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*Iourii Gribov**

# *Dark Matter as Pico-Windows to physically equal Multiverse Worlds with Myriads Civilizations around Us (in extra dimension)*[1]

## *Abstract*

This is proposed a full *inversion* of classical vacuum/matter paradigms: (a) "empty" vacuum becomes atomistic – built of Cooper-like (*e* /*e*+) *ghost bosonic composites* – realizing nongravitating, chargeless, supersymmetric superfluid medium, (b) elementary mass particles arise as elementary Diracian-like holes=defects in it. The underlying concept is based on the pure *spatial* dimensional enlargement 3*D* (3*D*+1), where our 3*D*-space is a quasiflat 3*D*-waveguide, being embedded into a global isotropic Euclidean 4*D*-hyperspace (*x*,*y*,*z*,*L*). The endless elastic waveguide's shell (*x*,*yz*,0<*L*<$L_{o4}$) confines the Einsteinian-like 4*D*-photon $C_4$-quanta $E_4=h_4$, where it has a non-stop *polygonal* /\/\/\/\/\/\ $C_4$-waveguide's dynamics with the hidden $C_4$-gauge symmetry (as the basic conceptual physical alternative to the global Minkowski 4*D*-spacetime). This waveguided $C_4$-dynamics creates the *self-sufficient, united physical source* for the Einsteinian SR & the quantized equivalence principle & GR & the QM & the Kaluza's cyclical condition & the confined-massive Yang-Mills bosons with local gauge invariance, etc., being different sides of the same waveguided wave-interference phenomenon. The global 4D-hyperspace (*x*,*y*,*z*,*L*) consists of the $L_{o4}$-periodical parallel 3*D*-waveguides with the $L_{o4}=$ $_{el.Compton}$ $10^{10}$cm thickness, building together an endless coupled Multiverse (with enormous Universes density $_L$~$10^{10}$ $_{Universes}$/$cm_4$), consisting of *physically identical, periodical and parallel Universes/Antiuniverses* with the large–scale *matter/antimatter=gravity/antigravity hypersymmetry*. The proposed waveguided-periodical design explains:

(1) the interconnected nature of Dark Energy (DE) and Dark Matter (DM) & the flatness of our Universe/Multiverse & the accelerating expansion & the "bubble" large-scale structure, with the estimated theoretical ratio DE/**(**DM + Ordinary Matter) ~74%/26%, that is very near to the recently done measurements;
(2) creates massive-quantized – elementary, hyper-periodical fermions / antifermions, with the string-like properties and the GR-like black holes free of singularities;
(3) predicts *antigravity* in the future antihydrogen-gravity test (preparing in CERN);
(4) explains the Cooper-like (*e* /*e*+) *composite-ghost* nature of the supersymmetry (SUSY), providing zero vacuum energy density;
(5) predicts natural *absence* of the hypothetical *elementary* SUSY *sparticles* (at CERN);
(6) predicts *absence* of the "elusive" Higgs bosons, excluded by the holistic waveguided rest-mass creation mechanism (at CERN in the LEP experiments);
(7) predicts existence of plenty (physically "cloned", interconnected) parallel, dark Universes, with enormous density of hyper-civilizations (placed proximally near 10 -100 *light minutes* in a $R_4$-distance around us)!

* Contact-Email: igribov@aol.com

[1] The article published here is the essentially expanded version of a text, in which Iourii Gribov has written down his concept of the Periodical Multiversum and the interconnected nature of Dark Energy, Dark Matter, Supersymmetry, singularityless black holes etc. A first version (50 pages) has been submitted to the Leibniz-Sozietät on 24.06.2010 and presented a group of experts of the Leibniz-Sozietät on 06.01.2011. Unfortunately, extent and range of the published article limited the possibilities of an editorial treatment. The not-linked table of contents, later inserted by the author, in some cases is different from the written text und presents the side counting for 2 pages lower than the head line information of the physical text. − The graphics 13d on page 74 has been corrected by the author on the 10th of April 2012.
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*Devoted to Giordano Bruno, tragic Renaissance genius, who predicted an endless plurality of the physically identical Worlds 423 years ago*

What nature demands from us is not a quantum theory or a wave theory; rather, nature demands from us a synthesis of these two views, which thus far has exceeded the mental powers of physicists (in: Pais 1983).

Albert Einstein

## INTRODUCTION

We will propose below a dramatic "inversion" of the basic physical paradigm of vacuum and elementary matter particles, historically going back to great ancient Greek philosophers Plato and Democritus (Gribov 1999, 2005, Gribov & Guseinov, in press):

1) Vacuum is traditionally perceived as a *totally empty*, free space or as an almost empty space, with sporadically arising - annihilated virtual ($e_-$) and ($e_+$) pairs…. We invert this very old and practically dominating paradigm. The easiest illustration here could be a dramatic transition from a dominating "empty darkness" on a photo of the starry night sky with tiny rare points of stars on it - to the inverted photo (from black to white). A totally dominating white, densely filled, space now arises with rare black matter points, like tiny holes on a white porcelain plate, looking as insufficient defects in the "monolithic"-white vacuum medium (Fig. 1), (Gribov, 1999, 2005). This is a kind of modern physical reincarnation of miracle Aether, being proposed by great Renaissance thinker and cosmologist Giordano Bruno more than 400 years ago (Bruno 1588).

2) Vacuum – looking traditionally as a continual emptiness – now becomes „*atomistic*"-cellular, nongravitating corpuscular structure, following the (now fully generalized) Democritus atomistic paradigm (Gribov, 1999, 2005).

3) Our Universe with its isolated global 3*D*-space now is considered as a microscopically many-dimensional. The tremendous 3*D*-Universe now becomes only a tiny part – a 4*D*-microscopical fragment of the periodical 4*D*-global mica-like „quasi-crystalline" structure of the 4*D*-Multiverse with very thin periodical „global 3*D*-shells-waveguides". They have the same thickness $L_{oe}=\lambda\!\!\!^{*}_{el.Compton}=2{,}426\times10^{-12}\mathrm{m}_4$, ($L_{oe}\approx10^{-12}\mathrm{m}_4\approx1\mathrm{pm}_4$). The 4*D*-Multiverse contains presumably an endless number of physically identical (!) Universes/Antiuniverses, with $\approx10^{12}$ Universes pro $1\mathrm{m}_4$ in the fourth dimension *L* (Gribov 1999, 2005).

4) The traditional elementary mass particle is a „point-like", sufficiently *localized* elementary spot with a huge energy $E=MC_4^2$ inside. A quite similar (slightly corrected) paradigm exists in the string theory. Witten writes: "with our present understanding, there would be nothing more basic than the string." (Witten 2003b). The elementary-dividingless mass particle is surrounded by the empty vacuum space. How this undivided-elementary particle can cause interference with itself on two shells, that showed famous precisions "double slit" experiments, performed by Clauss Jönsson with single electrons (Jönsson, 1961, 1974)? "I think I can safely say that nobody understands quantum mechanics" noted Richard Feynman (Feynman, 1985). Our paradigm of the elementary mass particle is laterally the opposite – the fully inverted picture – now our matter particle is a local, singularity-less „elementary confiscation" – an elementary "cellular defect" (like a single atom confiscation in a regular dense "liquid crystal") in the correspondingly deformed, many-cellular vacuum medium. The

"elementary" defect causes a symmetry break in the vacuum body and deforms its cellular structure. These deformations are spatially widely delocalized and exist as a *coherent field*, which can interfere with itself, in accordance with the Jönsson's experiments! This is maybe the most surprising and the most radical "particle/vacuum paradigm" shift in physics – the traditionally local, almost point-like elementary mass particle here arises as a dramatic result of all the surrounding cellular space deformations, caused by the tiny (but not the point-like), symmetry breaking cellular defect (Gribov 1999, 2005). Deep theoretical analogy between *defects in crystals* with the Standard Model physics, or gravity, definitely supporting our atomistic vacuum concept, was indeed, discovered in many works (e.g. Kleinert 1983,1989; Kröner 1996; Lazar 2000, 2009, 2010),

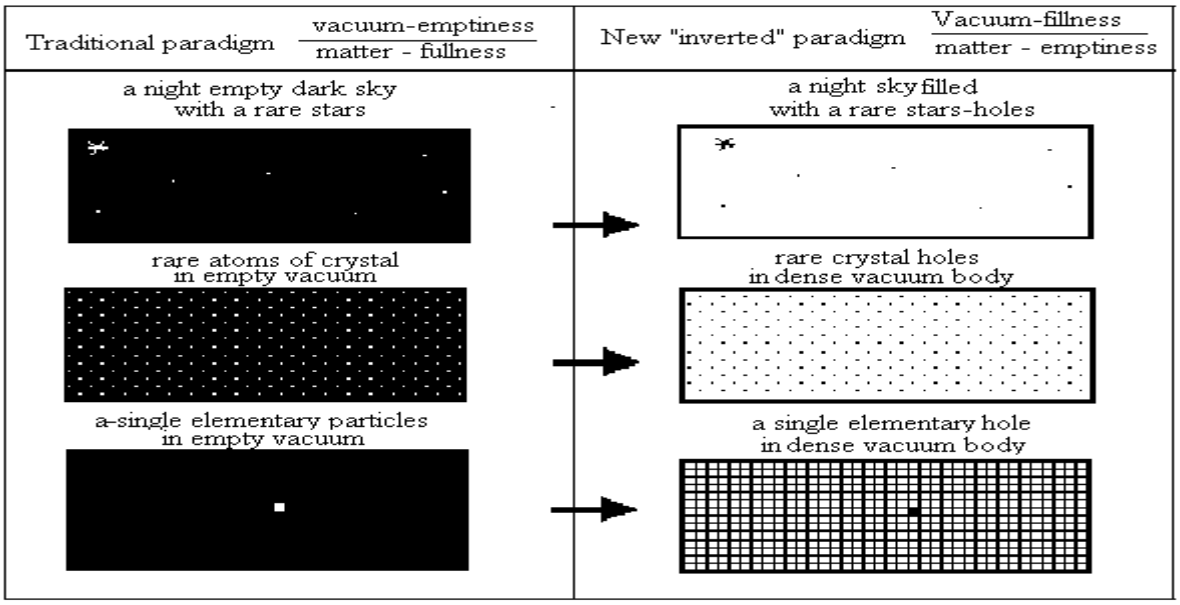



**Fig. 1** shows a dramatic (inverted) vacuum / particle paradigm change – from the empty vacuum /filled matter to the filled vacuum body / matter holes in it. A "night sky"– is a global picture, above; a small piece of a crystal – in the middle; a single elementary particle –below.

5) The second inversion-like paradigmatic shift is a shift from *the traditionally static to the dynamical elementary particle nature* and it follows intuitive insights of René Descartes. He proposed that our vacuum is not an empty space but it is filled by *dynamical vortexes* (Descartes 1644). Our *dynamically existing vacuum cell and cellular vacuum paradigm* have a quite similar (non-linear wave-dynamical nature, arising in the flat elastic $3D(x,y,z,0<L<L_o)$-waveguide of our space. This crucial – the dynamical shift creates the geometric-dynamical $4D$-string-like particle structure (as a self-focused $C_4$-quasiparticle) and so can explain the pure *dynamical nature* of the huge Einstein's rest mass energy $E=MC^2$. Feynman mentioned that contemporary physics couldn't explain where it is accumulated: "It is important to realize that in physics today, we have no knowledge of what energy is" (Feynman 1966, V1).

The physically clear explanation of the double slit experiment now arises immediately – an electron as an elementary e-cellular defect is presented (materialized) as principally *delocalized global deformation in the coherent spatial cellular architecture, coupled with this elementary defect*. It is able now to interfere with itself on two spatially separated shells! This concept also explains why common quantum teleportation (mysterious quantum binding of two distant particles) is quite possible – since coherent vacuum tissue is always an invisible - global system-building – medium, ultimately managing this quantum binding. These two

experimental miracles strongly support the here proposed delocalized particle paradigm, which holistically explains mysteries of quantum mechanical behavior.

*Note 1:* Frank Wilczek analogically expresses this definitely arising inversion of the old matter/vacuum paradigm, asking: "What is Space? Is it an empty stage, where the physical world of matter acts out its drama -- an equal participant, like the classical Ether, that both provides background and has a life of its own -- or the primary reality, of which matter is a secondary manifestation? Today, the third view is triumphant. Where our eyes see nothing our brains, pondering the revelations of sharply tuned experiments, discover the Grid that powers physical reality" (Wilczek 2008).

*Note 2:* What is the nature of the multi-waveguide structure? The fundamentally important periodical 3*D*-waveguide's space structure seems to be also a kind of periodical collective (condensed matter-like) phenomenon, remembering some cases in a low temperature quantum liquids: our framing membranes have very strong surface-tension. They could arise, for example, as a very thin interface between two superfluid phases (e.g. like the interface between two liquid phases in a common $^3$He-$^4$He mixture at low $T$). The underlying future theory could describe a concrete nature of the proposed hyper-periodicity and explain empirical relation between leptons family masses, from a more fundamental, yet unknown, but definitely field-theoretical atomistic level.

*Note 3:* David Gross analyses in his article "Einstein and the search for unification" attempts of genius in this promising direction. Einstein "believed that the fundamental laws and principles that would embody such a theory would be simple, powerful and beautiful." (Gross 2005, p. 2035). We will show below that these attractive theoretical features arise in the pure 4*D*-hyperspatial Euclidean interpretation of the GR, being hyperspatially linked with the Einstein's second idea of the light photon.

## CONCEPTUAL PROBLEMS IN MODERN PHYSICS

Max Planck (1900), Albert Einstein, Louis de Broglie, Werner Heisenberg, Erwin Schrödinger, Max Born, Paul Dirac, Feynman and many other great physicists established the principles of quantum mechanics. At the same time it remains a kind of *empirical* theory, and has obvious *physical incompleteness*, as repeatedly noted by some of its founders such as Einstein, Feynman and Dirac, etc. Feynman even mentioned that nobody understands quantum mechanics. Einstein noted, „…alone corpuscular-wave dualism requires something unheard of before", (Einstein 1942). Leading physicists, (A. Einstein, P. Dirac, W. Heisenberg, E. Schrödinger, M. Veltman, G. 't Hooft, L.M. Lederman, V.L. Fritch, J.A. Wheeler, F.J. Dyson, R. Feynman, S. Weinberg, D. Gross, F. Wilczek, E. Witten, etc.) while creating and understanding modern physics well (Special and General Relativity, Quantum field theory, Standard Model (SM), String Theory (ST), etc.) often expressed deep discontent in connection with its conceptual incompleteness and inability to solve some ***fundamental problems*:**

1. Does nature have more than three space dimensions?
2. How does time differ from space and what is wrong in the Minkowski spacetime?
3. What is the origin of mass particle? Are there *alternatives* to the *Higgs mechanism?*
4. What is the united origin of the *quantized* electron mass & charge?
5. Do non-Abelian gauge theories with a mass gap actually exist?
6. Is spacetime fundamentally continuous or discrete?

7. Why the Planckian constant *h* is the *universal* fundamental constant for all fields?
8. How the *classical and quantum singularities* could be avoided physically?
9. Why do we have *zeros „quantum vacuum" energy density and space flatness*?
10. Is it possible to reanimate the experimentally totally "illusive" *supersymmetry*?
11. Why there is so strong prevalence of matter over antimatter in the Universe?
12. Why is the physical QED-vacuum *non-gravitating / cosmological constant so small*?
13. What is the nature of the *DE and DM*?
14. Are they connected? How is related the discovered accelerating DE-expansion with the dominating everywhere fractal "*BUBBLE"*-structure of our Universe, etc.?
15. Is the DE a pure vacuum energy, or it is like a "quintessence"?

### *Where is the origin of zero mass in the SM from? Why not a string theory?*

Martinus Veltman assumes, that "the miraculous thing with the Standard Model (SM) is that originally ALL the particles in the SM have some zero mass..." (Hargittai 2004, p. 101). He asks, "is there a deeper layer to understanding the balancing of forces?" and notes, "we don't know why, but it gives you the suspicion that in the Higgs system there is probably another layer where the idea of mass gets another interpretation" (Id. p. 101). He makes a penetrating remark: "The breaking of symmetry is not in the theory, not in the balancing of forces, it's in the way we look at it", (Id. p. 107). Veltman joins that the very big hopes for modern string theory did not prove true, and the "strings and supersymmetry...explain nothing from things what we don't understand today" (Id. p. 107).

Gerard 't Hooft says: "I think now that there must be some fundamental theory of Nature that we don't know about at all yet, where quantum mechanics does not enter any of the equations. The theory is totally deterministic, causal, coherent and consistent - having nothing to do with quantum mechanics (Id, p. 125).

### *Are there some unknown hidden symmetries?*

Val Fritch makes very important note, "…the CP violation observer in the weak interactions is not nearly large enough to account for the matter-antimatter asymmetry in the Universe (Id., p. 205). Sidney Coleman was quite sure that "Obviously, physicists have overlooked something fundamental in this universe, kind of mechanism, which care that all different components of cosmological constant are exactly zero" (Coleman 1993, p. 280).

Gerard 't Hooft asks: "Why the cosmological constant is so small? One possible reason could be that there is symmetry", (Id., p. 127). "There is no theory for such a cosmological constant at present. It's a great mystery" (Id. p. 128).

Leon Lederman notes, "There is a deep symmetry, which enables us to understand the *EH* force, the weak force, and the strong force. Gravity is stile a mystery" (p. 152). He asks, "Is there any evidence for the Higgs fields? NO" (Id. 153).

Anthony Zee notes, "The most unsatisfying…is the present formulation of gauge theories. Gauge "symmetry" does not relate two different physical states, but two descriptions of the same physical state"… Historically a very big surprise was to discover two fundamental hidden symmetries, *Lorentz invariance* and *gauge invariance*: two symmetries that "hold the key to the secrets of the universe. Might not our present day theory also contain some unknown hidden symmetries?"... "In dimensional destruction a *D*-dimensional theory may look (*D*+1)-dimensional in some range of energy scale: the field theory can literally create a

spatial dimension"… this suggests "that quantum field theories contain considerable hidden structures waiting to be uncovered" (Zee 2003, p. 456-457). "One of the disappointments of *string theory* is its inability to resolve the cosmological constant problem. But the brane world scenario offers "a glimmer of hope" (Id. p. 436).

Thus, we propose below the "something overlooked" in our very large matter-cluster – the large-scale matter-antimatter symmetry. Our periodical waveguide's particle/antiparticle concept and the corresponding gravity/antigravity create corresponding periodical hypersymmetry of physically identical (matter/antimatter) Universes/Antiuniverses with zero gravity mass density on the large cosmical scale, that explains simultaneously the microscopic, cooper-like vacuum supersymmetry (with the resulting zero cosmological constant) and the global cosmological DE&DM, etc. phenomena!

### *The comeback of the quantum ether*

Steven Weinberg recalls the "idea of "ether", and noted "Einstein solved the problem by IGNORING it."… (Hargittai 2004, p. 27). Later Einstein totally reconsidered his "anti-ether" conclusion and realized that "…according to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time". He claimed some essential physical properties for this hypothetical "propagator media" - ether:

(a) It must be a non-pondermotor, non-gravitating media;
(b) a corresponding sound-light waves in this media must be transverse (as the transverse light waves) and, thus "must be of the nature of a solid body" (Einstein, 1920).

### *The forces unification problem*

Why is gravity such a weak force? This is the most important "hierarchy problem" in modern physics. Christopher Isham writes: "The general relativity has "unavoidable space-time singularities",… "The weak and electromagnetic forces are neatly unified in the Salam-Weinberg model, and there has also a partial unification with the strong force. It is an attractive idea that a consistent quantum theory of gravity *must* include an unification of all fundamental forces"…"The deep incompatibility between the basic structures of general relativity and of quantum theory of quantum gravity requires a profound revision of the most fundamental ideas of modern physics." (Isham 1993, p. 4-5). Alexander Vilenkin mentioned that modern quantum cosmology "is not likely to become an observational science" (Vilenkin 2003, p. 662). Edward Witten concludes, "In the String Theory (ST) we do not have the analogue of the Einstein-Hilbert action or the principle of equivalence that led Einstein to it" (Witten 2003a, p. 458).

### *The general "problem-solving" way - the periodical waveguided hyperspace symmetry*

Recently we have proposed (Gribov 1999, 2003, 2005) this "hidden" symmetry and disclosed its very simple physical nature, arising in the periodical 3*D*-waveguide's hyperspace in the global Euclidean 4*D*-hyperspace. This concept reformulates the pioneering Diracian matter/antimatter interpretation: electron and positron have here *identical positive inertial masses (dynamical) energy* $M_{in(e-)}=M_{in(e+)}>0$, but positive and negative gravity masses. The $L_o$-periodicity changes periodically the ±electrostatic charge and ±*gravity charge (gravity mass) with corresponding symmetry* $M_{gr(e+)}=-M_{gr(e-)}$. The hyperspatial transition $e_{-}\leftrightarrow e_{+}$, manifests literally the $\pm L_o$-*shift* from any *3D*-waveguide to the nearest one (see the waveguide

gravity mechanism below). The "one-step" shift of a *3D*-waveguide changes the electron gravity potential and electrostatic charge sign into the opposite – describing positron (if we shift a waveguide's number $\boldsymbol{n \rightarrow n \pm 1}$ as $\mathbf{W_n \rightarrow W_{n\pm1}}$).

The inertial electron mass $M_{in(e-)}$ (as the measure of always positive dynamical energy $E_4=M_{in}C_4^2$ in it) is always positive for electron and positron, independently of the waveguide number: $M_{in(e-)}=M_{in(e+)}>0$ (you must add positive energy to accelerate the both particles). So the positive value of the dynamical energy $E_4=M_{in}C_4^2$, is concentrated in the $C_4$-dynamical by the nature particle (vacuum *e*-cell) and it is positive for all identical periodical 3*D*-waveguides $\mathbf{W_n}$. The (positively signed) property of the inertial mass and simultaneous oppositeness of the ±gravity "charges" of electron and positron $M_{gr(e+)}=-M_{gr(e-)}$ open the straight and promising way to the Cooper-like "composite-like" concept of common supersymmetry in the hypersymmetric vacuum tissue. This also explains why the composite supersymmetry is totally hidden experimentally. Indeed, our coupled composite ($e-/e+$) bosonic cell is nongravitating but it has its full inertial mass $M_{\text{in}(e-)}+M_{\text{in}(e+)}=2M_{\text{in}(e-)}>0$. This *composite boson* carries the exact *supersymmetric properties* comparable to its *two fermionic partners* – electron and positron, arising in the QED as virtual ($e_-$) and ($e_+$) pair. This pair carries exactly the same summary inertial mass $M_{\text{in}(e-)}+M_{\text{in}(e+)}=2M_{\text{in}(e-)}$. The proposed "composite supersymmetry" concept sufficiently reformulates, simplifies and practically fully rehabilitates the salvatory idea of the supersymmetry. Now it is realized much more economically – without need of new hypothetical elementary supersymmetric sparticles. Our composites arise quite normal physical way (as annihilation of an *e*-hole and *e*-antihole with annihilation of their opposite classical fields). This annihilation restores the resulting ghost coupled ($e-/e+$) cell – being immediately naturally hidden in the coherent and ghostly bosonic vacuum tissue. We should examine the question why it was so tricky before to propose existence of the ghostly composite superpartners.

The 3*D*-waveguide's space structure and its 4*D*-periodicity are sufficiently *generic* with respect to the here discovered new hidden symmetry – the gravity/antigravity mass - symmetry and common fundamental grand-symmetries, simultaneously arising here - *the Lorentz and 4D-gauge invariance*. The SR of Einstein & wave of de Broglie arise in our physically transparent waveguided concept; they are now surprisingly deeply connected - as two corresponding aspects of the same wave's dynamics as a pure *wave interference* effect in the 3*D*-waveguide (Gribov 1999, 2003, 2005). Some deep analogies between quantum field theory, based on the SR and theory of quantum liquids at low temperature, are common in modern physics (the SM, etc.). Grigorii Volovik summarized these analogies in his profound book and actually formulated "the ultimate goal" of theoretical physics to find underlying hidden vacuum tissue, creating its so demonstratively obvious superfluid properties, but he had no answer how to do so (Volovik 2003).

The hidden periodical $\pm M_{gr}$ vacuum hypersymmetry appears very simply in our periodical wave-guide/anti-waveguide 4*D*-hyperspace structure, but purely *psychologically* it is very difficult to accept by modern physicists. Indeed, the outgoing gravity/antigravity symmetry sufficiently reformulates and surprisingly enlarges the prominent Einsteinian equivalence principle and the resulting GR. If we will take the matter/antimatter antigravity into consideration, we can recognize now a free fall of our laboratory in an outside gravity field $\boldsymbol{g}$. Our free falling laboratory will be accelerated ($\boldsymbol{g}$)-forwards along a geodesic line in the external gravity field $\boldsymbol{g}$, but the probe antiparticle in the same laboratory will be accelerated ($-\boldsymbol{g}$)-backwards along the same geodesic line. The double relative acceleration $2\boldsymbol{g}$ can be now properly detected inside the same laboratory! Now it is clear for experimenters in CERN (but

not for all theorists) that there was not yet possible a proper experimental gravity test with antimatter particles, since usual gravity is too small, relatively to an unavoidable electromagnetic noise. The first decisive (extremely difficult) antihydrogen gravity test is in the process of development and will be done in few years in CERN (see chapters below). We will show below that exactly the Equivalence Principle (EP) arises as a consequence of our waveguided gravity mechanism. It is the same (attractive) for matter/matter and antimatter/antimatter gravity interactions but for matter/antimatter interactions it becomes the "anti-equivalence" with the repulsive antigravity inside!

To determine where this new hypersymmetry comes from, we have proposed additional pure Euclidean spatial dimension (3*D*+1) – but in the simplest isotropic waveguided form. This concept deeply unifies classical physics. We have proposed that our quasiflat Euclidean 3*D*-space (*x,y,z*) exists in form of the quasiflat 3*D*-waveguide's "shells" in the isotropic Euclidean 4*D*-hyperspace – with periodically prolonged multilayered electron/positron waveguide's 4*D*-architecture:

$[x,y,z,\ldots;(-3L_o<L<-2L_o);(-2L_o<L<-L_o);(-L_o<L<0);(0<L<L_o);(L_o<L<2L_o);(2L_o<L<3L_o);\ldots]$.

It contains *waveguide's hypersymmetric shift, like* $\pm L_o$, (where $L_o=\lambda^*_{e.Compton}\approx 2{,}43\times10^{-12}$m). We will show below that the local space/antispace $\pm L_o$-"sandwich", being proposed and partially investigated earlier (Gribov 1999, 2005), is only a tiny discrete fragment of the presumably endless periodical 4*D*-hyperstructure and is able to include/explain the DE/DM existence. It contains dividing elastic 3*D*-membranes $\mathbf{M_n}$, constituting the elastic waveguide's borders - 3*D*-walls, fully reflecting waveguide's waves inside the corresponding 3*D*-waveguide. These periodically placed 3*D*-membranes are *L*-periodical quasiflat (*x,y,z*)-cross-sections:

$[x,y,z;\ldots\ \mathbf{M_{-n}}=-nL_o\ \ldots\ ;\ \mathbf{M_{-2}}=-2L_o;\ \mathbf{M_{-1}}=-L_o;\ \mathbf{M_0}=0;\ \mathbf{M_1}=+L_o;\ \mathbf{M_2}=+2L_o;\ \ldots\mathbf{M_n}=+nL_o;\ldots]$

The additional $0<L<L_o$ degree of freedom (the 3*D*-waveguide's shell in the 4*D*-hyperspace) provides very simple, quite organic physical alternative to the mysterious Higgs mechanism of the rest mass creation. The mass particle arises as a "massless" 4*D*-photon with the basic quantum-mechanical (as wave of de Broglie-like) properties. The GR-equivalence/anti-equivalence principles and consequently enlarged Newtonian-Einsteinian-like gravity/antigravity also arise in the same periodical waveguided hyperspace (totally missing in the SM and in modern cosmology). Here arises the periodical (±) gravity mass, (±) electrostatic charge, (±) spin. This opens possibility for (physically understandable) existence of the periodical massless ghost composites - Cooper-like bosons – atoms of a nongravitating electron-positron superfluid (ether), (see corresponding chapters below).

## HISTORICAL REMARKS

Albert Einstein (1905) discovered de facto the Euclidean 4*D-hyperspace* in his legendary SR, that directly discloses his fundamental relativistic energy-momentum equation for mass particle: $E^2=M_o^2+P^2(x,y,z)$, if $C=1$. It is obviously based on the exact Pythagorean 4*D*-distance in the Euclidean 4*D*-hyperspace and we will show below this unifying physical interpretation. Why this nontrivial and indeed revolutionary-hyperspatial physical breakthrough of the SR was hidden almost 100 years? The core of the answer is in the common pseudo-Euclidean global 4*D-spacetime* interpretation of the SR, which was very soon pompously presented by

prominent mathematician Hermann Minkowski (1908). This formally excellent mathematical form seems to be the fatal conceptual error, *hiding the pure* 4*D-hyperspatial physical sense* of the SR (especially obvious for the mass particle). Indeed, young genius mentioned soon fairly that the Minkowski's reformulation is no more than "superfluous erudition" (Pais, 1983, p.151), and "since the mathematicians have attacked the relativity theory, I myself no longer understand it any more." (Seelig 1954, p.46). We will show below that the *pure* 4*D-hyperspatial* (3*D*-waveguided) reinterpretation of the SR is much more reasonable - it discloses basic physical unity between the SR&GR and the QM, including immediately arising the "rest mass creation" mechanism and physical unity of the DE&DM and 4*D*-supersymmetry with a miracle endless window to the grandiose 4*D*-Multiverse around us. The too revolutionary "hyperspace shadow" in the SR, discovered by Einstein in 1905 remembers the comparable mega-geographic discovery by Christopher Columbus, who had de facto discovered absolutely unknown – gigantic American continents 500 years ago, but who was sure that it was common "spacetime" of India.

De Broglie has proposed the revolutionary connection between the Einsteinian SR and photon concepts, creating the *wave's properties* of a mass particle (de Broglie 1924). Remarkable positive reply on the de Broglie's wave discovery came soon from Einstein: de Broglie … had "lifted a corner of the great veil." (Cropper 2001, p. 278). The 3*D*-waveguide's wave-dynamics contains both the SR and the de Broglie's 3*D*-wave of matter, it enables to create-unify the SR and the arising GR-equivalence principle with the wave of de Broglie for mass particle. It discloses physical unity (waveguided by the nature) between quantum world and the classical SR&GR, with correspondingly arising quantized-linear 3*D*-rest mass spectrum, common for a classical oscillator and the "mass gap" between zero rest mass and the first rest mass harmonics, naturally assumed to be the mass of the electron (Gribov, 1999, 2005). The arising here (3*D*+1)-waveguide's mechanism of the 3*D*-mass particle creation and its fundamental unity with the simultaneously arising basic classical physical SR&GR&QM laws are caused by the simple classical 3*D*-waveguide's boundary conditions in the isotropic Euclidean 4*D*-hyperspace. This excludes the so-called Higgs mechanism of the mass particle creation, common in the Standard Model (SM), being proposed by Peter Higgs and some other physicists (Higgs 1964). It becomes theoretically non-necessary and too isolated conceptually, looking (also for many prominent experimentalists) as one of the most expensive "illusions".

The proposed 3*D*-waveguide/3*D*-antiwaveguide's sandwich-like *periodicity* discloses the second *legendary discovery of antielectron* by Paul Dirac in 1931, being de facto mini-periodical=sandwich-like electron-positron quantum mechanical transformation of the relativistic Einsteinian equation (Dirac 1931). Indeed, our periodical hypersymmetric "zebra" shows the pure hyperspatial particle/antiparticle-CPT symmetry nature (Gribov 1999, 2003, 2005). But now common CPT-symmetry has sufficient enlargement (all-important for the elementary particle physics and cosmology) as the additional gravity-antigravity "±charge" hypersymmetry between particle and antiparticle. This new hypersymmetry enables existence of the nongravitating *Cooper-like* (*e–/e+*) *composites* – scalar bosons - supersymmetric partners to theirs decoupled virtual $e_-$ and $e_+$ pairs. These composites are "atoms" of the proposed superfluid vacuum tissue; they are robust, but surprisingly-necessarily *ghost* and they fill densely, but weightlessly all the space as the scalar-bosonic and ghostly superfluid.

The supersymmetry between coupled composites and the well-known fermions *replaces* and reincarnates common salvatory hypothesis of the *supersymmetry*. The supersymmetry is absolutely necessary - only this way the monstrous ($10^{124}$) quantum vacuum energy density could be reduced to zero – only its hypothetical presence allows equalizing the QM-bosonic

and fermionic degrees of freedom in the consistent QED (Gol'fand, Likhtman 1971; Wess, Zumino 1974).

The "hyperspatial" Newton's gravity and GR must incorporate the $\pm M_{gr}$ gravity "charge", but with sufficiently positive inertial mass $M_{in} > 0$ for the both - particle and antiparticle, as a measure of mechanical inertia = resistance to accelerate in the second mechanical Newton's law. The $M_{in}=|\pm M_{gr}|>0$ is invariant for all equal periodical 3*D*-waveguides. Importantly, the GR-equivalence principle is not necessary to postulate anymore – it is now resulted (as the equivalence / anti-equivalence) principle from the naturally arising waveguided gravity mechanism, realizing the hypersymmetrical periodical Newton/Einsteinian gravity/antigravity in the periodical 3*D*-waveguide's hyperspace – the proposed Multiverse structure.

Cosmologist Jaan Eniasto writes: „Both Dark Matter and Dark Energy are the greatest challenges for modern physics since their nature is unknown" and the "realization that we do not know the nature of basic constituents of the Universe is a scientific revolution difficult to comprehend" (Einasto 2010, p. 1). "We even do not know is a radical change in our understanding of the Newton and Einstein theories of gravitation needed…" (Id., p. 23). Indeed, the DE problem is connected with the recent tremendous cosmological discovery of the accelerating Universe expansion (Schmidt *et al.* 1998, Riess *et al.* 1998, Perlmutter *et al.* 1999). Fritz Zwicky discovered the DM-phenomenon in astronomical studies of some rotating galactic groups. Later Vera Rubin and others discovered the DM in studies of stars rotation around galactic centers, (Zwicky 1933; Rubin et al 1970). The discovered DM is invisible for electromagnetic radiation, but it interacts gravitationally with the Ordinary Matter (OM) and sufficiently prevails the first one. The proposed here *holistic-Multiversal hyper-cosmology* (with the postulated large-scale periodical matter/antimatter = gravity/antigravity symmetry and the resulting natural large-scale space flatness) solves these two problems simultaneously and shows that they are *deeply connected phenomena in our Multiverse*. Indeed, gravitationally coupled parallel dark matter clusters repel symmetrical antimatter clusters, realizing exactly the DE=($U_{\text{antigr.}}\sim +1/r$) phenomenon, but the same DM clusters attract other matter clusters and antimatter clusters attract other antimatter clusters, realizing the summary attractive DM*=($U_{\text{gr.}}\sim -1/r$) phenomenon. Our theoretically predicted gravitationally neutral DE/(DM+OM) ratio is near $4:\sqrt{2}=76\%:26\%$ (see cosmological chapters below) and it is very near to the recent measurements of cosmic microwave background anisotropies (Hinshaw 2008). The summary attractive DM+OM includes empirically estimated 4% of common OM.

The most intriguing consequence of the presented physical concept (going surprisingly fare beyond the interests of physics itself) is opportunity to be surrounded by plenty of highly developed parallel civilizations, settled hyperspatially very densely (≈5 $C_4$-light minutes from us in the 4*D*-hyperspace). Here arise fantastic possibilities to communicate with them - to become a member of their super-intelligent super-knowledgeable Hyperclub! From this point of view our dear, experienced civilization looks "hyper-historically" like a "nesting, hatching from an egg".

*Note:* There are some hyperspatial physical theories, creating some basic physical laws (the SR and gravity, PCT symmetry, etc.) using more than 3 spatial dimensions. One of them is the 6*D*-spatial model by Igor Urusovskii (Urusovskii 2003, 2005, 2010). This model describes a point-like dynamical 6*D*-particle, confined on a surface of the hypercylindrical tube by a kind of hypothetical cosmological force; the tube is placed along our 3D-space, which remembers the compactified 5*D*-space by Theodor Kaluza (Kaluza, 1921). The point particle twists around the tube with a quasi-light speed and its axial projection is its common physical velocity. This kinematical model has some definite similarities to our hyperspatial concept.

The difference is that similar hypercylindrical tubes are emergent-quantized and are polygonal in our 3*D*-waveguide's space; the confining cosmological force is result of a quasi-optical non-linearity in the waveguide's 4*D*-medium, etc.; particles/antiparticles by Urusovskii are defined by the opposite twisting directions, but in our waveguided concept they are different hyperspatially – being in two *different-adjacent* waveguides.

## PERIODICAL *3D*-WAVEGUIDE'S CONCEPT OF THE GLOBAL 4*D*-HYPERSPACE

### *Attempts at building the 5D-general theory of electricity and gravity*

Mathematician Theodor Kaluza introduced heuristically the additional *cyclical* 5th space dimension into the classical 4–dimensional physical space (*x,y,z,t*) of the GR of A. Einstein (Kaluza, 1921). The problem is that the physical meaning of this 5th cyclical dimension was never clear. O. Klein (1926) and V. Fock (1926) discovered that trajectories of the charged particle in the Kaluza's space correspond to geodesic lines with the 0-length (geometrical beam). They showed that the classical *physics of relativity* is equivalent to the *geometrical optics* on a beams transmission in the 5*D*-space and the *quantum mechanical* movement of the charged particle is equivalent the *wave optics* on the transmission of scalar waves in 5*D*-space, but only if the wave function $\psi$ has Kaluza's *cyclical condition*:

$$\psi(x^1,x^2,x^3,t,x^5) = u(x^1,x^2,x^3,t)\, exp[2\pi i(MC/h)x^5] \qquad (1)$$

In this case will arise also the well-known equation for waves of matter as the (3*D*+1)-wave of de Broglie). A. Einstein and P. Bergmann (1938) suggested that the five-dimensional space is topologically closed in the fifth dimension. J. B. Rumer (1956) reformulated the cyclical 5th coordinate, and proposed that *all physical quantities are periodical* in the 5th coordinate of the action and this period is the Planck constant *h*. But in all these $x^5$-theories there was hidden the generic *physical nature* of the necessary, basic *cyclical condition exp*$[2\pi i(MC/h)x^5]$, (1).

### *The new base of unification - the 3D-waveguide in the isotropic Euclidean 4D-hyperspace*

We tried to solve the problem and proposed the simplest but physically widely relevant - the Euclidean, pure spatial concept (Gribov 1999, 2005), containing additional spatial dimensions:

(**a**) The pure mathematical Kaluza's discovery – the cyclical condition (1) is realized in the physically transparent *Euclidean, isotropic* 4*D-space* ($x,y,z,x^5=L$), where *L* is $x^5$- *the* 4*-th spatial* dimension. Our physical Euclidean 3*D*-space is a part of it – it is confined in the thin 3*D*-shell ($x,y,z,0<L<L_o$) – in form of the *quasiflat* 3*D-waveguide* $\mathbf{W_1}$, *framed by two elastic, strongly strained flat* 3*D-membranes* $\mathbf{M_0}=(x,y,z,L=0)$ *and* $\mathbf{M_{+1}}=(x,y,z,L=L_{oe})$, where the lightest elementary lepton particle constitutes our new fundamental 3*D*-"housing" constant $L_{oe}=\lambda^*_{e.Compton}=2{,}426\times10^{-12}\mathrm{m_L}\approx10^{-12}\mathrm{pm_L}$, (Fig. 1.1).

***Note:*** The convenient elementary "rest" mass of electron $M^*_{oe}$ discloses its 4*D*-spatial / dynamical nature, arising in the 3*D*-waveguide, with the essentially relativistic "twisting" 3*D*-component in it, reduplicating the full "rest" energy and correspondingly the full inertial "rest" mass of electron $M^*_{oe}$. We have now $M_{oe}=M^*_{oe}$ / 2 and the electron-waveguide thickness $L_{oe}$ must be derived as $L_{oe}=\lambda^*_{e.Compton}=2{,}426\times10^{-12}\mathrm{m_L}$, (see Fig. 3a). Most of the

intermediate algebraic calculations will be made in our present notations *without* the /*/ sign, as ($M_{oe}$, etc.) correctly reflecting their physical sense; the convenient notations ($M^*_{oe}$ ,$\lambda^*_{e.Compton}$, $M^*_{o\mu}$, etc.) will be substituted finally in the derived physical results.

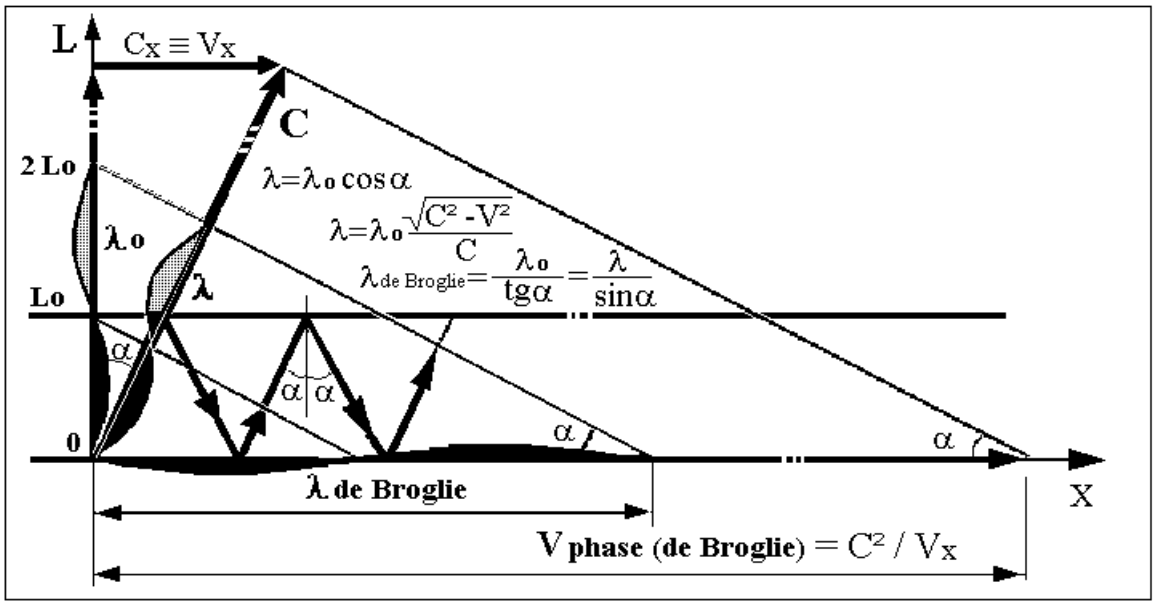



**Fig. 1.1** shows three basic intersections of the electron 4*D*-wave in the 3*D*-waveguide ($x,y,z,0<L<L_o$), this wave propagates, reflecting along a polygonal trajectory /\/\/\/\/\ with the corresponding self-interference waveguide's conditions (see Fig 1.2a), creating the SR, the wave of de Broglie and Kaluza's cyclical conditions simultaneously.

(**b**) The lightest lepton mass-particle (electron, as the basic mass of *effective, low energy physics*) arises here naturally as the 4*D*-light-speed "$\boldsymbol{C}_4$ -wave quanta" with corresponding *pure dynamical* "orthogonal" *L*-energy $E_{oe}=h\nu_{oe}=P_{4oe}C_4=(M_{oe}C_4)C_4=M_{oe}C_4^2$ component in this *non-dissipative* waveguide's space. This wave propagates with the phase speed $\boldsymbol{C}_4=(V_x,V_y,V_z,C_L)$, where $C_L\neq 0$ and $C^2_4=const$ in all 4*D*-directions. The isotropic 4*D*-space condition realizes different possible inertial coordinate systems of our ($x,y,z$) space. We follow common Einstein's generalization of the mechanical Galileo's principle, that all physical laws are the same in different inertial systems of coordinates. More over, this generalization is resulted from the proposed cellular superfluid vacuum medium concept, where, e.g. the Einsteinian light photons are spin waves - quasiparticles in this frictionless superfluid medium. We are not able (being made from quasiparticles) to sense our movement relative to this underlying medium (see chapter "Periodical space / antispace symmetry – as the periodical matter / antimatter concept" below).

(**c**) This concept discloses the (3*D*+1)-nature of the 3*D*-mass particle, its appearance in the 3*D*-waveguide, where this wave-particle moves always with the 4*D*-speed of light $\boldsymbol{C}_4$ *as a* 4*D-massless=*$\boldsymbol{C}_4$*-photon quanta,* carrying bosonic spin *S*=1. This nature of the mass particle creates the same Lagrangian form as the formally massless $\boldsymbol{C}_4$-wave, with only one basic difference that it is confined in the "substantial" 3*D*-waveguide, which keeps the key Lagrangian form intact and so allows quite massless QED-renormalization procedure for the SM mass particles. This natural mechanism of the mass particle creation does not contradict, but rather corresponds to the Standard Model (SM) logic, where all the SM-mass particles are paradoxically massless. The proposed here (3*D*+1) waveguide's rest mass creation mechanism is unshakeable, since physically it arises as general part to the simultaneously arising basic "stones" of theoretical physics (the SR, the Newton gravity, the wave of de

Broglie, etc.) and so, looks as the most realistic alternative to the common physically "isolated" Higgs mechanism. Indeed, Leon Lederman, Nobel Price laureate, working in the experimental elementary particle physics asks, "Is there any evidence for the Higgs fields? NO." (Hargittai 2004, p. 152). The Higgs are hypothetically very heavy massive bosons, they were never detected experimentally and (if they exist) they must be detected soon at CERN and it is the last, but almost vanished hope. The proposed alternative looks much more attractive and it presents something unthinkable before – the periodical waveguide's 4*D*-Multiverse, explosively reach and particularly (at leas gravitationally) overlapping with our Universe (see, the cosmological chapter about united Dark Energy and Dark Matter concepts below).

(**d**) This is the pure 4*D*-Euclidean (a) - the 4*D*-spatial + (b) – the waveguide's $C_4$-dynamics. They uncover a deeper - the 4*D*-spacial/3D-waveguide nature of the SR for mass particle and physically reconsider the classical (but physically obviously incomplete) geometric-mathematical concept – the Minkowski's pseudo-Euclidean 4*D*-spacetime. Indeed, the Minkowski's straight-linear time coordinate $\tau=iCt$ is significantly different of the above proposed physical source of the SR, being of the pure spatial Euclidean 4*D*-hyperspace ($x,y,z,0<L<L_o$) origin. The Minkowski's time coordinate $\tau=iCt$ has its global C-dynamical property by definition. Its global physical structure is now transformed radically into the nonstop $L$-↑↓ *polygonal cyclical* $\boldsymbol{C_4}$-wave movement inside the same $L$-interval $0<L<L_o$, (Fig. 1.1). The Minkowski's (global) linear time coordinate $\longrightarrow iC_3 \cdot t$ is transformed now into the *n*-polygonal cyclical *L-projection* ||||||||| (with a proximal sum $dL=iC_4 \cdot dt \approx \Sigma n|2L_o|$) of the *physically relevant polygonal* /\/\/\/\/\/\ 4*D*-length interval $dS(dx,dy,dz,dL)$. This invariant 4*D*-interval $dS^2$ is $dS^2=dx^2+dy^2+dz^2+dL^2$ *and* $dS \approx \Sigma n|2L_o|\cos\alpha$. The straight-linear time coordinate *iCt* becomes exactly *spatial* broken-polygonal 4*D*-length *parameter* and our "realistic" physical time *t* itself becomes imagery – following its cyclical forwards-backwards jumps. (Fig. 1.1, Fig. 2c). Common smooth "world line" of the mass particle in the SR becomes now physically united and more adequate (it carries now inseparably the wave-QM and the wave-dynamical rest-massive properties). These fundamental SR&QM-properties were totally lost in the global Minkowski's spacetime. The pure Euclidean 4*D*-space ($x,y,z,0<L<L_{oe}$) of the 3*D*-waveguide-shell now plays a physically new – fundamental, unifying role, recreating simultaneously the SR, the wave of de Broglie / Schrödinger, Dirac equations, etc., deeply connecting them with the Newton's-Einstein's gravity and the miracle (now physically clear) cyclical Kaluza's condition (Gribov 1999, 2005).

This is the physical reason to change the existing geometrical "status quo" of the legendary Minkowski's spacetime. Instead we have the simplicity and unity of the *Euclidean* 3*D*-*waveguide* physics. The reason is an additional miracle attribute - behind this physically very simple 3*D*-waveguide, immediately arises endless periodical 4*D*-Euclidean Multiverse structure. This periodical Multiverse naturally contains and unifies together the SR&QM with the particle & antiparticle concept and so creates the for cosmology necessary Newtonian-like waveguide's gravity/antigravity concept, with a corresponding waveguided equivalence principle. We have now sufficiently enlarged Einstein's GR with the periodical gravity and antigravity, and following natural DE&DM physics, etc. This periodical Multiverse explains and sufficiently enlarges the fundamental PCT symmetry on the basis of the periodical hyperspatial particle/antiparticle concept. This *simplifying and unifying* conceptual transformation opens a miracle "window" to an endless, periodical 4*D*-Multiverse-"Hyperbook" - surrounding, embracing few thin "pages" of our dear 3*D*-Universe. This periodical Multiverse, though, becomes a much more important story for our civilization, as the above-mentioned, physical unification itself (the profound physical unification property

shows strong evidence for the Multiverse's existence). The Multiverse arises as a natural theoretical *"hyper-cosmological" prediction*, superior to the so widely popular fictions (see corresponding chapter "The adjacent parallel universes, full of civilizations – hyper-internet and informational relocation" below).

The unification aspects, etc. are summarized below:

***I****. The periodical waveguide space creates and unifies*

– The cyclical $x^5$-Kaluza condition

– The Special Relativity

– The wave of de Broglie for mass particle and the Schrödinger/Dirac equations

– The particle/antiparticle symmetry with the Newton / Einstein gravity & antigravity charges

– The self-focused, dynamical and quantized – "string-like" - elementary particle structure arises in the "elastic" 3*D*-waveguide with "clipping" of common self-energy singularity.

***II.*** *The* 4*D- symmetry of the periodical waveguide/antiwaveguide space allows*

– The novel – 4*D*-hypersymmetrical – periodical matter/antimatter concept.

– Existence of the "ghost" composites – Cooper-like coupled nongravitating scalar ($e–/e+$) bosons – very robust "atoms" of the Diracian-like electron-positron vacuum.

– The novel – hypersymmetric, "atomistic" quantum vacuum concept – as a non-gravitating, superfluid at low *T*, with its "effective" – emergent physical laws.

