (not the molecular dynamics (MD) of homogeneous physics) ***can be explored with a mathematical rigor***, while we accept the ideas and vision of the nature of one and numerous electrons (atoms) in the determined volume. Those issues are different than in COHP explained hydrogen physics, for example, phenomena, while the hierarchical scaled approach allows contemplating the known phenomena at present at each scale of considered physics, homogeneous and/or heterogeneous.

For example, if in scaled physics the electron arrays should be and can be undoubtedly considered as the number of electrons (other sub-atomic particles), not a cloud of mathematical mass-points, in the aether, in the medium, not in the vacuum that has, nevertheless, the electrodynamics properties? If a medium is empty - means nothing inside of a volume, it should not have any properties by the logical and philosophical definitions. How the nothing can have internal properties?

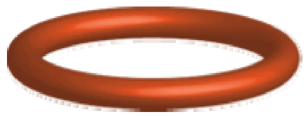

Figure 2. Electron in 3D - shown without the surficial movements and magnetic momentum and a spin, that is following

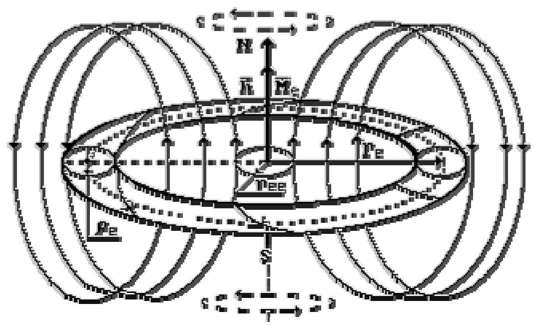

Figure 3. Electron in an aether - Kanarev, Ph.M. [45-47]

Then, we are concerned to the never correctly considered problem (well, it was considered either simplistically or bluntly incorrect regarding the mathematics and physics statement), of what are the properties of such an array if it is still or moving in space (aether) while particles (electrons, protons, etc.) explicitly have dynamics or due to initial impulse or due to external electromagnetic fields (while this definition of electromagnetic field needs to be specified additionally to get to more strictly and openly stated meanings), when even the governing equations are written incorrectly, with unrecognizable simplifications.

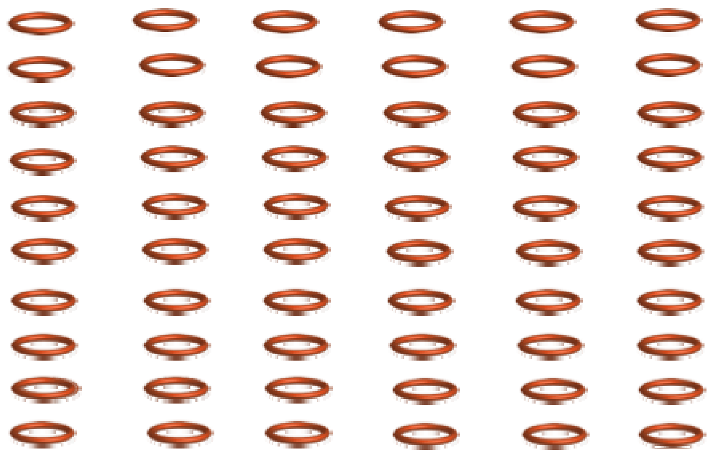

Figure 4. An array of ordered electrons in space. To theorize and model this array the COHP methods are artificial, so the modeling of particles swarm in particle accelerators, for example, is pretty simplified because can not be Upscale averaged, while dynamics equations are incorrect

3.3 Lower Sub-Atomic Scale Maxwell-Heaviside-Lorentz (MHL) GE in SI

Now we provide the set of Maxwell-Heaviside-Lorentz (MHL) GE in SI with $\mathbf{j} \neq 0$, $\rho \neq 0$ for a vacuum (aether) and moving charge point-like particles as for the homogenized mixture with sources (electrons, for example) as it is described in GOHP textbooks when $\mathbf{j} \neq 0$, $\rho \neq 0$:

in the (**e-b**) pair before averaging (real) for the upper scale governing EM equations

$$\nabla \cdot (\mathbf{e}) = \frac{\rho_{ch}}{\varepsilon_0}, \ \nabla \cdot \mathbf{b} = 0,$$

$$\nabla \times \mathbf{b} = \mu_0 \varepsilon_0 \frac{\partial \mathbf{e}}{\partial t} + \mu_0 \mathbf{j}, \quad \mathbf{j} = (\rho_{free} \mathbf{v}_{free} + \rho_{bound} \mathbf{v}_{bound}),$$

$$\mu_0 \varepsilon_0 = \frac{1}{c_0^2}, \quad \mathbf{b} = \mu_0 (\mathbf{h} + \mathbf{m}), \ \textit{with} \quad \mathbf{m} = \mathbf{0},$$

$$\nabla \times (\mathbf{e}) = -\frac{\partial}{\partial t}(\mathbf{b}),$$

These might be also compared to the pure vacuum0 Maxwell equations in (**e-b**)

$$\nabla \cdot \mathbf{e} = 0, \qquad \nabla \cdot \mathbf{b} = 0,$$

$$\nabla \times \mathbf{b} = \left(\frac{1}{c_0^2}\right) \frac{\partial}{\partial t}(\mathbf{e}), \quad \nabla \times \mathbf{e} = -\frac{\partial}{\partial t}(\mathbf{b}).$$

3.4 Galilean Electromagnetism Governing Equations by Klyushin (GEK)

As J.Klyushin [50-52] wrote - the "modern theory of electrodynamics possesses some drawbacks among which perhaps the most unpleasant is that Lorentz force does not satisfy the third Newton Law."

Also, "many experiments in many countries which cannot be explained in traditional ways were produced."

That were among a few motivations behind the development of the Galilean Electrodynamics by Klyushin (GEK) we named it.

Among many outstanding features of this electrodynamics theory might be mentioned the list of fundamental benefits (not complete) that J.Klyushin considers as main advantages:

1) the new GEK electrodynamics generalizations bring the following gains:

"a) divergence of Magnetic field is assumed to be non zero, i.e. existence of magnetic charge is accepted. But such charge does not coincide with Dirac monopole in many aspects. It is closely connected with magnetic moment of the electrically charged particles and in this sense it may be considered as an another incarnation of the electric charge. But in contrast to electric charges a force similar to Coulomb one does not appear between two magnetic charges. They begin interact only in movement;

b) total time derivatives are used instead of the partial ones in the equations. Physically this means that we can take into account the aether, i.e. media in which electric wave propagates. For this, the direct current which is introduced into traditional Maxwell equations "by hands" turns to be one of the two items forming convective part of the total time derivative. The second part of it is a curl expression which appears when electric wave is described and which was not a subject of investigation in the Maxwell system explicitly.

Mathematically this means that generalized GEK system is Galileo invariant and we do not need to use Lorentz transformation: total time derivative takes it into consideration automatically. Generalized MHL equations have a good mathematical peculiarity in addition: they have solution in the case of separate charge in contrast to traditional MHL equations.