– The exact supersymmetric compensation of the monstrous QED-vacuum energy density $\rho_{theor.}/\rho_{experim.}\approx 10^{124}$. The *decoupled virtual* $e_-$ *and* $e_+$ *fermionic pairs* (carrying the summary inertial mass $M_{inert.composite}=2M^*_{oe}>0$), now have their own "supersymmetric" *bosonic composite partners* ($e–/e+$), carrying the same positive inertial mass $M_{inert.composite}=2M^*_{oe}$. They look very much like the Cooper's superconductive bosonic composite - ($e–/e–$) pairs. Now they are paradoxically nongravitating – they have the sum of zero gravity mass $M_{grav.(e–/e+)}=0$, they are weightless, electrostatically chargeless and spineless *ghosts*. These ($e–/e+$) composites have huge coupling energy $E_{couple}=2M^*_{oe}C^2$ and they are much more stable (about $10^{10}$ °K / 10 °K ~ $10^9$ times) comparably to the very weakly coupled common Cooper ($e–/e–$) pairs.

– The "wanted" family of the elementary *supersymmetric* particles is completely replaced by these above described "ghost" *bosonic composites*, built from the *well known* elementary SM-fermions/antifermions.

***III.*** *The inevitable periodical* $L_4$*-prolongation of the local fragmental* 3*D-space*/3*D-antispace symmetry opens the miracle "hyper-geographical" window into billons of parallel Universes, physically identical with our Universe, picometer-densely surrounding our local* 3*D-space.*

The earlier proposed "minimal" space/antispace symmetry was connected only with two adjacent identical electron/positron waveguides $\mathbf{W_{-1}}$ / $\mathbf{W_0}$, as two adjacent flat $L_o$-shells $[x,y,z, -L_{oe}<L<0]$; $[x,y,z, 0<L<L_{oe}]$. Now it is expanded and is analyzed in frames of *the periodically $L_{oe}$-multilayered* 4*D*-"*Multiverse*"structure (Gribov 1999, 2005). We therefore have the corresponding periodical intervals in the macroscopic *4*-th *L*-dimension:

$\ldots[-nL_{oe}<L<(-n+1)L_{oe}]; \ldots[-L_{oe}<L<0]; [0<L<L_{oe}]\ldots[(n-1)L_{oe}<L<nL_{oe}]\ldots$ as

$\ldots|\mathbf{W_{-2n-1}}|\mathbf{W_{-2n}}|\ \ldots|\mathbf{W_{-3}}|\mathbf{W_{-2}}|\mathbf{W_{-1}}|\mathbf{W_0}|\mathbf{W_{+1}}|\mathbf{W_{+2}}|\mathbf{W_{+3}}|\ldots|\mathbf{W_{2n}}|\mathbf{W_{2n+1}}|\ldots$

– Realizing periodical and *physically* identical Universes/Antiuniverses that are literally parallel to each other and coupled with our Universe $\mathbf{W_0}$. They have enormous spatial density $\rho_{\boldsymbol{U}}$ within these Subuniverses along the *L*-coordinate, where

$$\rho_{\boldsymbol{U}} = 1\mathrm{cm}_{\mathrm{L}} / \lambda^*_{e.Compton} \approx \mathbf{10^{10}}\ \mathbf{Universes}/\mathrm{cm}_{\boldsymbol{L}} \ldots$$

– ***DARK ENERGY*** – here is a result of (a) an *equal average* $\rho_{matter} = \rho_{antimatter}$ *density* on the large -scale Universe and (b) *repulsive antigravity* between matter/antimatter Universes, like between our $\mathbf{W_0}$ Universe and two the nearest odd $\mathbf{W_{+1}}$ and $\mathbf{W_{-1}}$ antimatter Subuniverses. The $\rho_{matter} - \rho_{antimatter}=0$ provides the Euclidian *flatness* on the large-scale Multiverse.

– ***THE BUBBLE UNIVERSE STRUCTURE*** now is observable everywhere on the large-scale Universe. It seems to be the most obvious "visual" evidence – the strongest cosmological support of the exactly equally presented matter/antimatter clusters with the repulsive - spatially separated periodical counterparts $+M_{gr}$ and $-M_{gr}$ on the large-scale Universe. The periodical gravity/antigravity works naturally as bubbles making "*yeast*" in the expanding "hyper-dough" of the periodical Multiverse (see corresponding chapter below).

– ***SPACE FLATNESS*** – *our Euclidean global* 3*D-space*. This surprising fact has been proven experimentally very well and is also resulting in average as zero large-scale gravity mass density in the Universe (corresponding to our strictly symmetrical matter/antimatter Multiverse).

– ***DARK MATTER*** *(DM)*– arises as the *attractive gravity* between dark-even $\mathbf{W_{2n}}$-Subuniverses and corresponding dark $\mathbf{W_{2n}}$-Subgalaxies, being gravitationally coupled dark segments in hyperspatial "spinal hyper-columns" of gravitationally short-ranged coupled Subgalaxies. Our matter Universe $\mathbf{W_0}$ is gravitationally (hyperspatially short-range) coupled with two the nearest "shadow matter" Universes $\mathbf{W_{+2}}$ and $\mathbf{W_{-2}}$, being invisible - electrodynamically isolated by the intermediate "anti"-waveguides $\mathbf{W_{+1}}$ and $\mathbf{W_{-1}}$. The true nature of the "miracle" DM particles is similar to common "quasi-mirror" SM-family. These physically cloned elementary particles "families" are $\pm 2L_o$-shifted into two the nearest $+M_{gr}$ dark matter waveguides $\mathbf{W_{+2}}$ and $\mathbf{W_{-2}}$, thus only have gravity attraction to our $+M_{gr}$ matter, centered in the $\mathbf{W_0}$ waveguide. They are hyperspatially in the electromagnetic "shadow" and are invisible at the same time.

– The waveguide's periodicity is supported by qualitatively self-consistent *periodical* installation of the first SM-lepton family (electrons/positrons, *u*/*d* quarks/antiquarks with their triplet composites - the confined colored triplets (protons/antiprotons;

neutrons/antineutrons) inside the 4D-triplet blocks, as our $|\mathbf{W_{-1}}|\mathbf{W_0}|\mathbf{W_{+1}}|$ waveguides and $\pi$-mesons in these waveguides (Fig. 11).

The above-mentioned properties arise from the same physically transparent 4*D*-waveguide-dynamics. This dynamical concept deeply unifies the disconnected "main load-bearing columns" of modern theoretical physics (Gribov 1999, 2003, 2005).

Feynman noted many years ago in his famous lectures on physics the remarkable property of a usual planar 2*D*-wavegiude - its electromagnetic wave dynamics has the analogy with the phase waves of de Broglie, propagating along the 2*D*-waveguide with the corresponding super-light phase speed. He also noted that the relativistic momentum-energy equation for the mass particle $U^2=P^2C^2+(MC^2)^2$, if being described quantum mechanically as $U=h\nu$, is very similar to the wave dynamics in the waveguide. "Isn't this interesting?", exclaimed insightful Feynman (Feynman et al, 1966, p. 230).Why being so precisely insightful, Feynman never developed these attractive waveguide's advantages for creating waveguide's gravity and unification of the SR with the QM? Possibly, it was "bad" influence of a widely dominating skepticism to deal with additional spatial dimensions in his times, or maybe he touched this amazing analogy accidentally, as a lecturer, being focused on a very special educational goal - to show so wide universality of mathematical equations in physics. Indeed, in this case he "loosed the track", underestimating that *thinking by the* "so interesting" waveguide's *analogy* could create a new basic physical concept, as it was often done in the history of physics.

Einstein also used the promising idea of the flat 2*D*-waveguide almost directly (but differently) – in his famous "*substantial"* mirror clock construction. It contains two parallel 2*D*-mirrors with a $L_o$-like macro-distance between them and a perpendicular light beam periodically reflecting-flying between these mirrors. This 3*D*-light-clock has a timing period $T_o=2L_o/C_3$ and a corresponding clock-frequency $\nu_o=C_3/2L_o$. He "invented" this very simple and important „substantial" clock, immediately showing essence of the SR-time delay, but even Einstein never realized that there was a more promising opportunity, reducing the clock's macro-thickness $L_o$ to a very thin 2*D*-waveguide. This idea could have suggested him a radically novelty - the *wave-dynamical nature of the mass particle, vibrating in the* 3*D*-*waveguide* and existence of the 3*D*-wave of de Broglie (even in 1905). Indeed, his famous relativistic mass equation $M=M_o/\sqrt{(1-V^2/C^2)}$ and the frequency equation $\nu=\nu_o/\sqrt{(1-V^2/C^2)}$ for the 2*D*-waveguide (necessary for the beam-wave propagation along with this thin "substantial" clock) have identical forms (Fig. 1.2a).

If we multiply the frequency equation by the Planck constant *h*, we derive $h\nu=h\nu_o/\sqrt{(1-V^2/C^2)}$ and it is now directly related to the Einstein's second great 1905- idea – the concept of the *photon*. Indeed, his basic 3*D*-space equation $E_3^2=(M_oC_3)^2+(P_3C_3)^2$ for the mass particle appears as the same Euclidean 4*D*-hyperspace equation $E_4^2=(M_oC_4)^2+(P_3C_4)^2$, being simply the basic wave-interference condition for the 4*D*-wave, propagating along this flat *3D*-waveguide in the 4*D*-*Euclidean space*. The postulated Kaluza's cyclic condition here appears clearly as the cyclical 4*D*-wave dynamics in the 3*D*-waveguide.

**1)** Here we find *the purely wave-dynamic nature of the huge „rest mass" energy* $E^*_o=M^*_oC^2$ of the Einstein's SR. This famous physical equation is accepted as the biggest theoretical achievement and simultaneously as the biggest physical "mystery", as noted by R. Feynman. He mentioned the unclear nature of this huge energy. Now there is no "rest" anymore in the 4*D*-hyperspace – the *C-dynamical* wave-particle is confined in the substantial 3*D*-waveguide $\Delta L=L_o$ as the 4*D*-quanta. It has the classically quantized minimal dynamical energy $E_{o4}=h\nu_{o4}$,

where $\nu_o=C_4/2L_o$. So, the "*massive*" 3*D-particle exists as the* $\boldsymbol{C_4}$*-wave* (paradoxically massless – *C*-dynamical - in the 4*D*-hyperspace, but deriving exactly the SR rest-mass properties, and only because of the 3*D*-waveguide frames). It has common physical 3*D*-velocity as a $V=V_{x,y,z}$ as a $C_{4(x,y,z)}$ projection of the full $\boldsymbol{C_4}$-velocity vector $C_4^2= C^2_L+ V^2_{x,y,z}$

$$C_{4(x,y,z)} \equiv V_{x,y,z} = \sqrt{(C^2_4 - C^2_L)} < C_4 \qquad (2a)$$

This wave always moves with the 4*D*-light speed $\boldsymbol{C_4}$, reflecting and moving along the *quasi-polygonal trajectory* /\/\/\/\/\/\ , (see Fig. 1.1), where:

$$\sin\alpha = V/C_4 = C_{4(x,y,z)} / C_4, \qquad (2b)$$

$$\cos\alpha = [\sqrt{(C^2-V^2)}] / C_4 = \sqrt{(1-V^2/C_4^2)} \qquad (2c)$$

***2)*** *The Einstein's relativistic mass equation, and the following relativistic energy-momentum equation disclose the pure* 3*D-waveguide's wave-interference nature of the SR* – with exactly the same wave-roots as the quantum mechanics has in the waveguide. The relativistic mass equation $M=M_o/\sqrt{(1-V^2/C^2)}$, and the corresponding energy-momentum equation, here appear immediately as the 4*D*-"*self-interference effect*" in the 3*D*-waveguide - between parallel wave elements (Fig.1.2a, b).

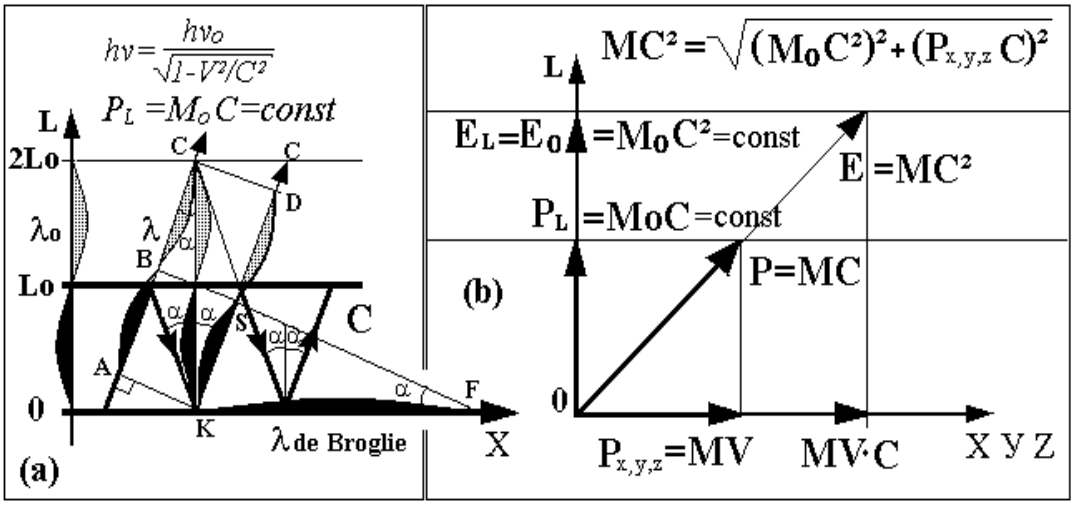



**Fig. 1.2a** shows how the waveguide wave interference *creates* the exact Einstein's relativistic mass equation for the mass particle - electron, being simply the necessary condition for electron wave propagation along the waveguide, common in the wave optics a long time before the 1905 – the SR year.

**Fig. 1.2b** shows the pure *wave nature* of the basic SR equation $E^2=(M_oC^2)^2+P^2C^2$. It is derived here from the 3*D*-waveguide's wave dynamics, creating the "frozen" orthogonal momentum projection $P_L = M_oC_4$ = const, as a simple interference condition for the wave-particle propagation alongside this waveguide.

It is quite similar to the thin 2*D*-oilskin in wave optics, studied even at school, and visible after rain on a street. A full dynamical quasiparticle energy *E* in the 3*D*-waveguide is $E(\alpha)=h\nu_4=h\nu_{o4}/\cos\alpha$ (where $\cos\alpha=\sqrt{(1-V^2/C_4^2)}$ and the corresponding relativistic mass $M(\alpha)$ is $M=M_o/\sqrt{(1-V^2/C_4^2)}$. The wave quanta $E_4=h\nu_4=h/(C_4/\lambda_4)$ could pass along the 3*D*-waveguide $L_o$, if two parallel wave-trains *AC* and *OD* have the same wave phase on the line $AK \perp AC$. Here the wave-paths difference $\Delta S$, is $\Delta S=AB+BK$ (Fig. 1.2). Our wave is

additionally reflected two times (in the points *B* and *K*, that adds the $\pi+\pi=2\pi$ phase. The $\Delta S$-interval must contain one integer wavelength $\lambda_4$ and is equal to the cathetus $AC=AB+BC=AB+BK=\lambda_4$ in the square triangle *KAC*, where $\angle KAC=90°$ and its hypotenuse is $KC=\lambda_{o4}$. From the triangle *KAC* we obtain the pure wave-interference source of the SR-relativism:

$$\lambda_4=\lambda_{o4}\cos\alpha,\ \nu_4=\nu_{o4}/\cos\alpha, \tag{3a}$$

and correspondingly,

$$h\nu_4=h\nu_{o4}/\cos\alpha \text{ and } M=M_{oe}/\sqrt{(1-V_x^2/C_4^2)}. \tag{3b}$$

In other words, if our massless $C_4$-wave freely propagates along the 3*D*-waveguide, it must have the "frozen" - "massive" $L_o$-harmonics – that is simply the interference condition for the $C_4$-wave propagation along the flat 3*D*-waveguide!

***3)*** *The* 3*D-wave of de Broglie arises here as the OX cross-section of the same wave front* (and its value is clear from the corresponding triangle *KSF* (see Fig. 1.2a):

$$\lambda_{de\ Broglie}=\lambda_4/\sin\alpha, \tag{3c}$$

where the waveguide's quanta $\lambda_4$ carries its pure dynamical energy

$$E_{(e-)}=M^*_{in(e-)}C^2=h\nu=hC/\lambda_4 \tag{3d}$$

and $\lambda_4$ is commonly connected with the electron's dynamical-inertial mass $M^*_{in(e-)}$:

$$M^*_{in(e-)}=h/C\lambda_4 \quad \text{or} \quad \lambda_4=h/CM^*_{in(e-)}. \tag{3e}$$

There are the unexpectedly very simple and identical *wave-roots* of the SR and the QM wave of de Broglie for mass particle! What we can learn from the disclosed unity? It becomes obvious that the proposed 4th dimensional waveguide's hyperspace structure plays its generic, fundamental role in common classical 3*D*-physics, since it so deeply unifies its basic physical columns. This surprising picture shows - we live in the physical world with more than 3 space dimensions! The periodical 3*D*-waveguide's architecture confirms the reasonable and insightful remark of famous physicist Robert Laughlin: "Symmetries are caused by things; they are not the causes of the things" (Laughlin 2007, p.187). We see that common Lorentz symmetry and the Yang-Mills-like gauge symmetry for the mass particle (related to the $C_4$-wave propagation) arise in the 3*D*-waveguide simultaneously! These "causing things" can be surprisingly simple spatial objects, as e.g. the quasiflat 3*D*-waveguide-modules, cloned periodically in the global Euclidean 4*D*-hyperspace.

**4)** Common "mystery" of the *Kaluza's cyclical condition naturally arises here as the physically transparent* ($L=x^5$) *cyclical* $C_4$*-wave dynamic in the* 3*D-waveguide*, since our mass-particle (electron) is the dynamical $C_4$-wave $\psi(x,y,z,0<L<L_o)$ in the 3*D*-waveguide*:*

$$\psi=\psi_o\cdot exp[-2\pi i\,(\nu t-K_xX-K_yY-K_zZ-K_LL)] \text{ or} \tag{4a}$$

$$\psi=\psi_o\cdot exp[(-2\pi i/h)(Et-P_xX-P_yY-P_zZ-P_LL\ )], \tag{4b}$$

(*where* $\boldsymbol{K}=(K_x, K_y, K_z, K_L)$ is the wave vector $\boldsymbol{K}$, with $|\boldsymbol{K}|=1/\lambda$, The full 4*D*-momentum $\boldsymbol{P}_4=M\boldsymbol{C}_4=M\boldsymbol{C}$ has its $P_L$ projection (see Fig. 1.1)

$$P_L(\alpha)=MC_4\cos\alpha=[M_oC_4/\sqrt{(1-V^2/C_4^2)}]\sqrt{(1-V^2/C_4^2)}]=M_oC_4=const \qquad (5)$$

This creates the now physically transparent cyclical $x^5$-condition (1).

**5)** The wave of de Broglie is fundamental in quantum physics, it emerges naturally and immediately as, e.g. the 3*D*-spatial intersection $\psi(x,y,z,L=0)$ of the 4*D*-wave, (see Fig.1.1). That means that here arises fundamental "machinery" of the quantum mechanical wave-particle, being now deeply united with the SR. Now they have the same very simple 3*D*-waveguide-dynamical nature. The (4b) here performs the $x^5$ "wave function" of quantum mechanics, mimicking also the relativistic Klein-Gordon (KG) equation, which is the requirement of the Einstein's energy-momentum equation $E^2=p^2+m^2$, ($C_4$=1), arising in the 3*D*-waveguide. It is common that the KG-equation can be formally reduced to the basic Schrödinger QM-equation, if $V_3=C_{x,y,z}<<C_4$ as it is shown in many textbooks. Thus, the fundamental Schrödinger QM-equation, adopted a priori, together with the SR and the Kaluza's cyclical condition (and Dirac equations, see below) appear simultaneously as the consequence of the proposed periodical waveguided hyperspace structure.

The QM associates particles to fields (classes of particles to classes of fields) and the coupled electron/positron particles can be associated with the (inertially) massive electron/positron field = (*e*–/*e*+) ghost superfluid. The (*e*–/*e*+) "atom" of our vacuum is a composite by its nature and has zero gravity mass="charge", zero electrostatic charge and zero spin (see below). These scalar "ghost atoms" build the largest part of our home – the superfluid vacuum ocean. They are "miracle", physically undetectable, being incorporated into the coherent vacuum tissue=the corresponding ghost quantum field. They are undetectable exactly as "empty" vacuum is! Common conclusion that the relativistic Klein-Gordon field is unphysical seems to be wrong – it is now very physical but undetectable. These composites become vastly dominating from the view of our hypersymmetric vacuum tissue concept, creating an endless scalar superfluid vacuum tissue. Only if we separate the coupled (e–/e+) pair – that means creation of two symmetrical *e*-holes - then the KG equation will be re-warped into the Diracian relativistic QM equations for two *e*-fermionic (electron and positron) holes. Now they become detectable equal hypersymmetrical matter/antimatter parts, of the decoupled scalar composite (*e*-/*e*+). Now they are free electron and positron, that have indeed derived Dirac, who discovered fermionic electron and antielectron with fermionic spins *S*=1/2. Indeed, the factorization of the Klein-Gordon operator gives two multiplicands $(\Box-m^2)=(P-m)(P+m)$, creating the relativistic Diracian equations for fermionic electron and positron (Bogoliubov et al 1980, p. 40). Two opposite signs $-m$ and $+m$ are associated obviously with two symmetrical parallel 3D-waveguides ($+L_o/-L_o$), creating two opposite electrostatic / gravity "charges" (for electron and positron correspondingly). These equations show the matter/antimatter symmetry and show a *hypersymmetric distinction* between electron and positron particles.

**6)** Two stretched elastic membranes shape the 3*D*-waveguide and two symmetrical cavities realize self-focusing gravity effects for a $C_4$-photon-like 4D-quasiparticle, accompanying with a very strong 4*D*-" optical" non-linearity of the waveguide' s 4*D*-medium. This self-focusing

wave-process creates the twisting $L_o$-waveguide's attractor with the minimal relativistic 2*D*-spherical, cophased surface with the radius $R_o \sim L_o$, but with the sufficiently hypercylindrical

*3D*-sub-surface in the 4*D*-hyperspace. This process defines the simplest elementary mass particle (electron) structure and shows the 4*D*-relativistic non-linear wave-interference nature of the $R_{oe}$-form-factor. This dynamical $R_{oe(rel)}$ attractor realizes the generic, robust spatial structure of the elementary (twisting) mass-particle with the relativistic radius $R_{oe(rel)}\approx\lambda_{e.Conpton}$ and the exactly relativistic-dynamical by the nature fermionic spin $S=1/2$, arising in its " resting" frames of coordinates (connected with the center mass of the twisting electron

wave). This the simplest 4*D*-photoparticle has the non-point structure of the 3D-surface with natural 2*D*-spherical (*x,y,z*)-cross-section. It has vibrating dynamical properties (like vibrating hypothetical strings) and it is also free of classical singularities. Practically all-starting advantages of the string arise in our case as emergent properties in the 3*D*-waveguide.

The hypothetical, very strong (quasi-optical) non-linearity in the 4*D*-medium corresponds to common non-linearity in the bosonic Yang-Mills fields, basic for the Standard Model (SM). This fields are represented by the massless *C*-particles with the photonic spin $S_{Y\text{-}M}=1$ and are designed like massless Maxwell-like *C*-photons, and now these nonlinear "photons" attract each other. The non-linear behavior of the self-focused 4*D*-wave in the 3*D*-waveguide is reduced proximally to the *C*-dynamical 3*D*-wave, twisting on the 3*D*-subsurface. Now it has the additional (3*D*-spatially quantized, $L_o$-dependent) twisting electron-wave component, creating the minimal-orbiting form-factor with the relativistic radius $R_{oe}=(h/4\pi)(2/\sqrt{3})/M^*_{oe}C$ and *L*-spin $S_{Le}=1/2$, realizing common *SU*(2) group symmetry for electron or positron. We restore the rest-mass creation mechanism, lost in the reasonably "massless" Yang-Mills concept, which is restored by the quantized standing $L_{oe}$-wave component, based on the 3*D*-waveguide's structure. This circumstance discloses the miracle, but physically necessary quasi-Maxwell's "masslessness" of the Yang-Mills theory, being originally the 4*D*-hyperspatial and acquiring the dynamical relativistic rest mass/spin of electron, etc. in the 3*D*-waveguide. The arising hypercylindrical 3*D*-surface is very thin, it is strongly curved with the constant curvature along $0<L<L_o$, representing dynamical hypercylindrical hypertube of electron.

The arising cross-sections of our massive 3*D*-hypercylinder's surface can look as closed or open 1*D*-strings, but these cross-sections themselves are physically fragmental (as parts of the whole indivisible elephant), as the string concept itself is for today. Our simplest electron mass particle structure is a string-like, but it lives in a quite basic physically – necessary bulk medium (=ideal frictionless superfluid) and follows to waveguide's boundary conditions. These bounders are physically realized as "substantial" framing/dividing membranes – like "branes", being e.g. physical mirror-like borders between two bulk superfluid phases. All this huge and globally represented surrounding system is inseparable part of our string-like electron-"photoparticle". So, matter/antimatter concept in the String theory (ST) must be reconsidered on the same "paradigmatic inversion" way as we have proposed – as an elementary string-looking hole in the periodical bulky hyperspace.

**7)** The orthogonal wave-dynamical pressure $F_L=\pm M_{oe}C^2/L_{oe}$, mentioned above, deviates the framing 3*D*-membranes and creates the simplest physical field in this model – the waveguide's gravity. It has the same form for weak fields as the classical Newton's gravity potential $\delta L_{oe}(r)\sim 1/r$ with the corresponding attractive gravity force between two waveguide's electrons. This $\pm F_L$ pressure realizes the periodically arising elementary electron/positron "gravity charge" $\pm M_{oe}$. Now we have pure 4*D*-wave-dynamical gravity/antigravity for the waveguided mass-particles (see the chapter "Wave-optical mechanism of gravity", below).

**8)** The ($x,y,z,0<L<L_o$) waveguide's hyperspace has the same SR-transformations for (3*D*+1)-spacetime intervals, where time intervals are imaginary in the 3*D*-waveguide (cyclical and hyperspatial by the nature), as it is shown on the Fig. 1.3 below. This structure explains why the imaginary time switches the "wrong" classical physics to the QM operators, sensitive to the 3D-waveguide's nature. The proposed *fundamental waveguide's 4D-space isotropy* means that $C_4$-velocities of all possible $C_4$-wave-particles are invariant in all possible 4*D*-spatial directions: $|\boldsymbol{C}(\alpha)|=C_4$=constant, where $\alpha=\sqrt{(1-V^2/C_4^2)}$. Here we have physically motivated system coordinates transformation $K\rightarrow K'$: not only the ($L,X$) hyperspace is turned formally on as a whole on the angle $\alpha$, but now we have correspondingly "turned" 3*D*-waveguide, "operating" as more thin and mo "massive" in the moving coordinate system *K'*. It has corresponding $L_o'=L_o\cos\alpha$ - shortening. We examine, e.g., two "resting" point masses in the points $X_0=0$ and $X_1=X_1$, realizing classical space interval ($OX_1$) in the resting referent frames *K*. Two parallel identical $\boldsymbol{C}_K$ vectors $\boldsymbol{C}_{X=0}=\boldsymbol{C}_{X=X1}=(0,0,0,C_L=C)$ express their classical „resting" states ($V_{X=0}=V_{X=X1}=0$) with correspondingly resting interval $OX_1$ between these dynamical waveguided masses. These "resting" $C_K$ vectors are parallel to the axes *OL* and are perpendicular to the 3*D*-waveguide's plane (to the axes *OX*). The same point-masses, now moving in the *K* frames and resting in the moving frames *K'*, have identical 3*D*-velocities $V_{X'=0}=V_{X=X'1}$ in the resting system of coordinate *K*. The resulting 3*D*-projections are $V_{X'=0}=V_{X=X'1}=C_4\sin\alpha$ and the $\alpha$-turn constitutes the comoving system of coordinates *K'*. Now moving particles have $C'_4$-vectors $\boldsymbol{C}'=\boldsymbol{C}'_0=\boldsymbol{C}'_{X'1}=(C\sin\alpha,0,0,C\cos\alpha)$ in the *K* and they must be physically parallel to the comoving frames of coordinates *K'*– to new coordinate axes *L'* and perpendicular to new waveguide's plane – the axes *OX'*. The *K*-resting "substantial time period" $T_o$ in the *e*-waveguide's could be defined as $T_o=2L_o/C_4$ (exactly as in the substantial 2*D*-mirror clock of Einstein, where $T_{o(\text{Einstein})}=2L_{o(\text{Einstein mirror-clock})}/C_3$). The corresponding periodical "substantial" time interval in the *K'* is now $T'_o=(OA+AB)/C_4=2L_o/C_4\cos\alpha$, and expresses exactly the SR ticking clock-rhythm slowing, literally identical to the Einsteinian "substantial mirror clock" slowing. Here we see sufficient difference – the so classically created waving SR-reality is based now on the *pure spatial* 4*D-hyperspace* & 4*D-isotropy* & 4*D-waves interference in the 3D-waveguide*. The rest mass (as the relativistic dynamical mass) arises as common, pure classical holistic wave-interference effect in the flat 3*D*-waveguide. The 3*D*-spatial interval shortening in the *K'* is a new distance $OX'_1=OX_1\cos\alpha$ between two parallel *C'*-waves directions *OC'* and $X_1C'$. The pure spatial 4*D*-hyperdistance between these two *C*-dynamical by the nature events in the 3*D*-waveguide *is* 4*D-invariant*: $[\Delta S_4(\alpha)]^2=\Delta L^2+\Delta X^2=OX_1^2=constant$ and $\Delta L'^2+\Delta X'^2=OX_1^2$.

If we use imaginary time parameter $\tau_{Minkowski}=iCt_{Einstein}$ of the Minkowski spacetime, we can connect our ($L,X$) hyperspace with the Einsteinian *S*-interval between two events: now $\Delta L^2=(C_4\Delta\tau)^2>0 \rightarrow \Delta L^2=(iC_4\Delta t_{Einstein})^2$.

All spatial 3*D*-intervals, e.g. the 3*D*-electron loop size $R_{oe(rel)}$, become proportionally smaller as $R_{oe}\rightarrow R'_{oe}=R_{oe}\cos\alpha$. This relativistic spatial interval contraction explains why the resting particle (enough large electron loop, for example) being accelerated to relativistic velocities somewhere in DESY or LHC colliders behave as "collimated" coherent wave "beam" with very small de Broglie wavelength along the 3*D*-waveguide. This electron "beam" remembers the almost point-like particle, which is able to probe even tiny quarks inside the resting proton. This does not mean common evidence about the exactly point-like-elementary electron structure, as it is usually concluded. The true spatial electron's loop structure itself and the 3D-waveguide presence must be investigated in the resting frames of coordinates *K* for resting particle. The electron loop size in this case is near common length $L_{oe}\sim\lambda_{e\ Compton}$.

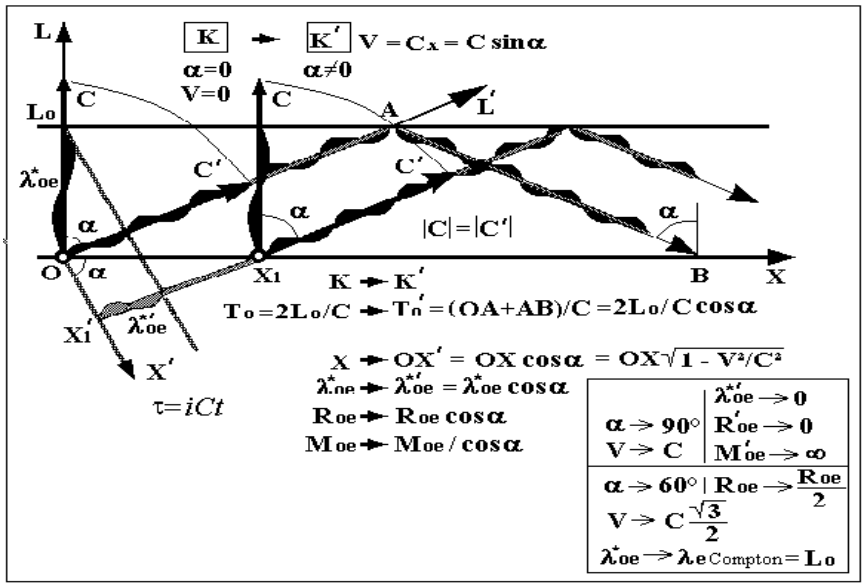



**Fig. 1.3** shows two different inertial systems of coordinates in the hyperspace: *K* – is referent with $C_x=V=V_x=0$ and *K′* moves with a constant relative velocity $C_x=V_x$. The $K\rightarrow K'$ means: The time period in the *K*-"substantial clock" $T_o=2L_o/C \rightarrow T_o'=T_o/\cos\alpha$ with the corresponding SR- period slowing. Space interval transformation is $OX_1\rightarrow OX_1\cos\alpha$. The *K′* looks as $\alpha$-turned *K*-waveguide where $L_o=\lambda^*_{e.Compton}\rightarrow\lambda'^*_{e.Compton}=L_o\cos\alpha$, etc.

It is remarkable that dynamical *L*-intervals ~$C_4t$ -time intervals in the proposed 3*D*-waveguide space are imaginary quantities like the time coordinate $\tau_{Minkowski}=iCt_{Einstein}$ in the Minkowski spacetime. But the proposed fundamental 3*D*-waveguide's space is sufficiently different of the abstract Minkowski spacetime. It has new basic *physical* preferences comparably to the Minkowski's spacetime – since it unifies the SR&GR&QM with the mass particle (as classical wave-interference phenomenon in the isotropic 4*D*-Euclidean space with the 3*D*-waveguide's boundary conditions). Now it looks trivial that corresponding quantum-mechanical wave function $\psi$ for the mass particle is a complex number and Schrödinger equation has $ih\partial\psi/\partial t$ term if we use the classical-real time $t_{Einstein}$ in it. The imaginary cyclical time looks now much more "real" for spices living in the 4*D*-hyperspace. The cyclical wave-particle has formally a "timeless" dynamical existence – jumping forwards and backward "in time" along the same cyclical-polygonal ||||||||| waveguide's "time coordinate" – staying on the same "timing" place – "without a history". This "timeless" conclusion becomes wrong if we exchange common time coordinate by the cyclical *L*-spatial process. Historical one-directional time is crucial surely only for complicated classical world of vacuum defects (matter or antimatter) with usual frictions and growing entropy with macro-historical irreversibility, as it is true for life and for human being, fighting against this growing entropy.

*Note:* Einstein's first reaction on the Minkowski's geometrical 4*D*-spacetime generalization of the SR was curious - he noted that he stopped to understand his own theory. Why? We realize that the formal mathematical SR-structure in the Minkowski's 4*D*-geometry is externally perfect and looks mathematically even much more "beautiful", but access to very simple (but so long time "unthinkable") – the pure Euclidean spatial physical (4*D*-hyperspatial) nature of the SR was practically lost for 100 years under this "hypnotic mathematical beauty". This so perfect "hypnotic trap" contains the correct *imaginary time*, but it is still sufficiently out of the unifying - physically very simple hyperspatial context – with the $C_4$-dynamical mass particle nature, confined in the 3*D*-waveguide. This tremendously remarkable historical case in theoretical physics shows deep abyss between

physical and mathematical thinking. Basic physical "things", existing in the nature, must be indeed primary in physics and theirs mathematical descriptions (symmetries, etc.) must be always secondary modeling interpretations of these basic things, as reasonably concludes Laughlin (Laughlin 2007, p.187). In fact, incredibly insightful Einstein pure physically discovered principles of the SR, by generalizing the Galileo's principle of relativity in mechanics on the whole physics. But even Einstein did not recognize later the waving hypersymmetric "ribs", hidden in his tremendous SR-discovery. His legendary physical intuition was "discharged" under so bright and hypnotic mathematics – the global Minkowski's 4*D*-space-time geometry. Einstein could easy unify classical physics (the SR/GR with wave-QM, etc.) on the so simple – quasi-classical waveguided way 100 years ago! Minkowski played here indeed a curiously mixed role of "good and evil" genius.

*Summary:* The basic, till now divided stones of classical physics look surprisingly easily united and comfortable with gravity, etc. in the tiny 3*D*-shell of the 3*D*-waveguide embedded into the global Euclidean 4*D*-hyperspace! The Minkowski spacetime abstraction disappears, but instead arises the pure 4*D*-hyperspace with amazing - imaginary – $C_4$-dynamical time parameter, based on the 3*D*-waveguide's dynamics.

## THE WAVEGUIDE'S MECHANISM OF GRAVITY ACCELERATION

The *e*-wave's dynamics always goes proximally with the $\boldsymbol{C_4}$-speed of light in the 3*D*-waveguide. The waveguided particle creates the orthogonal momentum $MC_L = \pm M_{oe}C_4 = const$ and provides the orthogonal *L*-pressure on two elastic stretched membranes $L=0$ and $L=L_{oe}$, framing the waveguide layer and *deforms* its initial plane thickness $L=L_{oe}$. We assume that basic physical *interactions* between rare waveguide particles (as potential fields) are realized across such deformed framing membranes. The gravity acceleration $g_x$ (as the gravity effect for the wave-optical approximation) was shown for very small opening of the angle $\beta \approx 0$.

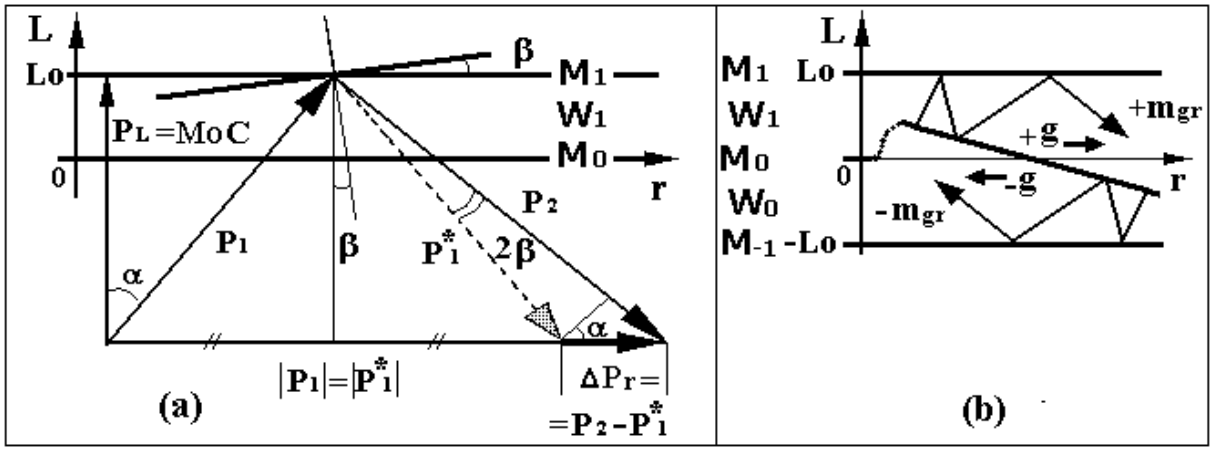



**Fig. 2a** shows the 3*D*-waveguide ($x,y,z,\ 0<L<L_{oe}$) with a very small non-parallelism $\beta \approx 0$ between two framing membranes $\mathbf{M_0}=(x,y,z,L=0)$ and $\mathbf{M_1}=(x,y,z,L=L_{oe})$. This case creates the exact non-relativistic classical gravity acceleration along the waveguide $g_{x(gr)}=\beta_x C_4^2/L_{oe}$.

**Fig. 2b** shows the gravity/antigravity mechanism as the opposite gravity acceleration directions, arising for two particles under the "$\pm\beta$"-gravity potentials", located in two different nearest adjacent waveguides $\mathbf{W_0}=(x,y,z,-L_{oe}<L<0)$ and $\mathbf{W_1}=(x,y,z,0<L<L_{oe})$ with arising the opposite $\pm\beta$ waveguides openings.

The $\beta$ is very small angle between two quasiparallel 3*D*-membranes framing the above-mentioned 3*D*-waveguide (Fig. 2a), (Gribov 1999, 2005). The local accelerating force is on average $f_x=\Delta P_x/\Delta t$. *Here* $\Delta P_x \approx 2\beta \mid P_1 \mid /\cos\alpha = 2\beta MC_4/\cos\alpha$ and $\Delta t \approx (2L_{oe}/\cos\alpha)/C_4$, i.e.,

$$f_x=M_e g_{x(gr)}=\beta M_e C_4^2/L_{oe} \rightarrow g_{x(gr)}=\beta_x C_4^2/L_{oe} \quad (6)$$

Thus, the derived quasi-optical acceleration $g_{x(gr)}=\beta_x C_4^2/L_{oe}$ does not depend of the $M_{oe}$. If we imagine more heavy mass particles with the higher waveguide's transverse harmonics $\nu_n=n\nu_o$, and correspondingly quantized mass $M_n=nM_{oe}$, ($n$=1;2;..;$k$) they will have the same kinematical triangles geometry for the $f_{xn}$ account and we will derive correspondingly the same acceleration $g_{x(gr)}$ as

$$f_{xn}=(nM_e)g_{x(gr)}=\beta_x (nM_e) C_4^2/L_{oe} \rightarrow g_{x(gr)} \approx \beta_x C_4^2/L_{oe}. \quad (7)$$

So the $g_{x(gr)}$ *is the same for all linearly quantized harmonics - masses* $nM_{oe}$ at the same space point and the local unparalleled deformation (the waveguide opening $\beta$) can be strictly considered as a *purely geometrically determined waveguided gravity potential* in the correspondingly deformed 3*D*-waveguide, where $L_{oe}(x) \rightarrow L_{oe} + \delta L_{oe}(x)$:

$$U_{gr}(x) = -\delta L_{oe}(x) C_4^2/L_{oe} \quad (8)$$

Our (waveguided) gravity potential $U_{gr}(x)=0$ if $\delta L_{oe}=0$ (very fare from matter particles), where $L_{oe}(x)=L_{oe}$.

*Note 1.* Thus, the Equivalence Principle (EP) – the basis point for the GR is not necessary to postulate any more – it becomes the result of our *quantized* waveguide's gravity mass physics. The classical GR, on the contrary, is directly based on the postulate of the equivalence principle: "In general relativity the response of matter to gravity is independent of mass (equivalence principle), while space-time curvature is generated directly by energy-momentum, according to $R_{\mu\nu}-(1/2)g_{\mu\nu}R=kT_{\mu\nu}$, with $k\equiv 8\pi GN/C^2$. Mass appears as a contributing factor to energy-momentum, but it has no uniquely privileged status. At an abstract level, mass appears as a label for irreducible representations of the Poincare group. Since representations with $m\neq 0$ appear in tensor products of $m$=0 representations it is possible, at least kinematically, to build massive particles as composites of massless particles, or massless particles and fields." (Wilczek 2002, p. 2). We discover here the very simple united nature of the basic EP that discloses deep relation between our waveguide's *(classically quantized) gravity concept* and the GR! Einstein could be very surprised to see arising here conceptual GR-deepening, and unity of the waveguide's gravity with the QM, which he did not like. We will derive below also exactly the same - Schwarzschild radius $R_{\text{Schw.}}$ – for a Multilayered Waveguide Black Hole (MWBH), arising in the periodical waveguided hyperspace. Now it becomes free of common GR-singularity – the MWBH has totally flat - minimally possible gravity potential $U(r<R_{\text{Schw.}})=U_{\min}=-C^2/2$ if $\delta L_{oe}=-L_o/2$ in the equation (8) and correspondingly exactly zero gravity field inside this radius – inside the MWBH (see chapter "Periodical black holes in the multiwaveguide's hyperspace", below).

If deviations $\delta L_{oe}(x)=0$, we have $L(x)=L_{oe}$ and corresponding $\delta L_{oe} \sim U(x)=0$ in the "empty" vacuum space fare from gravitating bodies. The waveguide thickness $L_{oe}$ cannot be voluntary changed as classical gravity potential level, since $U(x)+\Delta U=(\delta L_{oe}+\Delta L_{oe})C_4^2/L_{oe}$, and $\delta L_{oe}>L_{oe}$ can ruin the basic physical waveguide's constant $L_{oe}=h/2M_{oe}C_4$, determining the elementary

electron rest mass and a full physical hyperspace geometry. It is similar to common physical significance of the vector potential in the electrodynamics.

We obtain for a non-relativistic particle the exact classical gravitation field $F_{x(gr)}=-\partial U(x)/\partial x$, where $tg\beta_x(x)=\partial L(x)/\partial x\approx\beta(x)$ for very small $\beta(x)\approx 0$,

$$\boldsymbol{g}=(\beta_x,\beta_y,\beta_z)C^2/L_{oe}, \qquad g^2=(\beta^2_x+\beta^2_y+\beta^2_z)(C_4^2/L_{oe})^2 \tag{9}$$

*Note 2*. It is interesting to show that the "resting" *e*-wave $E_{o4}=h\nu_{o4}$, ($T_{o4}=2L_o/C_4$) behaves exactly like the microscopic "substantial" mirror clock of Einstein's SR under a gravity potential $U$. Indeed, and this clock "ticks" slower in the thicker substantial waveguide with $L_o \rightarrow L_o+\delta L_o>L_o$, (where $T_4 \rightarrow T_{o4}+2\delta L_o/C_4$), if $C_4(\delta L_o)=const.$ The slowing of corresponding substantial 4*D*-time-period is $\delta T_{o4}\sim U/C_4^2$ and

$$T_4(U) \approx T_{o4}(1-U/C_4^2) \tag{9.1}$$

is the same as in the general relativity of Einstein.

This means also that the 4*D*-rest mass $M_{o4}C_4^2=h\nu_{o4}=hC_4/2(L_o+\delta L_o)$ slightly steps down if $\delta L_o>0$ and grows if $\delta L_o<0$ as

$$M_{oe}(\delta L_o) = M_{oe}(U) \approx M_{oe}(1+U/C_4^2) \tag{9.2}$$

This relation predicts sensible difference between positron and electron (or $M_p$ – mass of proton and antiproton) rest masses in the same gravity potential $U$ and it is about $10^{-6}M_p$, if we involve the huge gravity potential $U_{Milky\ Way}$ of our Milky Way Galaxy. At the same time we know that proton and antiproton $Q_p/M_p=Q_{\underline{p}}/M_{\underline{p}}$ charges/inertial masses relations are experimentally equal till $10^{-9}M_p$ on the earth. This discrepancy can be explained by the same deviation of the proton and antiproton electrostatic charges, keeping their relation constant and that could be natural in our unified membrane-model of charge and mass (see below). Another explanation of the equality could be if to propose that not only the usual $C_3$-light velocity, but also our substantial $\boldsymbol{C}_4$-light velocity is slightly changeable under the gravity potential $C_4=C_4(U_{gr}) \sim C_4(\delta L_o)$, as it does usual 3*D*-light under gravity potential. This means that the invariance of the rest mass needs equation

$$\nu_{o4}(U)= \nu_{o4}(\delta L_o) = (C_4+\Delta C_4) / 2(L_o+\delta L_o) \approx constant, \tag{9.3}$$

and the mentioned above deviation of the rest mass (and charge) under gravity potential $U$ remains zero in these "breathing" waveguides. This circumstance could explain also why the proposed *e*-cellular periodical structure practically doesn't affect gravitational deviations of membranes under widely valid Newtonian-like *e*-holes gravity. This short analysis (the rest mass equalization) shows that we are able to go out of possible theoretical difficulties, keeping our basic-unifying multi-waveguide's (particle, gravity, charge, etc.) concept intact.

*Note 3.* We illustrate below our multi-waveguided "analogy" to common "naive" Feynman's-Stueckelberg's CPT-symmetry interpretation (in frames of the global Minkowski's space-time concept), describing antiparticle as particle moving backward in time. The particle moves in a constant gravity field $\partial L(r)/\partial r\sim\beta(r)=const$ with $\boldsymbol{g}\approx\pm\boldsymbol{\beta}C^2/L_o$=constant. We see normal gravity acceleration $\boldsymbol{g}$ for the particle, but literally "backward" gravity acceleration for the antiparticle with the resulting forward-"backward"

particle and antiparticle accelerations movements. Here arise the opposite curvatures $+k$ (for particle) and $-k$ (for antiparticle). These trajectories are realized in two different adjacent 3*D*-waveguides, presenting waveguide ($r$, $0<L<L_o$) and antiwaveguide ($r$, $-L_o<L<0$), (Fig. 2c). Electrostatically ±charged, coupled particle and antiparticle ($e-/e+$) are very well coupled electrostatically and will not fill small ±gravity fields, as do all atoms of our vacuum superfluid. They exist as perfect nongravitating "ghosts" (see chapter "Periodical space / antispace symmetry – as the periodical matter / antimatter concept", below).

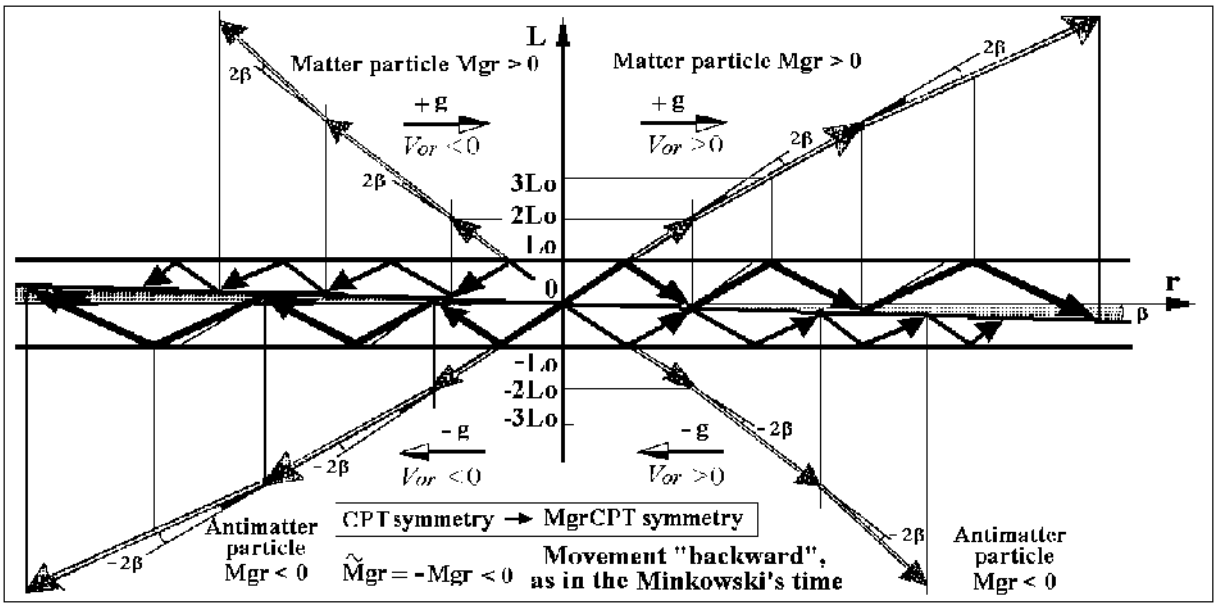



**Fig. 2c** shows the *imaginary* quasi-linear curved $C_4$-sweep of the $C_4$-sloping waveguide's trajectory in the swept ($L$,$r$) waveguide's space as a curved analogue to the gravitationally curved (here beveled) the global Minkowski's 4*D*-manifold (x,y,z,$iCt$). We see two matter particles in the ($x$,$y$,$z$,$0<L<L_o$) waveguide (initial velocity $V_{or}>0$ on the right side, and $V_{or}<0$ on the left side); two antimatter particles in the adjacent ($x$,$y$,$z$,$-L_o<L<0$) "antiwaveguide" under the same gravity potential (realizing by the middle dividing membrane $\beta\approx 0$ non-parallelism), where the same initial velocity $V_{or}>0$ on the right side, and $V_{or}<0$ on the left side. This picture shows the hypersymmetric nature and enlargement of common fundamental matter/antimatter CPT concept as CPT→$M_{gr}C_{el}$PT. Now it includes the $\pm M_{gr}$ gravity "charge" symmetry. This hyperspatial picture gives also a pure spatial explanation to the Feynman-Stueckelberg's CPT-interpretation.

## ON THE SPATIAL STRUCTURE OF THE WAVEGUIDED PHOTOPARTICLE

Wilczek noted very important quantum mechanical obstacle, critical to the point-like static-like electron particle concept: "Indeed, due to the uncertainty principle the picture of electrons as ideal point particles certainly breaks down for distances $r \leq \sim h/2\pi mC$, the Compton radius. At momenta $p \geq \sim h/2\pi r$, the velocity $p/m$ formally becomes of order $C$, and one cannot regard the electron as a static point source" (Wilczek 2002, p. 3). The waveguide's confining frames and the pure wave-dynamical electron quanta = mass/energy $E_e=h\nu$ nature allow construction of the indeed relativistically twisting dynamical electron structure, exactly relativistic – fermionic with the corresponding $SU(2)$ group, where electron acquires its physically natural 3*D*-waveguide's rest mass and is free of singularity. This way we shift the famous Einsteinian idea of 3*D*-photon to the "Yang-Mills-like" 4*D*-photon quanta, realizing quantum mechanically & relativistically the 3*D*-mass wave-particle's form-factor, when a Maxwell-like wave's quasiparticle is spreading along the very thin 3*D*-surface of hypercylinder, living in

the 4*D*-hyperspace. These elementary atomistic *e*-cells are coupled as (*e*-/*e*+)-"atoms" and are placed periodically in the 4*D*-hyperspace. This hyperstructure includes periodical matter/ antimatter and Cooper-like supersymmetry. This enables to solve modern cosmological problems of cosmological constant and dark energy (DE) & dark matter (DM) problems. We proposed this periodicity earlier (Gribov, 1999, 2005), but systematical analysis and proofs of its existence is the main goal of the present article (see chapters below). Historically interesting that Einstein and Bergman had very similar way of the direct hyperspatial prolongation, but without our self-consistent unifying waveguide's dynamics and periodical hyperspatial modularity. It was without corresponding for our modularity confinement of the massive wave-particle inside a single 3*D*-waveguide, where our periodically positive and negative gravity charge and periodical matter/antimatter hypersymmetry could not arise.

### *The relativistic dynamical nature of the fermionic spin S=h/4*

The orthogonal pressure $\pm f_{\perp}$ from the waveguide $\mathbf{W_1}$ (Fig. 3 below) creates two local symmetrical 1/*r* singularity-less "flat-bottom" cavities (realizing the double gravity potential and the corresponding doubled gravity charge $M^*_{oe}=2M_{oe}$ in the opposite framing membranes $\mathbf{M_1}=(x,y,z,L_{oe})$ and $\mathbf{M_0}=(x,y,z,0)$. We assume that these inevitable, local and symmetrical gravitating cavities support and trigger the existing - non-linear (existing for Yang-Mills fields), wave-optical–like – hypothetical - self-focusing effect in the 4*D*-*e*-wave, existing in all the same *e*-cells and in all the same parallel 3*D*-waveguides. This creates the crucially important phenomenon – the self-organizing *self-focused e-wave dynamics*, living as ideal frictionless loop-like excitation in superfluid. It has form of tiny quantum 4*D*-attractor with thin 3*D*-walls – "quantum topological defect" – with spinning, non-dissipative co-phased quantum vortex.

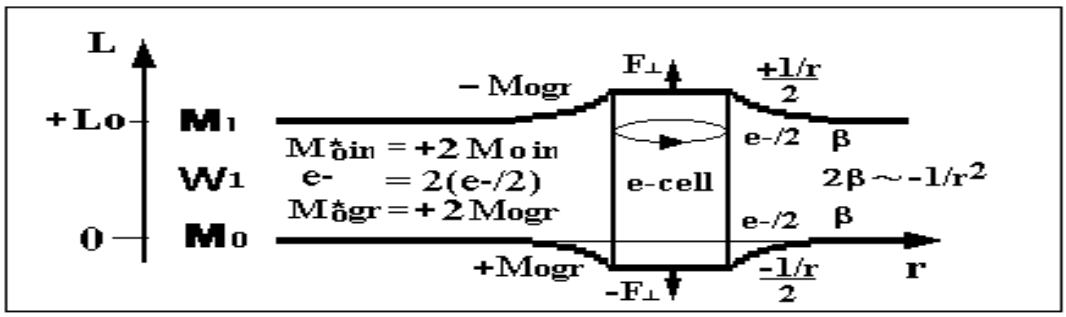



**Fig. 3** shows the elementary electron 4*D*-quanta inside the 3*D*-waveguide $\mathbf{W_1}=(x,y,z,0<L<L_{oe})$ with two framing elastic 3*D*-membranes $\mathbf{M_0}=(x,y,z,L=0)$ and $\mathbf{M_{-1}}=(x,y,z,L_{oe})$, whose small symmetric deformations create the exactly Newton/Coulomb double $2\beta$-gravity potential $U\sim 1/r=2(1/2r)$ and the double electrostatic charge potential $U\sim 1/r$.

It exists as common 3*D*-spin-wave = exactly in the form of the Einstein's 3*D*-photon, but now inside the sufficiently "curved" non-linear twist in the waveguide's superfluid medium. This way is created almost *point-like particle*, but it has now strictly finite twisting quantum $L_{oe}$-tube size with the radius $R_{oe}= (2/\sqrt{3})\ (h/4\pi M^*_{oe}C)$ and very thin (self-focused) electron $L_{oe}$-tube walls. The derived electron size is $2R_{oe}=(2/\sqrt{3})(h/2\pi M^*_{oe}C) > h/2\pi M^*_{oe}C$ and our electron has the quantum-mechanically stable size. We describe electron as pure *C*-dynamical excitation on the 4*D*-vacuum, which is self-focused on the 3*D*-surface of the tiny "empty" hypercylinder. Here arises long-awaited *physical* cutoff of the common "terrible" point-like electron energy singularities. This self-focused, relativistically rotating *e*-tube expresses the *generic spatial structure of the $C_4$-dynamical by the nature elementary mass particle*.

We assume that the *e*-wave has its bosonic nature in the also *muon/antimuon* mini-cellular medium, filling 3*D*- *e*-waveguides – it is the bosonic spin wave ($S$=1) excitation – *the quanta* $E_4=h\nu_4$ propagating inside this 4*D*-space, transporting *e*-wave energy inside the $L_{oe}$-waveguide. This fine-grained medium must be analogical to the hypersymmetric Diracian-like (*e*-/*e*+) vacuum superfluid and it fills the whole $L_{oe}$-waveguide space with its 200 times smaller ($\mu$+/$\mu$–) cells, realizing the second - thinner cellular ($\mu$+/$\mu$–) leptonic superfluid vacuum level. We assume that the known leptons-family expresses three similar by the hypersymmetric nature, superfluid vacuum mediums which will be presented below. We will show below that the if the 4*D*-spin vector along $\boldsymbol{C}_4$-direction $S$=1, (here corresponding to the exactly the Yang-Mills *C*-quasiparticle excitation) twisting around the *OL* axes with $\alpha_L$=60° in the *e*-vortex, has two spatial projections $S_L=\pm 1/2$ and $S_{||}=S_{x,y,z}=\sqrt{3}/2$, where $S_x=S_y=S_z=1/2$, *related to the common fermionic spin of electron*, where $(h/4\pi)^2+(h/4\pi)^2+(h/4\pi)^2=(3/4)(h/2\pi)^2$, (see Fig. 3a).

In the non-relativistic frames the natural minimal co-phased *e*-loop $2\pi R_{oe}$ must contain *only one* $\lambda_{deBroglie}$ *length* and according the equation (3c) we can write:

$$2\pi R_{oe}=\lambda_{deBroglie}=\lambda/\sin\alpha, \text{ where} \tag{10}$$

$$\sin\alpha=V/C_4=C_{||}/C_4=\sqrt{(C^2_x+C^2_y+C^2_z)}/C_4 \tag{11}$$

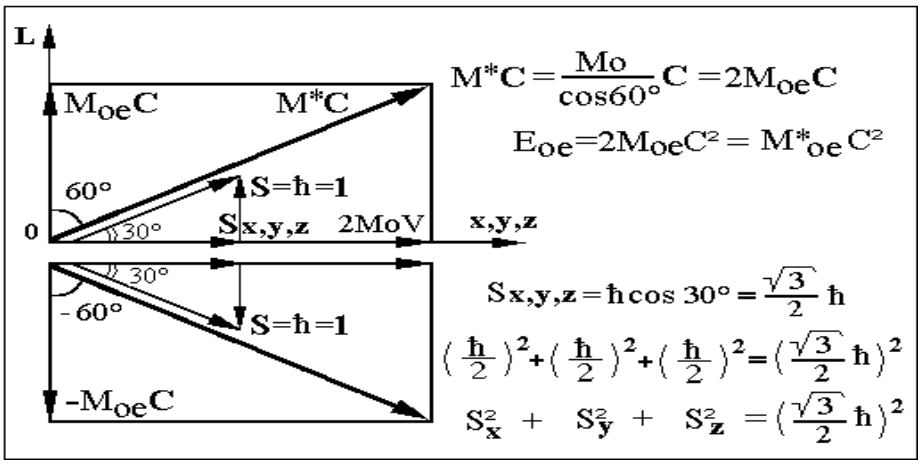



**Fig. 3a** shows the doubled relativistic - twisting "rest mass" momentum $P_4=M^*C=2M_{in(oe-)}C_4$, arising in the most compact, co-phased and the most stable - twisting electron wave attractor, where its "resting" dynamical-relativistic "rest mass" energy is $E_{oe}=M^*_{in(oe-)}C_4^2=2M_{in(oe-)}C_4^2$ and the $L$-momentum $P_L=\pm M_{oe}C=\pm M_{in(oe-)}C_4=const$, but the relativistic by the nature common electron rest mass is $M^*_{in(oe-)}=2M_{in(oe-)}$.

But we could wait here very small *e*-loop for minimal twisting radius - naturally smaller as, for example, the first electron orbit in the hydrogen atom - with correspondingly very small $\lambda_{deBroglie}$ and sufficiently relativistic 3*D*-speed of rotation $V=C_{||}$, comparable with $\boldsymbol{C}_4$. We must replace the non-relativistic $2\pi R_o$ length (10) using the *relativistic length -shortening* factor $\sqrt{(1-C^2_{||}/C_4^2)}$:

$$2\pi R_{oe}\sqrt{(1-C^2_{||}/C_4^2)}+\Delta l. \tag{12}$$

Now the co-phase wave of de Broglie *must twist two times* around the new minimal co-phased "relativistic" 2-loops-length (12), with

$$2\pi R_{oe}\sqrt{(1-C^2_{||}/C_4^2)}+\Delta l \rightarrow 2\pi R_{oe}\sqrt{(1-C^2_{||}/C_4^2)}+2\pi R_{oe}\sqrt{(1-C^2_{||}/C_4^2)}. \quad (13)$$

Obviously, the new minimal relativistic length $4\pi R_{oe(rel)}$ will be derived after the 360°+360° double-loop twisting, if the $\sqrt{(1-C^2_{||}/C_4^2)}=1/2$:

$$\sqrt{(1-C^2_{||}/C_4^2)}=\cos\alpha = ½ \rightarrow \sqrt{(C_4^2-C^2_{||})}=C_{\perp}= C_4/2, \quad (3a)$$

giving correspondingly - the double-loop with the co-phase condition:

$$(13) \rightarrow 2\pi R_{oe(rel)}+2\pi R_{oe(rel)} = 4\pi R_{oe(rel)}=\lambda_{deBroglie} \quad (14)$$

$$R_{oe(rel)}=\frac{\lambda_{deBroglie}}{4\pi} \quad (14a)$$

Now we derive important equation, using (3c): $\lambda_{deBroglie}=\lambda_4/\sin\alpha$

$$R_{oe(rel)}= \lambda_4/4\pi\sin\alpha \quad (14b)$$

The relativistic co-phased result means that the twisting and periodically $L_o$-reflecting co-phased wave vector $\boldsymbol{C}_4$ has following twisting vector components:

$$\boldsymbol{C}_4= [C_L\ ;\ C_{||}] = [C_4/2\ ;\ C_4\ (\sqrt{3}/2)] \quad (15)$$

and $\alpha = \pm 60°$ in the derived *relativistic e*-vortex (Fig. 3a). The searched orthogonal spin $S_{eL}$ of the vortex is:

$$S_{eL}= P_{e_{||}} R_{oe(rel)} = (M^*_e C_{||})R_{oe(rel)} = \pm M^*_{eoe}C_4 \sin 60° R_{oe(rel)}, \quad (16)$$

where $M^*_{oe}$ is common relativistic "rest" mass of electron, twisting around its resting center mass and $M^*_{oe}=2M_{oe}$. Using $R_{oe}=(h/4\pi)(2/\sqrt{3})/M^*_{oe}C_4$ we derive $S_{eL}$ being *invariant-independent of* the 3*D*-waveguide thickness $L_o$:

$$S_{eL}= \pm M^*_{oe}\ C_4\ (\sqrt{3}/2)\ (h/4\pi)(2/\sqrt{3})/M^*_{oe}C_4 = \pm h/4\pi. \quad (17)$$

According the Fig. 1.1 we derive the *OL* cross-sections of the twisting 4*D*-wave in the electron attractor, using corresponding relations for $\alpha = 60°$:

$$\lambda^*_4/2L_o = \lambda^*_4/\lambda_o = \cos 60° = 1/2, \quad (17a)$$

$$\lambda^*_4 = 2L_o\ \cos 60° = 2L_o/2 = L_o = \lambda^*_{e.Compton}, \quad (17b)$$

$$\nu^*_4 = 2\nu_{o4} = 2(C/2L_o) = C/L_o = C/\lambda^*_{e.Compton}. \quad (17c)$$

The corresponding twisting wave has frequency $\nu_4 = 2\nu_o$ with paradoxically exactly *doubled relativistic inertial "rest" mass* $M^*_{in}=2M_o$, being at "rest" – as does its resting center mass, being in the center of the twisting electron attractor. The relativistic electron "rest" mass $M^*$

is the measure of its dynamical "rest" energy $E^*=M^*C_4^2$ and it is doubled, comparably to the vertical $L$-rest-mass component $M_L=M_{in}=M_o$ where $\alpha=0$ and $M_{inL}=M_{oL}$ ; $E_{oL}= M_{oL}C^2$

$$M^*_{in(oe)}=2M_{oeL} \tag{17d}$$

$$E_{oe}^* = 2M_{oL}C^2 = M^*_{in(oe)}C^2 \tag{17e}$$

The 3$D$-radius $R_{oe(rel)}$ is derived for $\alpha=60°$ from the (14a) and $\lambda^*_{e.Compton}=h/M^*_{oe}C$ as:

$$R_{oe(rel)}=\lambda_{deBroglie}/4\pi = \lambda^*_{e.Compton}/4\pi\sin60° = (2/\sqrt{3})\, h/4\pi M^*_{oe}C_4 \tag{18}$$

***Note* 1:** It is common that a charged particle (electron) in the quantum field theory of Dirac experiences kind of common *Zitterbewegung* with frequency $\nu_o=4\pi M^*_{oe}C^2/h=1{,}6\text{x}10^{21}$Hz smearing out the charge over a region comparable to the Compton wavelength, as it was shown by Schrödinger (Schrödinger 1930). Now this radius gets its fundamental sense as the twisting "atomic" (near the electron Compton-length) radius in the ($e–/e+$) cellular quantum superfluid (Gribov 1999, 2003, 2005).

***Note* 2:** The intrinsic magnetic moment of electron is $\boldsymbol{\mu}_{Se}=-g_s\mu_{Be}\boldsymbol{S}_e/(h/2\pi)$, where the $g_{s(Dirac)}=2$, the Bohr magneton $\mu_B$ is defined in SI units as $\mu_{Be}=-eh/4\pi M^*_{oe}$ and the electron spin is $\boldsymbol{S}_e=h/4\pi$. Our 2 symmetrical magnetic "half-charges" realize two coaxial and symmetrical Diracian half-monopoles in the electron hole, living in the periodical Multiverse. The calculation gives the same Diracian equation for the intrinsic (here indeed /-/ twisting by the nature) magnetic moment of electron:

$$\mu_{SL(e\text{-holl})} \approx -\,2J_{\perp}R_{oe} = [-2(e/2)C_4(\sqrt{3}/2)][(2/\sqrt{3})h/4\pi M^*_{oe}C_4] = -\,eh/4\pi M^*_{oe}, \tag{18a}$$

where the electric loop-current $J_{(2\ \text{half-monopoles})}\approx -2(e/2)C_4(\sqrt{3}/2)$ and $R_{oe}=(2/\sqrt{3})h/4\pi M^*_{oe}C$. This electron-current twists backward to the $C$-"mechanical" twist (electron spin) of the spinning electron attractor.

### *Analogue to the Kaluza-Klein $nM_o$ mass tower with $R(n)_{oe(rel)}= R_{oe(rel)}/n$ form-factor*

We have accounted the relativistic e-attractor radius $R_{oe(rel)}$ for the first $L_o$-waveguide's harmonics, according to common "effective" theory ideology – to the low energy limit for the electron-positron vacuum. We obtain for higher linear spectral frequencies in the $L_o$-waveguide the correspondingly linear-quantized $M_n=nM^*_{oe}$ mass spectrum with the same co-phase conditions, being analogue to the *Kaluza-Klein mass tower*, described below and keeping $\alpha=60°$. Here we obtain very important - the stepwise shortening of the "compactification" radius $R_{oe(rel)}$ , since the new first-minimal co-phased loop condition will be derived naturally for the stepwise smaller $n_e$-attractor's loops:

$$R(n)_{oe(rel)} = R_{oe(rel)}/n \tag{18b}$$

So quantized $M_n$ mass-particles obtain very simple similar - electron-like 4$D$-hypercylindrical spatial structures, where the $C_4$-wave $\lambda_n=\lambda_{oe}/n$ is twisted (like a usual 3$D$-photon in the Maxwell electrodynamics) along the $R_{oe(rel)}/n$ curved, thin 3$D$-surface of these 4$D$-hypercylinders, arising in our 3$D$-e-waveguide. The $M_n$-attractor will have corresponding radius $R_n=R_{oe(rel)}/n$ keeping exactly the same initial fermionic spin $S_n=\pm h/4\pi$ properties. The minimal mass in this spectrum is required for the lightest elementary mass particle - electron,

if $n$=1. The full electrostatic electron charge $Q_{e*}=2Q_e$ is the e-hole charge $Q_{e*}$ which is ½-divided on two symmetrical **M**-membranes, framing this *e*-hole (Fig. 4.1, below). The *e*-hole gravity "charge" $M^*_{oe(gr)}=2M_{oe}$ is also ½-divided on these two symmetrical membrane's gravity potentials, sufficiently including three surrounding waveguides bulks, constituting gravity potentials of the *e*-hole. The inertial (dynamical) "rest" mass $M^*_{oe(inert)}=2M_{oe}$ of the *e*-hole is sufficiently relativistic and exactly identical to the gravity mass $M^*_{oe(gr)}=2M_{oe}$ of the hyperspatial *e*-hole.

Later we will identify some of the "mass tower" harmonics with the other elementary Standard Model particles (e.g. protons and antiprotons), which *are allowed if they minimize electrostatic energy of the dominating (e–/e+) superfluid vacuum* - their electrostatic charge must be the opposite to the elementary charge of *e*-hole. They have presumably similar 3*D*-hypertube's form (with ~1/$n$ times smaller loop radiuses, ~$n$ times bigger inertial mass, and the same fermionic spin ½, described above). We will use these structural features for creation of the (ud)- quark/antiquark cellular vacuum superfluid with very simple qualitative explanation of the quarks confinement/asymptotic freedom mechanisms (see chapter "Periodical quarks / anti-quarks hyperspatial *L*-tubes" below).

## PERIODICAL MATTER / ANTIMATTER WAVEGUIDS IN THE MULTIVERSE

Our second *basic hypothesis* of the waveguide's space design is the waveguide /anti-waveguide, i.e. literal physical (3*D*-space /3*D*-antispace) *division and adjustment* (Fig. 4.1). It seems to be the easiest-natural way to realize (in the context of the proposed, unifying physics, waveguide's concept) the existing symmetrical properties of electron and positron and total physical equality of the matter and antimatter worlds. The potential anti-physicist will discover exactly the same physical laws as we do. The Newtonian attractive gravity force arises between mass particles in the same 3*D*-waveguide, but it is not possible to create also the opposite (the membrane-like) electrostatic electron and positron charges in the same waveguide, with the opposite ±1/$r$ potential. We will show further that the proposed periodical space/antispace symmetry with its global *e*-cellular structure allows not only to solve this nontrivial problem, but it opens principally new opportunities to understand the old basic physical laws and (that is much more interesting) to predict the significantly new physical reality (as the Multiverse existence) on its base (Gribov 1999, 2003, 2005, 2007).

This new (periodical) space/antispace symmetry naturally creates periodical ±$M$-gravity mass and ±electrostatic charge symmetry for particle and antiparticle. At the beginning we have analyzed only the double-waveguide $|e-|e+|-$ structure, as the $\pm L_{oe}$ doubled waveguide's sandwich, consisting of two identical, symmetrical flat waveguides - $\mathbf{W_0}=(x,y,z,0<L<L_{oe})$ for *particles* and $\mathbf{W_{-1}}=(x,y,z,-L_{oe}<L<0)$ for *antiparticles*, (Gribov 1999, 2005). This "minimal" $\pm M_{gr}|e-|e+|$ hypersymmetry could be nearly associated with the similar symmetry, proposed by P. Dirac in his great 1928 work, predicted positrons (Dirac, 1928). We connect the Diracian ±$M$ symmetry for particle/antiparticle only with the gravity "charge" $\pm M_{gr}$, depending of the waveguide placement (the above waveguide +$M$ / the down waveguide –$M$), (Fig. 4.3 a, b).

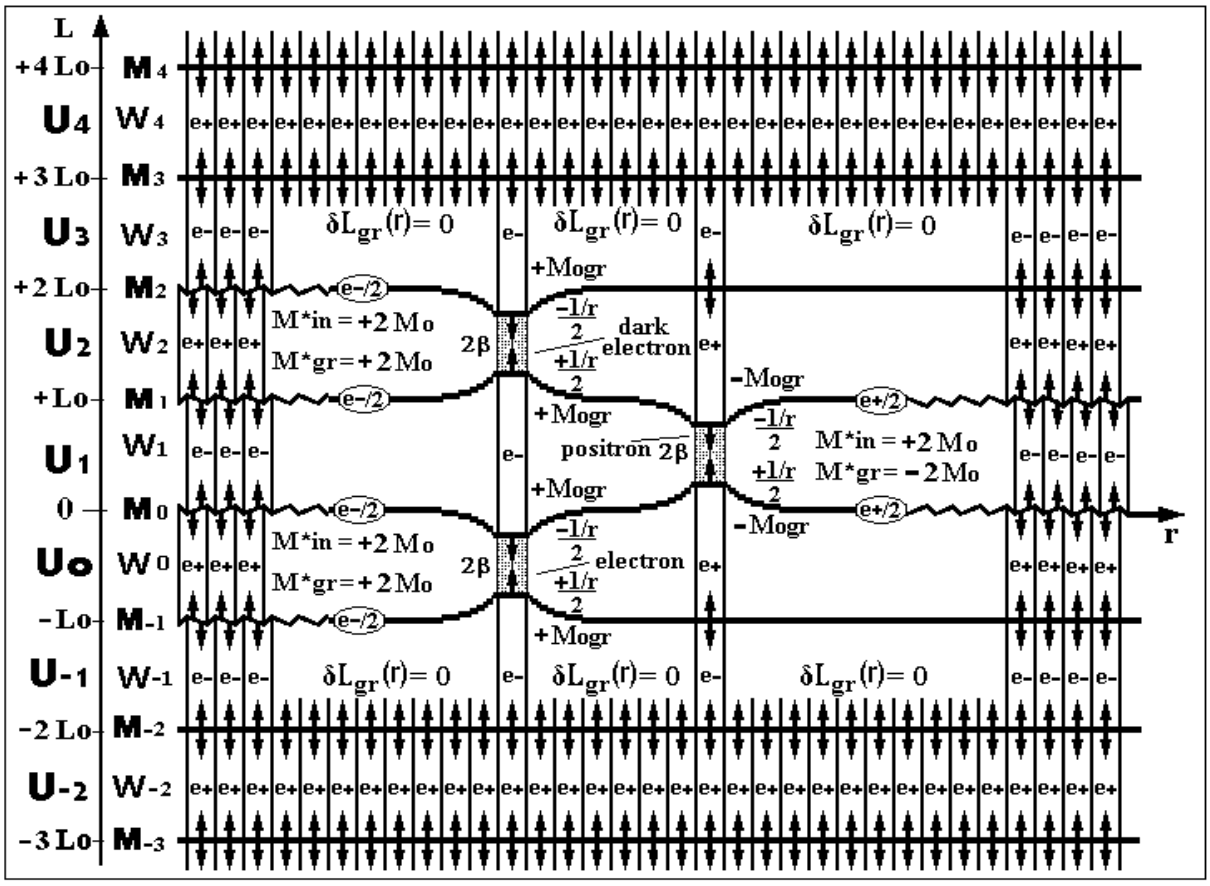



**Fig. 4.1** shows schematically a fragment of the $L_{oe}$-periodical 4*D*-space with endless number of quasiflat, adjusted and 3*D*-waveguides $\mathbf{W_n}$ , formed by the stretched quasiparallel 3*D*-membranes $\mathbf{M_n}$ (**n**=0, ±1; ±2; ±3….). All waveguides are densely filled by identical *e*-cells. Each even waveguide $\mathbf{W_{2n}}$ (by convention) contains electron cells (*e*-cell), and each odd waveguide contains positron cells (e-anticells), carrying the same dynamical energy $E_4=M^*_{oe}C_4^2$ >0 and positive inertial mass $M^*_{oe}$>0. Each *e*-cell is coupled with its *e*-anticell, realizing composite superfluid vacuum, built from (*e–/e+*) bosons. Adjacent *e*-cells layers are strictly divided by the dividing membranes $\mathbf{M_n}$ and cannot "annihilate" – but they are strongly - electrostatically coupled and form the layered, ghost scalar $(e–/e+)_{\mathbf{n}}$ bosonic "atoms" – non-gravitating, chargeless and spinless "grains" of our *3D*-vacuum. Periodical matter and antimatter particles arise as *e*-hole and e-antihole and are shown in three waveguides: $e_+$ hole (=electron particle) in the $\mathbf{W_0}$ waveguide of our $\mathbf{U_0}$-Universe; $e_-$ hole (=positron particle) in the $\mathbf{W_1}$ waveguide of the nearest $\mathbf{U_1}$-Anti-Universe; the nearest dark electron as $e_+$ hole (= dark electron particle) in the $\mathbf{W_2}$ waveguide of the Dark Matter Universe $\mathbf{U_2}$. These *e*-holes are defects; they break the total *e*-vacuum hypersymmetry and create elementary gravity and electrostatic potentials in it. The electron and the dark electron have the *half-overlapped* gravity potentials (created by the intermediate waveguide $\mathbf{W_1}$, which creates $\mathbf{W_1}$-gravity potential-layer, equal for the electron and for the dark electron). But their electrostatic potentials are reciprocally isolated – are hyperspatially *not "overlapped"* – they are created by (*x,y,z*) polarization ~$1/r^2$ of the (*e–/e+*)-atoms, acting *only* in the corresponding $\mathbf{W_0}$ and $\mathbf{W_2}$ waveguides (where these *e*-holes are located). These electrostatic polarizations corrugate the 3*D*-membranes $\mathbf{M_{-1}}$ and $\mathbf{M_0}$ for $e_0$-electron and (sufficiently different) membranes $\mathbf{M_1}$ and $\mathbf{M_2}$ for dark $e_2$-electron correspondingly. So, the electron and dark electron physically interact half-gravitationally, but are strictly "isolated" electrostatically, as the DM does. The $e_1$-positron *interacts equally gravitationally and electrostatically* with the $e_0$-electron and the dark $e_2$-electron and can be a perfect *mediator* for the electrostatic and electrodynamical interaction between our matter Universe $\mathbf{U_0}$, and the DM-Universe $\mathbf{U_2}$.

At the same time we assume that inertial masses of mass-particles and antiparticles are always positive – the inertial mass expresses the positive *dynamical energy* $E_{dynam}=M_{in}C_4^2>0$ in all waveguides (Gribov 2003, 2005). The positively signed inertial-relativistic mass $M_{in}$ is used, indeed in the famous Dirac's dynamical equations, describing electron and positron, where (by the convention) the electrostatic charges of electron and positron create the opposite signs. The discussed above condition $M_{in}C_4^2>0$ arises as physically natural and absolutely necessary base for the *supersymmetric properties* of the (*e–*/*e+*) cellular quantum superfluid in the periodical Multiverse (see below).

### *The space/antispace symmetry creates equivalence/anti-equivalence principles*

The proposed division between gravity and inertial mass of the elementary antiparticle breaks the common Einstein's Equivalence Principle (EP): indeed, it is now possible to detect outside gravity field in the freefalling (matter) laboratory by testing the positron gravity anti-acceleration in this laboratory. The free falling positron (or antihydrogen, etc.) will be *accelerated exactly in the opposite to the electron* direction in the same gravity field and so, the freefall-acceleration of the laboratory will be disclosed (see Fig. 2b). We will show further that the Einstein's EP is not the axiomatic principle anymore – it becomes the straight consequence of our waveguide's gravity concept (and moreover, it's, the old form, is applicable only independently - for matter, or antimatter particles, but their combination creates the "anti-EP principle" – assuming the anti-acceleration of the antimatter!

### *New relation between gravity mass and inertial mass*

The initial - Diracian $\pm M$ symmetry was sharply criticized and even strictly forbidden in physical community, as, for example, a "perpetual mobile" (but indeed, this critics is totally right only for the inertial mass $M_{in}$). The $\pm M_{gr}$ gravity "charge" symmetry for particles and antiparticles, arising in our periodical waveguided concept, has very good general cosmological DE&DM&SUSY supports. Till now there *was no any direct experimental confirmation* for the negative/or the positive gravity mass for the antiparticle in laboratories – it remains presumably the biggest "open experimental questions" in physics. Why? It is extremely difficult to realize the appropriate antiparticle's gravity test. The best opportunity is connected with the neutral antihydrogen gravity test at CERN, which uses deeply cooled neutral antihydrogen atoms (see below).

Our principal difference with the famous Dirac's proposal is following - we strictly distinguish gravity mass from inertial mass of the same antiparticle: Inertial (dynamical by the nature) mass $M_{in}$ of the particle and antiparticle are the same – positive, as the absolute temperature $T > 0$, or kinetic energy. The inertial masses equality expresses their identical dynamical nature ($M_{in} > 0$). Dirac never distinguished gravity mass and inertial mass, (following the Einstein's gravity theory). Indeed, his equations need always only inertial mass of involved particles – electrons or positrons and so have no formal discrepancy with the Einstein's positive mass concept.

We can always keep the $M_{in} > 0$ in all dynamical equations without gravity interaction, but the sign of gravity charge depends of the "above/bottom" sides ± pressure on the same dividing membrane $\mathbf{M_0}$, changing the pressure sign $\pm F_{\perp}$, since electron and positron press the dividing membrane from the opposite sides and create the opposite gravity potentials – the mirror-like deformations of the same membrane $\mathbf{M_0}$ (Fig. 4.1). These gravity $1/r$-deformations and corresponding gravity interactions are shown in the multilayered waveguide's (*e–*/*e+*) space (Fig. 4.2). The corresponding double gravity potentials are created (a) by $2F_{gr}$-attraction

between two *e*-holes (as two electrons) in the same waveguide; (b) by $-2F_{gr}$-repulsive electron and positron (as two one-step-shifted *e*-holes); (c) by electron and dark positron, being ½ attracted with $F_{gr}$ (as two-steps-shifted *e*-holes); (d) by gravitationally/electrostatically non-interacting ($F_{gr}$=0) electron and dark positron or dark electron (3 or *more* steps shifted *e*-holes), (see Fig. 4.2). The arising here periodical ±*gravity charge* of *e*-holes seems to be a new inevitable gravitational basics of the Multiverse-applicable elementary particle physics, especially inevitable for the Multiverse-cosmology and QED/QFT - it enables construction of the non-gravitating composite bosonic particles – ghost "atoms" - quantum spatial blocks of the proposed very dense *non-gravitating e*-cellular/anti-cellular superfluid vacuum tissue (see below).

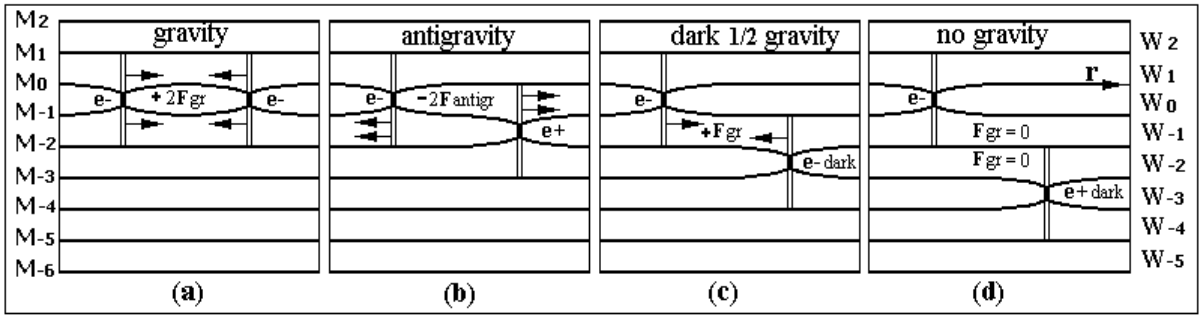
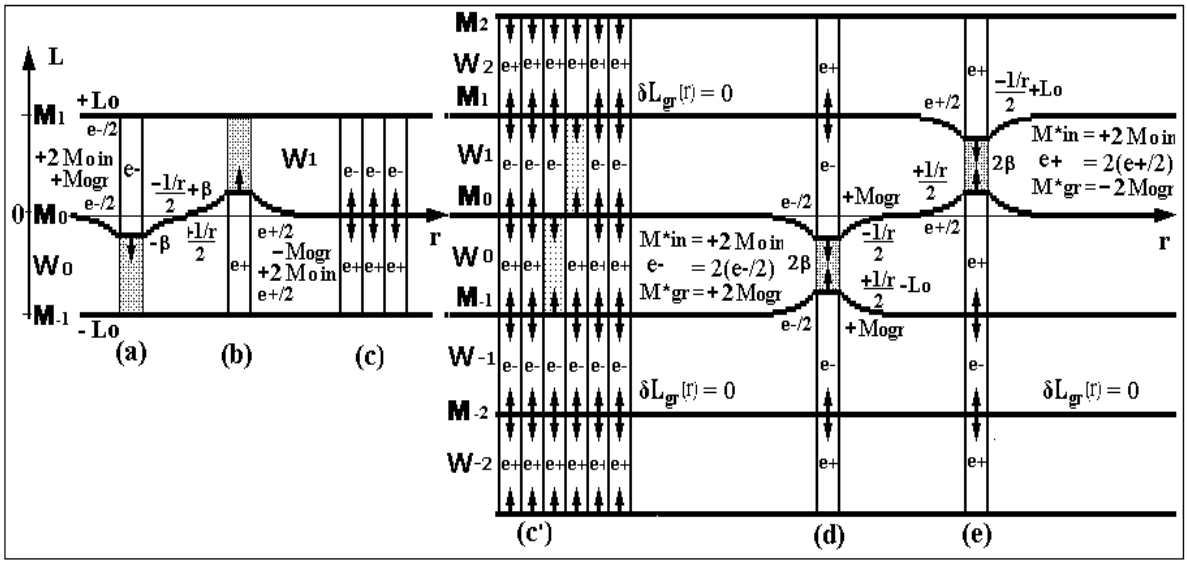



**Fig. 4.2 (a,b,c,d)** The corresponding double gravity potentials are created by
(a) two gravitationally $2\boldsymbol{F}_{gr}$-attracted matter electrons $e_0$ and $e_0$ in the same waveguide $\mathbf{W_0}$;
(b) two symmetrically $2\boldsymbol{F}_{gr}$-repulsed electron $e_0$ and positron $e_{-1}$ (one step shifted *e*-holes);
(c) two $\boldsymbol{F}_{gr}$-attracted electron $e_0$ and dark electron $e_{-2}$ (two steps shifted *e*-holes);
(d) gravitationally non-interacting electron $e_0$ and dark positron $e_{-3}$ (three $L_o$-steps shifted *e*-cell).

### *The $M_{in}$ versus $M_{gr}$ discrepancy in the waveguide's sandwich*

Initially, for simplicity, we have studied only the double (*e–/e+*) waveguide sandwich architecture: $\mathbf{W_0}$ and $\mathbf{W_{-1}}$ with the elastic middle membrane $\mathbf{M_0}$ and two non-elastic framing membranes $\mathbf{M_1}$ and $\mathbf{M_{-1}}$, (Fig. 4.3, a,b), (Gribov, 1999, 2005). We considered that only one – the middle tensioned membrane $\mathbf{M_0}$ is elastic and can be deformed, creating simultaneously the novel ±gravity and ±electrostatic ~1/*r* potentials (Fig. 4,3 a, b). We remember, that the "doubled" dynamical energy $E^*_{oe}$ of the very compact, dynamical electron vortex is radically relativistic and its "rest" mass – as the "rest" energy are doubled: $E^*_{oe}=M^*_{oe}C_4^2=2M_{oe}C_4^2$ and the corresponding dynamical inertial mass $M^*_{oe(inert)}$ of the "resting" electron vortex is now $M^*_{oe(\ inert)}=2M_{oe}$. We see here a transparent theoretical discrepancy of the electron inertial mass $2M_{oe}$ with the electron gravity mass $M_{oe(grav)}=M_{oe}$, corresponding to the single elastic membrane $\mathbf{M_0}$ consideration (Fig. 4,1a,b).

The so obvious discrepancy immediately disappears in the multilayered waveguide's 4*D*-space. This takes place if we return to the *multilayered periodical waveguide's* 4*D*-spatial structure, where all 3*D*-waveguides are *equal* and all of them are densely filled by the mono-layered *e*-cells - identical electron-cell vortexes …/e/e/e/e/… . The sign ($e_+$) or ($e_-$) depends exclusively of convention, but it is changed periodically from any waveguide to the nearest one (see Fig. 4.3 c',d,e below).




**Figures 4.3 (a,b,c,c',d,e)** show physically necessary, correcting shift (reduplicating gravity and electrostatic charge of electron, etc.) from the waveguide/antiwaveguide sandwich space (the left side, Fig. 4,3a,b,c) to the basic - periodical waveguide's 4*D*-space architecture (the right side, Fig. 4,3c',d,e,). Here arises a non-contradictive relativistic matter/antimatter concept as the "elementary defects-holes", arising in the corresponding cellular (superfluid) vacuum structure, reincarnating the "Electron Sea" and elementary "Electron-Holes" concepts by Paul Dirac.

**Fig. 4,3a** shows electron $e_0$ in the form of the symmetry breaking $e_+$ hole in the waveguide $\mathbf{W_0}$ in the "sandwich-like" space/antispace $\mathbf{W_0}$ / $\mathbf{W_1}$ structure, with 3 framing membranes $\mathbf{M_{-1}}$, $\mathbf{M_0}$, $\mathbf{M_1}$.

**Fig. 4,3b** shows positron $e_1$ in the form of the symmetry breaking $e_-$ hole in the waveguide $\mathbf{W_1}$ of the sandwich-like space/antispace.

**Fig. 4,3c** show the basic $\pm M_{oe(gr)}$ and the opposite $\pm Q_{oe(el)}$ electrostatic charge symmetry in the flat vacuum space/antispace, densely filled by identical (*e*)-cells, building coupled (*e–/e+*) pairs.

**Fig. 4,3c'** shows the proposed here periodical 4*D*-space structure, densely filled by the coupled (*e–/e+*) pairs, looking as a vertical "string-like" coupled (*e–/e+*) hyper-polymer's *L*-tubes.

**Fig. 4,3d** show electron $e_0$ in the multilayered waveguide's 4*D*-space in form of the "symmetry breaking" elementary $e_+$ hole in the $\mathbf{W_0}$, waveguide, surrounded by two the nearest symmetrical $\mathbf{W_{-1}}$ and $\mathbf{W_1}$ waveguides, reduplicating gravity "charge" ($2M_{oe(gr)}$) and electrostatic charge 2(*e–*/2) of electron, comparably to the previous sandwich space/antispace (**a,b**) on the left side.

**Fig. 4,3e** shows positron $e_1$ in the form of the symmetry breaking $e_-$ hole in the $\mathbf{W_1}$ waveguide, that creates the opposite to the electron gravity and electrostatic charges.

The 3*D*-layers of these spinning/anti-spinning "atoms" stabilize and flatten the neutral – non-gravitating, chargeless and spinless 3*D*-space/3*D*-antispace, realizing periodical 3*D*-monolayers of a non-dissipative, literally 3*D* -transparent and weightless quantum liquid at low *T*, where propagating bosonic quasi-particles are spin waves in this (e–/e+) superfluid, transporting electromagnetic energy along the 3*D*-waveguides. The 3*D*-spin waves physically realize our common light photons (and electron neutrinos). The mass creating 4*D*-waves could be the same – the "spin waves"-nature, but in the more fine-graded, also cellular-like spin/anti-spin liquid, filling the bulky 4*D*-volumes of waveguides. They could be muons/antimuons - performing the second lepton family and playing the same "atomistic" role on the next deeper vacuum level. These dipole-like (*e–/e+*) cells create an analog of the Van der Waals chemical potential, keeping them together as a dense liquid medium. Electron ($e_-$) is presented as a hole in the positron layer and can be described as an "elementary cellular defect" in this ideal, flexible quasi-crystalloid structure.

Electron (or positron) is here a single "*e*-hole" in this cellular periodical 4*D*-space. This $\mathbf{W_0}$-hole involves only 3 significantly deformed waveguides [$\mathbf{W_{-1}}$;$\mathbf{W_0}$;$\mathbf{W_1}$], and has only *two symmetrically curved membranes* $\mathbf{M_0}$ and $\mathbf{M_1}$, (Fig. 4.3 d,e), instead of the *single elastic membrane* $\mathbf{M_0}$ in the previous sandwich architecture (Fig. 4,3, a,b, left). These framing membranes $\mathbf{M_0}$ and $\mathbf{M_1}$ create duplicated gravity potential $2U_{oe(grav)}$ for the single electron *e*-"hole", with the corresponding *duplicated gravity "charge"* $2M_{oe}$ and also duplicated electrostatic potential $2U_{oe(electr)}$ and correspondingly duplicated electrostatic electron charge $q_e^*=2q_e$ (see below). The mentioned above discrepancy between the effective gravity and inertial masses of the electron disappears.

We confirm here an obvious physical need and adequacy of the *periodical multilayered w*aveguide structure, proposed some years ago as natural *hypothetical* extrapolation of the waveguide/anti-waveguide sandwich, naturally keeping physical - geometrical symmetry between matter and antimatter (Gribov, 1999, 2005).

### *Diracian $L_o$-segmented ±monopole pairs, arising in the periodical (e-/e+) hyperspace*

"Father" of the relativistic quantum mechanics and the antimatter paradigm was legendary Paul Dirac, who incorporated miracle (the 4*D*-hyperspatial by the nature) Einsteinian SR in the quantum mechanics and could obtain the right- fermionic electron spin together with the tremendous positron prediction. He was busy the rest of his life with some fundamental unsolvable problems such as electron self-energy singularity and charge quantization, etc. He wrote: "The quantization of electricity is one of the most fundamental and striking features of atomic physics, and there seems to be no explanation for it apart from the theory of poles. This provides some grounds for believing in the existence of these poles" (Dirac, 1948).

Our electron or positron particles are elementary *e*-cellular defects = *e*-holes. The cell/anti-cell symmetry breaking components (disclosing before hidden elementary physical charges) around the *e*-hole are *two free open ends* of the nearest elementary *e*-cells (above and below) in the *L*-hyperspace (Fig. 4.3 d,e). We can consider our elementary twisting *e*-waves as elementary (circular) electrical currents: if the *mechanical* circular movements of two adjusted *e*-cells have the opposite angular directions, we have at the same time two corresponding electrical currents *in the same angular direction* and the whole periodical (…|*e*−|*e*+|*e*−|*e*+|… ) *L*-hypertube looks like the *L*-endless (pico-thin, periodical $L_o$-segmental) solenoid with corresponding magnetic flow, going inside and along the *L*-tube parallel this axes. The elementary *e*-hole is a cat-off of the single-elementary *e*-cell $L_o$-segment and it is equal to cutting away its elementary current loop. We have here exact analogue to the classical endless monopole "strings", but with the obvious hypersymmetry - there are always two tiny magnet poles with the opposite elementary ± magnet charges on the $L_o$-distance from each other. Indeed, the hypothetical elementary Diracian monopole is presented in our *e*-cellular vacuum, being coupled together with the elementary *e*-cellular defect, but we have here *always two the opposite-equal, 3D-coaxial magnet charges* on very short distance $L_o$ between them in the 4-th spatial dimension. They are placed in the same 3*D*-center in our classical (*x*,*y*,*z*) subspace. So they exist but they well cancel each other and cannot be detected in this case (on the contrary to the doubled electrostatic charge of the *e*-hole)! The Diracian picometer-sized monopole is unavoidably "married" with the picometer-sized (the cannot be divided) antimonopole and in the summary it looks like a kind of the same ghost, as the ghost (|*e*− |*e*+|) vacuum cell. It is why there is no any experimental proves for the monopole existence, or existence of the (*e*− /*e*+) "atoms" of our ghostly vacuum – they are miracle ghosts, being coherent part of the whole ghostly nongravitating vacuum! We realize many

times (also in the Diracian monopole theory) that perfectly hidden involvement of the 4*D*-hyperspace with the proposed here periodical 3*D*-waveguide's modules is unavoidable on the way, unifying the SR&QM&SUSY, etc. (see below). "Rips" of the hyperspatial "zebra" arise as exotic "fishes" here and there in the fundamental Einsteinian & Diracian physical concepts, being sufficiently hyperspatial - waveguided by their physical nature.

### *The nature of the Planckian-Einsteinian photon and neutrino spin*

The cophased $\lambda_{de\ Broglie}$ wave is twisted *two times* around the cylindrical electron attractor. This relativistic, coaxial double-loop could be considered formally as consisting of two half-spinors $S_e = h/8\pi + h/8\pi$. In this case our undisturbed ($e–/e+$) coupled pair has zero spin with the minimal energy in the spins coupling, described as:

$$S_{coupled(e–/e+)} = (h/8\pi + h/8\pi) - (h/8\pi + h/8\pi) = 0. \quad (19a)$$

But it could be disturbed, creating the elementary bosonic spin of photon $S_{photon} = h/2\pi$:

$$S_{coupled(e–/e+)} \rightarrow S_{photon} = (h/8\pi + h/8\pi) + (h/8\pi + h/8\pi) = h/2\pi, \text{ or as} \quad (19b)$$

$$S_{coupled(e–/e+)} \rightarrow S_{neutrino} = (h/8\pi + h/8\pi) + (h/8\pi - h/8\pi) = h/4\pi. \quad (19c)$$

There are two basic types of elementary massless spin waves (19b,c) in the ($e–/e+$) quantum superfluid.

## THE PERIODICAL LEPTON/ANTILEPTON QUANTUM VACUUM PARADIGM

We proposed in our previous work (Gribov 2003, 2005) very natural cause of the structural similarity and structural succession between existing leptonic $\boldsymbol{V^n}$ vacuum families:

$\boldsymbol{V^4 = V^3 + 1}$ → **(*e*–/*e*+).** This is our global $\pm M_{oe}$-hypersymmetric ($e–/e+$) level, providing the common global Einstein-Lorentz invariant and the global QED-gauge invariant simultaneously. We have here 3*D*-globally massless quasiparticles – bosonic spin waves in the nongravitating ($e–/e+$) 3*D*-superfluid medium (the light $C_3$-photons of Einstein – carrying energy bosons with spin $S=1$). This is the massless vacuum of Maxwell's equations, classically describing the above mentioned - the global – and the most fundamental for us ($e–/e+$) vacuum. But this global – basic vacuum must contain its mother-vacuum-superfluid, consisting of the more fine-grained nongravitating "atoms" filling the $\pm L_{oe}$ waveguides. Indeed, the electron 4*D*-wave inside the substantial 3*D*-waveguide has exactly the same light velocity $C_4$! It must be similarly periodically layered, ghostly superfluid and second lepton family - muons realize its periodical "atomic" ($\mu$-cellular) structure, (see below). The correspondence principle is that the muon-hole creates the same electrostatic charge in the *e*-waveguide as the electron hole does.

$\boldsymbol{V^5 = V^4 + 1}$ → **($\mu$–/$\mu$+).** The mother-vacuum seems to be the next heavier lepton - muon, building massless composite "mini-atoms", the common muonic quantum liquid, having now locally absolutely the same massless properties, as the ($e–/e+$) quantum liquid. The electron $\boldsymbol{C_4}$-*e*-wave has the same maximal 3*D*-velocity $C_3$ in the waveguide, filled by the muonic quantum liquid. This means that the second – the muonic vacuum composite is also a

massless fermionic / anti-fermionic composite, consisting of the $\pm M^*_{o\mu}$-hypersymmetric coupled ($\mu$–/$\mu$+) Cooper-like pairs, building superfluid. These Cooper-like muonic attractors have much more thin muonic waveguides with $\pm L_{o\mu}=\lambda^*_{o\mu Compt}$ where the $\lambda^*_{o\mu Compt} = h/M^*_{o\mu}C$.

$\boldsymbol{V^6=V^5+1}$ **→ (*τ*–/*τ*+).** We could extend this general genealogical logic, to ever deeper leptonic generations and propose that the mother of the muonic vacuum – i.e., the grandmother of the ($e$–/$e$+) vacuum – is the $\pm M^*_{o\tau}$ hypersymmetric quantum liquid, consisting of the ($\tau$–/$\tau$+) and locally massless Cooper composites.