2) The last mathematical peculiarity of the Generalized MHL equations enables us to propose some new approaches to the concepts of the fields and their interaction.

a) Fields are defined not as a force acting on a charge but just as a solution of the GEK system. It is shown in appendix one that electric field has mechanic dimension of velocity and magnetic field is non-dimensional one and means rotational angle.

b) Thus we turn to be able to describe interaction between charges with the help of interaction between fields induced by these charges. Interaction energy and interact ion impulse are constructed with the help of the fields. Interaction energy gradient supplies us with the

Huygens part of the force and the time derivative of the interaction impulse gives us Newton part of it. The obtained formula describes all the experimental results known to the author.

3) Some examples are investigated.

a) A case nowadays investigated usually in the framework of Relativity theory examined. An alternative formula is proposed.

b) Peculiarity of interaction between two electrically charged beams is investigated. Existence of cluster effect is predicted.

c) It is shown that electric constant ε_0 means the free aether mass density and magnetic constant μ_0 means the free aether compressibility. They are different in different substances. Examples are proposed to show that many qualities of capacitors, solenoids, diamagnetics and paramagnetics are determined by ε_a and μ_a in these bodies."

We will set up the explanatory text of substantial character in an another work, but here the only pure notions of physical and mathematical character will be allowed.

Generalized formula for EM Two-Particles Interaction force

At the beginning of GEK formulation as for a one scale homogeneous theory Klyushin presents, first of all, the model for the two charges interaction while taking into account of both electric and magnetic fields.

Taking from Klyushin [51] we set up the rectangular right hand coordinate triple to be defined in three-dimensional Euclidian space. Where $\mathbf{x} = \mathbf{x}(x_1, x_2, x_3)$ to be a point in this space, t is the time dimension, and $\mathbf{i,j,k}$ are the unit vectors. Designate q_1, q_2 to be the electric charges 1 and 2, $\mathbf{v}_1$, $\mathbf{v}_2$ and $\mathbf{a}_1$, $\mathbf{a}_2$ are their velocities and accelerations. For simplicity the charges are assumed to be evenly distributed in a ball of radius r_1.

Let $\mathbf{E}_1$, $\mathbf{E}_2$, $\mathbf{B}_1$, $\mathbf{B}_2$ be electric and magnetic induction field intensities generated by the charges in a space (aether).

“In the development below, a double index means field intensity created by the charge whose index goes first evaluated at the point where the charge whose index goes second is situated. For instance $\mathbf{E}_{21}$ means the electric field intensity created by the second charge at the point where the first charge is situated. Let $\mathbf{r}_{21}$ be the radius-vector from charge 2 to charge 1, r is its modulus, $r \gg r_0$ and ε_0 is the dielectric constant” in an aether.

Note, that we have two spherical charges of radius r_0 that placed in an aether environment.

The model (formula) for the charge 2 producing the following force on charge 1 Klyushin [51]

$$\mathbf{F}_{21} = -\nabla[4\pi\varepsilon_0 c r^3(\mathbf{B}_{12}\cdot\mathbf{E}_{21})] + \frac{d}{dt}[4\pi\varepsilon_0 c r^3(\mathbf{B}_{12}\times\mathbf{B}_{21})]. \tag{3.1}$$

Here $c = c_0\,(\mathbf{i}\times\mathbf{j})\cdot\mathbf{k}$, where c_0 is light velocity. This quantity is called pseudo-scalar light velocity.

Klyushin [51] writes that each of the two charges moves creating electromagnetic fields in the surrounding space (aether) while these fields $\mathbf{E}_1$, $\mathbf{E}_2$, $\mathbf{B}_1$, $\mathbf{B}_2$ depend on the charge's value, its velocity and radius-vector. The fields may be found as solutions of some equations as of Maxwell-Heaviside-Lorentz system.

Now we bring in the homogeneous statement when the electric charge q somehow distributed in the space (where it is an aether and charges) with density ρ, originates electric and magnetic fields which are the solutions of the following system in SI:

the Gauss's law GEK equation

$$\mathrm{div}\mathbf{E} = \frac{\rho}{\varepsilon_0}, \tag{3.2}$$

the Faraday's law of induction GEK equation

$$\mathrm{rot}\mathbf{E} = -\frac{d\mathbf{B}}{dt}, \tag{3.3}$$

the conservation of magnetic induction **B** GEK equation

$$\mathrm{div}\mathbf{B} = -\frac{\rho}{c_0\varepsilon_0}, \tag{3.4}$$

and the Ampere-Maxwell law GEK equation (in an aether (vacuum0))

$$\mathrm{rot}\mathbf{B} = \left(\frac{1}{c_0^2}\right)\frac{d\mathbf{E}}{dt}. \tag{3.5}$$

In equation (3.4) is present the "magnetic charge" term $(-(\rho/(c_0\,\rho_0)))$ which is (Klyushin [51]):

1) “Such a "magnetic charge" is a pseudo-scalar, i.e. its sign changes when a right handed coordinate triple is changed for a left handed one.

2) It is c_0 times less than an electric charge; correspondingly, its dimension differs from the electric charge dimension.

3) And last but not the least, the force equation (3.1) implies that two static "magnetic charges" do not interact, because the second term in (3.1) responsible for magnetic interaction is zero in this case. I ask the reader to pay attention to this fact because "ordinary physical mentality" usually identifies field and force, two charges and their inevitable static interaction. We shall see that Newtonian (second) part in (3.1) does not contain static item.”

When all the arguments that were produced in a favor of this Homogeneous presentation of the medium with charges have been sounded in monograph by Klyushin [51] - we must add:

that the total time derivatives in two equations of GEK are needed because of long time standing confidence of that only the aether can connect interaction of the charges in any case, for example in an aether (vacuum0)), but and in any other phase while being in between the other phase atoms (molecules), or in the problems of an aether with the charges.

We now provide the arguments that the charges, volumes occupied by charges, should be considered as "phases", yes, special volumetrically designating themselves as the spatial "phases."

It is one of the prime statements in the polyphase medium that presents the best and the most rigorous mathematical description of polyphase medium while is showing the processes in each homogeneous phase separately. This gives ability to model and simulate processes (physics of processes) in the most accurate mathematical procedure ways. At the same time, it is the only approach at this time - end of the XX and beginning of XXI centuries, when the solution of these Two-scale physical problems can be achieved taking into account all the physical features of phenomena happened in both scales - some of them cannot be described and seen in the One scale homogeneous mathematical physics statements.