$\boldsymbol{V^7=V^6+1}$ **→ (*vera*–/*vera*+).** It follows that the last one, the ($\tau$□/$\tau$+) leptonic family simply might to have also the hypersymmetric quantum liquid unless it too has it own, now not yet known dear grandmother! Let us suggest a new name, the leptonic-Vera family (Vera is the name of my own dear mother from Hebrew/Russian name "Faith". It is miracle, but all our step-down vacuum families seems to have their $\pm M^*_{o(i+1)}$ − hypersymmetric foremothers! Our microcosmos could be unlimitedly decreasing, a fractal-like discrete structure, looking like Russian Matryoshka dolls, perhaps without the minimal "end-atom" in it. The fermionic $e$-cell's-spin $S$=1/2 does not depend of the waveguide thickness $L_o$ and this basic circumstance creates universality for the elementary $C_n$-action transport in all known vacuum's levels: Here seems to be the nature of common universality of the Planck constant $h$, applicable for all physical fields.

## THE SPIN-WAVE NATURE OF THE PLANCKIAN CONSTANT h

The fundamental Planckian constant $h$ was historically proposed only for the quantization of electromagnetic radiation (EM-field). This constant was later successfully applicable for all other physical fields, except gravity field. Today, after more than 100 years of its discovery "the physical origin of both quantization and universality of Planck's constant remains mysterious, as well as other 'peculiar' properties of quantum dynamics." (Kirilyuk 2001). The described above "spin wave"-action seems to be this natural energy carrier along the spatially quantized - cellular/anticellular composite medium, consisting of e.g. the ($e$–/$e$+) composites. The undisturbed composite consists of two hidden symmetrically spinning/antispinning particles with the summary zero spin $S_{\text{summ}}=h/4\pi-h/4\pi=0$ and disturbing of this zero spin opens opportunity to understand the Planckian "action constant" $h$ nature: it is simply equal to the elementary action – the "massless" *bosonic* spin-disturbance - the discrete switching from the undisturbed-stable zero spin state $S_{\text{summ}}=h/4\pi-h/4\pi=0$ to the stepwise-disturbed composite ($e$–/$e$+)-spin within the unstable state $S_{\text{summ-disturb}}\rightarrow h/4\pi+h/4\pi=h/2\pi$. The ($e$–/$e$+) composite expresses the cophased dynamical system, living as ideal-superfluid structure with the minimal dynamical energy inside. The minimal - $h/2\pi$ action means that this dynamical spin-distortion will be immediately "kicked out" of the ($e$–/$e$+) atom and … presented to a neighbor ($e$–/$e$+) atom (and so on) as the *elementary bosonic EM-quasiparticle*. Thus, the minimal-elementary discrete Planckian action is $C$-transported forever without absorption in the ideal vacuum superfluid with the minimal (for us zero) energy density level (free of defects). The *discrete-stepwise* $S=0\rightarrow S=1$ bosonic spin switching in the atomistic vacuum is crucially important, since these elementary bosonic actions-quasiparticles are able to condense into the bigger Einsteinian photons (as spin-wave quasiparticles) with $E=h\nu$ and $S=h/2\pi$. This grandiose coherent superfluid picture explains why common light photons are the fastest (massless), non-dissipative energy transporter along our 3$D$-space.

Why is the Planckian constant *h* universal for all different fields? We proposed further that our 3*D*-waveguides must be filled by the "one step thinner"- leptonic, non-gravitating quantum liquid medium from internally hypersymmetric and superfluid muon/antimuon composites ($\mu-/\mu+$), (Gribov, 2005). The electron *e*-wave quantum $E_e=h\nu_e$ moves with the 4*D*-light speed $C_4$ in the 3*D*-waveguide's 4*D*-bulk (as it was shown above) and could exist as similar collective bosonic spin wave (being quasiparticle and carrying $E_4$-energy and spin $S$=1 across waveguide's vacuum medium). We assume that these $C_4$-light quasiparticles live in the ($\mu-/\mu+$) superfluid medium. They arise the same way as arise the Einsteinian $C_3$-photons, but now in the $\mu-/\mu+$) quantum superfluid with the same bosonic-carrier spin $S_{ph}$=1 nature. Our massive electron $C_4$-wave's quasiparticle looks exactly as the Yang-Mills gauge-field *C*-particle, which has also bosonic internal spin $S_4$=1, but it has the hyperspatial $C_4$-light speed properties and esquires the rest mass in the 3*D*-waveguide! Of cause, it looks like common *massless* 3*D*-photon of Einstein in the Yang-Mills theory, building Maxwell electromagnetic waves. So, the Yang–Mills field quasiparticle, if living in the pure 4*D*-space of the 3*D*-waveguide and being stable, describes the twisting (fermionic) electron with resulting isospin $S_L$=1/2 and corresponding rotational group *SU*(2). This *e*-wave vortex keeps the local gauge invariance and simultaneously acquires the "impossible" dynamical rest mass with the waveguided rest mass gap, which cannot be less when the first rest mass harmonics, related to the rest mass of electron.

## THE SUSY NATURE – THE GHOSTLY COOPER-COMPOSITE BOSONS

Supersymmetry (SUSY) is so promising theoretically, but is so missing experimentally. Steven Weinberg dedicated his III-th volume of "*The quantum theory of fields*" to supersymmetry and noted the supersymmetric theories of fields have unique physical properties, missing in other field theories, but "unfortunately, after a quarter century there is no direct evidence for supersymmetry, as no pair of particles related by a supersymmetry transformation has yet bin discovered. There is just one significant piece of indirect evidence for supersymmetry: the high-energy unification of the *SU*(3), *SU*(2), an *U*(1) gauge couplings works better with the extra particles called for by supersymmetry than without them" and many other physicists "are reasonably confident that supersymmetry will be found to be relevant in the real world, and perhaps soon." (Weinberg 2000, p. XVi). Supersymmetry could solve the fundamental problem of very small cosmological constant in the QED vacuum. Cosmologist Ta-Pei Cheng writes: „The introduction of the cosmological constant $\Lambda$ in the GR field equation does not explain its physical origin." (Cheng 2005, p. 280). In the inflation model it represents the false vacuum energy of an inflation/Higgs field. However, the quantum vacuum "zero-point" energy density $\rho_{vac}=2\text{x}10^{91}\text{g/cm}^3$ is too large ($\sim 10^{124}$) for $\Lambda$. This is the tremendous quantum vacuum problem, surprisingly deeply contrasting with the excellent - the most precious theoretical QED predictions.

The wave function of bosons/fermions is symmetric/antisymmetric and the bosonic quantum vacuum energy is positive, but the fermionic vacuum energy is negative. This fundamental theoretical fact led to common salvatory hypothesis of the "supersymmetry", reducing the monstrous $10^{124}$ discrepancy, equalizing somehow the bosonic and fermionic degrees of freedom, so that resulted summary vacuum energy will vanish to the experimentally proofed zero level (Gol'fand, Likhtman 1971; Wess, Zumino 1974). All existing supersymmetric theories pair known bosons with unknown fermions and known fermions with unknown bosons. These ways were invented new necessary supersymmetric particles partners –

"sparticles": for example, for electron must exist a "selectron" with the same electron mass but with zero spin, etc. Unfortunately, these hypothetical supersymmetric partners were never detected experimentally and this very surprising obstacle led to an additional rescue idea that the supersymmetry is yet real, but it is somehow broken at low energies and exists at higher energies - above the achieved on the best colliders. Cheng estimates these hypothetically "broken" supersymmetric corrections - they reduce the monstrous zero-vacuum energy fare not enough - from $10^{124}$ to about $10^{80}$. "Clearly, something is missing in our understanding of the physics behind the cosmological constant." (Cheng 2005, p.282).

We introduce this laterally "missing" physical piece", since our hypersymmetric vacuum concept has own *supersymmetric ghosts composites* for each arising virtual electron / positron pair – existing in the form of the supersymmetric scalar (*e***–**/*e*+) composite with exactly the same double *inertial mass* $2M^*_{oe}$, as its defect - two virtual ($e_-$) and ($e_+$) fermions! The natural microscopic equilibrium between the (*e***–**/*e*+)-coupled and virtual-decoupled ($e_-$)*;* ($e_+$) pair states vanishes their contribution to the zero-vacuum energy to zero! We remember that the summary gravity mass of the (*e***–**/*e*+) composite particle is zero, as it is also with the summary gravity mass of the decomposed virtual pair. Hence, our very dense quantum vacuum medium – the (*e***–**/*e*+) superfluid is nongravitating! This way the supersymmetry is reincarnated, but absolutely without need in exotic elementary *s*-particles – on the Cooper-like "composite" base, composing them from the "old" elementary particles family. We find here surprisingly simple, and at the same time basic argument, solving the monstrous "$10^{124}$" problem, saving the QED and the SM and strongly supporting our hypersymmetrical (*e***–**/*e*+)-atomistic, superfluid vacuum concept. For example, a decoupled virtual quark/antiquark pair, like *u* and $\underline{u}$, also must have its supersymmetric Cooper-composite – the coupled ($u/\underline{u}$) bosonic pair, etc. We can exchange all the *s*-particles by the corresponding Cooper-composites from existing fermions and antifermions! It is now well understandable, why super-symmetrically arranged Feynman diagrams contain many component-field diagrams, which rise to miraculous cancellations of divergences.

K. Moriyasu writes very similarly about common Higgs field: "In the Weinberg-Salam theory, the Higgs field is analogous to an old-fashioned "aether" which pervades all space-time. It acts like a continuous background medium even at very short distances. … We saw in the case of the superconductor that the Higgs field was a composite system of electrons bound into Cooper pairs. … Could the Higgs field for the WS theory also be a composite system of bound particles? Unfortunately, the analogy with the superconductor breaks down because there is no background atomic lattice in the WS theory to provide the binding force." (Moriyasu, 1983, p. 120). Gerard 't Hooft also mentioned the composite possibility for the other scalar particles – the Higgs bosons: "…similar to the so-called Cooper pairs of bound electrons that perform a Higgs mechanism in ultracool solid substances, leading to superconductivity. Just because such phenomena are well known in physics, this is a scenario that cannot easily be dismissed" ('t Hooft 1999). Now we can say that this physically thinkable scenario indeed exists and looks very realistic and fruitful – as the much more robust "low energy analogue" to the "background atomic lattice". It arises naturally in the proposed concept of the periodical waveguide's hyperspace, etc. where very simple and very strong (electrostatic) binding mechanism creates periodical scalar (*e***–**/*e*+) field as the superfluid condensate, consisting of very stable "ghost" (*e***–**/*e*+) composites, reanimating exactly the "ether-like" - atomistic vacuum (the "background atomic lattice in the WS theory", now built from the well known particles - elementary fermions/antifermions (leptons and quarks). This way is created the exactly supersymmetric QED-vacuum, being nongravitating for different thinkable vacuum levels, with the resulting zero vacuum energy

density! So, our periodical 3*D*-waveguide's concept clearly exchange (and excludes) common Higgs field; instead arises the unifying and consistent - the waveguided mass creation mechanism with Cooper-like electron/positron composites and unthinkable before summary zero gravity "charge", electrostatic charge and spin! The first CERN-results on supersymmetry from Large Hadron Collider (LHC-2010-2011) did not fined sparticles - heavy copies of the SM particles and common SUSY theory falls in deep "troubles" with less and less hopes to be through. Indeed, ATLAS and CMS independently exclude such "sparticles" with masses less than roughly 900 GeV. But on the contrary, the miracle Cooper-like composites, arising in frames of the periodical Multiverse concept, survive and reincarnate the "illusive" SUSY, and properly explain steady experimental absence of the searched elementary (now *basically ghost*) sparticles → composite scalar bosons.

### *Where are our "wanted" supersymmetric composites from?*

Why we cannot test them experimentally? This is may be the trickiest story in the elementary particle physics. It looks like a joke of God, mystifying his intelligent-creative creatures, trying to understand his miracle physical world. Why we cannot find them? The answer is very easy – the "wanted" ghost's composites are not any more independent single objects in the cellular quantum medium – they become immediately incorporated coherent parts in the restored vacuum celled body - being for us a holistic, coherent quantum "*emptiness*"! These coupled composites are simply *non-sensible for our physical devices* (devices being made of the cellular defects). This strange story remembers the old tale about a "naked king" – his miracle physical clothiers look like our " ghost" ($e$–/$e$+) ether – as very-very light medium, so
light that it becomes totally invisible!

Young Einstein rejected the idea of ether, reasoning that we don't need this hypothesis in his so self-consistent SR. He concluded that inability to detect absolute motion relatively the hypothetical ether means that it is fundamentally undetectable and theoretically could be excluded from the theory. Later he returned back to its physical possibility and "naive" Dirac even filled our space with the hypothetical electron sea, considering positron as electron hole in it! Historically it became may be the most controversial, difficult question for its constructive physical understanding and development. The best physicists were always very near to this difficult topic (Lorentz, Einstein, Dirac, SUSY-authors, etc.), but its physical sense was always escaping, laughing as a "ghost" clown about never-ending human blindness!

## NAIVE UNIFICATION GRAVITATIONAL AND ELECTROSTATICS FORCES

### *The* ±Q*-Electro-Mechanical-Membrane Analogy (EMMA)*

R. Feynman showed that surface of a thin, elastic-stretched two-dimensional flat ($x,y$)-membrane with very strong surface tension $\tau$=*const*, works as the excellent *geometrical analogy* to ±electrostatic potential $U_{el}(x,y)$ – expressed by tiny static membrane $L$-deviations $\delta L(x,y) \sim U_{el}(x,y)$ from its flat state $L(x,y)$=constant (Feynman, et al 1966, v.2/5 p. 243-246). The orthogonal mechanical force $f_{\perp} = f_{\mathrm{L}}$ is the exact analog of ± "electrical charge" (if we imagine two cylindrical pencils with radius $R_o$, pressing the ($x,y$)-membrane surface from its opposite sides with the same force $\pm f_{\perp}$ ). The $\pm Q$ charges (and $\pm U$ potentials) are realized by the opposite $\pm f_{\perp}$ pressure, oppositely deforming this membrane, (Fig. 5).

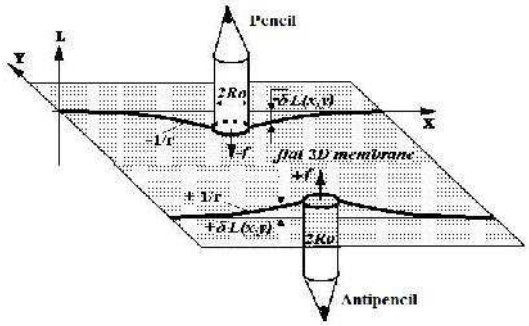



**Fig. 5** shows the "electromechanical membrane analogy" with visualized charge-anticharge (as mechanical pencil - anti-pencil pressures), described by Feynman. It obtains the fundamentally important physical sense in the 3*D*-waveguided-membrane ~1/*r* gravity, including periodical waveguide/antiwaveguide 4*D*-space architecture, containing periodical matter/antimatter particles.

If $\delta L$ deviations are tiny, $\delta L(x,y)\approx 0$, the membrane surface tension $\tau(x,y)\approx const$ and we derive, according Feynman (Feynman, et al 1966, v.2/5 p. 243-246), common physical equation

$$\nabla^2 \delta L(r) = - f_{\perp}/\tau \qquad (20)$$

It is the exact analog of electrostatic potential $\pm U(r)$ for charge $\pm\rho/\varepsilon_o$ in the equation

$$\nabla^2 U = -\rho/\varepsilon_o, \qquad (21)$$

(Id. p. 245). This deviation corresponds to the electrostatic potential $U\sim\ln(1/r)$ of a regularly charged endless cylindrical rod with the radius $R_o$. Feynman notes: "Distortions of a three-dimensional elastic body also are governed by similar equations, but we will stick to the two-dimensions." (Id, p. 245). Other words, the equation (20) will be the same also in the case of the 3*D*-membrane, realizing now deformation of the thin, tensioned flat 3*D*-elastic membrane (immersed into the Euclidean 4*D*-space (*x*,*y*,*z*,*L*), being now the 3*D*-EMMA analogy to the 3*D*-potential $U\sim 1/r$ of a charged sphere with radius $R_o$. Feynman never developed the 3*D*-EMMA, what incorporates gravity into the whole physics and allows understanding of gravity and electrostatic potentials similarity (Gribov 2005). Thus, now we generalize very important hyper-symmetrical 3*D*-membrane's analogy, exactly mimicking the Newtonian gravity/Coulomb-electrostatic potentials ~1/*r* as tiny hyperspatial $\delta L(x,y,z)$ -deviations of the initially flat 3*D*-membrane:

$$\delta L(x,y,z) = \delta L(r) \sim \pm 1/r, \qquad (22)$$

corresponding to the 3*D*-potential of a regularly charged sphere with, e.g., the form-factorized radius $R_o=R_{oe}$. Here arises the further fundamentally important feature – this visualized "gummy" potential has no classical singularities $U(r=0)=\pm\infty$ at all, since the $R_{oe}>0$: we have $\delta L(r)= \pm 1/r$ for $r\geq R_o$ and it is strictly constant in the small flat area $0\leq r\leq R_o$.

$$U\,(0\leq r\leq R_o\,) \sim \pm 1/R_o = \delta L(0\leq r\leq R_o\,) = constant \qquad (23)$$

### *The ±M-Gravito-Mechanical-Membrane Analogy (GRAMMA)*

The described above electro-mechanical-membrane analogy (EMMA) has the straight *geometrical* correspondence to the gravity potential, arising in our $L_{oe}$-waveguide, shaped by two parallel, tensioned elastic 3D-membranes (Gribov 1999, 2005). The identical 3*D*-waveguides in the proposed periodical waveguide's hyperspace are divided by their parallel,

tensioned flat 3*D*-membranes $(x,y,z,\mathbf{n}L_{oe})=\mathbf{M_n}$, where **n** = **0, +/-1, +/-2, +/-3…** (Fig. 4.1). So, the 3*D*-membrane $(x,y,z,L=0)=\mathbf{M_0}$ strictly divides two adjacent $\mathbf{W}_{e+}$ and $\mathbf{W}_{e-}$ waveguides in our periodical waveguided hyperspace, where our Universe is centered in the $\mathbf{W_0}$-waveguide. Very small *L*-deviations $\pm\delta L(x,y,z)\approx 0$, resulting from $f_\perp=\pm f_L$ acting on these 3*D*-membranes, create corresponding gravity/antigravity potentials $\pm U_{gr}(x,y,z)$, being now physically "materialized" as slightly ±curved membranes surfaces, according to the equation (8):

$$U_{gr}(x,y,z) \approx \pm\delta L(x,y,z)C^2_4/L_{oe}, \qquad (24)$$

This miracle GRAMMA/EMMA-correspondence allows connection the both - Coulomb-electrostatic and Newton-gravity potentials nature with the same source - the Newton-like middle 3*D*-membrane deviations $\pm\delta L(x,y,z) = \pm\delta L(r) \sim \pm 1/r$. The universal sense of the proposed 3*D*-membrane-like gravity mechanism arises in the periodical waveguided space from the linear $\pm\delta L(r)\approx 0$ GRAMMA-analogy. In the linearity of "near zero"-deviations is hidden the hyperspatial physical nature of the 3*D*-Poisson equation and corresponding *superposition principle* in the "Poisson" physics. Notably, the GRAMMA/EMMA open reasonable physical legitimacy for the simultaneous electrostatic charge ±*Q* and gravity "charge"=mass $\pm M_{gr}$ symmetry in our periodical electron/positron space/antispace (Gribov 1999, 2005). Free electron ($e_-$ /…) or positron (…/$e_+$) arise in the ($e_-/e_+$) cell as absence of the opposite fermionic partner – as the *e*-hole in the opposite-adjacent anticell side, that creates a local cellular symmetry break with resulting global deformations of the whole *e*-cellular vacuum medium, realizing the *geometric-dynamic gravity mass = gravity charge* with its tiny gravity potential $U_{gr} \sim \pm 1/r$, applicable for very small membranes deviation ($\beta\approx 0$). This "defected"=asymmetric *e*-cell creates the doubled orthogonal gravitational pressure $2f_\perp=\pm 2(h\nu_{oe}/L_{oe})=\pm 2M_{oe}C^2/L_{oe}$, breaking full hypersymmetry in the *e*-cellular vacuum (see Fig. 4.3d,e). We remember that the *inertial mass* of identical electron or positron *e*-cells is at the same time always positive (independent of a 3*D*-waveguide's number in the periodical 4*D*-Multiverse) and is measure of the $C_4$-dynamical energy $E_4>0$, identical in all *e*-cells, filling the Multiverse. But membranes deformations and corresponding gravity potentials have the opposite ± signs, changing $L_{oe}$ –periodically in the global 4*D*-Multiverse.

*Note:* Famous Soviet physicist Juri Rumer, friend of Lev Landau, who spend many years in Gulag prisons, noted about the GR: "Theory of gravity could never provide a satisfactory answer to the question – how do gravitating matter bends space in which it is localized" (Rumer 1956, p. 29). The discussed above periodical, hyperspatial *waveguide's nature* of gravity/antigravity explains this space-bending machinery and, moreover – the (quantized) equivalence principle itself naturally arises as consequence in the described above elastic 3*D*-membrane deformation under the *L*-hyperspatial (*x*,*y*,*z*)-orthogonal wave-particle pressure $f_\perp$.

### *The "hidden" reciprocal ±M symmetry creates the relation $F_{el}/F_{gr}\approx 10^{42}$*

Einstein tried to realize his famous fields' unification program after very impressive, vertiginous success of his general relativity (GR) theory. He hoped to find a kind of universal *geometrical* language for the unification, partially developed in the GR, but at the same time he did not realize how quantum aspects of matter could be incorporated into his theory. He hoped that the quantum properties would arise in a geometrization of classical fields. Einstein worked the rest of his life (from 1916 till 1955) on this fundamental problem, applying his insightful ideas of geometrization. But the hardest challenge lies in the "terrible" fact that the

difference between gravitational and electrostatic fields of electron is enormously huge number (~$10^{42}$).

We will show below, that the unification gravity and electrostatics could be derived practically on the similar *geometrodynamical* way, using enough simple *geometrization logic*, summarized below:

(a) Existence the proposed *periodical* 3*D-waveguide's hyperspace structure* with periodical *space-antispace symmetry* & the *dynamical concept of the mass particle/antiparticle* as surprisingly compact geometrodynamical base, generating and unifying the SR & GR & QM & SUSY with simultaneous explanation of the DE&DM, etc. cosmological miracles.

(b) The corresponding *geometrodynamical* concept of hyperspatial particle-antiparticle interaction and annihilation leads to existence of very stable coupled (*e***–**/*e*+) scalar bosons – tiny equal "ghost atoms" densely filling the *e*-cellular superfluid vacuum medium (Gribov 1999, 2003, 2005).

(c) The introduced physical design imposes a *strong non-linearity* of the 4*D*-medium in the 3*D*-waveguide for waving-twisting *C4*-quasiparticles, propagating inside the 3*D*-waveguide (common for the hypothetical Yang-Mills fields of the SM), creating the self-focusing effect, realizing *quantum-geometrical particle design* – as $R_{oe(rel)}$-spinning *$C_4$-electron*-wave, confined in the 3*D*-waveguide (Gribov 2005).

The introduced periodical space-antispace 4*D*-symmetry realizes radically new *geometric-dynamical*, periodical matter-antimatter concept – the presumably endless periodical Multiverse. The middle elastic membrane $\mathbf{M_0}$ divides spatially the quasi-plane $\mathbf{W_1}$-matter and $\mathbf{W_0}$-antimatter waveguides - two adjacent and divided 3*D*-shells (Fig. 4,1a,b,c). The elementary particle/antiparticle creation means creation of two adjacent stable holes - (hole/antihole) - two hypersymmetrical elementary defects in the ideal *e*-cellular, hyperspatial vacuum tissue, what acquires tiny hypersymmetry breaks – tiny deformations – arising non-locally as classical-quantum fields around the holes in initially fully symmetrical (ghostly) vacuum tissue (Fig. 8). Each hole acquires its effective inertial mass, equal to the inertial mass of the defected *e*-cell. This effective inertial (positive) mass-energy $E=M_{in}C_4^2$ is implanted into non-local (wave-dynamical), tiny gravitational and huge electrostatic deformations, adding this positive (above zero) energy into the initially minimal vacuum energy. Indeed, Feynman noted in his famous physical lectures that rest mass energy of electron is implanted in its electrostatic energy (Feynman et al. 1966). The backward hole/antihole annihilation means annihilation-disappearing of two the opposite holes and annihilation-disappearing of their the opposite non-local potentials. This annihilation leads to resulting coupling of the decoupled *e*-cells - restorations of the coupled (*e***–**/*e*+) atom and minimization of the whole vacuum energy density. The above-energy of these annihilated potentials is now literally "collapsed" - kicked out from the whole ideal vacuum tissue - is liberated as two EM-gamma quanta, carrying full dynamical energy $2M^*_{oe}C_4^2$ of the annihilated field/anti-field. So, the annihilation not only creates two gamma quanta and "kills" two holes, but it restores the coupled cell/anticell symmetry - restores the ideal vacuum tissue with its minimal (conventionally zero) vacuum energy. The coupled *e*-cell and *e*-anticell are divided by 3*D*-membranes – they are not able to "annihilate" each other – on the contrary, they build the radically new composite particle, being very stable "elementary ghost" – composite – "Cooper-like" scalar boson, realizing our very stable (*e***–**/*e*+) composite vacuum "atoms". They fill densely all periodical 3*D*-waveguide' "sandwiches" of our Multiverse and realize a liquid-like, ideal "atomistic" vacuum tissue, with correspondingly non-gravitating, chargeless,

spinless superfluid properties. Surprisingly - the simplest – composite scalar ($e$–/$e$+) bosons seem to be the most important (and non-contradictory) *ghost* physical "actors", densely populating the whole Universe, ultimately replacing the "elusive" bosonic Higgs "ether". Our quantum vacuum superfluid dictates basic physical laws of the holistically coupled periodical hyperspatial (supersymmetrical) ocean, where the mass particles are surprisingly very rare holes / anti-holes defects in it. These elementary defects exist together with also enough rare 3$D$-massless bosonic photons – $C_3$-quasiparticles, tirelessly transporting energy across the vacuum superfluid. They are electron-positron spin waves, propagation along 3$D$-waveguides with the light speed, forming the common 3$D$-photons of light quanta. This vacuum is the idea, non-dissipative atomistic quantum superfluid, carrying its "elementary 3$D$-massive defects" – like tiny "elementary" bubbles in water – without friction for $V_3<V_{\text{critical}}=C_3$, and also carrying freely propagating 3$D$-massless bosonic quasiparticles – spin waves, transporting energy along this ideal cellular quantum superfluid – causally – from atoms to another atoms without $e$-cells defection!

The coaxial, coupled ($e$–/$e$+) pair has its hypercylindrical structure, looking for us (three-dimensionally) as a thin 3$D$-spherical surface with the electron twisting 3$D$-radius $R_{oe(rel)}$. These "ghost" pairs remember Cooper-like composition of two electrons at very low temperature, but now they are spinless and are scalar bosons, being also much-much more stable. The coupling energy $E_{couple}=2M_{oe}C^2$ – keeps the enormous stability of these tiny "elementary atoms". This coupling energy very keeps the composite stability proximally till "low" temperatures limit $T<T_c=10^{10}$K and provides correspondingly very high stability of *non-dissipative* quantum superfluid (Gribov, 2005). We percept this dense vacuum tissue as deceptive, frictionless "emptiness", free of fields and matter, since we are made of its elementary defects. Our surprising fate is to sense only similar vacuum "defects", via 3$D$-photons, massless quasiparticles. Even in the middle of the stars this vacuum superfluid is very stable, as if it has near zero temperature $T\approx 0$.

### *The geometrodynamical nature of the gravity energy of electron*

We can account exact geometrical characteristics of the surely $\sim 1/r$ gravity potential form if we compare our waveguide's gravity potential of electron $U_{e(gr)}=\delta L(r)C^2/L_{oe} \sim 1/r$ with the Newton gravity potential equation, containing its empirical gravitational constant $G$:

$$U_{e(gr)}(r)= - GM_{oe}/r = \delta L_{e(gr)}(r)C_4^2/L_{oe}\ , \qquad (25)$$

where the $\delta L_{gr}(r)$ is a tiny deviation of the waveguide thickness $L_{oe}$, and $G$ is the gravitational constant, $C$-speed of light, $L_{oe}=\lambda^*_{e.Compton}= h/M^*_{oe}C_4= h/2M_{oe}C$

Thus, the 3$D$-membrane deviation $\delta L_{gr}(r)$, corresponding to the gravity potential of electron, if we remember that $M_{oe}C^2 = h\nu_{oe}= hC/2L_{oe}$ and use the (25), is following:

$$\delta L_{gr}(r) \equiv U_{e(gr)}(r) = -GM_{oe}L_{oe}/C^2r = -Gh\,/\,2C^3r. \qquad (26)$$

Now it includes combination of three fundamental physical constants, gracefully unifying special relativity with the quantum physics and Newton's gravity. We can easy derive the *finite* -minimal potential value for electron $U_{e-min}\equiv U_{oe(gr)}=U_{e(gr)}(r=R_{oe(rel)})$ which has its flat bottom potential $U_{oe(gr)}$ within the interval $0<r< R_{oe(rel)}$ without any singularity at $r$=0:

$$U_{oe(gr)} = -2\pi GM_{oe}/C^2 = -Gh\,/\,2C^3\,R_{oe(rel)} = const, \text{ if } 0 < r < R_{oe(rel)}\ , \qquad (27a)$$

$$U_{oe(gr)} = -2\pi G(\sqrt{3}/2)\, h / C^3\lambda^*_{e.Compton} = -2\pi G(\sqrt{3}/2)M^*_{oe} / C^2 \qquad (27b)$$

thus, the $U_{oe(gr)} \approx -3{,}68\times10^{-55}$cm for electron and *without* gravity potential singularity. This deviation $U_{oe(gr)}$ is so tiny, that the relation $\delta L_{e(gr)}(r)/L_{oe} \approx 10^{-55}/10^{-10} \approx 10^{-45}$. It is interesting also to note, that the $U_{oe(gr)}$ is very near to the GR-Schwarzschild radius of electron:

$$R_{e(Schwarzschild)} = 2GM^*_{oe}/C^2 = -U_{oe(gr)} / (\pi\sqrt{3}/2), \qquad (28)$$

but it is only the tiny deepness of electron "immersion" into the 4-*th* dimension! Thus, singularity-less elementary particles cannot build tiny Black Holes; physical conditions for their creation arise mostly in very dense neutron stars (see corresponding chapters below).

$$\delta r_{oe(gr)} \approx (1/2)\beta^2_{e(gr)}(r)dr \qquad (29)$$

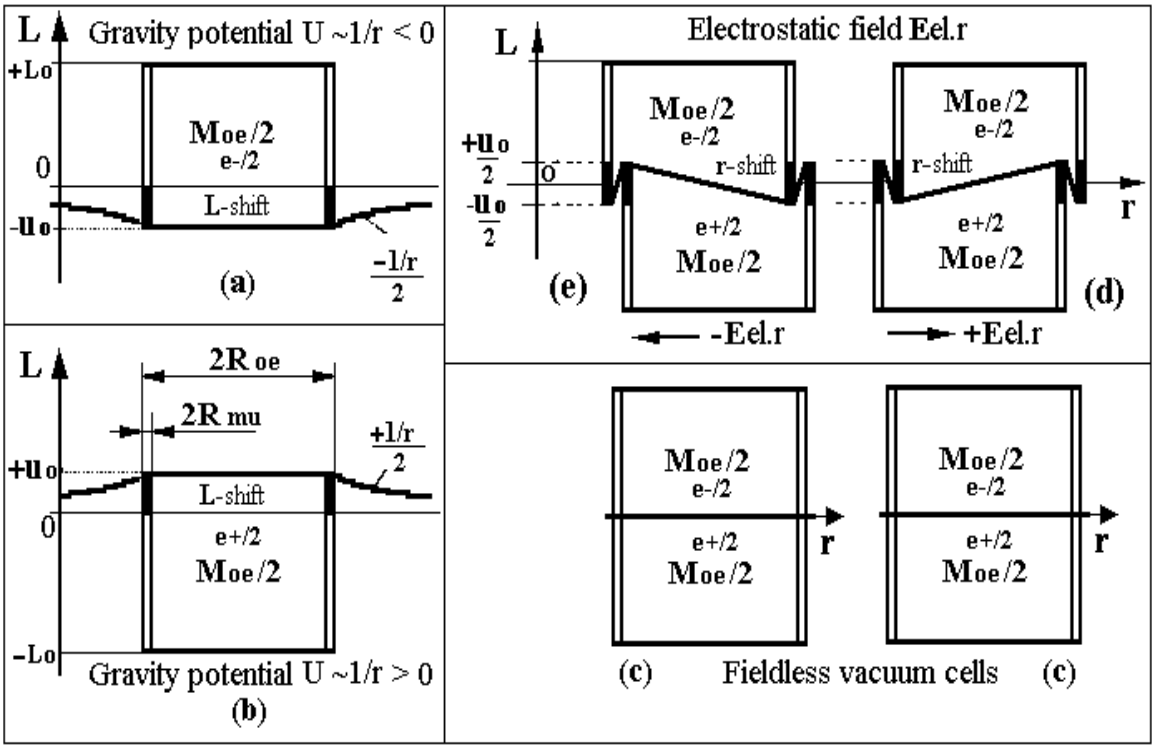



**Fig. 6a** shows a negative deviation of the middle membrane $L$=0 (its gravity deviations), creating the half of the gravity potential $U_{gr}(r) \sim -1/2r$ of the electron-cell, as result of a symmetry break of reciprocal $L$-forces, creating by the excluded positron-cell below.

**Fig. 6b** shows the opposite - positive deviation of the middle membrane $L$=0, creating half of the waveguide gravity potential $U_{gr}(r) \sim +1/2r$ of positron, caused by excluded *e*-hole above. We assume that the *e*-vortex has its very thin wall thickness $\sim 2R_{o\mu}$ – as the minimal granular size of the (femto-metric$\approx 10^{-15}$m) in the $\mu$-cellular ($\mu$–/$\mu$+) vacuum structure – a kind of more fine quantum ($\mu$–/$\mu$+) femto-superfluid, filling all the periodical $L_{oe}$-waveguides bulks.

**Fig. 6c** shows zero gravity potential $U_{gr}(r)$=0 for the ideal coupled (*e*–/*e*+) pair.

**Fig. 6d,e** show ***r***-symmetry breaking polarization (±***r***-shifts) inside the (*e*–/*e*+) vacuum cells, causing by the gravity ($L_o$-membranes non-parallelism), that creates the opposite $\pm\boldsymbol{E}_{el.r}$ electrostatic fields (expressing the local electrostatic $L_{oe}$-membrane tension).

The very-very tiny maximal membrane deviation $U_{oe(gr)}$ simply does not change the basic cophased waveguide's condition $v_{oe}=C/\lambda_{oe}=C/2L_{oe}$ and its "resting" mass $M_{oe}=h/2L_{oe}C$ *is practically the same*. The additional local 3*D*-membrane extensions $\delta r_{oe(gr)}$ are connected with a small membrane deviation from the parallelism on an very small angle $\beta_{e(gr)}(r)\approx dU_{e(gr)}(r)/dr\approx 0$, and is approximately, (see the corresponding triangle, Fig. 7):

The additional local 3*D*-membrane extension $\delta r_{oe(gr)}$ is connected with a small membrane deviation from the parallelism on a very small angle $\beta_{e(gr)}(r) \approx dU_{e(gr)}(r)/dr \approx 0$, and is approximately, (see triangle, Fig. 7):

$$\delta r_{oe(gr)} \approx (1/2)\beta^2_{e(gr)}(r)dr \qquad (29a)$$

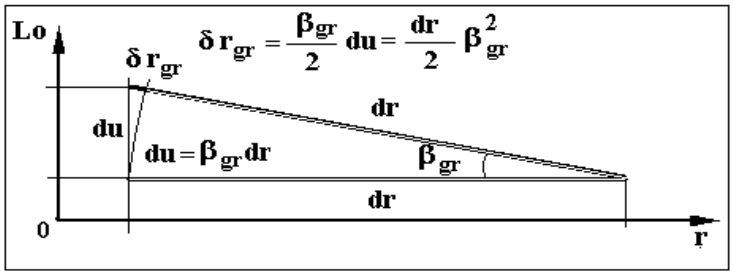



**Fig. 7** shows a smooth gravitational membrane extension $\delta r_{gr}$ for small $\beta$~0 in comparison to its flat length *dr*, going parallel to the coordinate axes *or*.

This angle $\beta_{e(gr)}(r)\approx 0$, it can be derived from the 1/*r* membrane deviation form, using corresponding empirical gravity potential value $U_{e(gr)}=-GM_{oe}/r$ for free electron and gravitational acceleration $g_{e(gr)}(r)$, arising in the created non-parallel waveguide:

$$g_{e(gr)}(r) \approx \beta_{e(gr)}(r)C^2/L_{oe} = GM_{oe}/r^2, \text{ (if } \beta_{e(gr)} \approx 0\text{), thus,} \qquad (30)$$

$$\beta_{e(gr)}(r) = (GM_{oe}L_{oe}/C^2)/r^2 = \left| U_{oe(gr)} \right| R_{oe}/r^2, \text{ or} \qquad (31)$$

$dE_{e(gr)}(r)$ – as energy of the additional 3*D*-membrane extension could be accounted using $\delta r_{oe(gr)}(r)$ – additional extension of a very small and initially flat interval *dr* within initial spherical layer $dV_{layer}=4\pi r^2 dr$ of radius *r* and thickness *dr* around the free electron. This volume extension $\delta V_{e(gr)\ layer}(r)$ could be written as

$$\delta V_{e(gr)\ layer}(r) = dV_{layer}\ \delta r_{e(gr)} = 4\pi r^2\ \delta r_{e(gr)}, \qquad (32)$$

that expresses a tiny extension of the initially flat 3*D*-membrane volume $dV_{layer}=4\pi r^2 dr$ around free electron. The additional - extensional 3*D*-membrane energy is the local gravity energy of electron. Increment of additional energy $dE_{e(gr)}(r)$ of elastic extension of the 3*D*-membrane (with a membrane's bulk tension $\sigma_{3\mathbf{D}\text{-membr}}$) is

$$dE_{e(gr)}(r) \approx \sigma_{3\mathbf{D}\text{-membr}}\ \delta V_{oe(gr)}(r) > 0, \qquad (33)$$

in the differential form, if $\delta r_{e(gr)} << dr$, or $\delta V_{oe(gr)}(r) << 4\pi r^2 dr$ and

$$\sigma_{3\text{D-membr}}(r) = \sigma = const. \qquad (34)$$

It is the central point – the nature of the Einsteinian *geometrization* principle in our case – (if, for example, the $\sigma_{3D\text{-}membr}=1$), we manipulate mathematically with the potentials as only with corresponding geometrical structures – with their tiny deviations from the flat vacuum state. All classically behaving 3*D*-memebrane deviations and extensions must be very small, other words the *initially flat*, tensioned 3*D*-membrane must have enormously strong basic bulk tension $\sigma$, but it is the perfect vacuum state with the *dominating minimal tension energy* density $E_{min(membr)}$, corresponding to the strictly flat, "empty" vacuum. This minimal energy density always dominates all tiny classical physical potentials, carrying an additional (positive) extension energy $\delta E_{membr}$ , so $E_{min(membr)}>>\delta E_{membr}=\delta E_{e(gr)}$.

$$\delta E_{e(gr)} = \sigma \delta V_{oe(gr)}\,(r) = \sigma\, \delta r_{oe(gr)}\, 4\pi r^2 = \sigma\,(1/2)\beta^2_{e(gr)}\,(r) 4\pi r^2 dr, \qquad (35)$$

and using (35), we derive

$$dE_{e(gr)} = 2\pi\, \sigma\, U^2_{oe(gr)} R^2_{oe} dr/r^2. \qquad (36)$$

The full integral extension gravity energy of electron $E_{e(gr)}$ is the 3*D*-space integral across the non-flat *3D*-membrane area, the 1/*r*-like deformed space volume, on the interval $R_{oe}<r<\infty$.

$$E_{e(gr)} = \int_{R_{oe}}^{\infty} dE_{e(gr)} = \int_{oe}^{\infty} 2\pi\, \sigma\, U^2_{oe(gr)}\, R^2_{oe}\, (1/r^2)/dr, \text{ and finally,} \qquad (37)$$

$$E_{e(gr)} = 2\pi\sigma U^2_{oe(gr)} R_{oe} = \pi\sigma\, G^2h^2 / 2C^6\, R_{oe}, \qquad (38)$$

if we substitute the (27a), being $|U_{oe(gr)}| = Gh/2C^3R_{oe}$ into the (37). The derived $E_{e(gr)}$ has two impressive results:

(a) The potential gravity energy of electron contains 5 fundamental constants: $\sigma$ - the new one – the bulk elasticity of our substantial spatial membranes, the Newton's gravity constant *G*, the light speed $C=C_4$, the quantum Planck's constant *h* and the fundamental hyper-length constant – the 3*D*-waveguide thickness $L_{oe}=\lambda^*_{e.Compton}$.
(b) Classically unavoidable physical singularities = endless gravity or electrostatic energy of electron, arising in the traditional (the point-like) elementary particle paradigm, totally disappear in our case.

*Historical remark:* Isaac Newton wrote in his famous letter to Bentley: "That one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one another, is to me so great an absurdity that, I believe, no man who has in philosophic matters a competent faculty of thinking could ever fall into it." (Newton 1693). He intuitively used the idea of spatial "mediation" and a phenomenon of motion to explain the origin of various forces acting on bodies, but in the case of gravity, he was unable to imagine the motion that produces the force of gravity (in those times, without the electrodynamics, etc.). The Newtonian ideas of "mediation" and "motion" and the Einsteinian geometrical idea of the Euclidean "space deformation" are deeply united in our concept of the waveguided gravity - this is exactly the Newton-like conceptual $C_4$-*motion* (the waveguide-confined 4*D*-mass particle *L*-vibration, causing Einsteinian space deformation). It has the Newtonian dynamical inertial mass and two hyper-symmetrical (+/-) gravity "charges" for the particle and antiparticle correspondingly together with the waveguided wave-dynamics of de Broglie and the resulting Kaluza cyclical condition. The described above "waveguided physical synthesis", realizing organically arising gravity laws, shows extremely penetrating intuition of two great genii (Newton and Einstein)

many years ago – their enormous ability to feel the "truly" aspects of physical nature without a huge body of information about it.

*Note 1*: Feynman wrote once: "It is important to realize that in physics today, we have no knowledge what energy is" (Feynman 1966, V1). Newton predicted that motion is a source of gravity forces; here the confined-waveguided motion becomes the physically universal source of physical laws – as motion of *C*-light-like quasiparticles (predicted by Newton and aroused in the quantum concept of photon by Einstein). This nonstop motion becomes the basic - paradoxically - dynamical source of the rest mass itself and immediately explains its so huge energy $E=MC^2$.

*Note 2*: The basic physical gravitational parameter is the membrane deviating hyperforce, equal to the ± gravity "hypercharges" $\pm f_{\perp oe}$ in relativistic electron and positron holes. This hyperforce could be derived using a simplified wave-reflection. The orthogonal electron momentum $P_{\perp oe}$ is constant $P_{\perp oe}=M_{oe}C_4$ and it is periodically reflected into the opposite direction (by the total periodical electron wave reflection in the same 3*D*-waveguide) as the $P_{\perp oe}=-M_{oe}C_4$ in the doubled-relativistic electron-loop for the doubled time period $\Delta T=2(2L_{oe}/C_4 cos60°)=8L_{oe}/C_4$. The resulting orthogonal wave pressure $\pm f_{\perp oe}$ is surprisingly enormous for the so tiny relativistic inertial rest mass of electron $M^*_{oe}=2M_{oe}$:

$$f_{\perp oe}=\Delta P_{\perp oe}/\Delta T=\pm[2M_{oe}C]/[8L_{oe}/C]=M^*_{oe}C^2/\pm 8\lambda^*_{e.Compton}\approx\pm 0{,}8 \text{ kg (!)} \qquad (39)$$

*The geometrodynamical nature of the elementary electrostatic charge of electron*

Now we connect very smooth gravity deformations $U(r)\sim(-1/r)$ (Fig, 6), described above, with *corresponding simultaneous polarizations* inside each (*e*–/*e*+) vacuum "atom" around electron (positron-hole) under the oppositely acting gravitational/antigravitational forces $\boldsymbol{F}_{e-(gr)}(r)=+\boldsymbol{g}_{gr}(r)M^*_{oe-}=+\boldsymbol{\beta}(r)C^2/L_{oe}$ for electron, and the same opposite force $\boldsymbol{F}_{e+(gr)}(r)=-\boldsymbol{g}_{gr}(r)M^*_{oe-}=-\boldsymbol{\beta}(r)C^2/L_{oe}$ for positron in (*e*–/*e*+) vacuum cells respectively (Fig. 8).

The *e*-cells, filling the presumably endless global 4*D*-Multiverse, build *L*-endless periodical-$L_{oe}$-segmented (*e*–/*e*+) tubes – hyper-"polymers" (Fig. 4.3 c`). The *e*-cells themselves cannot be destroyed – any two *L*-adjusted and coupled ($e_i$ ; $e_{i+1}$) - cells can be only decoupled via reciprocal $+\Delta r\approx 2R_{oe}$ and $-\Delta r\approx 2R_{oe}$ -displacement along their 3*D*-waveguide (without destroying of other existing and the decoupled vacuum *e*-cells), with creation of two corresponding $e_-$ and $e_+$ holes, (Fig. 4.3 d, e). Other words – the full quantity of the *e*-cells in the liquid quantum vacuum is always constant. The *e*-hole looks as a stable elementary inter-space, arising between densely packed (but slightly shifted) *e*-cells, easy possible in the superfluid vacuum medium. The so created *e*-hole is very stable, since it realizes a bolt jamming mechanism, holding stability of the aroused *e*-hole and holding its non-local potentials (Fig. 8). The *e*-hole /anti-*e*-hole annihilation is well possible, since the bolt jamming can be destroyed by the opposite anti-bolt jamming, relaxing the middle adjusting 3*D*-membrane and eliminating the vacuum polarizations and these two *e*-holes simultaneously. The electrostatic and gravity straining-energy of the fully flattened membranes is transformed into two gamma quanta, common after annihilation $e_-$ and $e_+$ particles. It is natural to assumes that the vacuum composites (*e*–/*e*+) behave as common stable atoms of liquid with the composite coupling energy $E_{(e-/e+)coupling}=2M^*_{oe}C^2$ where the fermionic dynamical *e*-cells themselves are very stable and cannot disappear, since all levels of underlying sliced vacuum mediums are "effective" – cooled and have superfluid properties

at the minimal energy levels. The hole/antihole creation needs outside (above) decoupling energy $E_{(e-/e+)\text{decoupl}}=E_{(e-/e+)\text{coupling}}=2M^*_{oe}C^2$.

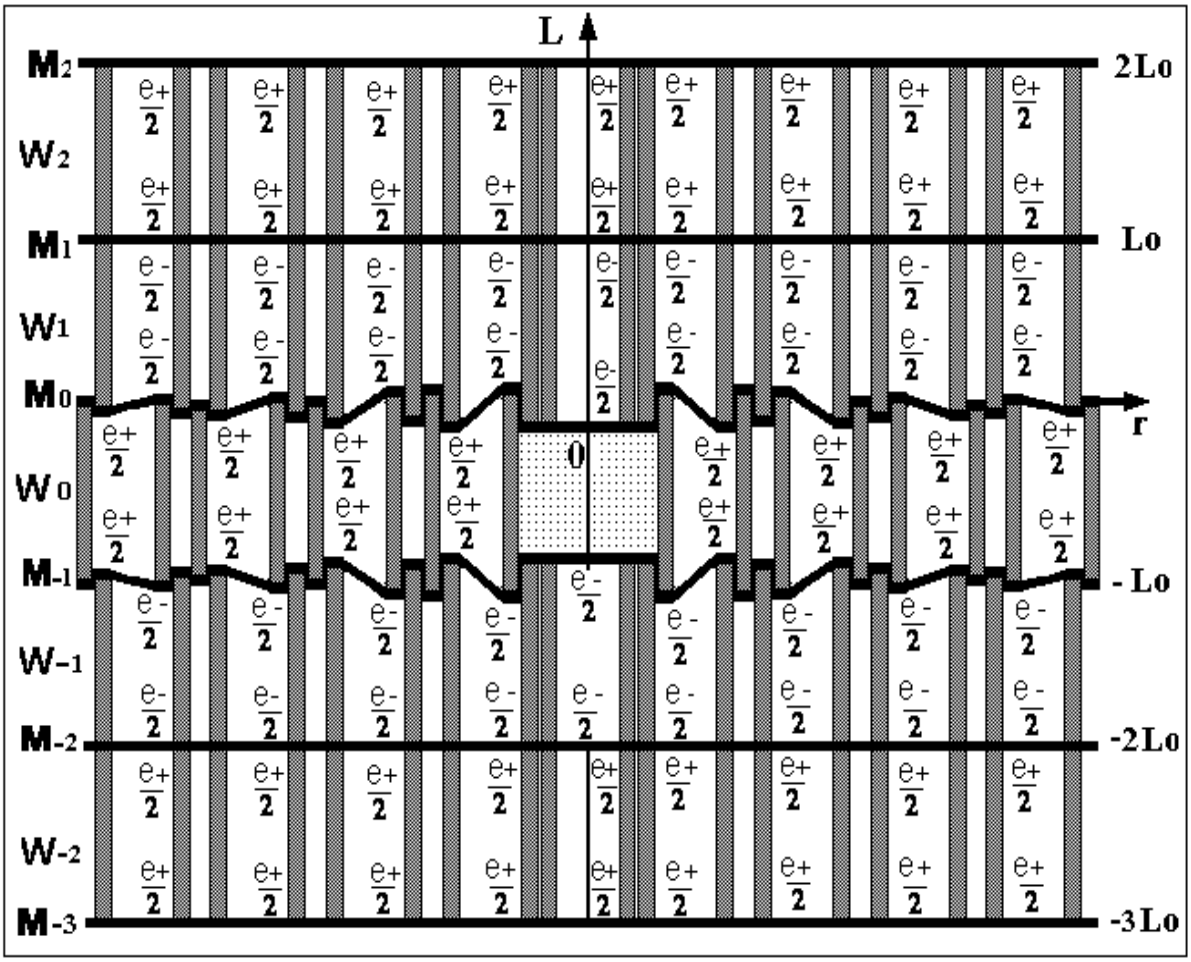



**Fig. 8** shows schematically a 2*D*-cross-section of five coupled *e*-waveguides. Only the middle - $\mathbf{W_0}$–waveguide contains an elementary "positron hole"- our material *electron* particle. Coupled bosonic (*e*–/*e*+) pairs fill all these adjacent waveguides (containing equal *e*-cells) and build together sliced 3*D*-superfluids. The "positron hole" causes tiny non-local pressing-out (with tiny local polarization shifts) of surrounding e-cells, but only along the $\mathbf{W_0}$–waveguide – since two very strongly "horizontally" tensioned membranes $\mathbf{M_0}$ and $\mathbf{M_1}$ localize these shifts only along the $\mathbf{W_0}$–waveguide. This relative shifts lead to local (*e*–/*e*+) pairs polarizations and to resulting symmetrical, reciprocal "electrostatic-hyperspatial" *L*-corrugations, only along of two framing membranes $\mathbf{M_0}$ and $\mathbf{M_1}$, realizing huge electrostatic potentials of electron. This means that the electrostatic extension energy is accumulated-located exclusively along of two framing e-hole membranes $\mathbf{M_0}$ and $\mathbf{M_1}$. Other surrounding membranes ($\mathbf{M_1}$, $\mathbf{M_2}$, $\mathbf{M_{-2}}$ and $\mathbf{M_{-3}}$), etc. are not affected by this e-hole – are not corrugated and "don't fill" electrostatic existence of our electron (e-hole in the $\mathbf{W_0}$–waveguide). Two symmetrical (*L*-coaxial) "bolt-like jamming" *e-hole-locks* in the middle of the picture confine and keep enormous stability of the whole e-cellular structure, surrounding this *e*-hole. Only the same *anti-lock* (the positron antiparticle) can effectively destroy the electron *e-hole-lock*. Hyperspatial contact of the lock and the anti-lock (electron and positron holes) naturally realizes a reciprocal simultaneous "knack" of these locks, as "fighting fire with anti-fire". This "knack" eliminates both e-hole and e-antihole – they annihilate together with their tiny ±potentials and ±charges. This tiny polarization has spherical (1/*r*)-"electrostatic" form, and is globally distributed around the e-hole along the $\mathbf{W_0}$–waveguide, realizes very stable, quasi-classical, sufficiently non-local electrostatic potential of electron.

Our ideal - "atomistic" superfluid vacuum without defects is totally hypersymmetric and has the lowest vacuum energy state without membranes deformations above the minimal –flat state. Zero vacuum energy density has very simple-limited meaning here, since all substation membranes $\mathbf{M_n}$ have always extremely strong constant tensions and correspondingly enormous "Zero-Zero" self-energy density, keeping their perfect flatness. But this enormous self-energy realizes and keeps the minimal – equilibrium vacuum state, free of elementary defects. It is totally out of our material physical perception and looks as a perfect "emptiness". The *e*-hole / *e*-antihole annihilation returns back the defectless zero vacuum state to it's the minimal = "zero energy density" state with the backward coupling - the (*e*–/*e*+) Cooper-like pair with liberation of the $E_{(e-/e+)\text{coupling}}=2M^*_{oe}C^2>0$ in form of two massless gamma-quanta. This means that *e*-cells in our *e*-cellular vacuum can be hypersymmetrically coupled or decoupled but they cannot disappear at all. Creation of the electron and positron pair (*e*-hole/*e*-antihole) is creation of two the opposite non-local space-deformations - potential fields around these elementary *e*-holes, accumulating always the positive stretching membrane energy – always above the minimal vacuum state.

The coupling energy $E_{(e-/e+)\text{coupling}}$ consists almost of the doubled *electrostatic* energy of electron $E_{(e-/e+)\text{coupl.}}=2M^*_{oe}C^2\approx 2E_{e(el)}$. Namely this electrostatic *e*-hole energy realizes physically the *effective dynamical energy* $E_{e\pm(\text{inertial})}=M^*_{oe}C^2>0$ and corresponding positive effective *inertial mass* $M_{e\pm(\text{inertial})}=M^*_{oe}>0$ of each elementary *e*-hole, being the same-positive in all-parallel 3*D*-waveguides. This energy is practically equal to the dynamical energy, implanted into the corresponding inertial mass $M^*_{oe}$ of the *e*-cell. Physicist percepts only elementary, massive vacuum defects and massless $C_3$-quasiparticles (photons) in different experiments, including the massive matter electrons, protons and massless photons, etc., and sporadically arising virtual fermionic pairs $e_-$ & $e_+$ in the vacuum superfluid tissue, e.g. with the resulting Casimir effect.

The electrostatic *e*-hole has its electrostatic charge $Q=\pm e$ with the sign depending of its waveguide's number $\mathbf{W_k}$: it is periodically negative for even numbers $k=2n$ (and for $n=0$) and it is positive for odd numbers $k=2n+1$); the corresponding gravity "charge" $M^*_{oe(gr)}=\pm M^*_{oe(in)}$ of the same *e*-hole also has its periodically changing signs (it is positive for $n=0$ and even natural numbers $k=2n$ and is negative for the odd $k=2n+1$). The *e*-hole creates its electrostatic potential $U\sim 1/r$ (plus a tiny energy part of $1/r$ gravity potential) being 3*D*-spatially exponentially ($\sim 1/r$) spread as additional 3*D*-membrane stretching from the energetically minimal-flat stat (see below). This additional stretching potential energy $E_{e(el)}\approx M^*_{oe}C^2$ is liberated (as doubled) after annihilation of the *e*-hole ($e_-$) and *e*-antihole ($e_+$) as two massless γ-quanta with $\Sigma E_\gamma\approx 2M^*_{oe}C^2$ with resulting substantial membranes flattening and disappearing of the previous electrostatic $\sim 1/r$ potentials. This way is realized the law of energy conservation in the system vacuum-matter-antimatter, where the superfluid vacuum tissue plays tremendously major physical-existential role. Here we have kind of a condensed matter physics analog, connected to endless quantity of identical coupled e-cells, etc., which physical behavior become unexpectedly very simple on the background of the coherent low energy physics, common in the condensed matter physics.

### *The geometrical sense of the electrostatic energy*

The relatively enormous density of the electrostatic energy arises here as unexpectedly very strong reciprocal vertical membrane extensions like ⎽/‾ and like ‾\⎽, caused by the *r*-shifted coupled (*e*–/*e*+) pairs under the smooth gravitational $1/r$ deviance of the dividing membrane (Fig. 6e,d; 8). We associate the smooth gravitational component ($1/r$) of the middle

membrane stretching-deformation with the gravity energy $E_{e(gr)}$ of the free electron. These – much more stronger reciprocal membrane tensions ⌐¬ , ¬⌐ are caused by very small reciprocal *r*-shifts - polarizations inside the (*e*–/*e*+) cells and are associated with the arising electrostatic vacuum energy $E_{e(el)}$ of the same free electron (*e*-hole), arising in all surrounding (*e*–/*e*+) vacuum atoms via their positional asymmetry (polarization) – equal to the corresponding local spatial symmetry break in vacuum atoms without their decoupling!

The local membrane extension $\delta r_{e(gr)}$ ($r$) for free electron is connected with its deviations $\delta L(r)$ from the initial flat form. It could be consider independently for the smooth $1/r$ membrane deviation $U_{e(gr)}(r)=-(GM_{oe}L_{oe}/C^2)/r$ – for the smooth gravitational straining $\delta r_{oe(gr)}$, and for the reciprocal ⌐¬ deviations – the corresponding electrostatic straining $\delta r_{oe(el)}$. We can acquire the enormous relation $E_{e(el)}/E_{e(gr)}$ between these two membrane extensions, if we assume that:

(a) The smooth gravitational potential $U_{e(gr)}(x)\sim 1/r$ of electron will provide polarizations of the (*e*–/*e*+) vacuum pairs around of the *e*-hole for $r > R_{oe}$, that means *r*-reciprocal coaxial shifts between the coupled $e_-$ and $e_+$ companions in each coupled pair, filling our vacuum;

(b) It causes very strong reciprocal *radial* ⌐¬ membrane extensions inside each polarized (*e*–/*e*+) cell around the *e*-hole (Fig. 6e;8);

(c) The $2R_{oe}$-periodical cellular ⌐¬ membrane extensions $\delta r_{e(el)}$ must be distantly reduced as $1/r^2$, as is reduced the polarizing reciprocal gravitational Newton-like force, described above

$$g(r)= \pm dU_{e(gr)}(r)/dr \sim \pm 1/r^2, \qquad (40)$$

providing the distantly $\sim 1/r^2$ reduced *r*-polarization of the (*e*–/*e*+) pairs (see Fig. 8).

(d) We propose also that very narrow spherical shell between polarized electron and positron spheres in the (*e*–/*e*+) pair provides physically rather unusual conditions, connected with very strong additional extension of the dividing membrane, literally being stacked in these hypercylindrical shells. Our naive assumption means that this extension is comparable to the maximal gravitational electron immersion $U_{oe(gr)}$, mentioned above; this maximal extension arises if the polarized (*e*–/*e*+) pair is placed very near to the "free" *e*-hole, causing the (*e*–/*e*+) "atoms" polarization and very strong local membrane's *L*-extensions ⌐¬ , ¬⌐ . Naively thinking, the shell-stacked dividing membrane could be stepwise extended by additional fluctuating reciprocal forces to the maximal value $U_{oe(gr)}$ near $r=R_{oe}$.

The local *maximal* electrostatic extension $\delta r_{e(el)}$ near $r=R_{oe}$ around the *e*-hole consists of 2 identical quasi-orthogonal $\Delta L$-intervals $u_{ab}\approx |U_{oe(gr)}|$ and $u_{cd}\approx |U_{oe(gr)}|$ for each (*e*–/*e*+) pair cell (see Fig. 9b). But we must also take in account roughly the same additional straining interval $u_{da}\approx |U_{oe\,(gr)}|$, arising between all neighboring (*e*–/*e*+) atoms, *if they are placed very closely* to each other (what is natural for the (*e*–/*e*+) liquid medium) in our 3*D*-space along the 3*D*-radius ***r***. (Fig. 9b).

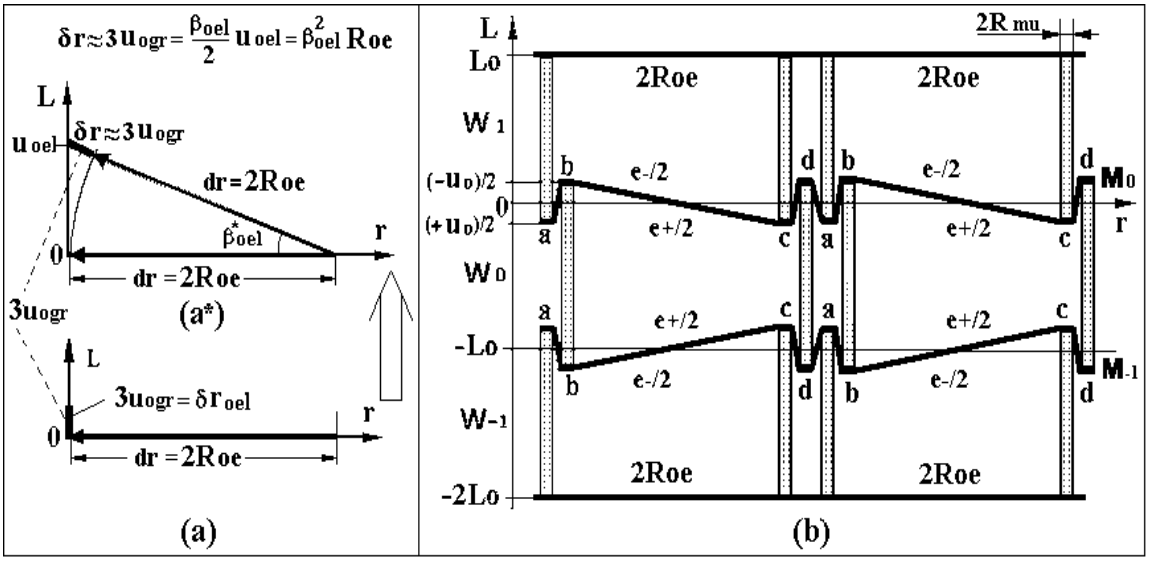



**Fig. 9a** shows the full vertical *L*-straining $\delta r_{oel} \approx 3U_{oe(gr)}$ for the (*e*–/e+) cell, nearest to the *e*-hole.
**Fig. 9a*** shows the electrostatic membrane straining for one (*e*–/e+) vacuum cell, for very small $\beta^*_{oel}$ (since $3U_{ogr} << 2R_{oe}$) and correspondingly keeping $U_{el}$ ~1/*r* –like electrostatic straining electron potential, realizing in one of two symmetrically deformed membranes $\mathbf{M_o}$ or $\mathbf{M_{-1}}$.
**Fig. 9b** shows electrostatic ***r***-polarizations for the nearest (*e*–/*e*+) vacuum cells, placing along ***r*** near to the electron hole in the $\mathbf{W_o}$ waveguide, creating very the strong vertical membranes straining *ab=cd=da* for each vacuum cell, providing here enormous electrostatic-straining potential energy, comparably to the smooth gravity-straining potential energy ~1/*r* of the same membranes $\mathbf{M_o}$ and $\mathbf{M_{-1}}$around the electron hole.

We could (imaginary) unfold these *radial* ⎍ membrane ($|U_{oe(gr)}| + |U_{oe(gr)}| + |U_{oe(gr)}|$)-extensions, related to each (*e*–/*e*+) pair (Fig. 10a), into the smooth elements, building now imaginary smoothed common electrostatic potential function $U_{e(el)} \sim k_{e(el)}/r$ (see Fig. 9a*). This imaginary smooth function $U_{e(el)}$ has its local (also very small) angle $\beta(r)_{e(el)} = dU_{e(el)}(r)/dr \approx 0$, and it is changed as $\beta(r)_{e(el)} \sim 1/r^2$. We have here $\beta_{max}(r=R_{oe}) \equiv \beta_{\mathbf{o}el}$ and thus, $\beta(r)_{e(el)} = \beta_{\mathbf{o}el} R^2_{oe}/r^2$. The $\beta_{\mathbf{o}el}$ can be derived from similar geometrical reasons for $\beta_{\mathbf{o}el} \approx 0$, as the derived above equation $\delta r_{e(gr)} \approx (1/2)\beta^2_{e(gr)}(r)dr$, where $\beta^2_{e(gr)}(r) \sim 1/r^2$.

$$\delta r_{e(el)max} = 3|u_{oe(gr)}| = (1/2)\,\beta^2_{e(el)max}\, 2R_{oe} = \beta^2_{e(el)max}\, R_{oe}\,, \tag{41}$$

from the (43) we derive $\beta^2_{e(el)max}$

$$\beta^2_{e(el)max} = 3|U_{oe(gr)}| / R_{oe}\,, \text{ near } r=R_{oe} \text{ and} \tag{42}$$

$$\beta(r)_{e(el)} = \sqrt{[(3|U_{e(gr)}|/R_{oe})(R^2_{oe}/r^2)]} \tag{43}$$

and electrostatic extension $\delta r_{e(el)}(r)$ will be here

$$\delta r_{e(el)}(r) \approx (1/2)\beta^2(r)_{e(el)}\, dr = (1/2)[(3|U_{oe(gr)}|/R_{oe})R^4_{oe}/r^4]dr \tag{44}$$

The derived here resulting local electrostatic extension $\delta r_{e(el)}(r)$ goes in all directions around spherical layer with radius $R_{oe}$ for each (*e*–/*e*+) pair and so, we must take into account the spherical-layered forms of the corresponding membrane extensions. Walls of our ($e_–$) and ($e_+$)

hyper-cylinders $R_{oe}$ could have a minimally small thickness, it cannot be thinner as the $2R_{o\mu}$, since these walls are constructed from the corresponding muonic vacuum "mini-atoms", (coming from the second leptonic generation) filling our waveguides 4*D*-volumes with the dense, quasi-continual fine-grained ($\mu$–/$\mu$+) quantum liquid… (see our fractal vacuum concept above). It is naturally to propose that the minimal (cutoff) thickness $d_{ewall}=d_{min}$ is exactly the $d_{ewall}=2R_{o\mu}$. Thus, the electron/positron orthogonal reciprocal extensions are distributed in each polarized (*e*–/*e*+) pair along *two* thin 3*D*-spherical layers, each with the proximally volume $\delta V_o \approx 4\pi R^2_{oe} 2R_{o\mu}$ since $R_{oe} >> R_{o\mu}$, with summary double volume

$$2\delta V_o \approx 2(4\pi R^2_{oe} 2R_{o\mu}) \quad (45)$$

The whole space "micro-box", containing an electron-positron pair is approximately cubic $(2R_o)^3$ volume $V_{(e-/e+)}=V_{▣}$, containing the $R_{oe}$ sphere

$$V_{(e-/e+)} \approx V_{▣} = (2R_{oe})^3 \quad (46)$$

In the right integral account we must use the membrane extension, averaging on the full approximately cubic (*e*–/*e*+) micro-volume $V_{▣}=(2R_o)^3$, containing these extended spherical layers, i.e. we must use averaging multiplicand

$$2\delta V_o / V_{▣} = 2\pi R_{o\mu} / R_{oe}, \quad (47)$$

thus, the local extension $\delta r_{e(el)}(r)$ will be rewritten for the cubic $V_e=(2R_o)^3$ cell as the

$$\delta r_{e(el)}(r) \approx 2\pi (R_{o\mu}/R_{oe})(1/2)[(3 \mid U_{oe(gr)} \mid / R_{oe}) R^4_{oe} / r^4] dr, \text{ or} \quad (48)$$

$$\delta r_{e(el)}(r) \approx 3\pi (\mid U_{oe(gr)} \mid R_{o\mu} R^2_{oe} / r^4) dr \quad (49)$$

Now we form spherical layer $4\pi r^2$ around the free charged electron and multiply with membrane bulk tension $\sigma$ will derive differential form of the extension membrane energy $dE_{e(el)}(r)$*:*

$$dE_{e(el)} = \sigma \delta r_{e(el)}(r) 4\pi r^2 \text{ or , using (49) we derive} \quad (50)$$

$$dE_{e(el)} = 3\pi\sigma (\mid U_{oe(gr)} \mid R_{o\mu} R^2_{oe} / r^4) 4\pi r^2 dr = 12\pi^2 \sigma (\mid U_{oe(gr)} \mid R_{o\mu} R^2_{oe} / r^2) dr \quad (51)$$

and then it is easy to write the final integral form, also integrating, as in the case of gravity extension energy, for the interval $R_{oe} \le r < \infty$

$$E_{e(el)} \approx \int_{R_{oe}}^{\infty} 12\pi^2\sigma (\mid U_{oe(gr)} \mid R_{o\mu} R^2_{oe} / r^2) dr \text{ or} \quad (52)$$

$$E_{e(el)} \approx 12\pi^2\sigma \mid U_{oe(gr)} \mid R_{o\mu} R^2_{oe} \int_{R_{oe}}^{\infty} (1/r^2) dr. \quad (53)$$

$$E_{e(el)} \approx 12\pi^2\sigma \mid U_{oe(gr)} \mid R_{o\mu} R_{oe}, \quad (54)$$

Thus, according the (38): $E_{e(gr)} = 2\pi\sigma U^2_{oe(gr)} R_{oe}$, and we derive the desired ratio $E_{e(el)}/E_{e(gr)}$ ,

$$E_{e(el)} / E_{e(gr)} \approx 6\pi R_{o\mu} / U_{oe(gr)} = 6\pi R_{o\mu} / (Gh/2C^3 R_{oe}) = C\,h / \pi M^*_{o\mu} M^*_{oe} G, \quad (55)$$

where $U_{oe(gr)}=Gh/2C^3R_{oe}$ , $R_{oe}= (2/\sqrt{3})\ (h/4\pi M^*_{oe}C)$ and $R_{o\mu}=(2/\sqrt{3})\ (h/4\pi M^*_{o\mu}C)$

The numerical computation gives, (with some crude approximations, as e.g. the cubic (*e*–/*e*+) micro-volume $V_{▱}=(2R_{oe})^3$, etc.) this huge numerical ratio:

$$(E_{e(el)\ EMMA}/E_{e(gr)GRAMMA}) = F_{e(el)}/F_{e(gr)} \approx 5{,}5\times10^{42}. \quad (56)$$

This means that we derive enough similar ratio to the empirical* ratio $E^*_{e(el)} / E^*_{e(gr)} \approx 4{,}169\times10^{42}$. We recall that electrostatic $F^*_{e(el)}$ and gravity $F^*_{e(gr)}$ interactions between two electrons have common classical relation

$$F^*_{e(el)}/F^*_{e(gr)} = (e^2/r^2 4\pi\varepsilon_o)/(GM^{*2}_{oe}/r^2) = U_{e(el)}/U_{e(gr)} \approx hC / \pi M^*_{o\mu}M^*_{oe}G. \quad (57)$$

The electron charge $e_{EMMA}$ is derived from the last equation:

$$(e^2/4\pi\varepsilon_o)/(GM^2_{oe}) \approx hC / \pi M^*_{o\mu}M^*_{oe}G, \quad (58)$$

$$e^2_{EMMA} \approx 4\varepsilon_o hC\, M^*_{oe} / M^*_{o\mu} \quad (59)$$

This means that the electron charge (or simultaneously the opposite – positron charge) obtains now its enough clear geometric-dynamical nature, supporting our periodical Multiverse concept with the periodical foliated space-antispace symmetry, and the following "atomistic" (*e*–/*e*+) quantum vacuum concept. Electrons arise as e-holes (elementary defects), the electrostatic charge and gravity mass of the *e*-hole arises as sufficiently collective phenomenon in superfluid vacuum medium. The electron arises via elementary microscopic, symmetry breaking defect – a lateral positron "hole", following the penetrative Diracian terminology. Our matter particles look not as a physically dominating local "quintessence in emptiness" - on the contrary – they are very rare, tiny defects in the enormously dense, dominating grandiose Superfluid Ocean – with totally "deceptive emptiness", being an omnipresent physical incognito under the hypersymmetry cover. Behind the enough important charge nature arises something much more tempting and exiting – the Multiverse "hyper-ripples". This Multiverse is enormously dense, but weightless, Euclidean-like-flat, coherent but invisible, very stable but penetrable without friction (as realized once Galileo Galilei and Isaac Newton) – it behaves as a non-dissipative quantum superfluid, a kind of a "Heavenly Helium" at low *T* – as the reincarnated old-one Ether, now integrating our physical laws and myriads of physically identical worlds. Now it arises with the periodical quantum outfit, as 4*D*-"hyperether" of the 21 century.

*Note 1:* Using the cubic $V_{▱}=(2R_{oe})^3$ packing approximation for (*e*–/*e*+) "atoms" gives roughly similar numerical value for $(E_{e(el)}/E_{e(gr)})$. This relatively good numerical correspondence indicates that the (*e*–/*e*+) vacuum "atoms" are indeed packed not as a very dense solid crystal, but as a more flexible packed atoms of superfluid with a small flexible free space between them, that allows this liquid to stream and to fill all possible forms. This allows substation membranes to "brief" under gravity pressure, etc. This means also that this liquid has no torsion effects, common for a solid body. Transverse spin waves - quasiparticles with photonic spin *S*=1 penetrate this superfluid medium, realizing common physical principle of causality, where all Feynman's paths and corresponding path integrals are self-calculated and selected simultaneously. This medial *e*-cellular vacuum works like as a parallel, hyperspatial *C*-speeded quantum super-computer.

*Note 2.* The classical electron radius $R=b=(2/3)R_e=(2/3)e^2M^*_{oe}C^2$ was assumed for classical electron electrostatic charge, being distributed on the sphere $R_{eClass}=b$ with the full electromagnetic mass $M_{oe(electromagn)} \approx M^*_{oe}C^2$ (see Feynman, 1966, v.6, p. 306). It has its value $b=1{,}878\times10^{-15}$m and is approximately equal to the $2R_{o\mu}=2{,}15\times10^{-15}$m, that is the muonic wall thickness, building the spherical *e*-cell surface (see Fig. 5.3). In this case the full membrane tension energy $E_{e(el)}$ for free electron (54) and corresponding enormous membrane bulk tension $\sigma_{3D\text{-}membr}$ could be calculated from the equation below:

$$E_{e(el)} = 12\pi^2\sigma_{3D\text{-}membr} R_{o\mu} R_{oe} \left| U_{oe(gr)} \right| \approx M^*_{oe}C^2 , \qquad (61)$$

$$\sigma_{3D\text{-}membr} \approx M^*_{oe} M^*_{o\mu} C^6/\sqrt{3}\pi G h^2 \approx 2\times10^{72} \text{ g s}^{-2} \text{ cm}^{-1} \qquad (62)$$

This enormous $\sigma_{3D\text{-}membr}$ value explains common linearity of the basic classical equations and the superposition principle in physics. Feynman noted, "nobody could create theory of electricity", in which the basic equation $\nabla^2 U=-\rho/\varepsilon_o$ is understood "as a smoothed approach to a more deep mechanism". But, on the other hand, this "leads to a wild absurd on the unlimitedly small distances, which nobody yet could avoid" $/U(r=0)= -\infty/$, (Id. p. 257). The waveguided GAMMA / EMMA provide the $\sim\pm1/r$ potentials forms without singularities, both for gravity (as the "vertical" *L*-symmetry break, created by the *e*-hole) and electrostatics charges (as the following tiny symmetry breaks inside each (*e*–/*e*+) vacuum cell, creating very big reciprocal membrane stretching – local electrostatic micro-potentials. They are located only in two the nearest membranes $\mathbf{M_0}$ and $\mathbf{M_{-1}}$, framing "defected" waveguide $\mathbf{W_0}$ containing the e-hole (Fig. 8). So, the electrostatic *e*-hole energy is located strictly on two the nearest framing membranes around the *e*-hole, but its gravity potential involves corresponding very thin $L_{0,-1}$ and $L_{0,1}$ bulks thickness of two the nearest surrounding waveguides $\mathbf{W_{-1}}$ and $\mathbf{W_1}$. The 3D-membrane tension and its tension energy density are enormously huge, as it was shown above. It is natural to assume that all other waveguides $\mathbf{W_n}$ in the multi-waveguide's hyperspace (with natural waveguide numbers $n < -1$ and $n > 1$) are much less affected by the *e*-hole in the $\mathbf{W_0}$ –waveguide. Two the nearest membranes $\mathbf{M_0}$ and $\mathbf{M_{-1}}$ are electrostatically and gravitationally 1/r-deformed, but other parallel membranes $\mathbf{M_n}$ (with all natural membrane numbers n<–1, n>0) keep their flatness. This means that the thickness $L_{oe}=L_{on}\approx constant$ is constant for all mentioned above waveguides $\mathbf{W_n}$ (with natural all waveguide numbers $n < -1$ and $n > 1$), except only three waveguides [$\mathbf{W_{-1}}$, $\mathbf{W_0}$, $\mathbf{W_1}$], as if the *e*-hole in the $\mathbf{W_0}$ -waveguide does not exist for the other $\mathbf{n}$-Subuniverses. These simple and natural hyperspatial (electrostatic & gravity) fields-"shielding" phenomena manage electrodynamical and gravitational interactions between matter, antimatter and DM in physically equal Subuniverses being integrative in the periodical Multiverse. This explains the "dark" DM&DE mysteries without new elementary particles and fields (see chapters below).

## PERIODICAL SINGULARITYLESS BLACK HOLES IN THE MULTIVERSE

The multilayered waveguide hyperspace concept gives a novel Multilayered Waveguide's Black Hole (MWBH) phenomenon, absolutely free of singularities, but with the same Schwarzschild radius as it is in the GR of Einstein. It is not so surprising, since the SR is based indirectly, as we could show above, on the thin – the flat 3*D-waveguide's space* in the 4*D-Euclidean space* and the GR is a small deformation of its flat sheet, associated with the non-Euclidean-like geometrizated gravity. Our definition of the Black Hole (BH) is very

simple and natural for the Multiverse: The MWBH arises as a local "collapse" of the initial middle waveguide $\mathbf{W_0}$ thickness $L_{oe}$ to zero, inside the MWBH. Roughly speaking, the $\mathbf{W_0}$ - waveguide area must contain a critical quantity of elementary matter particles (elementary holes=elementary defects), (Fig. 10a), creating collapse of the $L_{oe}$-thickness to zero under an enormous reciprocal pressure of defectless vacuum cells, always existing around the waveguide $\mathbf{W_0}$ and located in the nearest waveguides $\mathbf{W_{-1}}$ and $\mathbf{W_1}$, (Fig. 10b).

The *maximally possible symmetrical deviations* of the membranes $\mathbf{M_{-1}}$ and $\mathbf{M_0}$, framing the waveguide $\mathbf{W_0}$, is $\delta L_{oe(gr)}(r) = -L_{oe}/2$ for the $\mathbf{M_0}$ membrane and $\delta L_{oe(gr)}(r) = L_{oe}/2$ for the $\mathbf{M_{-1}}$ membrane, correspondingly (see Fig. 10b). In this case they contact to each other and *consolidate* - build a topologically new - exactly equilibrium flat membrane-ball inside the MWBH. Our MWBH works as a restless vacuum "trash" exhauster, attracting and killing "defected" elementary matter holes around. It looks like a kind of a topological defect in the initially quasiflat periodical waveguide's 4*D*-structure, acting proximally as a stable and properly ≈1/*r* gravitating mass $M_{MWBH}$. The MWBH creates a local topological "hole" in the $\mathbf{W_0}$ waveguide and the consolidation of the normally strictly divided framing membranes $\mathbf{M_{-1}}$ and $\mathbf{M_0}$ realizes usually impossible local flat "bridge"- a direct contact between two normally strictly separated waveguides $\mathbf{W_{-1}}$ and $\mathbf{W_1}$. The MWBH looks like a stable, gravitating "scar" on the healthy body of our multilayered cellular vacuum structure.

We derive the MWBH Schwarzschild-like radius if we connect our soft waveguide's gravity potential equation (8) and proximally the waveguide's Newtonian gravity potential (12) arising as the deformed 3*D*-membranes, into the equation (30) using $\delta L_{gr}(r) = L_{oe}/2$:

$$\delta L_{oe(gr)}(r) \rightarrow \delta L_{oe(gr)}(R_{Schw.MWBH}) = L_{oe}/2 \qquad (63)$$

Our gravity equation, connecting deviation $\delta L_{gr}(r)$ with a Quasi-Newtonian (~1/r) gravity potential (where $G$ is the Newtonian gravity constant and $M$ is spherical gravity mass), is following:

$$U_{gr}(r) = -GM/r = -\delta L_{gr}(r)C^2/L_{oe}, \qquad (64)$$

and under the MWBH condition (63) it is now

$$-GM_{\mathbf{MWBH}}/R_{Schw.MWBH.} = -(L_{oe}/2)\,C^2/L_{oe} = -C^2/2, \qquad (65)$$

$$R_{Schw.MWBH} = R_{Schw.BH} = 2GM_{\mathbf{MWBH}}/C^2 \qquad (66)$$

We have derived exactly the same BH-Schwarzschild radius as in the General Relativity (GR) of Einstein! In the theory of GR, a black hole could exist of any mass, as it is assumed for the point-like mass particle (with practically endless point mass density – with a common classical GR-singularity in the center). Our quantized elementary mass particle concept avoids the GR-singularity – the point-like mass density and the proposed above MWBH also cannot have singularities in the quasi-crystalloid periodical waveguide's hyperspace, since the $\delta L_{gr}(r)$ *newer can be deeper then* $-L_{oe}/2$, so $|\delta L_{gr}(r)| \le L_{oe}/2$ and it is the lowest gravity potential $U(r<R_{Schw.}) = C^2/2 =$ *constant, ever possible* inside all possible MWBH.

We would like to *estimate* this singularity-less MWBH (as a collapse of the central waveguide $\mathbf{W_0}$ and consolidation of its framing membranes $\mathbf{M_{-1}}$ and $\mathbf{M_0}$), using a *neutron star* - the

densest bulk matter known in Nature. Neutron stars have overall densities near $\rho_{neutr}\approx 10^{17}\div 10^{18}$kg/m$^3$, comparable with the approximate huge density of an atomic nucleus of $3\times 10^{17}$kg/m$^3$ (North 1995, etc.). It is known that if the star accumulates matter at nuclear density and all stellar energy sources are exhausted, it would fall within its own Schwarzschild radius and would be a *stellar black hole*. The maximum mass of a neutron star is not well known, but is believed to be about 3 solar masses. There are no known processes that can produce BHs with mass less than a few times the mass of the Sun, ($M_{Sun}\approx 2\times 10^{30}$ kg). The smallest known black hole was recently discovered by N. Shaposhnikov and L. Titarchuk in NASA, it has the mass of 3.8 solar masses and the diameter of only $D_{BH}=2.4\times 10^4$m, i.e. $R_{BH}=D/2=1{,}2\times 10^4$m, (Lovett, 2008). This tiny MWBH could be described naturally as a baby-MWBH, aroused from the neutron star with the maximally possible mass and with the same average density $\rho_{neutr.star}$. This proximal density could be roughly calculated, using a volume $V_{BH}=(4/3)\pi R^3_{BH}$ of this black hole, accounted for its radius $R_{BH}=1{,}2\times 10^4$m:

$$\rho_{neutr.star}\approx 3.8M_{sun}/V_{BH} = 3.8\text{x}2\text{x}10^{30}\text{kg}/(4/3)\pi(1.2\text{x}10^4\text{m})^3 \approx 10^{18}\text{kg/m}^3 \qquad (67)$$

This neutron star density $\rho_{neutr.star}$ is near $10^{18}$kg/m$^3$ and the estimated above average density of the very small BH ever fond are quite the same. We derive from the (66) practically the same Schwarzschild radius, corresponding to the MWBH with 3.8 solar masses:

$$R_{Schw.MWBH} = 2GM_{\boldsymbol{MWBH}}/C^2 = 2G\cdot 3.8\cdot 2\text{x}10^{30}kg/C^2 \approx 1.12\text{x}10^4\text{m} \qquad (68)$$

*Neutron stars with mass $1.5M_{sun}\div 3.8M_{sun}$ are "pregnant" with hidden black holes*

Simple analysis of the Newton-like gravity potential of a proximally homogenous neutron star shows gravity potentials $U_{ns}$ inside it ($0<r<R_{ns}$) as a parabolic function $U_{ns}\sim +r^2$ and outside the star ($r>R_{ns}$) it is usual Newtonian potential $U_{ns}\sim -1/r$:

$$U_{ns}(0<r<R_{ns}) = GM_{ns}(r)/r + U_{ons} = G(4/3)\pi r^3\rho_{ns}/r + U_{ons} = G(4/3)\pi r^2\rho_{ns} + U_{ons} \qquad (68a)$$

$$U_{ns}(r>R_{ns}) = -G(4/3)\pi R^3_{ns}\rho_{ns}/r \qquad (68b)$$

These potentials functions are equal on the star's surface with $r = R_{ns}$

$$G(4/3)\pi R^2_{ns}\rho_{ns} + U_{ons} = -G(4/3)\pi R^2_{ns}\rho_{ns}\ ,\ \rightarrow\ U_{ons} = -2G(4/3)\pi R^2_{ns}\rho_{ns} \qquad (68c)$$

From (68a) and (68c) we derive

$$U_{ns}(0<r<R_{ns}) = G(4/3)\pi r^2\rho_{ns} - 2G(4/3)\pi R^2_{ns}\rho_{ns} = \delta L_{gr}(r)C^2/L_{oe} \qquad (68d)$$

The first-minimal point-like MWBH will arise inside the neutron star if $\delta L_{gr}(r) = -L_{oe}/2$ and two symmetrical potential's parabolas (Fig. 10b) will contact *pointy* with each other:

$$G(4/3)\pi r^2\rho_{ns} - 2G(4/3)\pi R^2_{ns}\rho_{ns} = \delta L_{gr}(r)C^2/L_{oe} = -C^2/2 \qquad (68e)$$

This equation shows that the initial collapsing condition $\delta L_{gr}(r) = -L_{oe}/2$ is possible in the single tangent point at $r=0$ in the equation (68d). For this case we derive necessary mass of the neutron star, creating the point-like "*embryonic*" MWBH:

$$R^2_{ns\ with\ point\ BH} = C^2/[4(4/3)\pi\rho_{ns}G] = 3C^2/16\pi\rho_{ns}G \qquad (68f)$$

This gives the neutron star radius $R_{ns}\approx 8.9\text{x}10^3$m and the corresponding neutron star mass $M_{ns.(pointMWBH)} \approx 2.9\text{x}10^{30}\text{kg} \approx 1.5M_{sun}$ with the created point-like embryo-MWBH with zero $R_{Schw}=0$ and zero mass $M_{point\ MWBH}=0$, (see Fig. 10b). This means that very small embryo-like MWBH are quite possible, but they arise only inside a huge & dense neutron stars centers. They cannot exist independently without huge "pregnant mother" - the matured neutron star. We remember that ratio between the minimal *open* MWBH and the $L_{oe}$-thickness is $R_{(open)Schw.min}/L_{oe}\approx 10^4\text{m}/10^{-12}\text{m}=10^{16}$, so the $R_{(open)\text{-}Schw.min}>>L_{oe}/2$, and the $r^2$-like, and the $1/r$ membranes deformations are extremely tiny. It means that $\beta\approx 0$ is here very good approximation and our basic equation for gravity acceleration $\boldsymbol{g}=\beta C^2/L_{oe}$ is quite correct for all MWBH regions. It is interesting that the MWBH looks gravitationally as very thin massive spherical surface, being "*empty" inside* - with the exactly flat inside gravity potential $U_{inside}=-C^2/2$=constant, the same for different MWBHs. They are free of singularity for all possible MWBHs masses! The full MWBH-mass is formally distributed on the 2*D*-surface of its Schwarzschild radius. This analysis, together with the derived (67) and (68) equations, shows that neutron star with the mass $M_{ns}$ less when $1.5M_{sun}$ cannot contain hidden black hole inside (Fig. 10a). Neutron stars with mass in the interval $1.5M_{sun} < M_{ns} < 3.8M_{sun}$ contain *the hidden MWBHs*, starting from the zero MWBH radius $R_{MWBH}\approx 0$, for correspondingly critical neutron star radius $R_{ns} \geq 8.9\text{x}10^3 m$, (see Fig. 10b), growing to the *maximal hidden MWBH* radius $R_{MWBH} \approx 1.12\text{x}10^4$m, with transition to the *minimal open MWBH* with this radius (Fig. 10d).

The neutron matter (holes) totally disappear between the collapsed membranes and instead is created the minimal open MWBH without liquid neutron shell, if $M_{MWBH} > 3.8M_{sun}$, (Fig. 10d,e). This analysis shows unexpectedly simple and rather new structural features of the neutron stars and black holes, being fantastic singular incognito before.

Astronomers have found the most massive neutron star yet measured — one nearly twice the mass of our sun (Choi 2010). This discovery indicates that these stellar remnants really are made mostly of neutrons, but neutron stars with the masses $1.5M_{sun} < M_{ns} < 3.8M_{sun}$ contain and mask "embryo" MWBHs inside.

It has mass $M_{ns}=1.97M_{sun}$ and so, we can say that it must have small "closed" BH inside. This mass value is inside our estimated - the maximal possible neutron star mass $M_{ns}<3{,}8M_{sun}$, since $M_{ns} > 3.8M_{sun}$ assumed to be transformed into the smallest open MWBH. Our proximal estimations are derived for $\rho_{neutr.star} \approx 10^{18}\text{kg/m}^3$ and this gives enough realistic maximal neutron star mass about $3.8M_{sun}$.

The MWBHs have surprisingly smooth gravity potentials (membranes deformations). It is easy to see that the MWBHs, placed in the "dark matter" waveguides $\mathbf{W_{-2}}$ and $\mathbf{W_2}$ - the nearest to our central $\mathbf{W_0}$ waveguide, rapidly develop similarly centered, parallel MWBHs in these waveguides. This way could be created hyper-periodically prolonged and "darkly"-gravitationally - "one-to-one" – interacting, very long coupled dark *L*-MWBHs-tubes. These *L*-axially coupled Periodical MWBHs have a sufficiently new - the doubled waveguide's thickness $2L_{oe}$ inside $r < R_{Schw}$, where $dU/dr=0$ and gravity field inside is zero (!), (see Fig. 10e,d). Virtual $\mathbf{W_{-1}}$-positron and $\mathbf{W_1}$-positron inside the Periodical MWBHs-tubes behave exotically as particle and antiparticle to each other and are gravitationally confined inside these MWBHs-tubes. These periodical tubes contain a twice-lighter periodical $(e/2)$-vacuum with twice-lighter exotic electron- and positron-holes, etc.

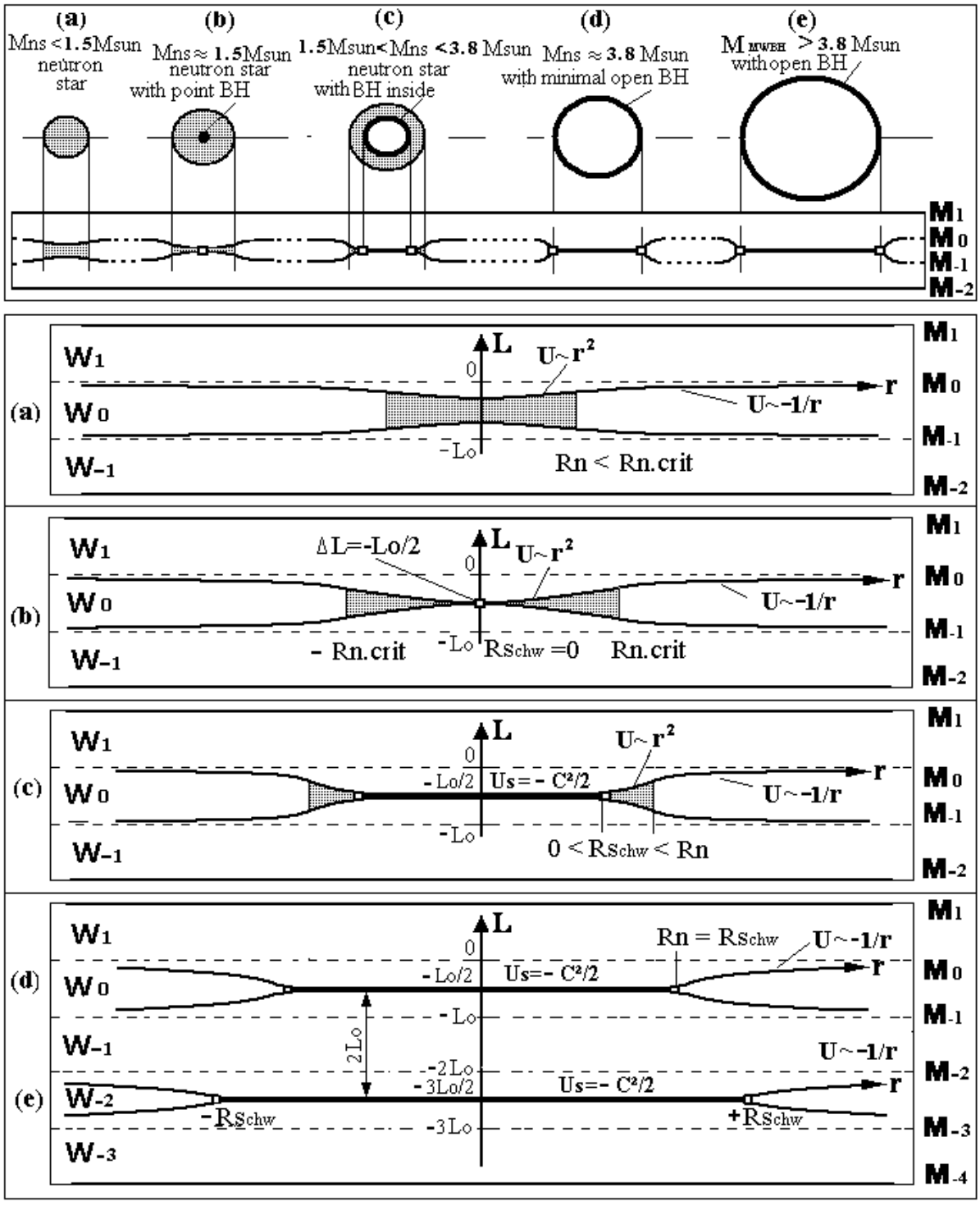



**Fig. 10(a)** shows small spherical neutron star with two symmetrically curved, but not contacting framing membranes $\mathbf{M_{-1}}$ and $\mathbf{M_0}$, realizing gravity $U\sim 1/r^2$ inside of the star and $U\sim 1/r$ outside the star radius, $|\delta L_{gr}(r)|<L_{oe}/2$ (no black hole inside);

**Fig. 10(b)** shows the minimal point-like hidden MWBH, if $\delta L_{gr}(r=0)= -L_{oe}/2$ creating "*point-like"* membranes $\mathbf{M_{-1}}$ and $\mathbf{M_0}$ contact.

**Fig. 10(c)** shows bigger hidden MWBH inside of the neutron star with $0<R_{Schw}<R_{ns}$, containing flat *potential area* $0<r<R_{Schw}$. with the neutron matter shell $R_{Schw}<r<R_{ns}$ around it.

**Fig. 10(d)** shows the minimal open MWBH, when $R_{Schw}=R_{ns}$ without the neutron matter shell.

**Fig. 10(e)+10(d)** show two coupled open MWBHs, our (e) and "dark" MWBH (d), with the double $2L_{oe}$ waveguide thickness between them, if $r<R_{Schw}$.

These hyper-tubes work like a hyper-system, forming "spinal hyper-columns" what helps to explain why our $\mathbf{W_0}$-Universe galaxies (with visible baryonic matter) were developed so quickly (being themselves too light for theirs formation tempo). The same $\mathbf{W_0}$-MWBHs, being shifted - placed in the nearest "antimatter" waveguides $\mathbf{W_{-1}}$ and $\mathbf{W_1}$, will be repulsive for the $\mathbf{W_0}$-Universe – they will repulse our $\mathbf{W_0}$-matter and could be named as White Holes (MWWH). They also build the correspondingly gravitationally attractive - segment-to-segment coupled hyper-"spinal columns" of Periodical MWWHs …+$\mathbf{W_{-5}}_{WH}$+$\mathbf{W_{-3}}_{WH}$+$\mathbf{W_{-1}}_{WH}$+$\mathbf{W_1}_{WH}$+$\mathbf{W_3}_{WH}$+$\mathbf{W_5}_{WH}$+… of antimatter on the contrary to the gravitationally segment-to-segment coupled hyper-"spinal columns" of the Black Holes …+$\mathbf{W_{-6}}_{BH}$+$\mathbf{W_{-4}}_{BH}$+$\mathbf{W_{-2}}_{BH}$+$\mathbf{W_0}_{BH}$+$\mathbf{W_2}_{BH}$+$\mathbf{W_4}_{BH}$+$\mathbf{W_6}_{BH}$+…. The periodical hyper-spinal column of the black holes repeals the periodical hyper-spinal column of the white holes.

*Notes:* M. Begelman theoretically investigated a quite similar possibility of "seed" black holes in super-massive stars, like our "closed" MWBHs, arising inside of very compact neutron stars. He calculated "how super-massive stars might have formed, as well as masses of their cores. These calculations allowed him to estimate their subsequent size and evolution, including how they ultimately left behind "seed" black holes (Begelman 2009).

### *Dark matter density in the galaxy centers*

Recent measurements of dark matter (DM) density in the galaxy centers showed that it is surprisingly constant – it does not grow to the galaxy center, as it must be, according to the Newtonian gravity low (Gentile, et al 2009). We assume that the Newton low is exact only if:
(a) The membranes deviations $\delta L_o$ are *very small* $\delta L_o << L_o$, and, correspondingly,
(b) Difference $\Delta L_o = L_o(e_-) - L_o(e_+)$ between two waveguides thickness $L_o(e_-)$ for electron waveguide $\mathbf{W_0}$ and corresponding thickness $L_o(e_+)$ for the adjusting positron waveguides $\mathbf{W_{-1}}$ and $\mathbf{W_1}$ is enough small (that corresponds to relatively very small usual matter density).

From this point of view gravity potential in very massive galactic centers could deviate from the Newtonian curves and become more smoothed then the Newtonian one. Growing resistance of the *e*-cells of vacuum medium, filling waveguides, could cause this smoothness. This could be the case in the galactic centers, having increased waveguides thickness asymmetry $\Delta L_o$. Our vacuum is proposed to be extremely dense *e*-cellular layered medium, divided by the elastic 3*D*-membranes. Each tiny *e*-cell creates huge perpendicular *L*-pressure $F_{\perp i} = M_{oei}C^2/L_{oi} = (hC/2L_{oi})/L_{oi} = hC/2L^2_{oi}$. This enormous pressure is reduced to zero by the same backpressure of e-cells in the adjacent waveguides - and all membranes stay flat. This reciprocal equilibrium pressure is equal for equal waveguides thickness; it realizes the perfect – totally flat – "empty" vacuum. If these $L_{oi}$ thickness become different under the gravity mass potential, their differences $\Delta L_{oi,i+1}$, arising near very big gravitating masses, create $\Delta F_{\perp i,i+1} = F_{\perp i} - F_{\perp i+1}$ asymmetry for the coupled *e*-cells-medium of the vacuum space, inducing a resisting pressure, trying to equalize waveguides thickness. It works as a locally *inducted negative mass density*, leading to the local smoothing of the Newton gravity potential. So, this resisting pressure will decrease the Newtonian membrane 1/*r*-deviations (when these deviations become too big) and this mechanism can lead to the observed smoothed central gravity potential areas, found by astronomers.

The same smoothing mechanism must be everywhere in our periodical waveguided hyperspace, where very deep gravity potentials could arise – in the super-massive galaxies. Their central areas must have smoothed central gravity potentials without any singularities. The surprising central galaxy potential flattening (Gentile, et al 2009) is supported also by the

trivially flat gravity potentials inside the MWBHs, described above. Indeed, the MWBHs gravity does not follow the Newton's gravity low at all – it is simply too radically smoothed - flat over some too huge mass density (inside the $R_{Schw.MWBH}$) dominating in the galactic centers.

### *Black holes as positrons "factories"*

The electron/positron vacuum is full of coupled/decoupled - virtual electron and positron pairs and in the extremely strong gravity field of a Black Hole (BH) gravity could separate these decoupled pairs and prevent their back coupling, since the separated positrons gravitationally are repulsed and are accelerated out and the corresponding electron partners attract to the BH and they charge the BH with the negative charge. This process could destroy vacuum itself, but very soon on the way of this distortion arises a quasi-spherical electrostatic layer with equilibrium between the oppositely acting polarizing electrostatic and gravity fields, so preventing the further gravitational decoupling of the coupled ($e–/e+$)-atoms. Instability in the growing BH and fluctuations, etc. permanently destabilize this spherical equilibrium and part of the decoupled positrons is able to escape the BH (being for antiparticles a repulsing White Hole (WH). These positrons cannot be anti-gravitationally accelerated till very high energies, about 100 MeV, but it was detected experimentally in the cosmic rays. Much more stronger – electrostatic acceleration of the high-energy positrons near BHs was proposed recently by (Bambi, et al, 2009). The BH, accordingly this work better absorbs heavy protons from surrounding BH plasma than very light electrons. The positively charged BH's surface attracts virtual (decoupled) electrons but repulses electrostatically virtual (decoupled) positrons outward from the positively charged BH. We assume that the both repulsive mechanisms (the WH-antigravity and the positive BH charging and exchanging - protons-in/positrons-out) accumulate these repulsive energies and are responsive for the recently discovered massive positrons flow near central areas of our Milky Way galaxy.