3.5 Averaging of the GEK Governing Equations at the Sub-Atomic Scale in SI

Among the sufficiently numerous versions of possible formulations of GEK Upper meso-scale governing equations we take the following. At first we write down the **scaleless** pseudo-averaged homogeneous version of equations:

the Gauss's law GEK equation

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0},$$

the Faraday's law of induction GEK equation

$$\nabla \times \mathbf{E} = -\frac{d\mathbf{B}}{dt},$$

$$\nabla \times \mathbf{E} = -\left[\frac{\partial \mathbf{B}}{\partial t} + (\mathbf{v} \cdot \nabla)\mathbf{B}\right],$$

the conservation of magnetic induction **B** GEK equation

$$\nabla \cdot \mathbf{B} = -\frac{\rho}{c_0 \varepsilon_0},$$

and the Ampere-Maxwell law GEK equation (in an aether (vacuum0))

$$\nabla \times \mathbf{B} = \left(\frac{1}{c_0^2}\right)\frac{d\mathbf{E}}{dt},$$

$$\nabla \times \mathbf{B} = \left(\frac{1}{c_0^2}\right)\left[\frac{\partial \mathbf{E}}{\partial t} + (\mathbf{v} \cdot \nabla)\mathbf{E}\right], \ \mu_0 \varepsilon_0 = \frac{1}{c_0^2}.$$

3.5.1 GEK EM sub-atomic Particles (Lower scale) and Media (aether first) GEs (full time derivative)

Taking the approach that at all we have the two phase electrodynamics phenomena - when the three phase interacting in a known in particle physics way, we write down the GEK governing equations.

Aether phase EM GEK (Lorentz style) in the (**e-b**) pair:

$$\nabla \cdot (\varepsilon_0 \mathbf{e}_0) = 0,$$

$$\nabla \cdot ((c_0 \varepsilon_0)\mathbf{b}_0) = 0,$$

$$\nabla \times (\mathbf{b}_0) = \frac{1}{c_0^2}\frac{d}{dt}(\mathbf{e}_0), \quad \nabla \times (\mathbf{b}_0) = [\mu_0 \varepsilon_0]\frac{d}{dt}(\mathbf{e}_0),$$

$$\nabla \times (\mathbf{e}_0) = -\frac{d}{dt}(\mathbf{b}_0),$$

$$\mu_0 \varepsilon_0 = \frac{1}{c_0^2}, \quad \mathbf{b}_0 = \mu_0(\mathbf{h}_0 + \mathbf{m}_0), \ \textit{with} \quad \mathbf{m}_0 = 0; \ \sqrt{\mu_0 \varepsilon_0} = \frac{1}{c_0},$$

Now we can draw the GEK equations for an electron. The Gauss's law GEK equation and the conservation of magnetic induction $\mathbf{b}_1$ GEK equation

$$\nabla \cdot [\varepsilon_1 \mathbf{e}_1] = \langle \rho \rangle_1 = e,$$

$$\nabla \cdot [(c_1 \varepsilon_1)\mathbf{b}_1] = -e,$$

and Ampere-Maxwell law GEK equation

$$\nabla \times (\mathbf{b}_1) = \frac{1}{c_1^2}\frac{d}{dt}(\mathbf{e}_1), \quad \nabla \times (\mathbf{b}_1) = (\mu_1 \varepsilon_1)\frac{d}{dt}(\mathbf{e}_1),$$

the analogue of Faraday's law of induction GEK equation

$$\nabla \times (\mathbf{e}_1) = -\frac{d}{dt}(\mathbf{b}_1),$$

$$\mu_1 \varepsilon_1 = \frac{1}{c_1^2}, \quad \mathbf{b}_1 = \mu_1(\mathbf{h}_1 + \mathbf{m}_1), \ \textit{with} \quad \mathbf{m}_1 \neq 0; \ \sqrt{\mu_1 \varepsilon_1} = \frac{1}{c_1}.$$

Note, that the whole litany regarding the "speculative" like formulation of electrodynamics for the phase of electron is not worthwhile the piece of paper for its placement - because it is of better justification then numerous artificial constructions of QM and QF theories. As of, for example, particle is the wave - wave-particle famous "duality." That is not of physical reality.

Pretty important is that the equations of particles momentum should be assessed and taken into the whole set of governing equations.

3.5.2 GEK EM Sub-Atomic-Meso-Scale Averaged GEs in SI

The first two divergence GEs

$$\nabla \cdot (\langle \mathbf{E}_{K3} \rangle) + \frac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{E}_{K3}) \cdot \vec{ds} = \frac{\langle s_1 \rangle ne}{\varepsilon_1} = \frac{\langle \rho \rangle_1}{\varepsilon_1},$$

$$\nabla \cdot (\langle \mathbf{B}_{K2} \rangle) + \frac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{B}_{K2}) \cdot \vec{ds} = -\langle s_1 \rangle \left(\sqrt{\frac{\mu_1}{\varepsilon_1}} \right) ne = -\frac{\langle s_1 \rangle ne}{(c_1 \varepsilon_1)}.$$

only if we accept here that

$$\langle \mathbf{E}_{K3} \rangle = [\langle m_0 \rangle \tilde{\mathbf{e}}_0 + \langle s_1 \rangle \tilde{\mathbf{e}}_1] \ \text{ and } \ \mathbf{E}_{K3} = (\mathbf{e}_0 + \mathbf{e}_1)$$

$$\langle \mathbf{B}_{K2} \rangle = \left[\langle m_0 \rangle \widetilde{\mathbf{b}}_0 + \langle s_1 \rangle \widetilde{\mathbf{b}}_1 \right] \text{ and } \mathbf{B}_{K2} = (\mathbf{b}_0 + \mathbf{b}_1).$$

Or if to take the averaged electric strength

$$\langle \mathbf{E} \rangle = \langle \mathbf{E}_K \rangle = [\langle m_0 \rangle \varepsilon_0 \widetilde{\mathbf{e}}_0 + \langle s_1 \rangle \varepsilon_1 \widetilde{\mathbf{e}}_1],$$

while the hypothetical not existing because it is only the virtually "local" field

$$\mathbf{E} = \mathbf{E}_K = (\varepsilon_0 \mathbf{e}_0 + \varepsilon_1 \mathbf{e}_1),$$

then

$$\nabla \cdot (\langle \mathbf{E} \rangle) + \frac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{E}) \cdot \vec{ds} = \langle s_1 \rangle ne = \langle \rho \rangle_1 .$$

and if the two-phase averaged magnetic induction

$$\langle \mathbf{B} \rangle = \langle \mathbf{B}_K \rangle = \left[\langle m_0 \rangle (c_0 \varepsilon_0) \widetilde{\mathbf{b}}_0 + (c_1 \varepsilon_1) \langle s_1 \rangle \widetilde{\mathbf{b}}_1 \right],$$

while

$$\mathbf{B} = \mathbf{B}_K = ((c_0 \varepsilon_0) \mathbf{b}_0 + (c_1 \varepsilon_1) \mathbf{b}_1), (c_0 \varepsilon_0) = \sqrt{\frac{\varepsilon_0}{\mu_0}} ,$$

then we have finally the GEK averaged equation of this form

$$\nabla \cdot (\langle \mathbf{B} \rangle) + \frac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{B}) \cdot \vec{ds} = -\langle s_1 \rangle ne.$$