## PERIODICAL HYPERSPATIAL, COAXIAL QUARK / ANTIQUARK *L*-TUBES

Electron *e*-hole, living in the $\mathbf{W_0}$-waveguide, creates its elementary electrostatic charge by the corresponding ($\Delta r_{(e–/e+)}$)-polarizations of surrounding ($e–/e+$)-atoms, described above. These polarizations are caused exclusively by the ($\Delta r$)-displacement of *e*-cells in the $\mathbf{W_0}$-layer. Two surrounding *e*-cells layers in the $\mathbf{W_{-1}}$ and $\mathbf{W_1}$ waveguides remain unbiased, and resulting electrostatic membrane energy is localized only on two the nearest membranes $\mathbf{M_{-1}}$ and $\mathbf{M_0}$, framing the $\mathbf{W_0}$ waveguide. Our positron *e*-hole is assumed to be the same *e*-hole as for electron, but being displaced into the nearest $\mathbf{W_{-1}}$ or $\mathbf{W_1}$ waveguide. This displacement acquires the opposite ($-\Delta r_{(e–/e+)}$)-polarizations for electron and positron and these opposite polarizations can cancel each other, indeed as two the opposite electrostatic charges.

Why much more heavier proton with positive gravity mass creates the same elementary ($e+$) anti-charge - with the opposite spatial ($-\Delta r_{(e–/e+)}$)-polarizations, exactly neutralizing the electron charge? We assume that the proposed above waveguided, " effective", globally coherent ($e–/e+$)-vacuum dictates and allows creation only few other stable massive (waveguided) $C_4$-particles, compatible to the elementary charge of electron, if they are able to minimize-eliminate electrostatic strengthens of the *e*-holes. We know the most stable composite particles – protons, playing this role. We assume they are constructed from selective higher $n\nu_{oe}$ harmonics in the same *3D*-waveguides. They have the *e*-cell-like hypercylindrical form with $R_p \sim R_{oe}/n$ and create a much bigger orthogonal *L*-pressure $nF_{Le}$,

increasing electron ($\Delta r_{(e-/e+)}$)-polarization-shifts exactly till its the opposite ($-\Delta r_{(e-/e+)}$)-polarization state with resulting the opposite e+ charge of proton. We describe below our heuristics waveguide's quarks concept, *qualitatively* clarifying the –1/3+2(+2/3) triplet electron-like +charge nature in the (*udu*)-proton composite. We assume existence of the hyper-periodical, coaxial-doubled quark's *ud*-$L_o$-tubes, periodically filling the whole Multiverse (Fig. 11-1). Quarks, as also our matter electrons above, assumed to be a local *ud-cellular exclusion* in these periodical, quarks-cellular *ud-quark tubes*.

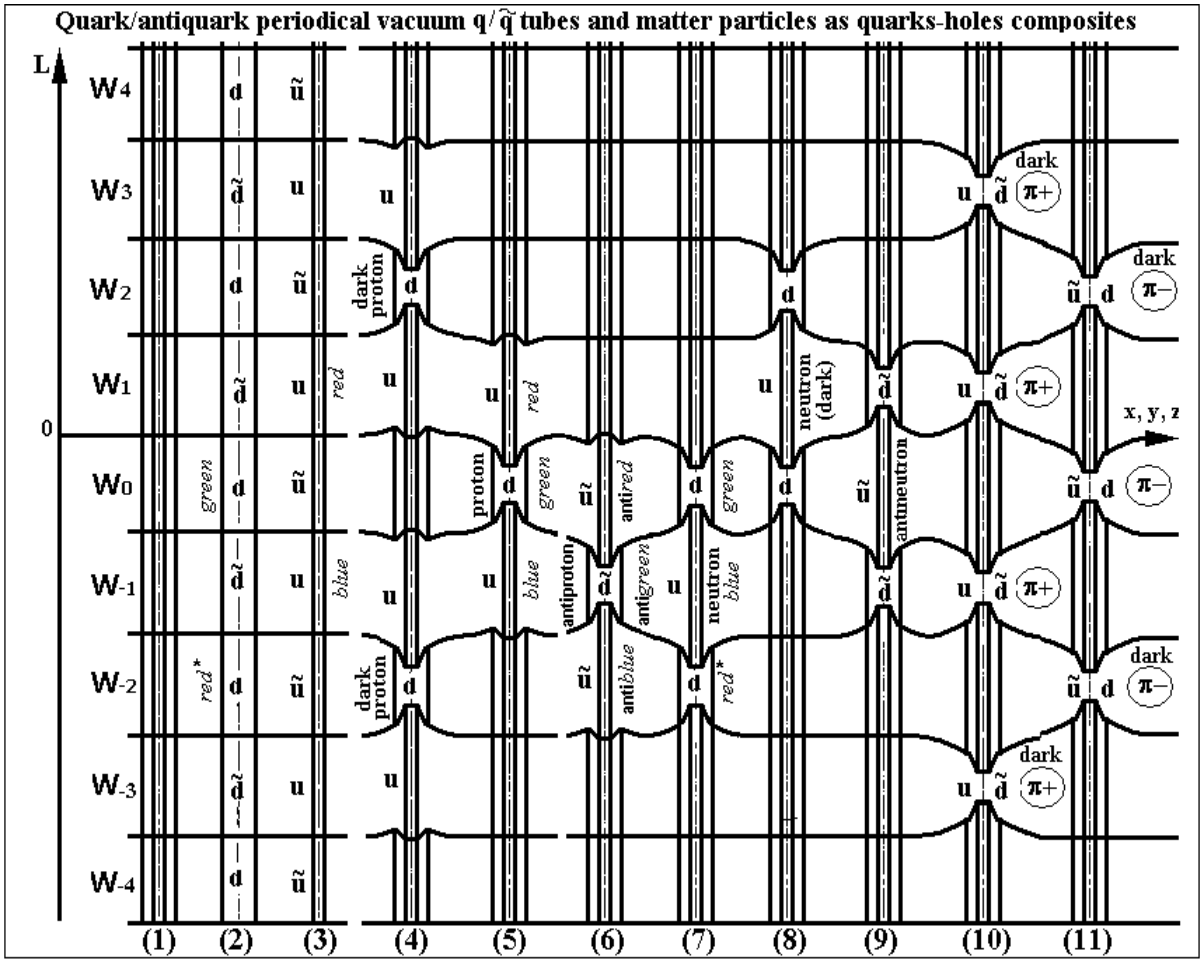
The widely confirmed proton stability supposes well working confinement mechanism, related to 3 *double tubes exclusions*, realizing the proton quark-holes *u,d,u,* existing as corresponding confined *quark-cells defects*. The matter waveguides triplet [$\mathbf{W_{-1}}$;$\mathbf{W_0}$;$\mathbf{W_1}$] must contain these three *ud*-cells (as three holes-exclusions). Three common quarks colors in proton manifest simply 3 different *e*-waveguides, mentioned above, (Fig. 11(5)). Two our SM-symmetrical, $L_o$-shifted $\pi_+$ mesons in the symmetrical $\mathbf{W_{-1}}$ and $\mathbf{W_1}$ waveguides and the middle $\pi_-$ meson in the $\mathbf{W_0}$ waveguide realize totally broken elementary segments of the doubled *L*-quarks-tubes (Fig. 11(10)). These matter $\pi_+$ meson-holes, living in the $\mathbf{W_{-1}}$ and $\mathbf{W_{+1}}$ waveguides, have the same overlapping "dark" meson-holes role, identical to the neighbor dark baryons.

The miracle *color force* of the QCD, confining these 3 quarks, here looks like the universal *hyper-cylindrical bolt-mechanism*, described for the electron *e*-hole above. The color force potential shows suddenly very simple - a stacked-bolt nature: you cannot divide two symmetrical *d*-tube-holes in proton, since they are stacked inside of the stable middle *u*-tube - are confined in the hypercylindrical frames of the wider *u*-tube. These confined tubes can easy reach their "asymptotical freedom" in the very coaxial co-position (very small distant between the tubes axes, where the bolt-like "3-color force" potential has its steady minimum, (where the color interaction is reduced exactly to zero). The so easily - "bag-like"- confined quarks behave as if they are essentially free particles in the proton near the equilibrium coaxial position (what was postulated by Bjorken (Bjorken 1969)).

Moriyasu writes: "No free colored quarks or gluons have been observed in experiments. Gluon carries red and antired (two-color picture of gluons." (Moriyasu 1984, p. 124). It is not so difficult to understand if the underlying multileveled vacuum tissue is performed and exists as it is proposed here - it dictates what is allowed or is not allowed in strictly synergistically arranged excitations: the electron charge unit dominates this coherent cellular space tissue - no free quarks with $Q_{el} < 1$, no free cluons, strictly *confined* inside the *q*/*q* hypertubes.

Here they exist presumably as spin waves via hypersymmetric quark-antiquark spin-excitations, arising without the *q*/*q* hypertubes break. Indeed, gluons are chargeless, theoretically massless and have spin *S*=1. Gluons could be described slightly differently (quasi-mechanically) as phonons (bosons with spin *S*=1), confined inside the spherical "3*D*-layer" between *u* and *d* hypertubes on the 3*D*-membrane, realizing proper Quantum Chromodynamics (QCD) interactions between the confining quarks-hypertubes. We see some *qualitative* correspondences between our periodical waveguide's (hyperspace/cellular) vacuum structures, baryonic and dark baryonic matter, giving simple qualitative explanation to the key physical questions (as confinement, colors, etc.) in contemporary QCD.

It is significant that these periodical doubled-coaxial quark/antiquark tubes (as perfect-defectless quark/antiquark vacuum cells) behave as multilayered fermions/antifermions. They can be coupled into superfluid composites, as a Cooper-like coupled quarks/antiquarks.




**Figures (11.1-11.11)** show qualitatively common SM quarks composites as multi-waveguide's quark/antiquark vacuum defects in the proposed filled quark/antiquark vacuum tubes:

(1) *u*$\underline{d}$ and $\underline{u}$*d*-quark double *L*-tubes (a perfect quark vacuum) without elementary defects-exclusions;

(2) *d*/$\underline{d}$ –tubes with periodical exclusions-holes of the inside *u* and $\underline{u}$ elementary sub-tubes;

(3) *u*/$\underline{u}$-tubes with exclusions-holes of the outside *d* and $\underline{d}$ elementary sub-tubes;

(5) Our common matter SM-proton contains a colorless-stable *udu* quark's-holes composite with the bolt-like confinement mechanism via "tube-in-tube"; 3 colored quarks manifest here 3 involved adjusted waveguides in the triplet [$\mathbf{W_{-1}}_{(u\text{-}blue)}$;$\mathbf{W_0}_{(d\text{-}green)}$;$\mathbf{W_1}_{(u\text{-}red)}$], and their quarks;

(4) Two symmetrical (mirror-like) dark SM-protons, centered in the $\mathbf{W_2}$ and $\mathbf{W_{-2}}$ waveguides (as our SM matter proton in the waveguide triplet [$\mathbf{W_{-1};W_0;W_1}$], ±shifted from the $\mathbf{W_0}$ waveguide);

(6) Our repulsively gravitating SM-antiproton has anticolored antiquark-holes and it is exact the (5)-proton, "one step" (±) shifted (here down) into the [$\mathbf{W_{-2}}_{(\underline{u}\text{-}antiblue)}$;$\mathbf{W_{-1}}_{(\underline{d}\text{-}antigreen)}$;$\mathbf{W_0}_{(\underline{u}\text{-}antired)}$] waveguides triplet;

(7) Two symmetrically placed SM-neutrons, consisting of 3 *dud* matter quarks-holes, placed in the adjacent waveguides triplet [$\mathbf{W_{-2};W_{-1};W_0}$];

(8) Or it is placed symmetrically in the [$\mathbf{W_0;W_1;W_2}$] triplet**.** It is significant that the SM-neutrons are the same "overlapping" neutrons also for our DM baryons, centered in the $\mathbf{W_2}$ and $\mathbf{W_{-2}}$ waveguides;

(9) Our SM-antineutron-holes $\underline{d}$ $\underline{u}$ $\underline{d}$ are centered in the $\mathbf{W_0}$ waveguide with its repulsive gravity to our proton, electron or neutron.

(10) Two our symmetrical ($\pi$+)=(*u*,$\underline{d}$) mesons-holes in the $\mathbf{W_{-1}}$ and $\mathbf{W_1}$ waveguides, and two the nearest DM ($\pi$+) mesons-holes, (±) shifted in the $\mathbf{W_{-3}}$ and $\mathbf{W_3}$ waveguides.

(11) Our centered ($\pi$–)=($\underline{u}$,*d*) meson-holes in the $\mathbf{W_0}$ waveguide (antimeson to the nearest ($\pi$+)=(*u*,$\underline{d}$) mesons) with two (±) shifted DM ($\pi$–) mesons-holes, (±) shifted in the $\mathbf{W_{-2}}$ and $\mathbf{W_2}$ waveguides.

These quarks/antiquarks condensate can behave like the described above coupled (*e*–/*e*+) Diracian-like condensate (at least in fireballs of high energy nuclear collisions and as Cooper-like neutron-neutron composites in dense and cooled neutron stars, etc.).

Moriyasu writes: "Thus our understanding of the strong interaction is complicated by the fact that the fundamental color charges and gauge fields are hidden and their properties only can be studied indirectly." (Moriyasu 1984, p. 124). Human intellectual fate is miracle, since being made of "dusty defects", swimming in a perfect - undetectable vacuum ocean, we are limited to experience and investigate only similar material defects; but natural intellectual need in the complete-holistic physical understanding push us beyond the world of a "defected physics". We are forced to create the holistic, consistent (monotheistic) physical theory, which must paradoxically include untouchable, perfect oceanic "porcelain", creating us and patiently holding us alive (thanks the gravity/antigravity symmetry, saving the porcelain itself).

*Note:* The idea that a SM-*"mirror" sector* (very much like our gravitationally attracting dark clones of the SM- electrons, protons, etc. particles) might exist was proposed earlier, prior to the advent of the SM of particle physics, in (Lee and Yang 1956; Kobzarev, Okun, Pomeranchuk 1966, etc.). "It is reasonable to suppose that the dark matter particles, like the proton and electron, will also have a good reason for their stability. On the other hand, we also know that the standard model works very well. There is no evidence for anything new (except for neutrino masses). For example, precision electroweak tests are all nicely consistent with no new physics. A simple way to introduce dark matter candidates which are naturally dark, stable, massive and don't modify standard model physics is to introduce a mirror sector of particles and forces" (Foot 2007, p.2). Indeed, our periodical multi-waveguide's hyperspace naturally contains plenty of physically identical $L_o$*-periodical, dark* SM-sectors, now with arising gravity mass symmetry, with periodically "mirror" / "anti-mirror components, where two the nearest SM-waveguides perform the matter/antimatter = gravity/antigravity and the mirror "dark matter" sector (dark sectors) are placed periodically as even or odd waveguides numbers.

## THE SM-ANALOGIES IN CRYSTALS DEFECTS AND SUPERFLUIDES

### *A gauge theory of crystal dislocations*

It is important to note that our cellular vacuum concept and its elementary matter particles as an elementary "cellular defects" in this (elastoplastic and frictionless) vacuum medium find a lot of conceptual and formal mathematical support in (a rather similar by the physical nature) gauge theory of crystal dislocations, where was discovered some basic, deep analogues with the Maxwell electromagnetic theory, the Einstein gravity theory and the SM Yang-Mills gauge field theory. The *gauge theory of crystal dislocations* was historically formulated as a 3-*dimensional translation gauge theory in analogy to gravity* (e.g. Kleinert, 1983, 1989, Kröner, 1996. This theory was essentially developed, considering the *elastoplasticity* of crystals and could show very close analogy with the SM physics. Elasticity of the membranes in our waveguide's vacuum and corresponding fields' concepts are also very important conditions in our waveguided physics. Importantly that the elastoplastic material plays in the theories of defects in crystals a role of a kind of an *anisotropic "ether" for the defects* in direct analogy to our *e*-cellular vacuum. It is interesting that in the theories of defects in crystals arise the "elastoplastic" Yang-Mills type gauge field equations and Euler-Lagrange equations, which can be interpreted as equilibrium equations. Indeed, due to the nonlinear

geometrical character of elastoplasticity, the field equations are nonlinear partial differential equations (Lazar 2000, 2009, 2010).

### *Condensed superfluid matter as an "empty" vacuum space*

Here we follow Laughlin & Pines (2000), and Volovik (2003) guidelines. According to the anti-GUT analogy, (Hu 1996; Padmanabhan 1999; Laughlin & Pines 2000) "properties of our world such as gravitation, gauge fields, elementary chiral fermions, etc.., all arise in the low energy corner as low energy soft modes of the underlying Planck condensed matter" (Volovik 2003 p.7). "It is assumed that the quantum vacuum of the Standard Model is also a fermionic system, since the bosonic modes are the secondary quantities, which are the collective modes of this vacuum." (Id. p. 5). Indeed, "In the limit $T \rightarrow 0$ the superfluid 3HeA gradually acquires from nothing almost all the symmetries which we know today in high energy physics: (an analogy of Lorentz invariance, local gauge invariance, elements of general covariance, etc." "The quasiparticles and collective bosons perceive the homogeneous ground state of condensed matter as an empty space a vacuum since they do not scatter on atoms comprising this vacuum state: quasiparticles move in a quantum liquid or in a crystal without friction just as particles move in empty space". "The dynamics of the zero modes is described within what we now call 'the effective theory' ". (Id. p. 3). "This quantum field remains the effective field which is applicable only in the long wave-length limit, and does not give detailed information on the real quantum structure of the underlying crystal (except for its symmetry class). (Id. p. 7). "One of the most important consequences of such symmetry breaking is the existence of topological defects in both systems. Cosmic strings, monopoles, domain walls and solitons, etc., have their counterparts in condensed matter: namely, quantized vortices, hedgehogs, domain walls and solitons, etc." (Id. p. 3).

### *The "ultimate goal" is to reveal the still unknown structure of the superfluid ether*

"Its physical structure on a 'microscopic' trans-Planckian scale remain unknown, but from topological properties of elementary particles of the Standard Model one might suspect that the quantum vacuum belongs to the same universality class as 3He-A. More exactly, to reproduce *all the bosons and fermions of the Standard Model*", "but the effective gravity still remains a caricature of the Einstein theory. (Id. pp. 5, 8). We remember that great creators of the classical gravity theory Newton and later Einstein were also uncomfortable with the notion of "action at a distance" and practically meant kind of paradigm of continual vacuum-medium, transmitting gravity interactions (Newton 1693, Einstein 1920).

*Notes.* This analogue supports our superfluid frictionless vacuum architecture, consisting of the hypersymmetric-condensed electron/positron tubes composites; quark/antiquark doubled-coaxial tubes composites, etc. – the quantized periodical hypercylindrical vortexes. We even don't need to care about our quasi-particles physics – it must surely contain the SM complex with its $U(1)\times SU(2)\times SU(3)$ symmetry, being quantum Fermi-liquid on all vacuum levels! It must contain and explain also the basic leptonic families' phenomena and weak interaction, arising between these levels (being out of discussion in present work). So-called spinons "carrying electrical spin" (Id. p. 149) and holons ("slave" bosons, carrying its electrical charge) find their analogies in our mass/charge concept. Volovik (Id., p. 18) supposes that the hypothetical quantum vacuum consists "of some discrete elements – bare particles – whose number is conserved". These conserved "bare particles" are identical *e*-cells in our superfluid vacuum, filling the Multiverse, building very strongly coupled $(e^{-}/e^{+})$ pairs, very well conserved at low temperature, that keeps global $U(1)$ gauge invariance in the $(e^{-}/e^{+})$ vacuum

and keeps a $U(1)$ gauge invariance together with a local $SU(2)\times SU(3)$ symmetry for all other quantum vacuum levels, based on a *C*-quasiparticles, confined in our 3*D*-waveguides .

### *The paradigm of the non-gravitating superfluid vacuum*

Einstein claimed some essential physical properties for this hypothetical ether (Einstein, 1920):
(a) It must be a non-pondermotor = non-gravitating media;
(b) The corresponding sound-light waves in this media must be transverse (as the transverse light waves) and, thus "must be of the nature of a solid body".

In his times Einstein could not take in consideration a new promising ether analogy with superfluid, where the "transverse light waves" are natural (Volovik 2003), as also the corresponding, now *non-gravitating*, quantum-liquid-like ($e-/e+$) vacuum structure (Gribov 1999, 2003, 2005, 2007, 2009). Volovik writes: "The paradigm of the non-gravitating equilibrium vacuum, which is easily derived in condensed matter when we know the microscopic trans-Planckian' physics, can be considered as one of the postulates of the effective phenomenological theory of general relativity. This principle cannot be derived within the effective theory. It can follow only from the still unknown fundamental level" (Volovik 2003, p.8). He concludes, that we need a '*perfect' quantum liquid*, "where in the low-energy corner the symmetries become exact to a very high precision as we observe today in our Universe, where "$E_{Lorentz} \gg E_{cutoff}$." (Id. p. 463), but "such quantities as atoms of the vacuum and the related chemical potential are not known by an inner observer who uses the effective theory" (Id. p. 465). He recalls that the scheme of the emergent phenomena "is not complete: quantum mechanics is still fundamental. It is the only ingredient which does not emerge in condensed matter." (Id. p. 468).

Anderson, Laughlin and Pines suppose that all "fundamental" physical laws are emergent, as it is, for example, in superconductivity and superfluidity, resulting of a many-body interaction at low temperature. These laws emerge out of a many-body interaction and will simply disappear if one tries to take it apart to a single-particle level (Anderson 1972, Laughlin& Pines 2000).

*Notes.* Why the fundamental microscopic level of the non-gravitating atomistic vacuum "is still unknown"? (Volovik 2003, p. 8). The answer seems to be very simple - this medium-like vacuum was practically impossible to realize all the time without the here proposed periodical 3*D*-waveguided particle/antiparticle concept, what allows existence of the composite scalar ($e-/e+$) bosons with the summary zero gravity mass. All other necessary features of the realizable now vacuum's medium – as non-dissipative foliated superfluids, etc. – are not so problematic after this basic conceptual correction (Gribov 1999, 2005). It is clear that without the $\pm M_{gr}$ hypersymmetry there was no way to create this microscopic fundamental level, being at the same time non-gravitating & supersymmetric - with zero vacuum energy (friendly with the SM and being now organically connected to the Newton-Einstein ±gravity). The necessary "non-pondermotor" postulate by Einstein is exactly "at home" in our multi-waveguided vacuum - it is the straight result of the underlying ±space-symmetry and immediately arising antigravity.

Michio Kaku once noted: "Even the powerful gauge symmetries of Yang-Mills theory and the general covariance of Einstein equations are insufficient to yield a finite quantum theory of gravity" (Kaku 1999, p.4). The proposed 3*D*-wavegude's hyperspace creates and unifies the

SR, QM and GR as *simultaneously emergent* on this level. Quantum mechanics with waves of de Broglie also is emergent. Here we find basic quasi-classical stones, unifying gravity with the (now periodical-hyperspatial) SM, where so tiny elementary particles and even so monstrous black holes have no common classical singularities (see below).

## THE UNITED DE/DM COSMOLOGY WITH THE PERIODICAL $\pm M_{gr}$ SYMMETRY

### *The large-scale cosmology with $\pm M_{gr}$ symmetry in the Multiverse*

The $\pm M_{gr}$-neutral matter-antimatter cosmological paradigm (Gribov 1999, 2003, 2005; Ripalda 2001) provides a quite universal and simple solution for the most fundamental and mysterious cosmological problems named the *Horizon Problem*, the *Flatness Problem*, the *Repulsive Dark Energy Problem*, the *Accelerating Expansion Problem*; the large-scale *Bubble-like Structure Problem*. We can solve these problems simultaneously if we keep our fundamental background condition - the zero vacuum energy, generic for the hyper-symmetric vacuum – and suppose the full conservation of the large scale $\pm M$ baryon-antibaryons matter *symmetry*, i.e.

$$\sum(+M_{gr(baryonic)} - M_{gr(antibaryonic)}) = \sum M_{gr} = 0, \qquad (69)$$

across the whole evolution of our matter - Universe, being an organic, indivisible part of the periodical matter-antimatter Multiverse. The repulsive - counterpart $-M_{gr(antibaryonic)}$ functions quite similar to the hypothetical cosmic "quintessence" medium, proposed in (Caldwell, et al 1998), needed for the flatly Multiverse: our repulsive ($-M_{gr}$) antimatter (DE) and DM matter plus dark matter also are evolved equally-dynamically, they develop fluctuations, co-participate in the microwave background anisotropy, etc. Crucial here is that our cosmological paradigm of the hyper-periodical large-scale $\pm M_{gr}$-neutrality is not some kind of isolated hypothesis, rescuing physics but it has fundamental genetic roots in the hypersymmetric microscopic quantum vacuum structure, compatible with the periodically "cloned" hypersymmetrical SM- and underlying classical physics. The $\pm M_{gr}$ in the periodical matter and antimatter Multiverse (see Fig. 13a,b,c) is connected with the significantly improved Einsteinian $+M_{gr}$ gravity concept and with arising here overall simplicity – the Cooper-composed QED-supersymmetry - zero vacuum energy density, keeping the compact SM elementary fermions family intact), (Gribov 2003, 2005).

Resent, very fine astronomical observations showed strong evidences not only for very large-scale cosmic antigravity (Perlmutter, et al 1999), but it was fond also the astronomically short distance antigravity evidences at about 2÷5 Mps, existing around some galaxies groups (Chernin, et al 2009). The "local antigravity" studies observed matter flows around galaxies clusters, starting from the centered attraction zone (flows-in) with some radiuses $R_{attractive}$ to a neutral zone $R_{neutral}$ without gravity and to the most interesting repulsive zone with $R_{repulsive} > R_{neutral}$ – with corresponding quasi-spherical outflow. The observed minimal $R_{repulsive}$ was about 2Mps from the cluster center. This means, accordingly our symmetric matter/antimatter Universe, it could be a proximal minimal distance between matter and antimatter clusters, being today so fare away from each other (2Mps ~ $6 \times 10^6$ ly~$10^{20}$km). This is too large distance for cosmic space travels (if we want to transport the antimatter "fuel" from the unlimited antimatter sources to the Earth (Gribov 2007). This huge distance explains why the matter/antimatter symmetrical Multiverse is saved so well from their annihilation and why it is so difficult to experience and imagine the symmetrically existing

matter and antimatter cosmos. They are enormously repulsed-separated now in the endless cosmic space. Indeed, the fundamentally important mentioned above global and "local antigravity" findings support the symmetrical matter/antimatter Universe concept. This concept is also in a total harmony with the universally observed today and fundamentally important - the fractal "empty bubble" Universe structure. These fundamental cosmological data can be very easy explained by the periodical matter /antimatter - gravity/antigravity effects in the periodical Multiverse (Fig. 12).

If we have only *asymmetric – the attractive matter* in our Universe and if only the constant vacuum energy density itself is a full drive of the recently observed macro-cosmic antigravity, we must observe many huge massive matter islands, locating somewhere in a middle of some existing cosmic bubbles. Why real cosmic bubbles are surprisingly EMPTY inside?

The void in Böotes with a diameter of 60 Mpc was discovered some decades ago (Kirshner, et al 1981). Observations have shown the existence of many similar voids and computer analysis of galaxy distribution gave evidence that voids occupy about 50% of the volume of the Universe and their "bubble" structure practically dominate everywhere (El-Ad & Piran 1997). Several models have been proposed to explain the origin and dynamics of the bubbles "but until now, no exhaustive and fully consistent theory has been found". (Capozziello, et al 2004). Traditional theories supposed "voids are the consequence of the collapse of extremely large wavelength perturbations into low-density black holes and of the comoving expansion of matter surrounding the collapsed perturbations" (Capozziello, et al 2004). The voids-theories with the exclusively attractive matter try to survive the void creation and the further voids stability by the very unlikely claim that in the center of each void must be an enormous black hole, exactly compensating its disappeared mass (Stornaiolo 2002).

The unnatural need in the super-huge "black holes" in the optically empty bubble centers is the straight result of the common asymmetric matter concept – only attractive positive matter gravity mass, filling our theoretical Universe. Antigravity was proposed later as the hypothetically *repulsive vacuum energy*, which has a constant density, independent of the Universe expansion. But the existing cosmic bubbles keep these hypothetical - super-heavy central black holes as total incognito, on the contrary to the galactic black holes, being enough well detectable inside galactic centers. Disability to explain the voids emptiness and their miracle emergence everywhere seems to be for us the strongest - decisive contra-argument to the asymmetric (+matter) Universe concept and to common (being artificial) - salvatory hypothesis of the repulsive dark energy of vacuum itself.

On the contrary, the large-scale, periodical matter/antimatter antigravity is natural drive to the bubbles creation and the continual accelerating expansion of the repulsive Universe' foam. We see that the repulsive vacuum dark energy concept alone is not able to explain empty voids structure; it also needs the enormous "illusive" black holes in these voids!

On the contrary – very natural spherical voids creation from the always symmetrically presented repulsive matter and antimatter "powder" (initially produced via common Big Bang matter/antimatter symmetry) strongly supports our basic concept of the matter-antimatter symmetry – decisive across the microscopic ($e-/e+$) vacuum level till to the global – large-scale level and the whole Universe. The antigravity of the antiparticle in the multi-waveguide hyperspace allows physical reformulation of the microscopic supersymmetry concept, which creates corrected physically QED without common monstrous singularities - with experimentally verified ~ zero vacuum energy.

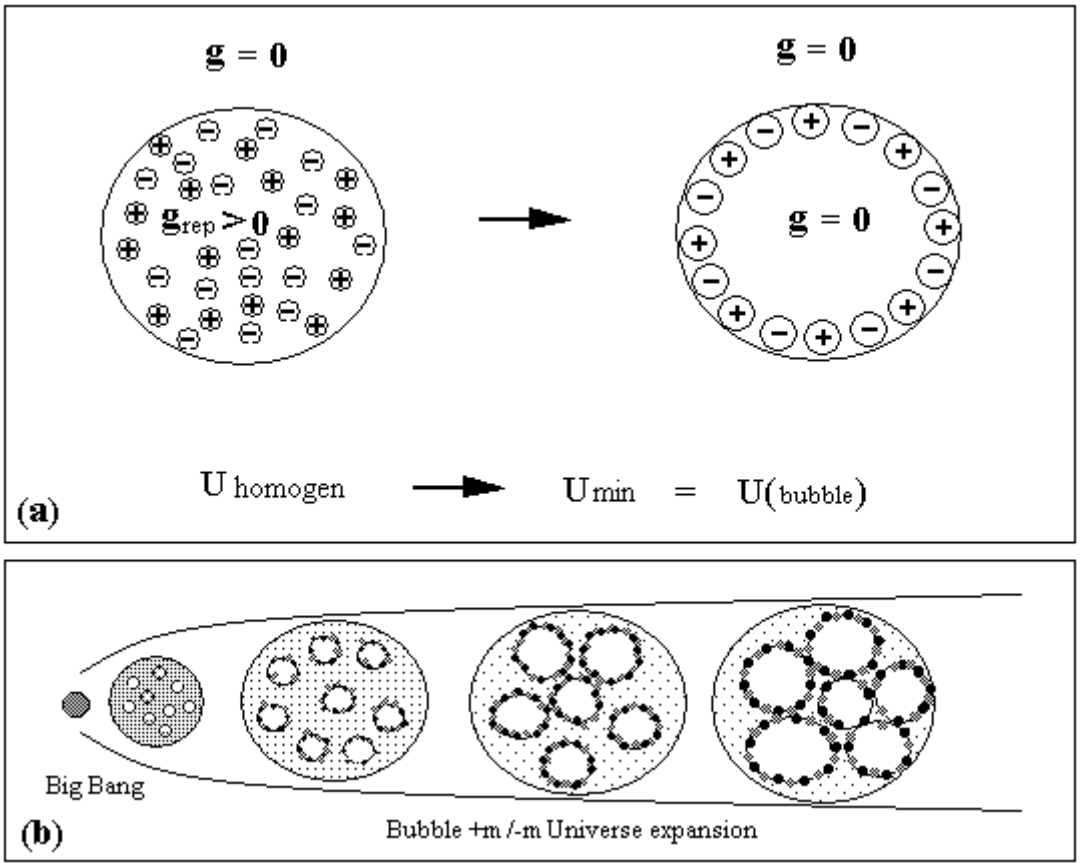



**Fig. 12a** shows cosmic evolution, minimizing the potential gravity/antigravity energy $U_{grav/antigrav}$ (resulting in creation of empty and growing mini-bubbles) in a quasi-homogeneous *neutral* 3*D*-mixture of the equal $+m$ and $-m$ "powder", consisting from matter and antimatter seeds, with arising sporadically local repulsive antigravity fields $\boldsymbol{g}_{rep\ inside}$ between these seeds inside this voluntary spherical region, so $\boldsymbol{g}_{rep.\ inside}>0$ in this spherical space volume. At the same time there is no antigravity fields $\boldsymbol{g}=0$ outside of this sphere, producing from the same inside +m and –m seeds, containing the zero summary gravity mass (see the left sphere). This homogeneous state intends to be transformed into the spherical "bubble" state with a devastated inside volume with spherically symmetrical 2*D*-distribution of the $\pm\ m$ seeds on the spherical surface. In this case we have the same zero outside gravity field $\boldsymbol{g}=0$, but all inside particles are devastated by the ± repulsion (the right bubble). The both states show that the minimal potential energy $U_{min}=U_{bubble}<U_{homogen}$ and so, the homogeneous "powder" will revolute to the locally created devastated mini-bubbles everywhere, minimizing the summary potential energy.

**Fig. 12b** shows resulting bubble Universe states (with more and more expanding bubbles radiuses), as it is indeed everywhere in our expanding Universe! The summary potential gravity/antigravity energy of the "powder" is decreased and the powder behaves as a decompressing spring, accelerating the Universe expansion with asymptotically constant speed of ever expansion without acceleration.

The cosmological – large-scale matter/antimatter symmetry explains simultaneously (as it is common for our wise grandmothers) (a) the "yeast dough" of the growing voids (Fig. 12a), (b) the corresponding Universe repulsive expansion and (c) the mysteries nature of the here deeply related DM and DE (see the chapter below).

How could we distinguish matter clusters from antimatter clusters in our Universe? Optically it looks impossible – photons and anti-photons seem to be the same particles, but we could try to detect neutrinos bursts of newborn matter neutron stars and correspondingly the

antineutrinos bursts from new-born antineutron stars. This common asymmetry could be theoretically detected, but we must now take in account so very big distance ($R$~$10^{20}$km) to the nearest antimatter clusters, creating the antineutron bursts. Who could detect such a small antineutrino-bursts till now? As we know, nobody ever detected these events, since the antineutrons bursts from the antimatter sources are too fare away (comparably to the mentioned above neutron bursts sources, created by the surrounding us matter cluster) and the antineutrino-antimatter signals are much-much lower.

### *Periodical repulsive matter/antimatter clusters drive the Multiverse-DE expansion*

The described Multiverse expansion creates huge parallel Multiverse bubbles with periodical parallel $+m$ matter and periodical $-m$ antimatter clusters, distributed on the bubbles walls. Fig 13a,b,c show bunch of parallel Universes/Anti-Universes $\mathbf{W_{2n}}$ / $\mathbf{W_{2n+1}}$, driving this accelerating expansion. These parallel multi-clusters/multi-anticlusters are built from aggregations of periodical dark (gravitationally attracting each other) $\mathbf{W_{2n}}$ galaxies and dark (the same way attracting each other) $\mathbf{W_{2n+1}}$ antigalaxies. This hyperspatial gravitational interaction is clearly a *very short-distance interaction via the L-dimension* in our waveguide's gravity concept (it involves directly only the nearest $n=n_o\pm2$ waveguides). For example, our central waveguide $\mathbf{W_0}$ contains the visible $+M$ matter with the Milky Way galaxy, with its gravity potential $\boldsymbol{U}_{VisibleMilkyWay}$. Its positive gravity mass interacts *attractively* with two the nearest dark matter galaxies (shadow-dark Milky Way galaxies), centered in the waveguides $\mathbf{W_{-2}}$ and $\mathbf{W_{+2}}$. They have corresponding gravity potentials $U_{+2DarkMilkyWay}$ and $U_{-2DarkMilkyWay}$, *half*-acting from *two joint deformed waveguides* $\mathbf{W_{+1}}$ and $\mathbf{W_{-1}}$ above and below correspondingly. So, our visible Milky Way galaxy "gravitationally senses" only half of these "dark" gravity potentials, added to our Milky Way gravity potential $U_{VisibleMilkyWay}$ and acquires the corresponding joint gravity potential $\Sigma U_{MilkyWay}$:

$$\Sigma U_{MilkyWay}=U_{VisibleMilkyWay}+U_{+2\mathrm{DarkMW}}/2+U_{-2DarkMW}/2\approx(5\div10)U_{VisibleMilkyWay} \qquad (69a)$$

The nearest shadow $\mathbf{W_{-2}}$ and $\mathbf{W_{+2}}$ DM-galaxies contain the summary gravity potential near $2(5\div10)\ U_{VisibleMilkyWay}$., empirically estimated by cosmologists. Our matter galaxies have their attractive (visible and dark, Fig 13c) matter neighbor galaxies in the *even-attractive* waveguides $\mathbf{W_{2n}}$ and correspondingly periodical repulsive antimatter neighbor's antigalaxies (visible and dark) in the $\mathbf{W_{2n+1}}$ - the *odd-repulsive* waveguides (see Fig. 13b). The basic physical laws are exactly the same in the whole periodical Multiverse structure – it is assumed to be quasi-identical periodical waveguides structure and we know today a lot of these physical laws. What we yet don't know – is their parallel existence and definitive interaction between our and theirs "cellular defects", manifesting our matter or antimatter particles. Namely here we find the DE and the DM simultaneously! The visible $\mathbf{W_{-1}}$ (antimatter), $\mathbf{W_{+1}}$ (antimatter) Universes are adjacent to the $\mathbf{W_0}$ (our matter)-Universe and have *two joint framing membranes* ($\mathbf{M_0}$, $\mathbf{M_{-1}}$) carrying two joint ½ electrostatic potentials of our matter particles. These identical partners interact (attractively) electrostatically as electron and positron. At the same time they repulse each other gravitationally and the same symmetrical way, realizing here the "anti-equivalence" principle, transforming the Einstein's GR.

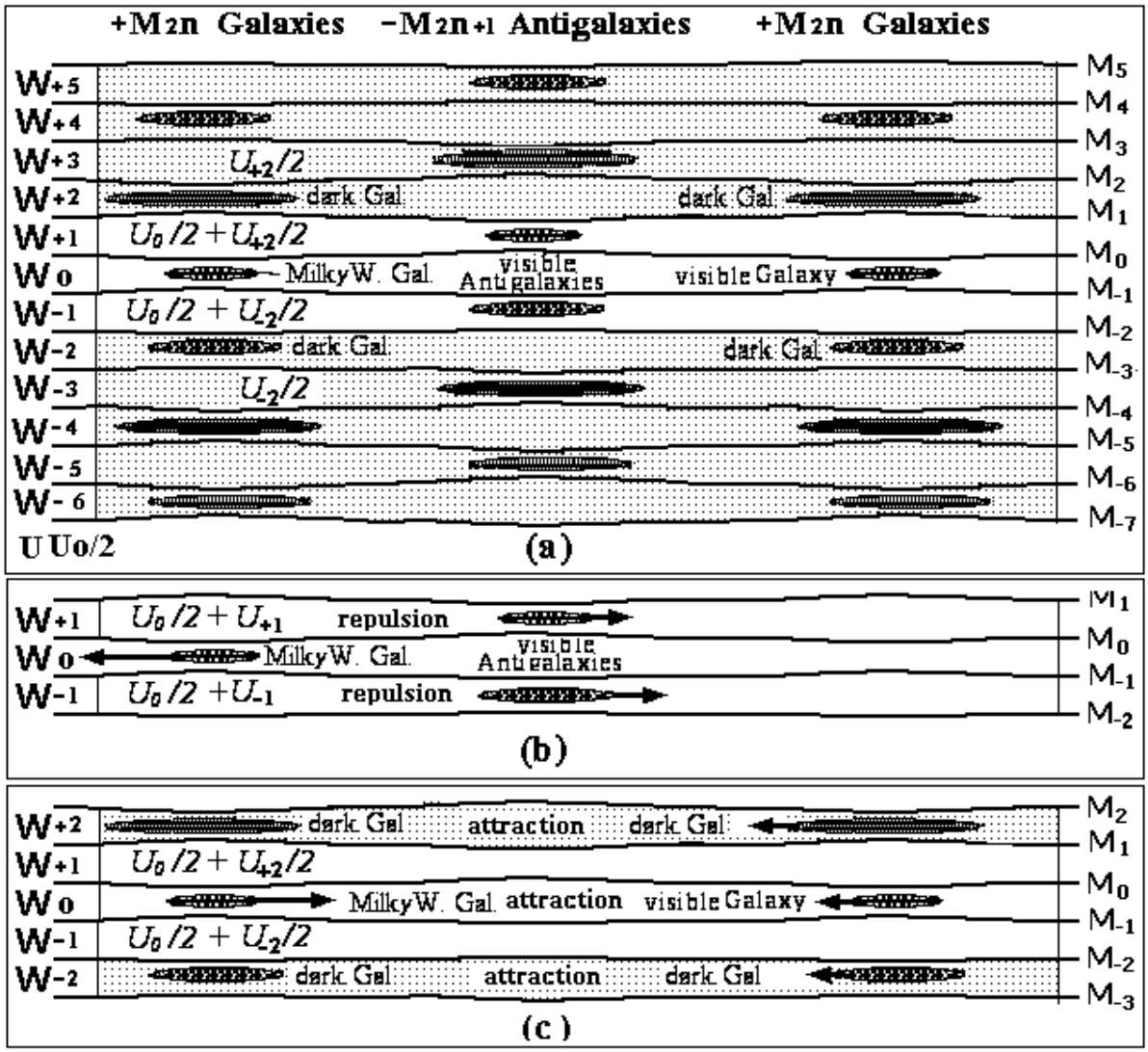



**Fig. 13a** shows parallel Universes/Antiuniverses $\mathbf{W_{2n}}$ / $\mathbf{W_{2n+1}}$.
**Fig. 13b** shows repulsive antigravity between all the nearest matter/antimatter waveguides, e.g. between $\mathbf{W_{-1}}$ (antimatter), $\mathbf{W_{+1}}$ (antimatter) and our matter $\mathbf{W_0}$ Galaxies.
**Fig. 13c** shows attractive gravity between the nearest "dark" waveguides (e.g. between $\mathbf{W_{-2}}$ Dark Matter, $\mathbf{W_{+2}}$ Dark Matter) and our Matter $\mathbf{W_0}$ Galaxies.

Fig. 13a shows parallel Universes/Antiuniverses $\mathbf{W_{2n}}$ / $\mathbf{W_{2n+1}}$. The visible $\mathbf{W_{-1}}$ (antimatter), $\mathbf{W_{+1}}$ (antimatter) Universes are adjacent to the $\mathbf{W_0}$ (our matter)-Universe and have *two joint framing membranes* $\mathbf{M_0}$ and $\mathbf{M_{-1}}$, carrying two joint electrostatic potentials. Our Milky Way Galaxy is surrounded by two the nearest DARK MATTER Galaxies $\mathbf{W_{-2}}$ and $\mathbf{W_{+2}}$ with *two joint gravity waveguides* $\mathbf{W_{+1}}$ and $\mathbf{W_{-1}}$ and our Galaxy acquires the corresponding joint gravity potential $U_{MWG}=U_{0MWG}+U_{+2}/2+U_{-2}/2 \approx (5\div10)U_{0MWG}$, but the $\mathbf{W_0}$ has no a joint chargeable membranes with the $\mathbf{W_{-2}}$ and $\mathbf{W_{+2}}$ Universes and is electrostatically isolated from them – resulting the absence of the electromagnetic interactions (and invisibility) between our matter and DM in the $\mathbf{W_{-2}}$ and $\mathbf{W_{+2}}$ Universes.

The underlying new ±*M*-symmetry and corresponding multi-waveguide features with periodic atomistic (*e*–/*e*+) structure, realizing our nongravitating vacuum, create physical origin of two fundamental "hidden" symmetries, discovered in the 19th century (Lorentz-Einstein invariance and gauge invariance, generating Special Relativity and massless Maxwell fields in the

generic quantum electrodynamics (QED) "that as we now know, literally hold the key to the secrets of our Universe", and he ask further that may be some other symmetries are hidden and are not discovered, may be they could explain existing physical troubles (Zee 2003, p. 457). The proposed here new - fundamental periodical hypersymmetry, indeed is deeply hidden in our huge matter cluster, but it is crucial not only for the physical microcosmos – elementary particle physics free of singularities, including the Standard Model, it is crucial for understanding the large-scale (now the $\pm M_{gr}$-neutral) Multiverse.

*Note:* The described above hyper-columns of parallel dark galaxies / dark antigalaxies could arise from a simultaneous hyper- (Big Bang), providing all hyper-"floors" of the Multiverse with expanding periodical defects/anti-defects.

### *The Horizon problem in the Multiverse*

This problem is a conflict between causality versus the large-scale isotropy and homogeneity versus density fluctuations of the Universe. In the initially homogenous and symmetrical $\pm M_{gr}$ baryonic matter we have an average repulsive-attractive gravity that has the dominating large-scale *repulsive potential* (see Fig. 13d below). This negative pressure was much higher in the early Universe, being much denser initially. Namely that very high negative pressure provided a very high expansion rate $R(t) \approx t^n$ ($n$>1) for the very early Universe. It is common that the very high (solving the Horizon Problem) expansion requires "the pressure to become negative, which makes it inadmissible in a Standard Model with positive pressure (Guidry 1991, p. 498). But we see that the $\pm M_{gr}$ antigravity Multiverse makes this quite possible and even unavoidable! In addition, we have on the smaller scale the local attractions between $+M_{gr}$ with $+M_{gr}$ matter and the same local attractions between $-M_{gr}$ with $-M_{gr}$ antimatter particles driving to their fluctuating consolidation, building growing / and simultaneously anti-gravitationally separating galaxy and anti-galaxy clusters.

### *The accelerating expansion and the Dark Energy problems in the Multiverse*

The above-mentioned repulsive $\pm M_{gr}$ gravity potential - the negative pressure - immediately explains very surprising resent observations data of the accelerating Universe expansion - the Accelerating Expansion Problem (Hinshaw 2008). This acceleration is simply impossible (and must be deceleration) from the point of view of the common asymmetrical $+M_{gr}$ physics. Our Newtonian estimations of ratio between repulsive and attractive parts of the gravity potential energies in the symmetrical $\pm M_{gr}$ distributions with different spatial configurations (but with zero average gravity mass density on the large-scale) give about 65%÷70% for the repulsive part - Dark Energy (DE) = repulsive energy between matter and antimatter) and 35%÷30% for the attractive part, correspondingly. The attractive energy part means the Newtonian attractive gravitational energy of matter-matter + DM, or antimatter-antimatter + dark antimatter, including here the Dark Matter (DM) and our Ordinary Matter (OM) components.

The WMAP measurements of cosmic microwave background (CMB) anisotropies, produced recently by spacecraft indicate that our Universe is very close to flat and correspondingly DE:(DM+OM)≈**74%:26%,** where DM≈22% and Ordinary Matter (OM)≈4%, (Hinshaw 2008). We will investigate below (for a short illustration) the simplest - flat, two-dimensional galactic cluster's-cell, built from 4 symmetrically places gravity masses $+m_{gr}; -m_{gr}; +m_{gr}; -m_{gr}$ with the summary *zero* gravity mass density (Fig. 13d).

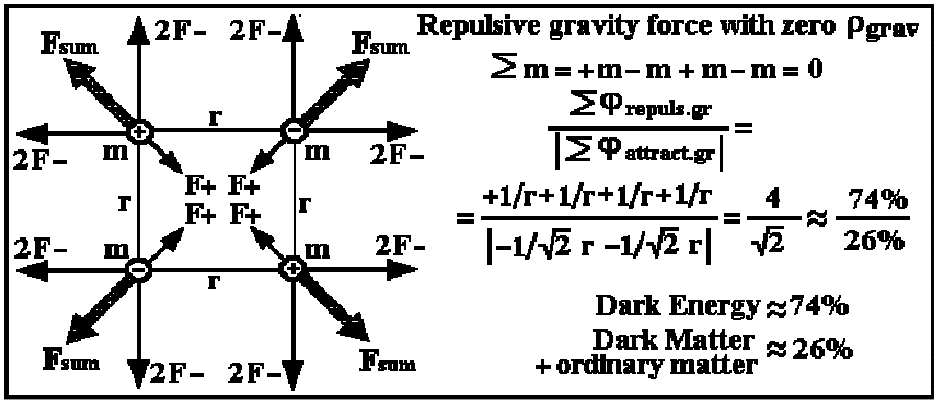



**Fig. 13d** shows a quasiflat, two-dimensional (here quadratic for simplicity) matter clusters/ antimatter clusters - Module from 4 symmetrically places gravity masses $+m_{gr}$; $m_{gr}$;$+m_{gr}$; $m_{gr}$ with the summary *zero* gravity mass.

This, the simplest elementary 2*D*-flat zero-gravity-mass module expresses proximally the same numerical proportion DE (DM+BM)=**74**% **26**% as was measured in the recent WMAP observations, mentioned above. Why the presented 2D-module is so instructive? The enormously huge cosmic babbles have very thin bubbles walls - very thin ~2*D*-monolayers – constructed from similar neutral 2*D-modules* (appearing everywhere on the large-scale Universe, carrying symmetrical quantity of matter and antimatter).

Recently was published a purely geometric, independent - the Alcock–Paczynski - test of the Universe expansion, also confirming its flatness and accelerating expansion. The DE - the antigravity part estimation, responsible for the accelerative expansion, is here between 60%-80% (Marinoni, Buzzi 2010) and is also near our theoretical estimations (~74%), presented above. The nature of the surprisingly decelerated expansion epoch of the Universe expansion after the BB will be proposed below (see the 'The cosmic-attractive "dark flow" nature').

The positive and negative mass seeds grow quicker because of an additional local outside antigravity-compression, shown below (Fig. 13e). This additional local compression and influence of the huge - the nearest to us DM-galaxies can explain why our Universe has developed first galaxies so quickly.

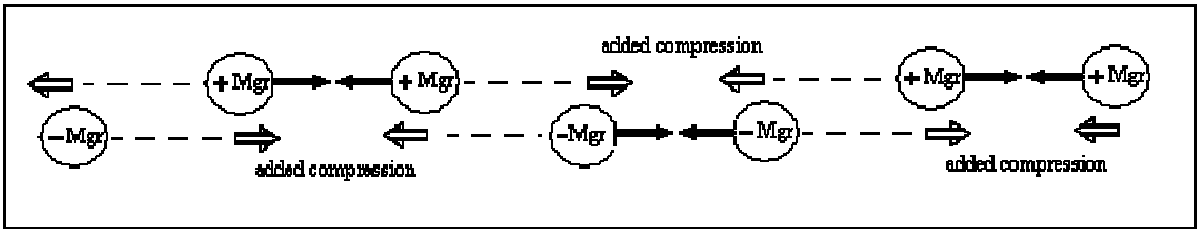



**Fig. 13e** shows additional outside compression, accelerating $+M$ and $-M$ seeds consolidation.

*Note:* A string-theoretical hope related to the nature of the DM was expressed by Joe Lykken, who assumes the common supersymmetry involvement: "In supersymmetric theories it is usually the case that the lightest superpartner particle has exactly the characteristics that dark matter has." (Lykken 2003). Our periodical (gravity/antigravity) Multiverse concept excludes the rather illusive - monstrously heavy superpartners (searched at CERN now) as the DM-candidates and discloses much more realistic cosmologically and much more promising – the hyperspatial DM nature, where the SM particles, shifted in the 2 waveguides (the nearest

dark nucleons in the mirror-"mirror sector") behave as the miracle DM, and, correspondingly the ±1 waveguides (the nearest anti-nucleons in the "mirror sector") express the DE repulsion.

### *The Flatness problem in the Multiverse*

The nature of the spatial flatness - becomes trivial, because the large-scale Universe has exactly zero average gravity mass density and could be described as quasi-empty *flat* space on the large-scale Universe. The repulsive DE nature and the attractive DM nature are connected now with the fundamental $+M_{gr}/-M_{gr}$ gravity/antigravity symmetry in the Multiverse. The baryonic antimatter ($-M_{gr}$) is not always dark; it must build exactly the 1/2 of all visible galaxies clusters, distributed in the Universe! Why astronomers did not noted this for so many years? We cannot distinguish the $+M_{gr}$ or $-M_{gr}$ galaxy clusters, using observational electromagnetic radiation, since photons are "their own antiparticles" and are the same for the $+M_{gr}$ and $-M_{gr}$ radiating matter and antineutrino bursts from antineutron stars are too weak to be detected today.

### *The "Bubbles Structure" problem in the Multiverse*

Recent observations state that the large-scale Universe structure consisting of giant and surprisingly empty "foam bubbles" (with enormous diameter about $10^8$ light years!). Computer analysis of galaxies distribution gives evidence that these voids occupy about 50% of the volume of the Universe (e.g., see El-Ad & Piran 1997). Several models have been proposed to explain the origin and dynamics of such features "but until now, no exhaustive and fully consistent theory has been found". (Capozziello, et al 2004). We must note, that all these "several models" were proposed in the frame of the traditional large-scale asymmetrical $+M_{gr}$-Universe paradigm. But the symmetrical $\pm M_{gr}$ "gravitationally massless" Multiverse has on the large-scale its natural repulsive expansion, calculated above, where empty bubbles arise quite naturally, because of the above-mentioned repulsiveness of the large-scale $\pm M_{gr}$ matter/antimatter "powder". Importantly, that a properly - finely mixed matter/antimatter powder (mixed presumably in the compact Hyper-Big-Bang "mixer") has so perfect foam quality! This local repulsive force will slowly empty arising and growing bubbles and pull out the $\pm M_{gr}$ matter powder on the local spherical surfaces of the cosmic bubbles. It is simply energetically profitable to devastate local cosmic areas being initially homogeneously filled by the $\pm M_{gr}$ neutral "powder". The further evolution of the $\pm M_{gr}$ neutral foam is its further global repulsive expansion with simultaneously growing attractive grains of the $+M_{gr}$ and $-M_{gr}$ matter clusters that corresponds to the grandiose bubble architecture of the Universe. Astronomers found that this large-scale structure is fractal-like and is everywhere!

## THE SOFT SUPERFLUID *n/n* BIG BANG SCENARIO IN THE MULTIVERSE

Our elementary particles (electron, etc.) and the MWBH - back holes are free of singularity. It seems to be natural if the mysterious Big Bang (BB) also has started (now backward to the MWBH creation) from the same natural vacuum mega-state, being also free of singularity. Let us turn the neutron star story backward in time, but from an enough big "nothing" as a neutron/antineutron superfluid state. The soft, singularityless MWBB could be safely realized through very shortly existing *electrostatically neutral* (neutron star/antineutron star) superfluid state. This initial state seems to have the same neutron star matter density, but now accurately 0.5/0.5 mixed with the antineutrons. Will this mixing immediately annihilate? If the proposed antigravity between matter and antimatter does not exist (as it is in convenient

physical theories), this strange mixing will annihilate immediately! But in the frames of our $\pm M$ gravity and matter/antimatter concepts this nuclear-like dense neutron/antineutron mixture will easily avoid this annihilation, since usually enormously compressing gravity (as in a pure neutron star) now does not exist - neutralized, since a *microscopic gravity mass density is zero*. The neutron/antineutron *bosonic mixture* is electrostatically neutral superfluid megaball. Importantly, the very dense weightless and spatially flat mega-ball's state has the extremely strong - negative antigravity pressure inside, effectively separating electrostatically neutral neutrons and antineutrons. Very short-range nuclear forces in the correspondingly self-heated megaball will be very quickly switched off into a nucleonic/anti-nucleonic repulsive – separating (antigravitational) expansion. The relatively smooth, long range separating antigravity pressure dominates in the further soft megaball expansion. It will cause explosive spatial separation of free micro-droops of neutrons and antineutrons and keep them from total annihilation. Spatially separated matter and antimatter seeds will be survived exactly symmetrically, along the initial very important electrostatic-chargeless time-interval of the anti-gravitating repulsive "inflation", preventing annihilation, but accompanying with a particular *n*-$\underline{n}$ annihilation (realizing a heating process, switching off a very short-range, initially attracting nuclear force between neutrons and antineutrons). This initially *electrostatically neutral* $n/\underline{n}$ antigravitational spatial separation is much more effective – for security of a full annihilation (comparably to alternatively thinkable antigravitational separation of initially dense proton/antiproton mixture). The electrostatically charged/anticharged proton/antiproton mixture has too strong *p*-$\underline{p}$ electrostatic attraction, exceeding the mentioned above antigravitational repulsion of the electrostatically neutral $n/\underline{n}$ mixture. Neutrons and antineutrons recombine later into separated, *electrostatically neutral* hydrogen and antihydrogen seeds, creating later survived-growing matter and antimatter macro-clusters. This means:

1) The large-scale Universe (as part of the large–scale flat Multiverse) is exactly flat on the large scale, as it was microscopically flat also directly from the beginning of the described here antigravitational $n/\underline{n}$ inflation.

2) The smooth antigravitational Big Bang "inflation" has a short but enough long time interval for the initial thermodynamic homogenization, because the initial neutron/antineutron star-like megaball size is relatively small - in order of about $R\approx 10^{12}$m and it is also obviously *superfluid* in the initial super-dense $n/\underline{n}$, state, where each $n/\underline{n}$ couple pair is a composite Cooper-like boson, like the ($e–/e+$) coupled bosonic pair.

Indeed, if all matter mass of our visible Universe is approximately $M_{Univ.}=8\times 10^{52}$ kg and the mass of neutron: $m_n=1.67\times 10^{-27}$kg, we can account full neutrons (nucleons) number in the Universe $N_n= M_{Univ.}/m_n=4{,}8\times 10^{79}$. Using the neutron radius $r_n=1.25\times 10^{-15}$ m we derive the proximal single neutron (nucleon) volume as $V_n=(4/3)\pi r^3_n \approx 4\times 10^{-45}$ m$^3$. This neutron star-like, very dense Universe has initial radius $R_{nBB}\approx 10^{12}$m (with the initial neutron/antineutron star-like inertial mass density about $10^{18}$kg/m$^3$ in the initial inflational Big Bang phase). It has the enough small initial size with the superfluid state for very fast and enough fine thermal homogenization. The light speed crosses the megaball in $T\approx R_{nBB}/C\approx$500min.

The average large-scale gravity mass density of our Universe (in frames of the Multiverse) is zero. This scenario *excludes* hypothetical repulsive vacuum energy for repulsion, hypothesized initially by Einstein and expressed in his famous cosmological constant lambda, incorporated "ad host" into the GR equation. Our super-dense ($e–/e+$) vacuum tissue is also frictionless ideal superfluid, consisting of the chargeless composite bosons. It is (and it must

be accordingly our all-day experience) supersymmetric and nongravitating ghost medium (as common cooled superfluid - having zero energy density).

*Note 1.* The latest measurement of charged *Pb-Pb* nucleons collisions at 2.76 TeV was realized at the CERN Large Hadron Collider (LHC) and was presented recently (ALICE Collaboration 2010). This collision requires the frictionless *hydrodynamic* properties inside the arising fireball (FB), related to the matter state at extremely high temperature $T_{FB}\approx 10^{13}$K, surprisingly contrasting to the expected gas-phase. This temperature is about 1000 times more than critical destructive temperature for the ($e-/e+$) pairs $T_{couple(e/\underline{e})}=1{,}2\text{x}10^{10}$K of the lightest (electron/positron) vacuum fraction. But the colliding protons mass is about 2000 times heavier than electron and corresponding $p/\underline{p}$ or $n/\underline{n}$ coupling energy is $E_{couple(p/\underline{p})}=2M^*_{op}C^2$. It is at least about 2000 times more than the electron/positron coupling energy $E_{couple(e/\underline{e})}=2M^*_{oe}C^2$. If the fire-ball temperature $T_{FB}$ is very high and $kT_{FB}>E_{couple(p/\underline{p})}=2M^*_{op}C^2$, than the perfect superfluid quark/gluons/antiquark vacuum can be locally destructed (inside the fireball volume by an overheating). This critical temperature $T_{couple(p/\underline{p})}$ estimation is $T_{couple(p/\underline{p})}\approx 2000T_{couple(e/\underline{e})}$ and thus $T_{couple(p/\underline{p})}\approx 2{,}2\text{x}10^{13}$K. This means the mentioned above *Pb-Pb* collision energy is very near, but above the distortion-border for the corresponding perfect *q/gluon/*$\underline{q}$ vacuum superfluid state and still is able to keep the liquid-like-ordered (superfluid) features of the sub-atomic *q/gluon/*$\underline{q}$ fireball. Leading investigators at the ALICE experiment in CERN suggested, that the Universe (immediately after the Big Bang) would behave like a super-hot *ideal liquid without viscosity* (what was confirmed in the mentioned above CERN *Pb-Pb* collision-experiment). These new experimental data correspond to our dense "superfluid hydrodynamic" MWBB scenario, described above, including very realistic-safety, flat and soft DE-inflation (flat, nongravitating, singularity-less, chargeless, etc.), effectively thermo-equalizing the initial superfluid MWBB phase.

## THE 4*D*-TERMAL GRADIENT AS ATTRACTIVE GRAVITY IN THE MULTIVERSE

The described above Universe expansion scenario has the asymptotically decreasing acceleration of the expansion along a whole its history, but there are some evidences of the opposite - decelerated expansion-epoch soon from the beginning to the middle of the Universe existence. Only after decelerated expansion-epoch we have very clear accelerating expansion epoch. We propose below kind of the "problem solving" physical mechanism, naturally including this decelerated phase – assuming a radically new gravity souse – a hypothetical thermal gradient in the multi-waveguides hyperspace, surrounding the overheated Big Bang hyper-region. This, physically natural, hypothesis can simultaneously explain the previous deceleration epoch and the nature of the recently discovered miracle Dark Flow in our super-large-scale Universe. Our 3*D*-waveguide's thickness variation $\delta L_{oe}$ is a source of the waveguide gravity and it could slightly depend of its local 4*D*- bulky temperature $T_4 < T_{4(critical)}$, keeping the superfluidity & membranes intact:

$$\delta L_{oe}(T_4) \sim k_4 \delta T_4 \qquad (70)$$

This means that a gradient $\partial T_4(r_3)/\partial r$ must create a new type of a Temperature Gradient Gravity (TGG) potential $U_{TGG}$ with a corresponding gravity field $g_{TGG}(r)$,

$$g_{TGG}(r) = [\partial(\delta L_{oe})/\partial r]\,(C^2/L_{oe}) = k_4(\partial T_4/\partial r)(C^2/L_{oe}) \qquad (71)$$

The $\delta L_{oe}(T_4)$ gravity potential is very special, because it exists without defects - matter or antimatter sources and a relatively higher $T_4$-temperature area around the MWBB hyper-center is *always attractive* for all possible matter or antimatter particles existing around, since we have an openness for all waveguides and anti-waveguides, directed into the growing $T_4(r_3)$–temperature area. Other words, all waveguides near the Universe's BB-"center" could be slightly more extended comparably to a cooler Universe periphery. It is naturally to propose that our 3*D*-Universe's Big Bang is a small part of a 4*D*-Multi-(Big Bang)=MWBB along our periodical *L*-Megatube and is connected with the increased temperature $T_4$ along this Megatube. The following TGG-waveguides openness creates automatically attractive gravity field $g_{TGG}(r)$ directed to the Megatube axis, and this soft gravity is directed oppositely to the large-scale negative - accelerating DE (antigravity) pressure, described above. The $T_4$-gradient (and attractive gravity of the more heated areas) must be relatively very strong in the early Universe and it even could neutralize the simultaneously existing DE-repulsive $\pm M_{gr}$ antigravity pressure. This global attractive gravity field could naturally relax later due to the $T_4(r)$-gradient relaxation. This explains the nature of the previous decelerated expansion epoch with latter predominance of the pure $\pm M_{gr}$ repulsion and the accelerating expansion of the 4*D*-Multiverse. Modern Chandra's data confirm that the expansion of the Universe was indeed decelerating and stopped slowing down about 6 billion years ago and then began to accelerate.

The present $\pm M_{gr}$ acceleration of the Universe expansion must be also naturally-asymptotically slowed down to zero - according the Newtonian gravity/antigravity low, since the expansion decreases to zero the large-scale $+m$ and $-m$ densities – a distances between repulsive $+M_{gr}$ and $-M_{gr}$ clusters will become endless. This scenario excludes common "terrible Big Rip" prediction – as a total disconnection of all existing clusters, galaxies and planet systems, molecules, atoms, etc. Instead, all existing matter and antimatter clusters in the proposed symmetrical matter/antimatter Multiverse will be stable "forever", with slowly growing and more isolated – as grandiose and totally autonomic $\pm M_{gr}$ cosmical mega-islands with usual stars, planets and life inside, being fast forever. This existence will be limited by stars ability to give a light and, of cause, by existence of the superfluid Multiverse itself. Indeed, group of prominent cosmologists, summarizing and analyzing the last redshift data, suggested that "cosmic acceleration may have already peaked and that we are currently witnessing its slowing down" (Shafieloo, Sahni and Starobinsky 2009). The slightly increased $T_4(r_3)$ temperature in dense areas with matter clusters (comparably to relatively colder empty Universe areas) could additionally accelerate the voids devastation. These voids are very large (including the "Cold Spot") showing the relatively low temperature of microwave radiation inside, measured recently by the WMAP (Wilkinson Microwave Anisotropy Probe).

## THE COSMIC-ATTRACTIVE "DARK FLOW" NATURE

The $T_4$-gradient-gravity, introduced above, could simultaneously explain also the miracle Dark Flow (DF) phenomenon, discovered recently, (Kaschlinsky, et al 2009). Indeed, two 4*D*-megatubes with two different MWBB-defects in the same Multiverse, being not so fare from each other, must be more slightly overheated, comparably to the intact surrounding 4*D*-vacuum hyperspace outside of these *L*-tubes. The described above $T_4(r)$-temperature gradient will create attractive TGG-gravity between these two 4*D*-tubes, and our observer will detect a non-isotropic Dark Flow on the sky, directed to the nearest neighbor hypertube. It is a so-called "landscape Multiverse", being very fare from our Universe, so fare that we cannot see it (Fig. 14). Mersini-Houghton proposed existence of this neighbor landscape Universe. He tried to explain the discovered miracle Dark Flow, grasping our huge Universe (Mersini-

Houghton 2007, Mersini-Houghton, Holman 2008).

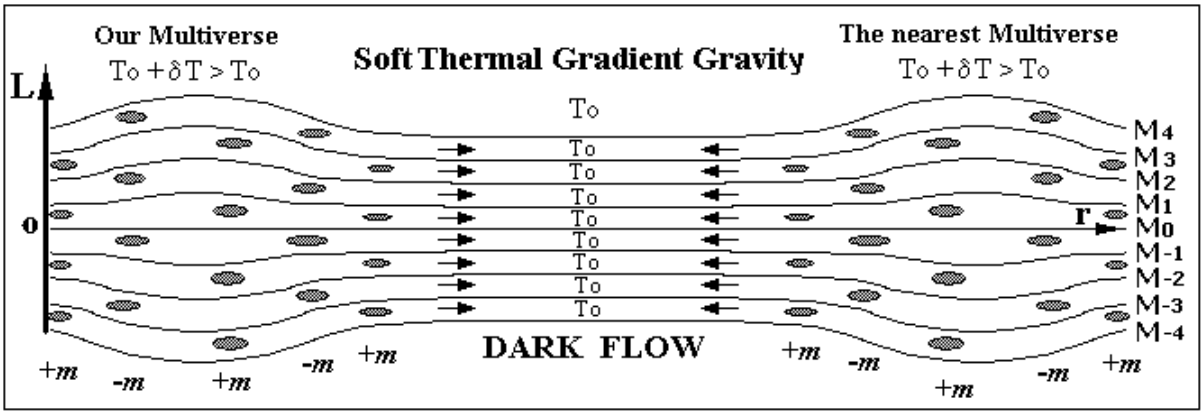



**Fig. 14** shows a soft thermal gradient gravity in the waveguide "hyperspace", creating the attractive DARK FLOW between two 4*D*-tubes - two periodical matter/antimatter Multiverses) for all theirs gravity masses (positive or negative), caused by the soft TGG-gravity.

We must note that this landscape Multiverse is rather different to our 4D-Multiverse proposal – in our case we have a picoscale distances between plenty of the nearest parallel Universes, creating the DM, DE with the beautiful equilibrium on the night sky, what inspired Einstein to introduce intuitively the legendary cosmological constant Λ. It is important to note that without the proposed here $T_4$-gradient's gravity there will not be attraction between two landscape Multiverses in the +/-$M_{gr}$ Multiverse, since both of them have zero gravity mass density (according our hyperspatial cosmology). The attractive TGG-gravity allows simultaneous explanation of (a) the discovered experimentally change from the slowing expansion epoch to the accelerating expansion epoch of our Universe, described above, (b) the Dark Flow mystery. It is quite possible that exist very light 4D-thermo-field quasiparticles (as thermo-particles and thermo-antiparticles. They have zero electrostatic charges and could fill galaxy's halos with very soft clouds-like density, what (together with the matter/antimatter defects) creates very soft and wide DM-bolls presence in our Universe.

## COSMOLOGICAL RÉSUMÉ

The periodical Global ±$M_{gr}$-Neutral Cosmological Symmetry, corresponding to our microphysical concept of the hyper-symmetric periodical vacuum shells, solves simultaneously the large-scale Cosmological Problems (DE & DM & Babble fractal structure & flatness & Dark Flow, etc) - discussed above. Our periodic hypersymmetric vacuum paradigm finds very impressive cosmological confirmation - precisely in the *large-scale phenomenology* of the Universe, where periodical (galactic matter + dark matter) and (galactic antimatter + dark antimatter) become suddenly equal co-partners – describing attractive dark Universes and repulsive on the large-scale matter and antimatter Universes. This equal partnership provides the "impossible" accelerating repulsive DE and attractive DM, Flatness and Bubble large-scale Universe structure from the same united hyperspatial base, presenting the singularityless, periodical black holes. This analysis shows that without the proposed above underlying periodical cellular vacuum microstructure with the compositional bosonic nongravitating ghosts, naturally created from the coupled SM-fermions-antifermions it could not be practically possible to make a correct explanation of the global - large-scale Universe phenomena (including the DE and DM), the hyperspatial gravity/antigravity and the SUSY nature.

## THE ADJACENT PARALLEL UNIVERSES, FULL OF CIVILIZATIONS – HYPER-INTERNET AND INFORMATIONAL RELOCATION

Thus, it is quite possible that we live on the "few 3*D*-pages of a giant motherly hyper-book", live between myriads of parallel Sub-Universes, physically identical to each other, glued together and packed hyperspatially with enormous density $\boldsymbol{N}_{1m}=1m/L_{oe}\approx 10^{12}$ Universes/m4, (Gribov 1999, 2005). It means that we could find our intelligent "hyper-brothers" somewhere within these neighboring similar parallel Universes and (if our brothers exist) can become members of their Intellectual Hyperinternet System. The estimated below, an average distance $R_4$ between the nearest hyper-civilization is very small: $R_4 = \sqrt{(x^2+y^2+z^2+L^2)} \approx 10^8$km, with corresponding timing delay of the $\boldsymbol{C}_4$-communication signal $\Delta T^*_{comm}\approx$10min. May be some of our hypersensitive brains are able themselves to "hear" these "extrasensory" communicative noise in dreams? This future hyper-communication, possibly, could safe and amazingly develop our young and brittle civilization and survive us of ourselves wildness, for example of possible social, ecological or cosmic catastrophes, etc.

Indeed, sun-like stars could account for up to half of the Milky Way's population of several hundred billion suns, and many of rocky earth-like planets might inhabit our galaxy (Farihi, et al 2010). Indeed, now astronomers rapidly discover plenty of the Earth-like planets, potentially suitable for life: "The fact that we've found so many planet candidates in such a tiny fraction of the sky suggests there are countless planets orbiting sun-like stars *in our galaxy*," said William Borucki of NASA's Ames Research Center in Moffett Field, Calif., the mission's science principal investigator. "We went from zero to 68 Earth-sized planet candidates and zero to 54 candidates in the habitable zone, some of which could have moons with liquid water." (Mewhinney&Hoover 2011).

Our Milky Way ($D\approx$100000ly, h≈1000ly) has its, grubby estimated, 3*D*-space volume

$$V_{MW} = \pi R^2_{MilkyWay} \cdot h \approx 3{,}14 \cdot D^2 h \approx 10^{13}\text{ly}^3 \approx (10^4\text{ly})^3, \qquad (72.1)$$

(where one light year ly≈$10^{13}$km). Imagine that only ~$10^3$ planets of more than billon rocky planets in our Milky Way have a high-developed intellectual civilizations, randomly distributed in the galactic $V_{MilkyWay}$ volume. We obtain here an average 3*D*-space volume $V_{1Civil}$ with 1 civilization inside:

$$V_{1Civil}=V_{MilkyWay} / 10^3 \approx (10^4\text{ly})^3 /10^3 \approx (10^3\text{ly})^3 = (10^{16}\text{km})^3 \qquad (72.2)$$

This single average volume $V_{1Civil}$ is so huge, that we simply have no physical chance to communicate "in real time" with our Milky Way intelligent neighbors. Indeed, an average light signal 3*D*-distance between these civilizations is too long

$$\Delta T^{(3)}_{delay}\approx 10^{16}\text{km}/10^{13}\text{km}=1000 \text{ light years } (ly). \qquad (72.3)$$

This volume can be dramatically "compressed" if we take in account a bunch of parallel 3*D*-Sub-Universes around us along the *L*-extradimension (Fig. 13a). They contain corresponding "hyper-stockpile" of a Milky Way–like parallel hyper-galaxies around us. Let us estimate this compression in the mentioned above modest "10 $C_4$-light seconds" – *L*-hyper-interval

$$\Delta L_{10sec}=C_4 \cdot 10\text{sec}\approx 10^9\text{m}=10^6\text{km}. \qquad (72.4)$$

This $\Delta L$-interval contains $\boldsymbol{N^*}$ parallel Hyper-Universes

$$\boldsymbol{N^*_{Univ}} = \Delta L_{10sec} / L_o \approx 10^9\text{m} / 10^{-12}\text{m} = \mathbf{10^{21}}_{\text{Universes}}. \quad (72.5)$$

The supposed periodical prolongation of the gravitationally bounded DM hyper-galaxies above and below of our Milky Way galaxy realizes corresponding periodical hyper-galactic (Milky Way)-"stockpile" (Fig. 13a, left). This short hyper-interval (10 light minutes) of the (Milky Way)-"stockpile" contains near $10^{24}$ hyper-civilizations inside the 10-seconds 4*D*-hyperslice:

$$\boldsymbol{N^*_{Civil}} = 10^{21} \cdot N_{MWCivil} = \mathbf{10^{24}}\ (!) \quad (72.6)$$

A new average 4*D*-volume $V^*_{1Civil}$ of presumably randomly distributed hypercivilizations (that contains only 1 hyper-civilization) becomes here extremely compact. Thus, the hypercivilizations are distributed unexpectedly densely around us (Fig. 15). Now this proximal single average 3*D*-volume $V^*_{1Civil}$ is $10^{24}$ times smaller:

$$V^*_{1Civil} \approx V_{1Civil} / 10^{24} = (10^{16}\text{km})^3 / 10^{24} = (10^8\text{km})^3. \quad (72.7)$$

This gives the dramatically "compressed" average hyper-distance $R^{(4)} \approx 10^8$km between two the nearest hyper-civilizations $C^*_i$ and $C^*_j$. This distance is shorter of the distance between the Earth and the Sun, being about $1{,}5 \cdot 10^8$ km. This "compression" provides correspondingly a very strong shortening of the potential average $C_4$-communication time delay $\Delta T^{(4)}_{delay}$, with $\Delta T^{(3)}_{delay} / \Delta T^{(4)}_{delay} = 10^{16}\text{km} / 10^8\text{km} = 10^8$. The average communicative $C = C_4$-time interval $2 \cdot \Delta T^{(4)}_{delay}$ between the nea*rest* 4*D*-civilizations becomes now $10^8$ times shorter:

$$\Delta T^{(4)}_{delay} = 2R^{(4)}_{C^*iC^*j} / C \approx 11\text{minutes!} \quad (72.8)$$

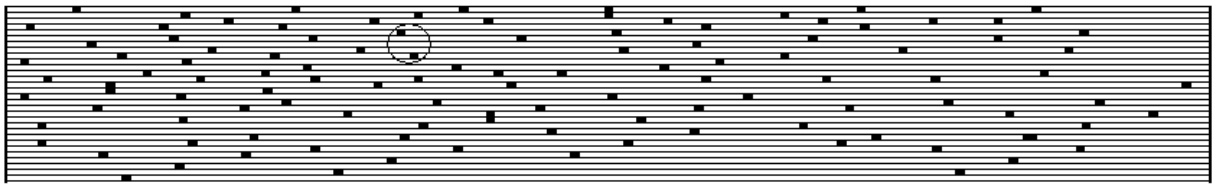


**Fig. 15** shows rapidly growing 4*D*-density of civilizations, occupying pico-slices of the periodical 4*D*-Multiversum.

This could allow a 4*D*-telecommunication between the hyper-civilizations, practically in the "real time". If we have only one civilization in the Milky Way (that is very-very unlikely), we have still very short average distance

$$R^{(4)}_{C1C2} \approx 10^9\text{km and } \Delta T^{(4)}_{delay} \approx 110\text{min}. \quad (72.9)$$

It seems to be almost sure that we will not be able to travel (as a complex material objects) through the monstrous substantial membranes, dividing waveguides**,** but (very likely) we would be able to send and receive back information through the 4*D*-continuous hyper-vacuum *medium*. Total physical identity of these periodical dark Hyper-Universes with our Universe, including the same SM elementary particles, the same physical laws and very similar, gravitationally hyper-coupled cosmology, planetary life, etc are crucial for the further effective and fruitful communication between these hyper-civilizations. The absolute

physical/chemical equality provides biological similarity or even identity. These crucial circumstances - similar forms of life in myriads of hyper-civilizations, living in identical physically 3*D*-worlds - could significantly simplify and enrich inter-communication between them. From this point of view, our great (now technological) civilization looks suddenly as a kind of a newborn "hatched chick biddy" in comparison to the potentially much more matured Hyper-Club of a parallel, long-existing and enormously developed surrounding us hyper-civilizations. It could be for us a new amazing and endless knowledge, enormously fruitful for our further development.

Our biological form of life and biological human being could become indeed immortal, being simply transported from our civilization to other hyper-civilizations via a pure informational way. It could be transported rather "by wire" as joked genial father of cybernetics Norbert Winner. Our genetic code could be enough quickly transported and reconstructed on other highly developed intelligent hyper-islands (as, for example, genetic codes of our geniuses, as dreamed at the beginning of the XX century Russian pioneer of astronautics Konstantin Tsiolkovsky). His naive interest to cosmonautic (in so terrible, wild times in the Russia) was cursorily motivated by "fictional" dreams of his teachers to "animate" our geniuses, to transport them somewhere on other planets and so, to build much better civilization. If we will be able to send our genetic code literally "by wires", with a corresponding knowledge to our hyper-brothers, they could restore and replant our human biological nature on another suitable for life hyper-planets. This exchange could involve genetic/biological/environmental information about our/their ontogenetic culture, art, etc. and realize dreams of Tsiolkovsky and Winner. These cloned islands of our Civilization could become simply "forever traveling" - importable hyperspatially and communicating with us as co-developing part of the other parallel civilizations. It could be tested enough quickly – possibly in few decades (even if the proposed physical hyperspace structure contains quite rare density of the hyper-civilizations inside, e.g., only one civilization – our "isolated farmstead" along the so huge Milky Way galaxy. Great science-fiction writer and insightful futurologist Herbert Wells wrote about our future – about inevitable future contacts with more developed extraterrestrial civilizations: "It is possible to believe that all that the human mind has ever accomplished is but the dream before the awakening . . . Out of our . . . lineage, minds will spring, that will reach back to us in our littleness to know us better than we know ourselves." (Wells 1902).

## FUTURE CERN-EXAMINATION OF THE PROPOSED $\pm M_{gr}$ - HYPERSYMMETRY

Physicists created a real opportunity for *the first experimental, laboratory-made gravity examination*, based on the *neutral anti-hydrogen* atoms studies, being developed recently at *CERN* (see *ATRAP*, *ATHENA, AEGIS,* - research groups leading by G. Gabrielsen, R. Landua, Kellerbauer, G. Andresen, etc.), where enough cold *neutral antimatter* was created and deeply cooled (but not enough deeply yet, as it is necessary for the gravity measurements). This experiment allows "unthinkable" investigations of very tiny gravitational anti-hydrogen properties – under the tiny gravity of the Earth (AEGIS). Phillips wrote: "There has never been a direct measurement of the acceleration of antimatter in the Earth's gravitational field. Several attempts have been made to measure *g* using charged antimatter, but these experiments have been stymied by the difficulty of shielding stray electric and magnetic fields to the degree required, as well as by the difficulty in obtaining an appropriate source of low-energy antimatter. Using neutral antimatter for the measurement would vastly reduce the shielding requirements, but the problem of making and controlling the antimatter becomes more difficult" (Phillips, 1997, p.357). The planned precision gravity measurement is mainly limited by enormously tiny antihydrogen temperature $T_{\underline{H}}$<100mK

needed, and this enormous limitation explains why it cannot be realized immediately in the AEGIS project.

Alban Kellerbauer recently wrote: “The primary scientific goal of AEGIS is the direct measurement of the Earth’s local gravitational acceleration $\boldsymbol{g}$ on anti-hydrogen. In a first phase of the experiment, a gravity measurement with 1% relative precision will be carried out by observing the vertical displacement of the shadow image produced by an anti-hydrogen beam as it traverses a Moiré deflectometer, the classical counterpart of a matter wave interferometer. In spite of its limited precision, this measurement will represent the first direct determination of the gravitational effect on antimatter.” (Kellerbauer et al. 2008, p. 351). “The principle of the equivalence of gravitational and inertial mass is one of the cornerstones of general relativity. Considerable efforts have been made and are still being made to verify its validity. A quantum-mechanical formulation of gravity allows for non-Newtonian contributions to the force which might lead to a difference in the gravitational force on matter and antimatter. Since it is widely expected that the gravitational interaction of matter and of antimatter should be identical, this assertion has *never* been tested experimentally. With the production of large amounts of cold antihydrogen at the CERN Antiproton Decelerator, such a test with neutral antimatter atoms has now become feasible” (ID, p. 351). These direct antimatter gravity investigations could (according our basic theoretical prediction) open a new - much more complete hypersymmetric page of modern physics and confirm one more time that the miracle - unpredictable Nature is always surprisingly reach and inexhaustible.

*Added Notes:* 22-27, August 2011 was the Lepton-Photon Conference in Mumbai, India. Leading physicists discussed the latest results from the CERN’s collider, showing a confusing lack of Higgs bosons and supersymmetric particles. Jordan Nash was disappointed, as many other physicists working on one of the LHC's experiments, about the lack of the supersymmetric (SUSY) sparticles: "The fact that we haven't seen any evidence of it (SUSY) tells us that either our understanding of it is incomplete, or it's a little different to what we thought - or maybe it doesn't exist at all,". (Lepton-Photon Conference 2011, p.1). Physicist Joseph Lykken of Fermilab, notes: the SUSY is “ a beautiful idea” , "It could be that this whole
framework has some fundamental flaws and we have to start over again and figure out a new direction,". (Id., p.1). George Smoot, Nobel prizewinner for his work on the cosmic microwave background says: "Supersymmetry is an extremely beautiful model,", "It's got symmetry, it's super and it's been taught in Europe for decades as the correct model because it is so beautiful; but there's no experimental data to say that it is correct." (Id., p. 1).

The negative experimental SUSY-results at CERN seems to be natural and well predictable in the context of the proposed above periodical (supersymmetrical) waveguided Multiverse concept - these negative results are not against the Cooper-like composite supersymmetry itself at all – since our Cooper-composite supersymmetric partners are always ghosts – they are hidden in the ghostly-composite vacuum tissue and always avoid experimental verifications. These “negative results” strongly support our *e*-cellular nongravitating vacuum paradigm, in accordance with the LHC-lack of the hypothetical, mass-creating Higgs bosons. Indeed, “too lazy” and “too expensive” Higgs bosons could become “unemployed” by the CERN-judgment and might be soon exchanged by the widely consistent 3*D*-waveguide’s physics, creating locally gauge invariant rest masses and the modified Einsteinian EP. The SUSY (initially being proposed in Moscow by Gol’fand and Likhtman, 1971) seems to be not only “extremely beautiful model”, it has a lot of humor – being virtuously survived and hidden by a tricky turn into the Cooper-like “ghostly” composites. This looks so simple and salvatory for the QED, the QFT and the SM, but it is so difficult to grasp theoretically - in the

frames of the old physical paradigm, strongly dominating physical community around these tremendous CERN's "illusions". Legendary philosopher and historian of science - Tnomas Kuhn was deeply right, assuming (collective psychological) power of actual paradigms in science. A "*Paradigm shift*" (or revolutionary science) is a change in basic assumptions, or paradigms, within the ruling theory of science. Indeed, mentally a "paradigm shift" looks so natural afterward, but pure psychologically it is too difficult to realize at the beginning. Kuhn compares the ancient Aristotle's physics with the Newton's one and concludes that the Aristotle's physics is not a "bad Newton", just different. (Kuhn 1962). Kuhn quotes Max Planck, who sadly noted: "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it" (Id., p. 150).

## DISCUSSION

### *Some notes to the idea of " infinity of Worlds" , claimed by Giordano Bruno (1588)*

Max Born also noted with sorrow: "Science is so greatly opposed to history and tradition that it cannot be absorbed by our civilization." (Born 1968). We will try to show below quite the opposite examples, related to cosmology of the Universe. Traditional biblical-monotheistic cosmology (Genesis in Torah) describes the Universe creation by God. This miracle biblical picture is reincarnated today not only in the similarly miracle Big-Bang scenario. There are many other theologically stressed cosmological components, which were developed already in Renaissance and also were deeply related to the biblical paradigm. These great cosmological revolutions look sometimes as "embryonic" steps comparably to huge modern body of our knowledge about the Universe. But contemporary cosmological revolution seems to be far from the end, it is full of grandiose "Dark" Questions. Nikolaj Copernicus (1540) developed comprehensive heliocentric cosmology and surely displaced the Earth from the center of the Universe (Copernikus 1543). It was common scientific - Copernican – Revolution, but Giordano Bruno, also great and bold Renaissance thinker (theologist and cosmologist), went fare ahead. He was too fare ahead of his brutal time, when he claimed four centuries ago existence of a plurality of worlds (with civilizations, with "a Garden of Eden on each one") and their eternity, etc. in his famous text "On the Cause, Principle, and Unity", 5th dialogue. "I can imagine an infinite number of worlds like the Earth, with a Garden of Eden on each one." (Bruno 1588). Bruno was deeply religious person, he claimed that endlessness of biblical God assumes infinity of the Universe. Bruno assumed also that the boundary-less vast space, separating endless number of rare worlds (stars and planets), cannot be empty and is filled by an Aether, whose "miracle" non-gravitating superfluid properties were physically realized and discussed above. According Bruno, "The universe is the one, infinite, immobile.... It is not capable of comprehension and therefore is endless and limitless, and to that extent infinite and indeterminable, and consequently immobile." (Bruno 1588). From his point of view the same physical laws would operate everywhere.

If we change the conception "Universe" into the conception "Multiverse" in the Bruno's perspicacious cosmological picture, it could be in unexpected concordance with the proposed above periodical Multiverse structure. This structure indeed, includes Aether & tremendous plurality of worlds & universality of operating physical laws. Our conception of matter - as defects in this perfect Aether – also corresponds to common biblical – *monotheistic* – conception, expressed in the Genesis, in which God created all material substance of our World and then human being was created by God from a dusty substance (from dust, looking

readily as "defects"). The Multiverse physics expresses a kind of corresponding "physically manifested monotheism" and polyphony, which was basic for the biblical monotheistic tradition and was so naturally and deeply incorporated in the core of Newtonian and Einsteinian physical thinking. Einstein's way of thinking holds the biblical unity-simplicity and harmony of the created World, it remembers deep belief in Gods harmony, expressed beautifully in visual arts and music by great dreamers as Sandro Botticelli, Marc Chagall or Johan Sebastian Bach, whose religious musical polyphony sounds as a Bruno's prologue to a polyphonic plurality of eternal physical Worlds and an endless gallery of Civilizations inside.

### *Some notes to the book "A Different Universe", written by Robert Laughlin*

The proposed physical concept supposes emergence of our $3D_{Euclidean}$-space and corresponding emergence of the SR (arising in the $3D_{Euclidean}$-shell), of the wave of de Broglie, etc. The "elementary" particles of our vacuum become non-elementary – they are emergent "elementary" geometrodynamical excitations – equal quasiparticles with spatially coherent localized microstructure, arising in the frictionless (emergent), nongravitating ideal medium with the periodical waveguide's boundaries. All our matter particles are elementary cellular defects in the collective coherent world of these emergent dynamical *e*-cells, emerging in the gradually much more fine hyper-symmetric superfluids (also being somehow emergent). Empty vacuum space and the elementary point-like particle paradigm seem to be an old classical mythology. The emergence includes also the „vacuum atoms" – the *e*-cells, etc., they are *emergent collective dynamical phenomena*. This picture corresponds to penetrating thoughts of leading condense matter physicist Robert Laughlin: "I thing that spacetime tissue not only creates a scene, where is played a life, but it is phenomenon of an order, behind which is something bigger", (Laughlin 2007, p.190). He restores very significant (naively forgotten) fundamental statement, relating to the Nature, that this "something bigger" is the cause (and not the backward) of common "first principles" e.g. the fundamental symmetries in physics: „Symmetries are caused by things; they are not the causes of the things"; „If the relativity always true, there must be a reason" (Laughlin 2007, p.187). He concludes: "…science has now moved from an Age of Reductionism to an Age of Emergence, a time when the search for ultimate causes of things shifts from the behavior of parts to the behavior of the collective." and "…collective principles of organization are not just a quaint side show but everything - the true source of physical law, including perhaps the most fundamental laws we know.", and so, "The Transition to the Age of Emergence brings to an end the myth of the absolute power of mathematics." (Laughlin 2005).

We tried to understand the structure and the nature of this "something bigger" and here arise enormously huge physical worlds behind the old "mythological" picture. Indeed, as it was mentioned by Laughlin, "Like Columbus or Marco Polo, we set out to explore a new country but instead discovered a new world." (Id., 2005). We could imagine, being inspired by the fundamental analogy between real vacuum and quantum liquids (Laughlin & Pines 2000; Volovik 2003, etc.) and by modern string cosmology (Greene, et al 2003) that somewhere at the beginning of the Big Bang was e.g. 4*D*-global soup without 3*D*-waveguides. It was cooled and then has happened a spontaneous ($4D \rightarrow 3D$) periodical "crystallization". Presumably, the global undivided 4-th dimension-soap was spontaneously *L*-divided on the parallel …$L_{oe}/L_{oe}/L_{oe}$… slices with the coupled endless and *L*-periodical, nongravitating "polymer fibers" (…/*e*–/*e*+/*e*–/*e*+/…), etc. with an immediate deep cooling and spontaneously arising frictionless superfluidity of our Multiverse. This *process was not totally ideal* – somewhere arose natural (overheating) effects, with corresponding hyper-fibers-breaks - hypersymmetric by the nature *hole/antihole cellular defects* – our rare matter particles and antiparticles – as micro-babbles in an open bottle of bier. They were simultaneously arranged by their fields

and corresponding 3*D*-physics – existing "forever", freely swimming as gravitating/charged "fishes" in the invisible mother-ocean of aroused, emergent 3*D*-space. It could be our Multiverse with matter/antimatter periodicity, with the gravitationally related periodical DE&DM&SUSY, phenomena. May be the Multiverse is 4*D*-endless and also goes fare behind the 3*D*-events horizon. The discussed above "Dark Flow" phenomenon supports this point of view.

### *Some notes to the "Living in the Multiverse", written by Steven Weinberg*

Our hypersymmetric vacuum is globally coherent-united & nongravitating medium (following the superfluid helium at low temperature, (Volovik 2003)). It is insensible for us – for its elementary "defects" and quasiparticles -3*D*-photons of light, freely "swimming" in this maternal ocean (creating and holding matter). So our eyes and ears percept perfect vacuum medium as an empty space. The Lorentz invariance of the SR here looks like an emergent resulting phenomenon – all physical laws are invariant under the Lorentz transformation. We cannot determine our absolute movement in the vacuum medium and the Einsteinian relativity arises as the resulting relevant physical logic. Steven Weinberg writes that Einstein „offered a symmetry principle, which stated that not just the speed of light but all the laws of nature are unaffected by a transformation to a frame of reference in uniform motion." (Weinberg 2005, p. 1). It can be rewritten so as if Einstein have introduced vacuum as a hypersymmetric superfluid, where vacuum itself becomes "empty" - Lorentz invariant incognito - and Einstein (as a navigator) could simply "ignore" its reality. The hypersymmetric superfluid vacuum concept requires that common quantum field theory (being now improved and corrected – hypersymmetric-supersymmetric) expresses *universally "effective" physics* and is of cause an "effective" and emergent, exactly as it is in the liquid helium al low T. This picture corresponds to the other Weinberg's statement: "Our present Standard Model of elementary particle interactions can be regarded as simply the consequence of certain gauge symmetries and the associated quantum mechanical consistency conditions." and "The development of the Standard Model did not involve any changes in our conception of what was acceptable as a basis for physical theories. Indeed, the Standard Model can be regarded as just quantum electrodynamics writ large." (Id, p.2). But for decades "…there seemed to be something peculiar about the value of the vacuum energy $\rho_v$" and "Quantum fluctuations in known fields at well-understood energies (say, less than 100 GeV)", give "a value of $\rho_v$ larger than observationally allowed by a factor $10^{56}$ and "no symmetry argument or adjustment mechanism could be found that would explain such a cancellation." (Id, p.3). We could show above that common physical field theory is not complete – and the searched miracle "cancellation" comes from the embedding hidden-monstrous Multiverse and its dense vacuum's hyperstructure, immediately presenting corresponding monstrous cancellations. We are creatures & witnesses of an "effective" being – arising on the lowest vacuum energy level - with enough complicated, chemically fine forms of life, with resulting curiously "purblind" physics of Galilean Simplicio, ignoring vacuum itself. Complicated life could be created only in the enough cooled vacuum state, which well corresponds to common "anthropic arguments", being discussed by Lenard Susskind regarding to the string theory "landscape" (Susskind 2003).

The question about Multiverses sees to be the most difficult, dark question in modern physics. Weinberg notes that, e.g. multidimensional string theory tells about plenty of possible Multiverses with sufficiently different vacua and so called "string landscape" is estimated ***to be of order $10^{100}$ to $10^{500}$***. Weinberg assumes "at least four ways in which we might imagine the different "universes" (being described by the string landscape) actually exist. Various subuniverses may be simply (1) "different regions of space"; (2) "different eras of time in a

single big bang"; (3) "different regions of spacetime"; (4) "different parts of quantum mechanical Hilbert space". "These alternatives are by no means mutually exclusive. In particular, it seems to me that, whatever one concludes about alternatives 1, 2, and 3." (Id, p. 10-11). Indeed the case (1) seems to be the nearest for our periodical Multiverse picture, but "different regions of space" are now different hyperspatially and at the same time they are nearby here-everywhere – they are adjacent and literally parallel to our quasiflat Universe as physically identical periodical sub-Universes. Interactions between these Sub-Universes work correspondingly - globally + microscopically – everywhere (remember the anti-gravitational/gravitational DE / DM omnipresence in our Universe, being imbedded into the Multiverse), manifesting deep connection between physical Sub-Universes in the Multiverse.

Weinberg writes: "The test of a physical theory is not that everything in it should be observable and every prediction it makes should be testable, but rather that enough is observable and enough predictions are testable to give us confidence that the theory is right." (Id, p.12). Indeed, we cannot e.g. percept vacuum's medium, but we are able to build some basic physical concepts of it, that explain the illusion of emptiness, the miracle (but so necessary) weightlessness, the frictionless, etc. physically, what we derived above. The same way we cannot percept quantum mechanical wave function, but physicists widely apply its fundamental theoretical concept for accounting measurable QM-probabilities. Weinberg notes: "There is also a less creditable reason for hostility to the idea of a multiverse, based on the fact that we will never be able to observe any subuniverses except our own." (Id, p.12). The periodical Multiverse concept shows that *we "observe" Subuniverses* many decades via the gravitational DM/DE observations, but yet don't understand it this way!

Weinberg joked about a "confidence" to the Multiverse existence: "I noticed for sale the October issue of a magazine called Astronomy, having on the cover the headline "Why You Live in Multiple Universes." Inside I found a report of a discussion at a conference at Stanford, at which Martin Rees said that he was sufficiently confident about the multiverse to bet his dog's life on it, since Andrei Linde said he would bet his own life. As for me, I have just enough confidence about the multiverse to bet the lives of both Andrei Linde and Martin Rees's dog." (Id, p. 13). According to the presented periodical Multiverse concept, disclosing the DE&DM&SUSY "darkness", etc. it will be reasonable to support the bold decision by famous cosmologist Linde – but less, less bloody – to bet at least one or more sacrificial Lagrangians on the Multiverse existence.

### *Some notes to the "Einstein and the search for unification", written by David Gross*

Gross quotes Einstein, who believed that: "The supreme test of the physicist is to arrive at those universal laws of nature from which the cosmos can be built up by pure deduction". (Gross 2005). Albert Einstein was always encouraged by his naïve, invincible believe in a harmony, beauty and simplicity of the existing world. He was irreparable pacifist and idealist, with undamaged morality of teenager. Such insightful naiveté is natural for great geniuses and contains a powerful cognitive source for their creativity. They have not only usual – the adult one – grown-up verbal consciousness (placed in the left brain hemisphere), but also never-maturing teenager's sub-conscious, with well developed *additional speech center*, etc. living in their right brain hemisphere, which manages visual and emotional worlds of the human being (Gribov, 2002). Such bright personalities as Albert Einstein, Andrei Sakharov, etc. definitely had this kind of the doubled "super-brain" structure (being left-handers). This is one of the markers of the left-hemispherical "functional shift" into the right brain hemisphere. Indeed, Einstein was emotionally very sensitive, musical "right hemispheric" person, etc.). These outstanding people never become mentally old and never

loose their "naive" hopes and curiosity, they have extraordinary expressed global-holistic insights, realizing by very strong involvement of the global - right hemispheric functions in their thinking (Gribov, 2002). David Gross writes that Einstein "believed that the fundamental laws and principles that would embody such a theory would be simple, powerful and beautiful." (Gross 2005, p. 2035). We showed above that these features arise repeatedly in the pure hyperspatial-waveguided interpretation of the Einstein's SR&GR, being hyperspatially "married" with the Einstein's second genial creation - the quantum light photon, which now becomes 4*D*-hyperspatial, 3*D*-waveguided → relativistic, acquiring quantized, positive inertial "rest" mass and ±gravity "charge". The aroused here hyperspatial matter/antimatter symmetry and ±gravity "charge" allow radically novel physics, working as a "golden" tail-key, opening door into the periodical Multiverse (Gribov 1999, 2003, 2005). Young Einstein stood alone on a threshold of this fairy-tale door 106 years ago, with almost prepared "self-made" classical/quantum equipment to open it. But the Multiverse dragon was too quiet, invisible and serene, as a miracle "Tao", designed by genial Lao-tse long time ago: "There is a thing confusedly formed, born before Heaven and Earth, silent and void. It stands alone and does not change, goes around and does not weary. It is capable of being the mother of the world." (Lao-tse 600 B.C.). We could wait may be some billions years, but the fantastic DE and DM-manes, etc. arouse us and show us hyperspatial ocean, where we will try to find ourselves intelligent images, waving from our distant future.

Gross notes, for example, that the GR has common conceptual problem - there is "no principle to determine the properties of mass" in it (Id p. 2036). These properties are related to the *source* of curvature-mass, arising arbitrary in the GR. The proposed here waveguided gravity mass-"charge" concept presents this natural - holistic – the wave-dynamical hyperspatial source, caused by the orthogonal *L*-pressure of the massive quasiparticle, deforming 3D-membranes of the 3D-waveguide. This picture literally realizes Newtonian-Einsteinian gravity potential (by negative and positive potentials for matter and antimatter and with unavoidable involvement of the Planckian constant *h* and the corresponding quasiparticle - Einsteinian-photon concept).

Gross cites Einstein: 'That appears certain to me, however, is that, in the foundation of any consistent field theory the particle concept must not appear in addition to the field concept. The whole concept must be based on partial differential equations and their singularity-free solutions' (Id, p. 2036). He wanted to generalize the GR including electromagnetism and to "eliminate the right-hand side of his equations and deduce the existence of matter by constructing singularity free solutions that would describe stable lumps of energy" (Id, p. 2036). Einstein also "abhorred the arbitrary nature of the quantum rules and their probabilistic interpretation, he hoped to deduce them from these non-singular solutions." (Id, p. 2037). Gross writes, Einstein „imagined that the demand of lack of singularities in the solutions that would describe matter would lead to over-determined equations, whose solutions only exist for some, quantized values of physical parameters, say the radii of electrons orbits. Thus he could imagine reproducing the Bohr model of the atom. The core of this program was to include electromagnetism and derive the existence of matter in form of, that we call today, solitons. As Einstein understood, nonlinear equations can possess regular solutions that describe lumps of energy that do not dissipate:" (Id, p. 2037). The proposed waveguided – periodical modular hyperspace structure allows creating these necessary identical "stable lumps of energy" – non-linear, quantized, confined and twisting electron waves, indeed "remembering the Bohr model of the atom", realizing 3*D*-rest-massive/ 4*D*-massless Yang-Mills-like field with the Einsteinian-relativistic, twisting *e*-cell, realizing the *SU*(2) group symmetry and fermionic properties. These quantized clumps cannot dissipate, since these

clumps – elementary particles – live as hyperspatial photonic excitations in the unavoidably *periodically foliated* superfluid hyper-medium.