Then, instead of MHL averaged Ampere-Maxwell Upper scale equation

$$\nabla \times \langle \mathbf{B} \rangle + \frac{1}{\Delta\Omega} \int_{\partial S_w} \vec{ds} \times \mathbf{B} = \frac{\partial}{\partial t} \langle \mathbf{E}_{K3} \rangle - \frac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{V}_s \mathbf{E}_{K3}) \cdot \vec{ds},$$

where

$$\langle \mathbf{B} \rangle = \left[\langle m_0 \rangle (c_0 \varepsilon_0) \widetilde{\mathbf{b}}_0 + (c_1 \varepsilon_1) \langle s_1 \rangle \widetilde{\mathbf{b}}_1 \right],$$
$$\mathbf{B} = ((c_0 \varepsilon_0) \mathbf{b}_0 + (c_1 \varepsilon_1) \mathbf{b}_1), (c_0 \varepsilon_0) = \sqrt{\frac{\varepsilon_0}{\mu_0}} ,$$

and

$$\langle \mathbf{E}_{K3} \rangle = [\langle m_0 \rangle \widetilde{\mathbf{e}}_0 + \langle s_1 \rangle \widetilde{\mathbf{e}}_1], \ \mathbf{E}_{K3} = (\mathbf{e}_0 + \mathbf{e}_1),$$

we would have the following Ampere-Maxwell-Klyushin GEK Upper meso-scale GEs

$$\nabla \times \langle \mathbf{B}_{K2} \rangle + \frac{1}{\Delta\Omega} \int_{\partial S_w} \vec{ds} \times \mathbf{B}_{K2} = \frac{\partial}{\partial t} \langle \mathbf{E}_{K2} \rangle - \frac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{V}_s \mathbf{E}_{K2}) \cdot \vec{ds} +$$
$$+ \langle \mathbf{w}_i \cdot \nabla (\mathbf{e}_{K2}) \rangle, \ i = 0, 1;$$

so, here if

$$\langle \mathbf{B}_{K2} \rangle = \left[\langle m_0 \rangle \widetilde{\mathbf{b}}_0 + \langle s_1 \rangle \widetilde{\mathbf{b}}_1 \right] \text{ and } \mathbf{B}_{K2} = (\mathbf{b}_0 + \mathbf{b}_1),$$

and if

$$\langle \mathbf{E}_{K2} \rangle = \left[\left(\frac{1}{c_0^2} \right) \langle m_0 \rangle \widetilde{\mathbf{e}}_0 + \langle s_1 \rangle \left(\frac{1}{c_1^2} \right) \widetilde{\mathbf{e}}_1 \right] \text{ and } \mathbf{E}_{K2} = \left(\left(\frac{1}{c_0^2} \right) \mathbf{e}_0 + \left(\frac{1}{c_1^2} \right) \mathbf{e}_1 \right),$$

while there

$$\frac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{V}_s \mathbf{E}_{K2}) \cdot \vec{ds} =$$
$$= \frac{1}{\Delta\Omega} \int_{\partial S_{0p}} \left(\mathbf{V}_{sp} \left(\left(\frac{1}{c_0^2} \right) \mathbf{e}_0 \right) \right) \cdot \vec{ds}_0 + \frac{1}{\Delta\Omega} \int_{\partial S_{p1}} \left(\mathbf{V}_{sp} \left(\left(\frac{1}{c_1^2} \right) \mathbf{e}_1 \right) \right) \cdot \vec{ds}_1,$$

and

$$\langle \mathbf{w}_i \cdot \nabla(\mathbf{e}_{K2}) \rangle = \langle \mathbf{w}_i \cdot \nabla(\mathbf{e}) \rangle_0 + \langle \mathbf{w}_i \cdot \nabla(\mathbf{e}) \rangle_1 =$$

$$= \left(\tfrac{1}{c_0^2}\right)\left[\langle m_0 \rangle \widetilde{\mathbf{w}}_0 \cdot \nabla(\widetilde{\mathbf{e}}_0) + \widetilde{\mathbf{w}}_0 \cdot \left(\tfrac{1}{\Delta\Omega} \int_{\partial S_{0p}} \mathbf{e}_0 \, d\vec{s}_0 \right) \right] +$$

$$+ \left(\tfrac{1}{c_0^2}\right) < \widehat{\mathbf{w}}_0 \cdot \nabla(\widehat{\mathbf{e}}_0) >_0 +$$

$$+ \left(\tfrac{1}{c_1^2}\right)\left[\langle s_1 \rangle \widetilde{\mathbf{w}}_1 \cdot \nabla(\widetilde{\mathbf{e}}_1) + \widetilde{\mathbf{w}}_1 \cdot \left(\tfrac{1}{\Delta\Omega} \int_{\partial S_{p1}} \mathbf{e}_1 \, d\vec{s}_1 \right) \right] +$$

$$+ \left(\tfrac{1}{c_1^2}\right) < \widehat{\mathbf{w}}_1 \cdot \nabla(\widehat{\mathbf{e}}_1) >_1 ,$$

but again if here for the last two $\nabla \times$ equations taken

$$\langle \mathbf{B}_{K2} \rangle = \left[\langle m_0 \rangle \widetilde{\mathbf{b}}_0 + \langle s_1 \rangle \widetilde{\mathbf{b}}_1 \right] \text{ and } \mathbf{B}_{K2} = (\mathbf{b}_0 + \mathbf{b}_1),$$

and

$$\langle \mathbf{E}_{K2} \rangle = \left[\left(\tfrac{1}{c_0^2}\right) \langle m_0 \rangle \widetilde{\mathbf{e}}_0 + \langle s_1 \rangle \left(\tfrac{1}{c_1^2}\right) \widetilde{\mathbf{e}}_1 \right] \text{ and } \mathbf{E}_{K2} = \left(\left(\tfrac{1}{c_0^2}\right) \mathbf{e}_0 + \left(\tfrac{1}{c_1^2}\right) \mathbf{e}_1 \right).$$

Further, instead of MHL averaged Faraday law of induction equation if we take that

$$\langle \mathbf{E}_{K3} \rangle = [\langle m_0 \rangle \widetilde{\mathbf{e}}_0 + \langle s_1 \rangle \widetilde{\mathbf{e}}_1] \text{ and } \mathbf{E}_{K3} = (\mathbf{e}_0 + \mathbf{e}_1)$$

and

$$\langle \mathbf{B}_{K2} \rangle = \left[\langle m_0 \rangle \widetilde{\mathbf{b}}_0 + \langle s_1 \rangle \widetilde{\mathbf{b}}_1 \right] \text{ and } \mathbf{B}_{K2} = (\mathbf{b}_0 + \mathbf{b}_1),$$

then the averaged MHL Faraday law of induction equation is

$$\nabla \times \langle \mathbf{E}_{K3} \rangle + \tfrac{1}{\Delta\Omega} \int_{\partial S_w} d\vec{s} \times \mathbf{E}_{K3} = -\tfrac{\partial}{\partial t} \langle \mathbf{B}_{K2} \rangle + \tfrac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{V}_s \mathbf{B}_{K2}) \cdot d\vec{s},$$

where

$$\tfrac{1}{\Delta\Omega} \int_{\partial S_w} (\mathbf{V}_s \mathbf{B}_{K2}) \cdot d\vec{s} = \tfrac{1}{\Delta\Omega} \int_{\partial S_{0p}} (\mathbf{V}_{sp}(\mathbf{b}_0)) \cdot d\vec{s}_0 +$$

$$+ \tfrac{1}{\Delta\Omega} \int_{\partial S_{p1}} (\mathbf{V}_{sp}(\mathbf{b}_1)) \cdot d\vec{s}_1 .$$

Then we would have the following Faraday-Klyushin GEK Upper meso-scale $\nabla\ \nabla \times (<m_0>\{\mathbf{e}_0\}_0)$ GE with the same components summation:

for an aether phase

$$\nabla \times (\langle m_0 \rangle \widetilde{\mathbf{e}}_0) + \tfrac{1}{\Delta\Omega} \int_{\partial S_{0p}} d\vec{s}_0 \times \mathbf{e}_0 = -\tfrac{\partial}{\partial t} \langle \mathbf{b}_0 \rangle_0 + \tfrac{1}{\Delta\Omega} \int_{\partial S_{0p}} (\mathbf{V}_{sp}(\mathbf{b}_0)) \cdot d\vec{s}_0 -$$

$$- \left[\langle m_0 \rangle \widetilde{\mathbf{w}}_0 \cdot \nabla\left(\widetilde{\mathbf{b}}_0\right) + \widetilde{\mathbf{w}}_0 \cdot \left(\tfrac{1}{\Delta\Omega} \int_{\partial S_{0p}} \mathbf{b}_0 \, d\vec{s}_0 \right) + \right.$$

$$\left. + < \widehat{\mathbf{w}}_0 \cdot \nabla\left(\widehat{\mathbf{b}}_0\right) >_0 \right],$$

the averaged Faraday-Klyushin equation in electrons phase

$$\nabla \times (\langle s_1 \rangle \widetilde{\mathbf{e}}_1) + \tfrac{1}{\Delta\Omega} \int_{\partial S_{p1}} d\vec{s}_1 \times \mathbf{e}_1 = -\tfrac{\partial}{\partial t} \langle \mathbf{b}_1 \rangle_1 + \tfrac{1}{\Delta\Omega} \int_{\partial S_{p1}} (\mathbf{V}_{sp}(\mathbf{b}_1)) \cdot d\vec{s}_1 -$$

$$-\left[\langle s_1\rangle\widetilde{\mathbf{w}}_1\cdot\nabla\left(\widetilde{\mathbf{b}}_1\right)+\widetilde{\mathbf{w}}_1\cdot\left(\frac{1}{\Delta\Omega}\int\limits_{\partial S_{p1}}\mathbf{b}_1\,d\vec{s}_1\right)+\right.$$
$$\left.+<\widehat{\mathbf{w}}_1\cdot\nabla\left(\widehat{\mathbf{b}}_1\right)>_1\right],$$

then summing the two equations together we have the Faraday-Klyushin Upper scale (meso-scale) equation

$$\nabla\times\langle\mathbf{E}_{K3}\rangle+\frac{1}{\Delta\Omega}\int\limits_{\partial S_w}d\vec{s}\times\mathbf{E}_{K3}=-\frac{\partial}{\partial t}\langle\mathbf{B}_{K2}\rangle+\frac{1}{\Delta\Omega}\int\limits_{\partial S_w}(\mathbf{V}_s\mathbf{B}_{K2})\cdot d\vec{s}-\langle\mathbf{w}_i\cdot\nabla(\mathbf{b}_{K2})\rangle,\ i=0,1.$$

In this way we got all of the above and other averaged equations from the sub-atomic ($10^{-15}\div10^{-10}$) [m] scales to the some meso-scale ($10^{-7}\div10^{-5}$) [m] in a pretty obvious and complicated form.

One needs to understand that these two-phase two-scale GEK governing equations give a numerous ways for connecting the sub-atomic and meso-scale electrodynamics in any medium, substance within the conditions of moderate environmental boundary influence.

3.6 Particles Momentum Equations in the Aether (vacuum0)

Now - when the charged and magnetic moment particles (photons, electrons, nuclei, ions, atoms) are moving in an aether (vacuum0) and one might be using the Lorentz force formula developed for two, but used anyway for more charged particles where the fields $\mathbf{e}_2$, $\mathbf{b}_2$ are symbolizing (affecting) the force onto the charged test particle q_1

$$\mathbf{F}_{21}=q_1(\mathbf{e}_2+\mathbf{w}_1\times\mathbf{b}_2), \tag{3.6}$$

where both particles are the moving charges. Note, the issue of charge q_1 effecting the moving another charge q_2 even does not sound for Lorentz force formula. We guess that it is because at that time Lorentz did not know - How to do this?

The equation of motion of particle with mass m_1 in the present "inviscid" framework" of aether while the second particle having the fields $\mathbf{e}_2$, $\mathbf{b}_2$ is

$$m_1\dot{\mathbf{w}}_1=m_1\frac{d\mathbf{w}_1}{dt}=\mathbf{F}_{21}=q_1(\mathbf{e}_2+\mathbf{w}_1\times\mathbf{b}_2), \tag{3.7}$$

or commonly in the general fields "averaged" **E** and **B** the Lorentz force formula in the equation looks as

$$m_1\frac{d\mathbf{w}_1(\mathbf{r}_1,t)}{dt}=\mathbf{F}_{int}(\mathbf{r}_1,t)=q_1(\mathbf{r}_1,t)(\mathbf{E}(\mathbf{r}_1,t)+\mathbf{w}_1(\mathbf{r}_1,t)\times\mathbf{B}(\mathbf{r}_1,t)),$$

where **E** and **B** should be here taken or known as "averaged" already field variables? Or assigned or known "averaged" functions.

3.6.1 Averaging of the Force formulae Equations in the REV

Then we should phase average $< >_p$ this equation with the Lorentz's (Heaviside) force field formula over the phase of particles (p) as

$$\left\langle m_1 \frac{d\mathbf{w}_1(\mathbf{r}_1,t)}{dt} \right\rangle_p = \langle \mathbf{F}_{int}(\mathbf{r}_1,t)\rangle_p = \langle q_1(\mathbf{r}_1,t)(\mathbf{E}(\mathbf{r}_1,t) + \mathbf{w}_1(\mathbf{r}_1,t) \times \mathbf{B}(\mathbf{r}_1,t))\rangle_p,$$

where we get the averaged equation of momentum of collective array (field) of interacting particles - particle phase, electrons, for example, as (with the simplified for start electron mass $m_1 = m_e$ =const), while the total time derivative

$$\frac{d\mathbf{w}_1(\mathbf{r}_1,t)}{dt} = \frac{\partial \mathbf{w}_1(\mathbf{r}_1,t)}{\partial t} + (\mathbf{w}_1 \cdot \nabla \mathbf{w}_1),$$

the averaged particle phase 1 (electrons) equation will be

$$m_e\left[\langle s_1\rangle \frac{\partial(\widetilde{\mathbf{w}}_e)}{\partial t} - \frac{1}{\Delta\Omega}\int_{\partial S_{p1}} (\mathbf{V}_{sp}(\mathbf{w}_e)) \cdot d\vec{s}_1\right] + m_e\langle s_1\rangle \widetilde{\mathbf{w}}_e \cdot \nabla\left(\widetilde{\mathbf{w}}_e\right) +$$

$$+m_e\widetilde{\mathbf{w}}_e \cdot \left(\frac{1}{\Delta\Omega}\int_{\partial S_{p1}} \mathbf{w}_e\, d\vec{s}_1\right) + m_e < \widehat{\mathbf{w}}_e \cdot \nabla\left(\widehat{\mathbf{w}}_e\right) >_{p1} = < \mathbf{F}_e >_{p1} . \tag{3.8}$$

This Upper scale governing equation COHP is not even able to obtain, to derive. The methods of COHP don't allow doing this. Here we observe the 3 unknown in COHP terms included in this equation.

Comparing this upper scale momentum equation for the particulate phase (medium) with the COHP standard scaleless momentum equation with the Lorentz force formula

$$m_e \frac{d\mathbf{w}_e(\mathbf{r}_e,t)}{dt} = \mathbf{F}_{int}(\mathbf{r}_e,t) = e(\mathbf{r}_e,t)(\mathbf{E}(\mathbf{r}_e,t) + \mathbf{w}_e(\mathbf{r}_e,t) \times \mathbf{B}(\mathbf{r}_e,t)),$$

used, for example, in [50] (in chapter 6 and in other use of electron's momentum) and in million of such textbooks on COHP electrodynamics (and other disciplines) further as already the well done momentum equation for "generalized" electrons field (by the way, the focus in textbooks of COHP is shifted at once from the velocity field to other functions), everyone can observe a striking difference in mathematics and physics therein.

Well, this kind of mathematic-physics used in COHP everywhere. Because conventional physics professionals in COHP cannot do the averaging of this even simple kind of governing equation.

The force field should be averaged as over the phase of particles (remember, the particles are the volumetric objects with our some knowledge about their properties), so the field of external influence on the particle when using the Lorentz force **F**(**r**,t) can be seen as

$$< \mathbf{F}_{int}(\mathbf{r},t) >_p = < q_p(\mathbf{r},t)(\mathbf{E}(\mathbf{r},t) + \mathbf{w}_p(\mathbf{r},t)\times\mathbf{B}(\mathbf{r},t)) >_p =$$

$$= < q_p(\mathbf{r},t)\mathbf{E}(\mathbf{r},t) >_p + < q_p(\mathbf{r},t)(\mathbf{w}_p(\mathbf{r},t)\times\mathbf{B}(\mathbf{r},t)) >_p ,$$

but **E**(**r**,t) and **B**(**r**,t) are supposed to be already averaged external functions in the problem, in the space. Those could be and External Fields also, but now we are talking about only internal collective fields as a result of numerous dynamic charges that are present in the space.

While taking the charge at first as the constant value $q(\mathbf{r},t) = e = const$ for a separate electron and for a photon; we can write this averaged equation as, for example, for electrons force field

$$< \mathbf{F}_{int}(\mathbf{r},t) >_1 \; =< q_1(t)\mathbf{E}(\mathbf{r},t) >_1 \; + q_1(t) < (\mathbf{w}_1(\mathbf{r},t)\times\mathbf{B}(\mathbf{r},t)) >_1 \; =$$
$$= \langle s_1\rangle n q_1(t)\{\mathbf{E}(\mathbf{r},t)\}_1 + n q_1(t)\langle s_1\rangle\Big[\widetilde{W}_{1i}\times\widetilde{B}_i + \Big\{\widehat{w}_{1i}\times\widehat{B}_i\Big\}_1\Big],$$
$$\mathbf{w}_1(\mathbf{r},t) = w_{1i}(\mathbf{r},t), \quad \mathbf{B}(\mathbf{r},t) = B_i(\mathbf{r},t).$$

We should point out here that in homogeneous physics for more than 100 years COHP physicists just do the substitution in this formula as in [53] and not only, we described this with interest in [24,25]

$$\mathbf{F} = \iiint d\mathbf{r}(\rho\mathbf{E} + \tfrac{1}{c}\mathbf{J}\times\mathbf{B}),$$

while they cannot average (integrate mathematically correct) this kind of equations and processes. Physicists in conventional physics also use the equation (6.1) of motion for charge particle as in [53] in p. 63

$$m_1\frac{d\mathbf{w}_1}{dt} = \mathbf{F}_{21} = q_1(\mathbf{e}_2 + \mathbf{w}_1\times\mathbf{b}_2) = e_e(\mathbf{E} + \mathbf{w}_1\times\mathbf{B}), \qquad (6.1)$$

where used the already "pseudo-averaged" fields **E** and **B**, while they should be averaged along the whole equation of motion and MHL set of equations. Professionals in COHP - they do not make the averaging of the right hand side, they cannot do this.

At the left hand side we have the one particle velocity term, while at the right we have the already averaged fields $<\mathbf{e}_2> = \mathbf{E}$ and $<\mathbf{b}_2> = \mathbf{B}$?

These kinds of tricks one can often find in the homogeneous one-scale atomic, particle physics.

At last we need to do

$$< \mathbf{F}_{int}(\mathbf{r},t) >_1 \; +< \mathbf{F}_{int}(\mathbf{r},t) >_0 \; =< \mathbf{F}_{int}(\mathbf{r},t) >_1 \; =$$
$$= \langle s_1\rangle n q_1(t)\{\mathbf{E}(\mathbf{r},t)\}_1 + n q_1(t)\langle s_1\rangle\Big[\widetilde{W}_{1i}\times\widetilde{B}_i + \Big\{\widehat{w}_{1i}\times\widehat{b}_i\Big\}_1\Big],$$

as soon as for the aether (vacuum0) $<\mathbf{F}_{int}(\mathbf{r},t)>_0=0$. At least for a weak exchange with the aether.

The next is the Upper scale averaged Lorentz force fields equation for distributed in space arrays of charges. If the charged particles are not constant fields (with their mass and charge), and mostly they are not, then the averaged right hand part of the Lorentz force will be as

$$< \mathbf{F}_{int}(\mathbf{r},t) >_1 \; =< q_1(\mathbf{r},t)\mathbf{e}(\mathbf{r},t) >_1 \; +< q_1(\mathbf{r},t)(\mathbf{w}_1(\mathbf{r},t)\times\mathbf{b}(\mathbf{r},t)) >_1 \; =$$
$$= \langle s_1\rangle\Big[\widetilde{q}_{1i}\widetilde{e}_i + \{\widehat{q}_{1i}\,\widehat{e}_i\}_1\Big] +$$
$$+\langle s_1\rangle < \Big[(\widetilde{q}_1(\mathbf{r},t) + \widehat{q}_1(\mathbf{r},t))\Big(\Big(\widetilde{\mathbf{f}}_2 + \widehat{\mathbf{f}}_2\Big)\times\Big(\widetilde{\mathbf{f}}_3 + \widehat{\mathbf{f}}_3\Big)\Big)\Big] >_1 , \qquad (3.9)$$
$$\mathbf{f}_2 = \mathbf{w}_1(\mathbf{r},t), \quad \mathbf{f}_3 = \mathbf{b}(\mathbf{r},t).$$

Summarizing, we can write the dynamics equations for the two-scale commonly with the general fields "averaged" **E** and **B** in the Lorentz force formula in the dynamic equation on the lower scale

$$m_1 \frac{d\mathbf{w}_1(\mathbf{r}_1,t)}{dt} = \mathbf{F}_{int}(\mathbf{r}_1,t) = q_1(\mathbf{r}_1,t)(\mathbf{E}(\mathbf{r}_1,t) + \mathbf{w}_1(\mathbf{r}_1,t) \times \mathbf{B}(\mathbf{r}_1,t)),$$

and the upper scale dynamic equation for electrons is as (3.8) with the r.h.s. force field mathematics using (3.9).

3.7 Modeling of the Upper Meso-Scale (Almost Continuous) Formation of Classical 3D GEK Electrodynamics for Bodies With the Two-Scale Models as - Electromagnetic Particles (Electrons) and the Upper Scale Sphere of Electrons

The suggested in this development the spatial two-scale physical and mathematical model for an array of electrons with their electromagnetic fields and spin is the simplest probably in the great number of studies of scaleportation of sub-atomic particles configuration and with the consecutive spatial reconfiguration of electrons.

Note, that for a real substance we need to take also at least the atoms that present in a volume of a substance.

This model is intended for a low temperature two-phase medium; otherwise we would need to include the photons transport, which complicates the physical picture already outlined in the present model.

Why the Homogeneous Molecular Dynamics techniques are not applicable to this problem that seems quite suitable for MD techniques from the conventional homogeneous physics point of view?

We wrote on this in a few manuscripts, one is the most scrupulous [54]. It would be appropriate to have some model(s) for the rotation of electrons in an array. At this model we do not take into account the exchange with the aether, rather complicated feature for inclusion so far.

The distances and the initial spatial orientation of electron's spin in an array are also the parameters of a model.

Now we can provide the set of modeling equations for the problem.

The lower scale aether phase EM GEK (Lorentz style) in the (**e-b**) pair:

$$\nabla \cdot (\varepsilon_0 \mathbf{e}_0) = 0,$$
$$\nabla \cdot ((c_0 \varepsilon_0) \mathbf{b}_0) = 0,$$

$$\nabla \times (\mathbf{b}_0) = \frac{1}{c_0^2} \frac{d}{dt}(\mathbf{e}_0), \quad \nabla \times (\mathbf{b}_0) = [\mu_0 \varepsilon_0] \frac{d}{dt}(\mathbf{e}_0),$$
$$\nabla \times (\mathbf{e}_0) = -\frac{d}{dt}(\mathbf{b}_0),$$

$$\mu_0\varepsilon_0 = \frac{1}{c_0^2}, \quad \mathbf{b}_0 = \mu_0(\mathbf{h}_0 + \mathbf{m}_0), \ with \quad \mathbf{m}_0 = 0; \ \sqrt{\mu_0\varepsilon_0} = \frac{1}{c_0},$$

Now we can draw the GEK equations for an electron. The Gauss's law GEK equation and the conservation of magnetic induction $\mathbf{b}_1$ GEK equation

$$\nabla \cdot [\varepsilon_1 \mathbf{e}_1] = \langle \rho \rangle_1 = e,$$

$$\nabla \cdot [(c_1\varepsilon_1)\mathbf{b}_1] = -e,$$

and Ampere-Maxwell law GEK equation

$$\nabla \times (\mathbf{b}_1) = \frac{1}{c_1^2}\frac{d}{dt}(\mathbf{e}_1), \quad \nabla \times (\mathbf{b}_1) = (\mu_1\varepsilon_1)\frac{d}{dt}(\mathbf{e}_1),$$

the analogue of Faraday's law of induction GEK equation

$$\nabla \times (\mathbf{e}_1) = -\frac{d}{dt}(\mathbf{b}_1),$$

$$\mu_1\varepsilon_1 = \frac{1}{c_1^2}, \quad \mathbf{b}_1 = \mu_1(\mathbf{h}_1 + \mathbf{m}_1), \ with \quad \mathbf{m}_1 \neq 0; \ \sqrt{\mu_1\varepsilon_1} = \frac{1}{c_1}.$$

The upper scale averaged electric strength

$$\langle \mathbf{E} \rangle = \langle \mathbf{E}_K \rangle = [\langle m_0 \rangle \varepsilon_0 \widetilde{\mathbf{e}}_0 + \langle s_1 \rangle \varepsilon_1 \widetilde{\mathbf{e}}_1], \quad \mathbf{E} = \mathbf{E}_K = (\varepsilon_0\mathbf{e}_0 + \varepsilon_1\mathbf{e}_1),$$

and if the two-phase averaged magnetic induction

$$\langle \mathbf{B} \rangle = \langle \mathbf{B}_K \rangle = \left[\langle m_0 \rangle (c_0\varepsilon_0)\widetilde{\mathbf{b}}_0 + (c_1\varepsilon_1)\langle s_1 \rangle \widetilde{\mathbf{b}}_1\right],$$

$$\mathbf{B} = \mathbf{B}_K = ((c_0\varepsilon_0)\mathbf{b}_0 + (c_1\varepsilon_1)\mathbf{b}_1), (c_0\varepsilon_0) = \sqrt{\frac{\varepsilon_0}{\mu_0}},$$

then the GEK averaged equation of the form

$$\nabla \cdot (\langle \mathbf{B} \rangle) + \frac{1}{\Delta\Omega}\int_{\partial S_w} (\mathbf{B}) \cdot \vec{ds} = -\langle s_1 \rangle ne.$$

The Ampere-Maxwell-Klyushin GEK Upper meso-scale GEs

$$\nabla \times \langle \mathbf{B}_{K2} \rangle + \frac{1}{\Delta\Omega}\int_{\partial S_w} \vec{ds} \times \mathbf{B}_{K2} = \frac{\partial}{\partial t}\langle \mathbf{E}_{K2} \rangle - \frac{1}{\Delta\Omega}\int_{\partial S_w} (\mathbf{V}_s \mathbf{E}_{K2}) \cdot \vec{ds} +$$

$$+\langle \mathbf{w}_i \cdot \nabla(\mathbf{e}_{K2}) \rangle, \ i = 0, 1;$$

when

$$\langle \mathbf{B}_{K2} \rangle = \left[\langle m_0 \rangle \widetilde{\mathbf{b}}_0 + \langle s_1 \rangle \widetilde{\mathbf{b}}_1\right] \ \text{and} \ \mathbf{B}_{K2} = (\mathbf{b}_0 + \mathbf{b}_1),$$

and

$$\langle \mathbf{E}_{K2} \rangle = \left[\left(\frac{1}{c_0^2}\right)\langle m_0 \rangle \widetilde{\mathbf{e}}_0 + \langle s_1 \rangle \left(\frac{1}{c_1^2}\right)\widetilde{\mathbf{e}}_1\right] \ \text{and} \ \mathbf{E}_{K2} = \left(\left(\frac{1}{c_0^2}\right)\mathbf{e}_0 + \left(\frac{1}{c_1^2}\right)\mathbf{e}_1\right).$$

The Faraday-Klyushin Upper scale (meso-scale) equation

$$\nabla \times \langle \mathbf{E}_{K3} \rangle + \frac{1}{\Delta\Omega}\int_{\partial S_w} \vec{ds} \times \mathbf{E}_{K3} = -\frac{\partial}{\partial t}\langle \mathbf{B}_{K2} \rangle + \frac{1}{\Delta\Omega}\int_{\partial S_w} (\mathbf{V}_s \mathbf{B}_{K2}) \cdot \vec{ds} - \langle \mathbf{w}_i \cdot \nabla(\mathbf{b}_{K2}) \rangle, \ i = 0, 1,$$

(we repeat that this is - only if we accept here that

$$\langle \mathbf{E}_{K3} \rangle = [\langle m_0 \rangle \widetilde{\mathbf{e}}_0 + \langle s_1 \rangle \widetilde{\mathbf{e}}_1] \ \text{and} \ \mathbf{E}_{K3} = (\mathbf{e}_0 + \mathbf{e}_1),$$

$$\langle \mathbf{B}_{K2} \rangle = \left[\langle m_0 \rangle \widetilde{\mathbf{b}}_0 + \langle s_1 \rangle \widetilde{\mathbf{b}}_1\right] \ \text{and} \ \mathbf{B}_{K2} = (\mathbf{b}_0 + \mathbf{b}_1)).$$

The electrons dynamics two-scale set of equation:

$$m_1 \frac{d\mathbf{w}_1(\mathbf{r}_1, t)}{dt} = \mathbf{F}_{int}(\mathbf{r}_1, t) = q_1(\mathbf{r}_1, t)(\mathbf{E}(\mathbf{r}_1, t) + \mathbf{w}_1(\mathbf{r}_1, t) \times \mathbf{B}(\mathbf{r}_1, t)),$$

$$m_e\left[\langle s_1 \rangle \frac{\partial(\widetilde{\mathbf{w}}_e)}{\partial t} - \frac{1}{\Delta\Omega}\int_{\partial S_{p1}} (\mathbf{V}_{sp}(\mathbf{w}_e)) \cdot \vec{ds}_1\right] + m_e\langle s_1 \rangle \widetilde{\mathbf{w}}_e \cdot \nabla(\widetilde{\mathbf{w}}_e) +$$

$$+m_e\widetilde{\mathbf{w}}_e\cdot\left(\frac{1}{\Delta\Omega}\int\limits_{\partial S_{p1}}\mathbf{w}_e\ d\vec{s}_1\right)+m_e<\widehat{\mathbf{w}}_e\cdot\nabla\left(\widehat{\mathbf{w}}_e\right)>_{p1}\ =<\mathbf{F}_e>_{p1}\ ,$$

with the more simple Lorentz force averaged over the spatial distribution of electrons as

$$<\mathbf{F}_{int}(\mathbf{r},t)>_1\ =<q_1(\mathbf{r},t)\mathbf{e}(\mathbf{r},t)>_1\ +<q_1(\mathbf{r},t)(\mathbf{w}_1(\mathbf{r},t)\times\mathbf{b}(\mathbf{r},t))>_1\ =$$
$$=\langle s_1\rangle\left[\widetilde{q}_{1i}\widetilde{e}_i+\{\widehat{q}_{1i}\ \widehat{e}_i\}_1\right]+$$
$$+\langle s_1\rangle<\left[(\widetilde{q}_1(\mathbf{r},t)+\widehat{q}_1(\mathbf{r},t))\left(\left(\widetilde{\mathbf{f}}_2+\widehat{\mathbf{f}}_2\right)\times\left(\widetilde{\mathbf{f}}_3+\widehat{\mathbf{f}}_3\right)\right)\right]>_1\ , \qquad (3.9)$$
$$\mathbf{f}_2=\mathbf{w}_1(\mathbf{r},t),\quad \mathbf{f}_3=\mathbf{b}(\mathbf{r},t).$$

Simulating this set of governing equations is a challenge. The COH physics had no methods, tools even to formulate this kind of model through 1920-2010s. This unsteady simulation should demonstrate the limits of close range packing of electrons in dependency of spin orientation, electrons energy level, initial configurations, etc. Of course, the energy exchange mechanisms should be included later on.

3.8 Discussion

We develop and demonstrate the polyscale consideration of the sub-atomic physical problems - only dynamics and electromagnetism of 2-phase medium - aether and electrons in the unspecified volume. In this large volume every time can be selected and outlined the specific volume REV (Representative Elementary Volume) in which the upper collective, averaged medium and its properties are sought.

Because the dynamics of our particles are following the accepted electrodynamics theory we have chosen the GEK electrodynamics for the lower scale sub-atomic dynamics statements. This is done for better familiarity of students with the scaled physics, which is not taught in the universities.

As long as the 2-phase sub-atomic medium description is following in many parts to the more advanced HSP-VAT techniques for nanoscale and higher spatial scales polyphase physics, that can be used to draw the similarity features, questions. One of them is the formulation for the interior of final size (small, but not negligible) particles the physical and mathematical statements for possible electrodynamics phenomena. We know that any of these particles (electrons in this problem) may display some electromagnetic properties. Formulation of the interior space electrodynamic medium features does not contradict to the exterior electromagnetic features demonstration by these particles. Contrary, the formulation of the interior medium as having some electrodynamics properties should help to reveal some of these properties using the scaled polyphase HSP-VAT analysis and some simulation. The simulation results usually help to modify the initial reasoning.

Thus, we can observe in the above governing two-scale equations the additional terms that communicate between both media of particle arrays. These terms are fortunately directly interacting in a way to outline the exterior dynamics and electrodynamics of the media to the interior formulated possible properties of the media.

The two-scale dynamics of two-phase interacting via aether particles gives the opportunity to find out the exact values for interacting terms in the governing equations. And this is achievable for the first time in particle physics.

4. Conclusions

We have shown in this paper for the first time the obtained in 2001-2009 the full path to derivation of the two-scale (local-nonlocal) mathematical formulation for the sub-atomic scale particulate phenomena when the particles are the volumetric objects, but not fictitious point-like particles of conventional particle physics. Students are never told the real meaning of this point-like kind presentation for sub-atomic particles. The real physical category of volumetric particulate polyphase medium portrayal was not achieved throughout the previous 100 something years.

There was the lack of needed directly applicable concepts, methods and mathematics in the past ~100 years for the sub-atomic particles because they have been simplified to the volumeless point-like objects with assigned propertied. This is unphysical approach indeed.

Among advancements of HSP-VAT treatment of the sub-atomic electromagnetic particles - electrons (photons and other particles) as of volumetric particles with their internal (mostly unknown at present) and surficial properties; the more correct and mathematically fundamental electrodynamic governing equations - GEK equations; the inclusion in all dynamics of sub-atomic particles the intermedium of the aether.

Now the Polyphase-Polyscale-Polyphysics (3P) tools and methods of HSP-VAT particle physics are available for treatment of particle physics issues as of a physical science first of all.

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