### *"Viewpoints on String Theory" by Edward Witten, David Gross and Sheldon Glashow*

Edward Witten describes historical motivation to build the string theory (ST) in the NOVA-interview as "an attempt at a deeper description of nature by thinking of an elementary particle not as a little point but as a little loop of vibrating string." (Witten 2003b). The ST assumes a priory existence of plenty identical tiny 'musical instruments', expressing elementary particles as theirs vibrations: "All are different forms of vibration of the same basic string. In the case of string theory, with our present understanding, there would be nothing more basic than the string, and … It's indeed surprising that replacing the elementary particle with a string leads to such a big change in things. I'm tempted to say that it has to do with the fuzziness it introduces." (Id). So, the ST declared *a priory* very tiny string-particle with (fuzziness) as basic elementary-extra tiny physical object. It postulates additional (compactified) space dimensions and also large, even endless global branes. The extra dimensions were not yet observed, since they assumed to be very small. String theorist Barton Zwiebach writes with optimism about opportunity to observe existence of even enough large extra dimensions: "Surprisingly, it is possible that "large extra dimensions" exist and that we have not observed them yet." (Zwiebach 2004, p. 61). The proposed above Periodical Waveguided Multiverse (PWM) concept supposes that the fourth *L*-extra dimensional interval $\Delta L \sim 10^{-12}$m is indeed very small; it is 100 times smaller than the size of hydrogen atom (that's why it is not visible), but it is much-much bigger ($10^{23}$ times) as common - the Planckian string length $\sim 10^{-35}$m.

Here we will try to compare the ST and the PWM concepts, since the PWM also contains (now sufficiently emergent) compact stringy wave-particles/antiparticles "loops" with (a) self-focused hypercylindrical, coherent, constantly curved 3*D*-surfaces="branes" and (b) endless coherent 3*D*-membranes&wavegides. It is easy to note, that the ST contains the same generic weaknesses as the underlying classical physics – it accepts a quasi-empty vacuum space and a localized by the nature mass particle, plus it has the same – formally correct but physically mistakable – the global Minkowski's 4*D*-spacetime platform, which is a *priory* implanted into the ST. David Gross predicted this theoretical break in the NOVA-interview: "A lot of us are waiting for such a new idea that will give us an alternate to our traditional notion of space and time perhaps—or perhaps some other new idea. Something is missing that is most likely not just another technical development, another improvement here or there, but something that truly breaks with the past. And all the indications are that it has to do with the nature of space and time." (Gross, 2003).

The ST has, of cause, very useful (going to the right – the singularityless direction) physical elements – vibrating loop's fuzziness without singularities and with additional compactified dimensions, but the mentioned above "mistakable old clothes" make the ST-innovations similarly rootless. Indeed, Witten writes that in the ST "we do not have the analogue of the Einstein-Hilbert action or the principle of equivalence that led Einstein to it" (Witten 2003a, p. 458). The PWM concept, on the contrary, derives the basic physical laws as simultaneously emergent & united – arising together with the emergent quantized gravity "charge" and the (hypersymmetrically improved) *equivalence principle* with classically quantized, stringy-fuzzy elementary particles. These bosonic (massless) $C_4$-quasiparticles behave as relativistic fermions and acquire rest mass together with the composite supersymmetry in the modular - periodical 3*D*-waveguided Multiverse. The same basic motivation - to create the ST-like

theory - free of singularities - is realized here much more holistically way, where strings-like particles are emergent.

The rest mass in the ST "(or its rest energy) arises only because the string has a tension". (Zwiebach 2004, p. 108). This means that the ST-string is massless if its tension is zero. It is realizable for free 3*D*-light photons if they are not confined and if there are no barriers on the photons way. The ST postulates string tensions for the rest mass existence. The confined $C_4$-quasiparticle behaves in our case as localized-confined stringy $C_4$-wave with the enormous $C_L$-pressure, directed outward of the $L_o$-confinement, creating its $C_4$-dynamical rest mass. This stable dynamical confinement assumes the exact opposite tension, arising in the confining system, compensating the enormous outward $C_L$—pressure (on the contrary to the tensioned - static by the nature ST-string). The periodical 3*D*-waveguide's stability needs equal enormous resistance - bulk and framing membranes - tensions, keeping integrity of the periodical bulk and the waveguide itself and compensating the mentioned above $C_L$-pressure – as it is common in atomistic liquid mediums with waves-quasiparticles inside. This means that underlying very dense bulky-mediums must be hypersymmetric (nongravitating superfluids, as for example, the (*e*–/*e*+) vacuum) and the vacuum's atoms must be well self-integrated - coupled by a kind of microscopic Van der Waals forces, common in the condense matter physics.

The PWM stringy states are confined excitations in isotropic superfluid 4*D*-medium (paradoxically ghostly vacuum tissue, being hypersymmetrical) with the hypothetical $C_4$-waves-quasiparticles, being self-focused, as it is common in the non-linear optics. They are exactly associated with common Yang-Mills "photons". The simplest stringy-loop state is hypercylindrical with the quantized dynamical energy $E_n=h(n\nu^*_{o4})$ and the waveguided rest mass $M_n=nh\nu^*_{o4}/C_4^2$. These wave-particles are dynamical by the nature and have *different* stationary orbiting-twisting radiuses $R_n=R_o/n$, but they hold the same fermionic $L_n$-spin $S_n=1/2$ corresponding to the group $SU(2)$ and which arises as pure relativistic effect on the level of common - "effective" superfluid theory.

The obvious analogy to the ST-like branes are our global flat 3*D*-membranes, dividing two 4*D*-vacuums), but they are emergent and arise from conceptually deeper - condensed matter/antimatter 4*D*- or even more dimensional physics. The PWM-strings are not elementary and isolated entities in empty space any more, so, the ST must be revised and developed on the PMW-like, superfluid medium basis. Thus, the PWM shows the obvious paradigmatic deepening of existing convenient "paradigmatic physical landscape", including the both – as classical physics and as the ST. Stable stringy loops are not thinkable any more as basic elements without corresponding nonlinear superfluid medium around, holding these - sufficiently dynamical - strings "for ever". This includes superfluidity, superconductivity, etc. as basic surrounding vacuum properties, describing by common quantum field theory (but arising now as condensed, superfluid "vacuum" physics, being waveguided, composite-hypersymmetric, nongravitating and free of singularities.

It is symptomatic that much more successful development of the ST arose after the M-theory creation and involves additional hypothetical *macroscopic* objects like *branes*. These branes have analogue to our "substantial membranes", postulated at the beginning in the PWM concept. They have enormous tension and are elastic carcasses of 3*D*-waveguides. But these membranes arise physically in the PWM concept as thin surfaces, dividing different vacua, $L_o$-periodically placed in the hyperspace and so, they are not elementary – they are emergent global collective (sufficiently hyperspatial) phenomena - physical macro-surfaces with natural – common properties of strained elastic 3*D*-membranes. We see that these membranes are

sufficiently different from the postulated abstract ST-branes. Our stringy particles cannot "live" on the isolated brane (being a dividing surface)– since our isolated brane is physically disappearing fiction without two surrounding vacua as bulky slices and moreover, the PWM-particles (*e*-cells) need at least two parallel branes-membranes and particles live in the isotropic 3*D*-bulk-shell between these framing 3*D*-branes. Non-local electrostatic potentials "live" indeed on two reciprocally stretched 3*D*-membranes, but their collective sources are *e*-holes in the cellular-dynamical superfluid bulk-tissue. The minimal membranes quantity, containing *particles and antiparticles as elementary cellular defects and anti-defects* now needs six parallel, periodically placed 3*D*-membranes and five 3*D*-waveguides, this assumes their inevitable - further periodical prolongation in the hyperspace. Our periodically placed membranes seem to be emergent 3*D*-surfaces, dividing periodically layered vacuum/antivacuum. Underlying future theories (describing the substantial 3*D*-waveguide nature, the hyperspatial periodicity nature and correspondingly different masses of leptons and quarks) must be developed in the frames of hyperspatial by the nature condensed matter/antimatter physics. It is very possible that the sophisticated ST machinery plus hyperspatial condensed matter QFT, etc. contain kind of its useful geometric-topological elements. Indeed, the ST captures "so much of what we already know about physics since shedding so much light on theories that we already have" (Witten 2003b). But the task of a deeper theory is to solve at least some basic unsolved theoretical problems and to predict some new, experimentally testable physical phenomena, what was not yet the case for the ST. Indeed, Martinus Veltman wrote recently that very big hopes for modern string theory did not prove true, and the "strings and supersymmetry...explain nothing from things what we don't understand today" (Hargittai 2004, p. 107). We see that basic obstacles for the ST unsuccessfulness are the same old-fashioned paradigmatic physical frames of particle and vacuum, realizing in the physically blinding Minkowski's global spacetime, analyzed above. These frames were not changed also in the SM and now it becomes also clear, why (as Veltman notes), "the miraculous thing with the Standard Model (SM) is that originally ALL the particles in the SM have some zero mass...". (Id. p. 101). He asks, "is there a deeper layer to understanding the balancing of forces?", … "we don't know why, but it gives you the suspicion that in the Higgs system there is probably another layer where the idea of mass gets another interpretation" (Id. p. 101). The PWM concept gives surprisingly simple, but inevitably hyperspatial answers, crucial for arising picture of the Multiverse's physics, getting waveguided rest mass and DE/DM&SUSY- without need in the Higgs - interpretation.

Witten, indeed was deeply right (together with Gross, Glashow and some other prominent physicists) to question, first of all, the Minkowski's spacetime concept: "when we study it more deeply, we find that in string theory, spacetime becomes fuzzy" and "I suspect that the fuzziness of spacetime will play more of a role in the eventual answer than we understand now." On the other hand, the classical – global Minkowski's spacetime is, as we could show above, not more than physically wrong unrolling of the 3*D*-waveguide's wave-dynamics, where some basic physical features (as the 4*D*-space presence, rest mass, etc.) are lost. This classical-global unrolling stops the underlying opportunities to unify particles physics and to disclose corresponding extradimensional Multiverse. Witten says in the NOVA-interview: "I would conclude that extra dimensions really exist. They're part of nature. We don't really know how big they are yet, but we hope to explore that in various ways. They're beyond our ordinary experience just like atomic nuclei are. On the other hand, we don't understand the theory too completely, and because of this fuzziness of spacetime, the very concept of spacetime and spacetime dimensions isn't precisely defined." (Witten 2003b). The PWM concept shows that the electron-Compton length becomes not only analogy of the hypothetical ST-"fuzziness", it becomes the extradimensional "fundamental" physical length constant and fundamental hyper-period in the Multiverse.

Witten says: "That's a big problem that has to be explained. As of now, string theorists have no explanation of why there are three large dimensions as well as time, and the other dimensions are microscopic. Proposals about that have been all over the map." (Witten 2003b). An exemplary answer could be following – only the long-range force can provide the long-range (always *C*-dynamical) coherent existence of our dividing medial 3*D*-membranes and provide the long-range dynamical connections in ideal mediums. Only the long-range forces (*C*-quasiparticles) provide a long-range coherence - by common 3*D*-Maxwell's photons (as spin waves in the 3*D*-superfluid vacuum). Surface of the hypercylindrical electron's attractor is three-dimensional (two our and one hyperspatial dimension *L*) and the 4*D*-wave of electron is self-focused here (one from 4 spatial dimension is "condensed") - self-reduced into the loop-like 3*D*-wave. It behaves like a (locally gauge invariant) ordinary Maxwell's *C*-photon, twisting on this, very strongly curved, 3*D*-surface (being at the same time the Yang-Mills-like "photon", flying in the nonlinear 4*D*-medium, being massless only in the "illusory" (waveguide-less-unrolled) Minkowski's spacetime description. It becomes the "gapped" rest mass in the 3*D*-waveguide – with the minimal classical rest mass harmonics (the waveguided mass gap), common for classical 2*D*-waveguides. Here arises very simple sense of the mass gap existence in the Yang-Mills theory, being totally lost in the Minkowski' 4*D*-spacetime – it becomes hidden in the lost 3*D*-waveguide's hyperspace structure, which is able to create the SR, etc. as wave interference effects in the 3D-waveguide, where "illusive" Higgs bosons become "jobless". There are so many illusions in contemporary physics! After since, it seems to be clear that Jaffe and Witten have challenged in the "Mass Gap" - (Millennium problem) something bigger – the "illusory" Minkowski's spacetime itself, the "illusive" SUSY and the "illusive" Higgs mechanism. The so easy quantized - gapped rest mass was lost in the first one, lost together with the stolen waveguided "mass gap".

Witten notes about crucial role of the SUSY: "…many physicists do suspect that our present decade is the decade when supersymmetry will be discovered. Supersymmetry is a very big prediction; it would be interesting to delve into history and try to see any theory that ever made as big a prediction as that." (Witten 2003b). From our point of view the so necessary but always "illusive", *perfect supersymmetry indeed exists* and is provided by the Cooper-like fermionic/antifermionic composites in the PWM atomistic hyperspatial vacuum, but material spices/devoices (as being made of elementary vacuum "defects") are not able to percept this coherent global vacuum tissue. If they could directly percept it, their life could be very short, but it is practically endless, as our Universe life is. This ideal-perfect tissue is absolutely necessary for their existence, but at the same time it looks like a perfect emptiness for them. Imagine, that a fish, living in superfluid and clean ocean, will also percept it as emptiness. So, we cannot percept directly these single supersymmetric vacuum "atoms" – directly by physical experiments – they are truly dominating physical actors, but they are simply dominating ghosts, ghostly incorporated into the global coherent orchestra of the transparent superfluid vacuum. This miracle medium is our modest motherland - our invisible Tao, according (Lao-tze 600 B.C.), giving us (sophisticated bunches of its elementary defects) a wonderful freedom to fly free, fare away across the huge cosmos – our united vacuum's space, to arise and to exist (as could a fish in superfluid) in the confusedly illusive hyperspatial emptiness. Sheldon Glashow have predicted in the NOVA-interview: "I think the late 1990s and the beginning of this 21st century will be remembered as the coming together of the large and the small, the convergence of cosmology and particle physics. The two sciences, the two least useful sciences, one dealing with the smallest things in the universe, the other with the biggest things in the universe and the universe itself, are coming together as they have been for many years but more so today." (Glashow, 2003).

### *Some notes to the Pauli's invention of non-abelian Kaluza-Klein Theory in 1953*

Wolfgang Pauli developed in 1953 the first consistent generalization of the five-dimensional theory of Kaluza-Klein to a higher dimensional internal space, realizing that is known as the fundamental nonabelian Yang-Mills theory (Pauli 1999). Being too self-critical, Pauli never published his theory since "he saw no way to give masses to the gauge bosons…" (Straumann 2000). This theory was later recreated and published by not so self-critical Cheng Ning Yang and Robert Mills (Yang & Mills 1954). Indeed, the gauge bosons will never acquire rest mass on the base of the global (unrolled) Minkowski spacetime, incorporated into the GR and automatically incorporated into the Kaluza-Klein five-dimensional generalization of the GR, where the rest mass creation mechanism disappears together with its fundamental – the described above waveguided physical base.

### *The "Millennium Problem": Yang–Mills Existence and Mass Gap in the Multiverse*

Arthur Jaffe and Edward Witten have formulated the "Mass Gap" problem in four-dimensional space-time in the Quantum Field Theory (QFT) "… one does not yet have a mathematically complete example of a quantum gauge theory in four-dimensional space-time, nor even a precise definition of quantum gauge theory in four dimensions." (Jaffe, Witten 2006, p. 3). „Regardless of the future role of QFT in pure mathematics, it is a great challenge for mathematicians to *understand the physical principles* (our highlighting) that have been so important and productive throughout the twentieth century." (Id., p. 4). Indeed, we have turned the problem into - understanding "the physical principles" - into revision of the global Minkowski space-time itself. Jaffe and Witten write further: "QFT is the jumping-off point for a quest that may prove central in 21st century physics - the effort to unify gravity and quantum mechanics, perhaps in string theory." (Id., p. 5). Indeed, our 3*D*-waveguided SR&QM&GR and Newtonian-like quantized gravity arise, together with their "stringy music", as organically united waveguided realities, described above.

They formulate the problem: "Prove that for any compact simple gauge group G, a non-trivial quantum Yang–Mills theory exists on R4 and has a mass gap $\Delta > 0$." (Id., p. 6). Yang-Mills theory is the (non-Abelian) quantum field theory underlying the SM of particle physics; R4 is the Minkowski 4*D*-space-time. The mass gap $\Delta$ is the mass of the least massive particle in the theory. Yang-Mills theory is connected to a simple Lie Group, such as S(U2) or S(U3). Shortly: (1) Look existence of the Yang-Mills theory on the R4 manifold;

(2) Show that the Y-M particles have a mass gap with $m>0$.

Our present article shows that the tasks (1-2) are pure conceptual - physical. They could be solved only if to understand the adequate 4*D*-hyperspatial (3*D*-waveguided) physical background of the SR, analyzed above, and to construct a corresponding geometrical-mathematical (polygonal-like) space-time structure, based on the quasiflat 3*D*-waveguide's dynamics. It is indeed necessary to revise physical sense of the canonic-global Minkowski's R4-spacetime, where the corresponding global *iCt* coordinate becomes trivial polygonal length-parameter (Lagrangian-like) in the 3*D*-waveguide and the periodicity (the 4*D*-Multiverse) miracle way transforms the space-time "illusion". The waveguided "massive" $C_4$-quasiparticles are locally self-consistent - gauge invariant, simultaneously they acquire the SR&QM&GR, etc. properties with the minimal-gapped rest mass by the very simple waveguided way, described in the present work. The arising twisting - localized electron-cell structure has its natural rotational fermionic symmetry around the axis OL. This twisting, self-focused co-phase state acquires sufficiently relativistic intrinsic *L*-spin $S_L=1/2$, corresponding to common *rotational group SU*(2) of electron, the simplest spatial elementary particle structure, now being without singularities.

The task (2) has the hidden "expensive" question about a physically appropriate mechanism of the rest mass creation in nature (e.g. miracle for the SM, since the hypothetical, very heavy Higgs bosons practically were not found at CERN-2011 and hopes are now too small). Our waveguided mass-creation mechanism obviously exchanges common Higgs mechanism, etc. with the arising now classical waveguided gapping property: $M \geq M_{min} > 0$, where $M_{min}C^2 = h\nu = hC/2L_{oe}$ and $M_{min} = h/2CL_o$. The rotational group $SU(2)$ of hyperspatial twisting electron reflects fundamental structural features of identical elementary fermion cells (fermionic electron- or positron-cell), etc. in the context of the above proposed periodical waveguided Multiverse. The arising relativistic rotational group $SU(2)$ corresponds to the fermionic spin $S=1/2$. This basic obstacle equalizes the doubled-relativistic inertial mass $M_{oe(inert)} = 2M_{min}$ of the electron-cell with the doubled gravity mass $M_{oe\text{-}(grav)} = 2M_{min}$ of the electron-hole in the periodical Multiverse. Naturally arising negative gravity "charge" $M_{oe+(grav)} = -2M_{min}$ for positron (antimatter) finds very good cosmological DE&DM&SUSY confirmations, corresponding to the hypersymmetrical quasiflat-periodical matter/antimatter Multiverse with the hypersymmetrical-Multiversal (large-scale) bubble-structure. Out antimatter-antigravity prediction will be very soon proofed experimentally at CERN, using deeply cooled, electrostatically neutral antihydrogen atoms. The described above cosmological DE&DM confirmation suggests very strong hopes for antihydrogen antigravity!

Arthur Jaffe describes common axiomatic components of the QFT as "Life of a Particle at Imaginary Time" (Jaffe 2005). This "life" has common theoretical requisites as wave function, Euclidean Laplacian and its Green's function, the Osterwalder-Schrader quantization, the Poincare symmetry from Euclidean symmetry, monotonicity operator, periodic time reflection, reflection positivity, etc., that we find also in our 3*D*-wavegide with the polygonal $C_4$-quasiparticle-wave propagation. Jaffe writes further: "The proof of the existence of a "mass gap" appears a necessary integral part of solving the entire puzzle. This question remains one of the deepest open issues in theoretical physics, as well as in mathematics. Basically the question remains: can one give a mathematical foundation to the theory of fields in four-dimensions? In other words, can do quantum mechanics and special relativity lie on the same footing as the classical physics of Newton, Maxwell, Einstein, or Schrödinger—all of which fits into a mathematical framework that we describe as the language of physics. This glaring gap in our fundamental knowledge even dwarfs questions of whether there are other more complicated and sophisticated approaches to physics—those that incorporate gravity, strings, or branes—for understanding their fundamental significance lies far in the future." (Id., p. 9). The "mass gap" question arises in the QFT as unavoidable general "mass-illness", naturally created in common QFT-basis – mistakenly mixing the necessary gauge invariance with the *global* space-time of Minkowski. It is clear in the context of our present work that the "mass gap" problem indeed turns physics to its physical hyperspatial unity, derived in frames of the waveguided periodical Multiverse. This beautiful, lazy monster reminds us about himself by the DE&DM, etc. miracles, including the "glaring" Millennium - "Mass Gap" - problem.

### *Some notes to the book "Cosmos", written by cosmologist Carl Sagan*

Famous American cosmologist Carl Sagan analyzed (astronomically very short) human history, where genial thinkers tried to understand cosmical mysteries of our Universe: „As long as there have been humans, we have searched for our place in the Cosmos. In the childhood of our spices … among the Ionian scientists of ancient Greece, and in our own age, we have been transfixed by this question: Where are we? Who are we?". "We find that we live on an insignificant planet of a humdrum star lost between two spiral arms in the outskirts

of a galaxy which is a member of a sparse cluster of galaxies, tucked away in some forgotten corner of a universe in which there are fare more galaxies than people." (Sagan 1981 p. 120). Sagan was sure that we are not alone in the Universe and "understanding where we live is an essential precondition of improving the neighborhood" (Id. p. 120) He wrote: "The sixth century B.C. was a time of remarkable intellectual and spiritual ferment across the planet. Not only was it the time of Thales, Anaximander, Pythagoras and others in Ionia, but also the time of the Egyptian Pharaoh Necho who caused Africa to be circumnavigated, of Zoroaster in Persia, Confucius and Lao-tse in China, the Jewish prophets in Israel, Egypt and Babylon, and Gautama Buddha in India." (Id. p. 114). Sagan was sure about arising modern – Cosmic Renaissance, whose nations are cosmopolitans (now we could imagine that we are very near to the hyperspatial, "hyper-cosmical" cosmopolitans). He quoted many great persons, shaping basic scientific & cosmological concepts, existing in our civilization. Sagan quotes Lao- tze (600 B.C.), who claimed existence of something invisible, "silent and void", being "the mother of the world":

> "There is a thing confusedly formed,
> Born before Heaven and Earth.
> Silent and void
> It stands alone and does not change,
> Goes round and does not weary.
> It is capable of being the mother of the world.
> I know not its name
> So I style it 'The Way.'
> I give it the makeshift name of 'The Great.'" *Lao-tse (Id. p. 148)*

Lao-tse always associated and mixed human psychic states with physical states of the surrounding us Nature. He proposed a quasi-physical conception of a precursor of the world, intuitively describing it as the Tao – "the mother of the world" strikingly similar to the properties of the e-cellular superfluid vacuum medium in our physical paradigm of vacuum & matter in the Multiverse. Indeed, our *e*-cellular vacuum was also "born before Heaven and Earth"; it is also ghost – "silent and void" for our biological and technical sensors; "it also stands alone" and practically "does not change" along the Universe accelerating expansion; it also "goes around and does not weary", since we freely swim in this superfluid, frictionless - tireless medium; it is also "the mother of the world" and "the mother" existed before creation of our matter world (as its defects); it also could be styled as "The Way", since it shows very wide and very thin "windows" to the grandiose Multiverse around our Universe.

Sagan remembers legendary Euclid (300 BC), who created the Euclidean geometry: Euclid "…glimpsed an image of perfection and cosmic glory. Euclid was later to write: 'Geometry existed before the Creation. It is co-eternal with the mind of God . . . Geometry provided God with a model for the Creation . . . Geometry is God Himself.' (Id. p. 93). Other words, the Euclidean geometry manifests the "Godly Geometry" of Creator. Indeed, the Euclidean geometry is primary and dominating in the (globally 4*D*-Euclidean) Multiverse structure (including the MWBB scenario), where the quasiflat (quasi-Euclidean) Multiverse (as periodical, hypersymmetric and defectless vacuum with its initially Euclidean geometry) existed *before* the MWBB-Creation. The MWBB is the history of periodical matter/antimatter defects (tiny, secondary by the nature), once arose (for example under a local thermal fluctuation, etc.) and forever existing in the perfect - divine Multiverse medium. Indeed, 'Geometry existed before the Creation' and so, the Multiverse, as the cause and holder of this geometry, reflects the ancient Euclidean "God Himself".

### *Prediction of the picometer-limit for the singularityless Newtonian gravity law*

Three very precisions torsion-balance experiments were recently conducted to test the gravitational Newtonian inverse-square law at separations between 9.53mm and 55μm, probing distances, being less than the "dark-energy length scale" ($R$≈85μm), (Kapner, et al 2006). This test confirms the Newton inverse-square law down to a *length* scale $R$=56μm and if exist an extra dimension, it must have a size less than $R\leq 44\mu m$ (!). Our estimation shows that the Newtonian $F_{gr}\sim 1/r^2$ -law is singularity-less and is true proximally till very small micro-distances down to the radius of the proposed ($e–/e+$) vacuum "atom" $R_3\leq R_{oe}\approx 10^{-10}\text{cm}=10^{-12}\text{m}$ and is very fare ($56\text{x}10^{-6}\text{cm}/10^{-10}\text{cm}\approx 10^7$) from the proposed microscopic 4-th extradimensional size $R_4$, discussed in many articles:

$$R_4 \approx L_{oe}=\lambda^*_{e.Compton}=2{,}426\times 10^{-12}\text{m}_4=2{,}426\ \text{pm}_4\ . \qquad (73)$$

### *The geometrodynamical sense of unified fields*

This sense fully corresponds to the core of the Einsteinian Unification Paradigm. Indeed, very tiny membrane deformation, keeps the 3$D$-membrane's bulk tension $\sigma_{3\boldsymbol{D}\text{-membr}}$ constant. This allows pure geometrodynamical waveguided description of the arising additional (positive) membrane tension energy and potential fields. The $C$-dynamical - relativistic $e$-cell has its $C$-dynamical rest mass $M^*_{oe}=2h\nu_{oe}/C^2$ in the 3$D$-waveguide with the arising hyperspatial pressure $F_\perp$, creating two symmetrical static 3$D$-membranes deformations – with simultaneously arising gravitational and electrostatic potentials, having two clear identities:

(1) There are two symmetrical spatial $U_{e(gr)}$ and $U_{e(el)}$ membrane deformations (straining-like by the nature), balance its enormous orthogonal hyper-pressure, $F_\perp=\pm M^*_{oe}C^2/8L_{oe}\approx 0{,}8$ kg in two reciprocal ($+L$) and ($-L$) directions. These two symmetrical-reciprocal hyper-forces express simultaneously elementary gravity and electrostatic charges of the elementary e-hole.

(2) The confined, moving as a *massless* = $C_4$-dynamical quanta $2h\nu_{oe}$ (realizing the $e$-cell), keeps its dynamical energy $E=2h\nu_{oe}$ practically without changing after the very tiny $L_{oe}$-deviation ($\Delta L_{o_{emax}}=\pm u_{oe}\approx\pm 4{,}2\times 10^{-55}$cm) for ($e_–$) and ($e_+$), because of the enormous 3$D$-membrane tension. After annihilation electron the ($e_+$)-hole and positron ($e_–$)-hole disappear and the decoupled ($e–$, $e+$) –"atom" is restored → the framing 3$D$-membranes restore their over-flat state with the restored minimal 3$D$-membrane tension energies. This minimal membrane tension energy is very huge $E_{(membr\ min)}=E_o>0$ and corresponds to the membrane's flat state (with the minimal membrane 3$D$-volume). Additional 3$D$-membranes strainings, caused by the arising $e$-hole (electron or positron defect) increase this minimal membrane's volume and create always positive-additional straining energy $E_{(membr)}=E_o+\Delta E_{(membr)}=E_o+M^*C^2>E_o$, where $E_o>>\Delta E_{(membr)}$ and $\Delta E_{(membr)}>0$, that strictly corresponds to our basic EMMA and GAMMA – conditions $\sigma_{3\boldsymbol{D}\text{-membr}}=constant$, creating $1/r$ potential forms and corresponding Poisson equations. This non-local $1/r$ straining energy $\Delta E_{(membr)}=M^*_{e-(inert)}C^2=M^*_{e+(inert)}C^2>0$ is the same and is positive for electron and positron, but their potentials – 3$D$-membranes deviations – have the opposite deviations in the $L$-dimension (the opposite potentials-signs), creating the opposite charges (gravity and electrostatic charges). Annihilation of the opposite – the electron and positron – holes annihilates their potentials & charges (afterward corresponding framing membranes become flat). The so described annihilation liberates their extra-straining energies $M^*_{e-(inert)}C^2+M^*_{e+(inert)}C^2$, transforming these mass particles energies into two common massless gamma-quanta.

Thus, the electron-positron creation is result of decoupling of the (*e*–, *e*+) bosonic "atom", consisting of two coupled *e*-cells, living in quasiflat adjacent 3*D*-waveguides. This annihilation replaces two fermionic *e*-holes by the coupled back (*e*–, *e*+) –"atom" (now there are no e-holes any more in the e-cellular superfluid vacuum tissue). The coupled pair contains two hypersymmetrical e-cells with two generic, $C_4$-dynamical e-cell quanta $hv^*_{oe-}$ and $hv^*_{oe+}$ inside. These e-cells never disappear in the periodical *e*-cellular vacuum - they only can be in the hypersymmetrically coupled ("empty vacuum") or in the decoupled "matter holes" states.

### *The self – renormalizability*

Feynman, one of creators of the QED, critically wrote in 1985: "The shell game that we play ... is technically called 'renormalization'. But no matter how clever the word, it is still what I would call a dippy process! Having to resort to such hocus-pocus has prevented us from proving that the theory of quantum electrodynamics is mathematically self-consistent. It's surprising that the theory still hasn't been proved self-consistent one way or the other by now; I suspect that renormalization is not mathematically legitimate" (Feynman 1985, p. 128). Dirac expressed the most persistent criticism, related to the arising singularities: "Most physicists are very satisfied with the situation. They say: 'Quantum electrodynamics is a good theory and we do not have to worry about it any more.' I must say that I am very dissatisfied with the situation, because this so-called 'good theory' does involve neglecting infinities, which appear in its equations, neglecting them in an arbitrary way. This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity when it is small - not neglecting it just because it is infinitely great and you do not want it!" (Helge 1990, p. 184). L. Ryder resumes the story with conclusion: "In the Quantum Theory, these [classical] divergences do not disappear; on the contrary, they appear to get worse. And despite the comparative success of renormalization theory the feeling remains that there ought to be a more satisfactory way of doing things." (Ryder 1987, p. 390).

*The field theory arises as an effective theory* in condensed matter physics, moreover, the condensed matter medium is "continuous" only on the scale above of its finite atomic size and there are no infinities, that avoids common singularities arising in the "fundamental" field theories with a point mass particle extrapolation, etc. The "effective" sense of such emergent effective theory simply disappears on the shorter scale. Theoretically arising singularities (and their miracle renormalizations) are signs of the wrong classical extrapolations. Realistic (singularity-less) field theories must be *effective, medium-based* theories (near zero energy limit) from the point of view of our cellular, condensed, supersymmetric superfluid vacuum-medium.

The QED predicts monstrous discrepancy $\rho_{vacuum(theor.)} / \rho_{vacuum(experim.)} = 10^{124}$ for the vacuum energy density. On the contrary, the proposed above superfluid PWM-vacuum consists of hypersymmetrical Cooperian bosons, it is non-pondermotor and supersymmetric with resulting zero QED-vacuum energy density and has ideal applicability to cosmology. Historically behind this realistic (zero vacuum) concept was initial Diracian idea of the *negative mass* and his later nonstop search for a "renormalization-free theory". Now his promising ideas of the "electron hole" and the "electron ocean" can be hypersymmetrically and super-symmetrically understood and rehabilitated: we obtain simultaneously the full ±mass / ±charge / ±spin hypersymmetry in the non-gravitating, non-charged, spinless hyper-periodical quantum vacuum with the vacuum energy density $\rho_{vacuum} \approx 0$. Moreover, we discover here unavoidably periodical, very dense, coupled Diracian-like (*e*–/*e*+) 3*D*-oceans - behind paradoxically illusive, light-minded "vacuum emptiness".

The 4*D-dynamical – inertial mass density* $\rho_{(e-/e+)inert.}$ of the ($e-/e+$) vacuum fraction is formally enormous, but it is not endless – it is proximally

$$\rho_{(e-/e+)inert.} = 2M^*_{oe}/V_{oe} \approx 1000 g/cm^3 = 1000 \text{ tonn}/m^3, \quad (74)$$

where $M^*_{oe} \approx 10^{-27}$g, $R_{oe} \approx 10^{-10}$cm, the 3*D*-volume of ($e-/e+$) pair is $V_{oe} \approx 4R^3_{oe} \approx 4x10^{-30} cm^3$). For comparison, the neutron star density is $\rho_{neutr.star} \approx 10^{15} g/cm^3$. The enormous membranes tension $\sigma_{3D\text{-}membr}$ , derived in the (62) gives a "concept" of the "inertial mass" density $\rho_{3D\text{-}membr}$ of the 3D-membrane itself:

$$\sigma_{3D\text{-}membr} \approx 10^{72} g cm^{-1} s^{-2} \rightarrow \rho_{3D\text{-}membr} = (\sigma_{3D\text{-}membr})(1cm^2)(1cm)/C^2 \approx 10^{51} g \text{ (in 1 cm}^3). \quad (75)$$

This is much-much bigger energy density as the mentioned above $C_4$-dynamical (inertial) mass density $\rho_{(e-/e+)}$ of the ($e-/e+$) vacuum. These densities-levels are decreasing as

$$\rho_{3D\text{-}membr} >> \rho_{(e-/e+)inert.} \quad (76)$$

But these two super-monstrous energy densities of the vacuum medium (at the lowest potential energy of the flat membrane) are out of our possible energy use – they define so tiny gravity force in nature, etc. and explain the large-scale space flatness, etc. Our suitable physical energy is always something miserably small on this background, but always *above* this monstrous "minimum", which could be defined as zero-level (free vacuum level), suitable for physics, describing behavior of material defects. It is "suitable", but not enough to understand the nature of our physical world, what is "something bigger" as was shown above and was claimed by Dirac, Feynman, Laughlin and Volovik (see citations above).

### *Roots of the superposition principle in physics*

The superposition principle in physics is connected with (a) the extremely strong membrane tension $\sigma_{3D\text{-}membr} \approx 10^{72} g cm^{-1} s^{-2}$, mentioned above, and (b) very rare matter or antimatter holes density in the vacuum's medium. These basic obstacles create tiny-linear 3*D*-membranes deviations, as it is shown for almost flat waveguided gravity potential, where common 3*D*-Poisson equations arise simultaneously. The same situation exists for very tiny wavefunctions of elementary particles in the QM.

### *Why are elementary particles (e.g. electrons) identical to each other?*

The elementary particles (being quasiparticles) are quantized and naturally identical everywhere in the waveguided periodical Multiverse - because of the global/local universality of the proposed flat 3*D*-waveguided-hyperspace structure – its global flatness. Formally, the waveguide physics creates plenty of elementary electron-like particles with linear mass spectrum $2M_{oe}$, $3M_{oe}$, ..., $nM_{oe}$? We have no these particles in nature and this way was initially rejected the Kaluza's 5*D*-theory. Our vacuum must be a condensed quantum superfluid in the minimal – "effective theory" state, dictating all the subordinate particles properties. It is filled by endless number of coherent ($e-/e+$) pairs, grasping different injecting energy and protecting generation of different number of free ($e_-$) and ($e_+$) holes. As exclusion, this collective coherent system *energetically* supports generation of, e.g. much more massive mass particles with the opposite positive electron charge, minimizing - eliminating relatively very strong electrostatic energy, as it do protons $p_+$ and antiprotons $p_-$.

### *Why are wave functions $\psi(e_-) \rightarrow \psi^*(e_+)$ complex conjugate quantities?*

They are symmetric *complex* conjugate functions in two adjacent waveguides, where our physical time period $T_o$ becomes imaginary quantity $T_o=i2L_{o4}/C_4$, implanted into the QM operators $E\rightarrow i\hbar\partial/\partial t$, $p\rightarrow -i\hbar\nabla$. This means that two identical, complex conjugate wave functions correspond hyperspatially to two *different - adjacent and identical waveguides* (waveguide & anti-waveguide) = (particle and antiparticle), existing from the both sides of the dividing 3*D*-membrane, where one side is like our Sub-Universe and the other is the Sub-Anti-Universe. It is suitable to remember here penetrating poetic comments by Gottfried Leibniz (1646-1716) about complex numbers: "The imaginary numbers are a wonderful flight of God's spirit; they are almost an amphibian between being and not being" (Leibniz 1702). Leibniz was outstanding, universal genius, comparable with Newton; he developed the infinitesimal calculus (parallel and independently of Newton), he speculated about relativity of space and time, etc. and even about more than 3 space dimensions, being fare ahead of his time.

### *The generic wave-optical nature of the least action principle*

The Einstein geodesic line condition means the shortest distance S between two spatial points (a,b):

$$\delta \int^a_b dS=0. \qquad (77)$$

This simple condition gives the common Hamilton principle in mechanics and dynamics for weak fields $\delta \int^{t1}_{t2}(U-T)dt=0$. We could consider the massive *e*-wave in our unfolded *L*-space as the same quasi-classical "light" beam propagating with the light speed $C_4$ along the geodesic line $S_4$, situating now inside of the artificially *unfolded* 4*D*-space or 4*D*-antispace of the substantial 3*D*-waveguide (see Fig. 2c). It is a quasi-optical, the wave-optical situation, reduced now to the four-dimensional "minimal time" principle of Fermat, i.e.,

$$\delta \int^a_b dS= \delta \int^{t1}_{t2} (U-T)dt=0. \qquad (78)$$

From this point of view the idea of geodesic lines, proposed by Einstein is equal to the waveguided concept of gravity, since it has generic relation not only to classical mechanics, but also to the roots of quantum mechanics in its Dirac's (1933) and Feynman's (1948) path integrals interpretation. It is based on the Huygens wave principle, including the common 'path integral' concept in the wave-optical waveguide's machinery. The *e*–wave also propagates along the mainstream way, where wave phases are "fast the same" and "full amplitude has considerable quantity" (Feynman 1966, v2/6, p. 109). Thus, the minimal action principle is not heuristic anymore - it can be deducted from the wave-optical analogy, connected to the Schrödinger and Dirac equations as the following wave equations. Kaku attenuated generic role of the least action principle, which was used by Feynman to reformulate the quantum mechanics in terms of Feynman path integrals. He writes: "We can derive Newton's laws of motion, and vice versa", but "this equivalence, however, breaks down at the quantum level…and … thus, the action principle is the only acceptable framework for quantum mechanics" (Kaku 1998, p.20). This position corresponds well to our cellular-condensed vacuum media concept, where energy could be transported literally through the "atomistic" bosonic superfluid medium as spin waves (bosonic quasiparticles). These spin waves propagate *casually* from cell to cell - like it is along Feynman paths - where action *S* shows its essential wave-phase properties. Obviously, all Feynman's paths integral

*accounts* (for different possible paths) must be realized *simultaneously - parallel* "in the real time" in the whole cellular vacuum space along acting spin wave's fronts. The proposed cellular-quantized vacuum space indeed works as a natural quantum supercomputer – super-quick, coherent (playing "multi-dice") parallel calculator, realizing all the Feynman's part integrals and selecting the minimal-one! We could accept famous phrase of Einstein, related to the full Universe: "God does not play dice with universe" (Einstein 1926). But who can forbidden God to play a miracle multi-dice with "objectionable" elementary defects, arising in his perfect kingdom?

### *Could Einstein predict the waves of de Broglie and the periodical Multiverse in 1905?*

The waveguided equation $h(\nu)=h\nu_o/cos\alpha$ shows that Albert Einstein, as creator of the SR, was able to offer the fundamental de Broglie's idea already in 1905 (!), proposed only in 1924 by de Broglie. This could happen if Einstein had investigated the optical-waves properties of his miracle device - *parallel double-mirror-clock*. This "substantial" optical clock is *identical* to our waveguide model, as e.g. common thin oil film on the water surface, existing everywhere after reign. Einstein could immediately obtain *the same equation* for the double-mirror-wave $h\nu=h\nu(\alpha)=h\nu_o/\sqrt{(1-V^2/C^2)}$ as the *wave interference effect* for propagating wave, that was obtained in the wave-optics already by Frensel in the 18th century. But even de Broglie did not think about this opportunity in 1924 (and later), when he proposed his mass wave-particle. This technically very simple classical investigation could be enough to give him immediate association between SR & mass-particle & wave already in 1905! It could disclose him the determining geometrodynamical source of basic physical laws – the 3D-waveguded hyperspace structure, creating the SR&GR&QM&(Kaluza cyclical conditions), etc. simultaneously! Obviously, it could be a right key to a quasi-classical door into the hypersymmetric physical concept, describing the periodical SM-Multiverse, etc. proposed and defended in the present paper after 100 years after the SR.

*Note:* Einstein was one of the greatest intuitivists in the history of theoretical physics – he was not satisfied with the Kaluza's pure mathematical approach – Einstein estimated the Kaluza 5*D*-theory as a pure „abstraction", which resulted in absence of measurable quantities. He wrote that Kaluza's theory "means a questionable asymmetry forth of the cylindrical dimension comparably to other space dimensions and that the all five dimensions must be build as to be equal" (Einstein and Grommer, 1923, in: Wuensch 2010, p. 314). Our way to introduce the fourth spatial dimension – exactly as the isotropic 4*D*-Euclidean hyperspace with equal spatial dimensions – is in full accordance with his deep intuition, saying that all spatial dimensions must be somehow "equal". Einstein wrote Pauli in 1938: "the Kaluza's idea deserves a logical improvement" (Wuensch 2010, p. 315). This improvement was published together with Bergman. Einstein and Bergman noted: „We have therefore to take the fifth dimension seriously although we are not encouraged to do so by plain experience. […] Furthermore it is much more satisfactory to introduce the fifth dimension not only formally, but to assign to it some physical meaning" (Einstein, Bergman 1938). "The most essential point of our theory is the replacing of the hypothesis 2, of the rigorous cylindricity by the assumption that space is closed (or periodical) in the $x^5$ dimension" (Einstein, Bergman 1938). Obviously, Einstein and Bergman were very near to our periodical (waveguided) concept in 1938, but the Minkowski's spacetime yet was not revised and was not exchange by the waveguided $C_4$-dynamics. Edward Witten, one of the leading ST-creators, writes: "Since the Kaluza-Klein approach has always been one of the most intriguing ideas concerning unification of gauge fields with general relativity, it has languished because of the absence of a realistic model with distinctive and testable predictions." (Witten 1981). The so innovative-multidimensional and encouraging Kaluza's approach was indeed miracle geometrical

investment in physics, but it was made also (as practically all basic physical theories, using the SR) without necessary revision of the global Minkowski's spacetime. The Kaluza's abstract approach has very simple physical roots in the 3*D*-waveguided, wave-dynamical SR, described above. Two great mathematical-geometrical investments in physics (made by Minkowski and Kaluza) have created may be the biggest physical "breakthroughs-blindfolds", prepared by these brilliant mathematicians in modern physical science, where physical intuition played a secondary role. They masked the (so obvious here) hyperspatial physical sense of the SR&QM and the underlying hyperspatial Multiverse (as a deep "underwater" base of a visible thin iceberg). It was patiently hided of us, being always so near and patiently waiting for it's disclosing more than 100 years after 1905.

### *Goldstone bosons field-analogue in the (e–/e+) superfluid*

If we look attentively into the structure of a coupled (*e*–/*e*+) quantum vortexes (Fig. 6), we can note that their strictly reciprocal coaxial states $\Delta r_{e-/e+}=0$ eliminate confining cavities in the middle dividing membrane (Fig. 6c) - the dividing membrane becomes flat. Thus, a potential energy $U(\Delta r_{e-/e+})$, coupling these interacting (*e*–/*e*+) vortexes, has its unstable equilibrium state at $\Delta r_{e-/e+}=0$ and looks like common "bottle" potential of the "Goldstone bosons" ⊔∩⊔, (Goldstone 1961). This means that the *coaxial*-coupled state of the (*e*–/*e*+) vortexes is the *unstable equilibrium* point and will jump off into a kind of a stable equilibrium asymmetric state, $U(\Delta r_o\neq 0)=U_{min}$. This hidden radius is approximately the $\Delta r_o\approx 2R_{o\mu}$ (Fig. 6). This asymmetry allows all possible $\Delta \boldsymbol{r_o}$ orientations of these slightly quasi-polarized coupled pairs, being chargeless, spinless and *gravitationally massless* dipoles. This 3*D*-degree of freedom has common QED-association with the massless Goldstone boson and the Goldstone mode. This spatial asymmetry vector $\Delta \boldsymbol{r_{oi}}$ will have random distribution in the 3*D*-superfluid vacuum, filled by the coupled $(e-/e+)_{\boldsymbol{i}}$ pairs. If a free electron hole and resulting membranes deviations $u(r)\sim k/r$ arise, the previous zero random vacuum polarizations $\Delta \boldsymbol{r_o}$ will get a corresponding radial order proportional to the Newtonian gravity field $\boldsymbol{g}(r)\sim k/r^2$, i.e., $\Delta \boldsymbol{r_o}(r)\sim k/r^2$ and we could derive the same $E_{el}/E_{gr}$ calculation, $E_{el}/E_{gr}\approx 5\times 10^{42}$, as it was derived on the membrane-like conceptual level above.

The so called Goldstone's "bottle" potential $V_{\text{Goldstone}}(\varphi)$ of the scalar field φ has two equal minimums if $V(\varphi)=(1/2)m^2\varphi^2+(1/4)\lambda^2\varphi^4 \rightarrow V_{\text{Goldstone}}=-(1/2)m^2\varphi^2+(1/4)^2\varphi^4$ and the $V(\varphi)$-potential form is changed as ⊔ → ⊔∩⊔. The $V_{\text{Goldstone}}$ contains self-action term $(1/4)\lambda^2\varphi^4$ of the field φ and term $-(1/2)m^2\varphi^2$ with negative sign that can give association with hypothetical particles – tachyons, moving faster than light. Much more natural physical interpretation arises in or case – the "bottle" potential form exists since we have two equal, but opposite (positive and negative) gravity masses and charges for electron and positron correspondingly with the proposed hypersymmetrical *compositeness*, creating gravitationally massless Goldstone-like bosonic ghost "atoms", carrying inertial masses $2M^*_{oe}$.

### *Some psychological remarks*

*Creative thinking "by a pictorial analogy"* is a dominating methodology to create a new physical paradigm. This very natural – the "right-hemispheric" way of thinking was extremely fruitful in the history of physics – it was essential for many great achievements. Newton associated planetary movements with a falling apple; a light beam with a ray of tiny light-balls. Faraday and Maxwell compared electromagnetic fields with hydrodynamic lines of ideal liquid flows. Huygens compared wave-optical processes with the common waves in a

liquid media. De Broglie associated moving mass-particles with very strange waves, immediately initiating the Schrödinger wave-QM, etc. Young Einstein suddenly reanimated the "naive" Newtonian idea of tiny corpuscular light-balls (who noted similarity in light beams and balls reflection) and proposed massless discrete particles – photons, connecting this very simple, but really great (post-Maxwellian) idea with the Planckian quantum radiation revolution. Later Einstein associated gravity potential with a curved space-time. Creators of the now so popular ST associated classical point-like matter particle with vibrating modes of very small, one-dimensional "fuzzy" strings. Modern physics of a cold condensed matter (e.g. *superfluidity*, *superconductivity*, etc.) and gauge theories of *crystal defects* shows amazing analogues to the high-energy physics, expressed in the SM (see G. Volovik 2003, Lazar 2000, 2010, etc.). Rich visual imagination and thinking by analogy will always be an endless source of human scientific creativity; these mental features are brightly accentuated in personalities of the most innovative physicists, who were able to revolutionize physical "Weltbild" (like Newton, Huygens, Faraday, Maxwell, Planck, Einstein, de Broglie, Feynman, etc.). These features were brightly presented e.g., in famous, so non-formal lectures of wonderful "pictorial analogist" R. Feynman. Freeman Dyson, friend of him, wrote about Feynman: "The reason Dick's physics was so hard for ordinary people to grasp was that he did not use equations… . Dick just wrote down the solution out of his head without ever writing down the equations. He had a physical picture of the way things happen, and the picture gave him the solutions directly with a minimum of calculations. It was no wonder that people who had spent their lives solving equations were baffled by him. Their minds were analytical; his was pictorial." (Cropper 2001). Our presented physical concept was partially inspired by some of penetrating pictorial analogies, selected for his students. Following Einstein, he believed that modern physics demands unthinkable requirements to human *imagination*, that "degree of imagination, necessary now in science, incomparably surpasses that which was needed for some previous ideas" (Feynman et al 1966, v. 2/6, p. 133). The "Idea of Nature is much, much larger than that of man." (Feynman 2001, p. 20). He was (luckily) not too right to say so, since some times a tremendous Simplicity, as always believed "naive" Einstein, would like to reconstitute bunches of physical laws. Indeed, so "trampled down" - trivial *everyday images*, as shining oil films in rain puddles and a rising dough on a kitchen of our dear grandmothers contain may be the most significant information about our Universe secrets.

What has happened with physics today? Unfortunately, innovative, creative poverty of a non-formal visual imagination and thinking by analogy is widely replaced in modern theoretical physics by impenetrable clouds of elusively "self-sufficient" mathematical abstractions, being perfect, but internally limited - blinding instruments (like common icon of the global Minkowski's 4*D*-spacetime, or spatially structureless "first principles", like the least action principle, etc. or pure abstract symmetries, without reasonable looking into their objective roots - into the "something bigger"…that claimed Robert Laughlin (Laughlin 2007, p.187). Paul Dirac, one of the most significant creators of modern quantum physics, wrote: "the pure mathematician who wants to set up all his work with absolute accuracy is not likely to get very far in physics." (Cropper 2001, p. 373). Here we repeat one more time the related penetrating "pictorial" note of Laughlin, that this "something bigger" is an underlying physical cause (and not the backward) of common "first principles", etc., or the fundamental symmetries in physics: „Symmetries are caused by things; they are not the causes of the things"; „If the relativity always true, there must be a reason" (Laughlin 2007, p.187). Indeed, we could show above, that the joint reason of the classical physics (the SR, the rest mass creation mechanism, the wave/particle nature, the Kaluza-Klein cyclical condition, the Newton-like gravity, the equivalence principle and the nature of the least action principle, etc.) is in the underlying wave-dynamics in the 3*D*-waveguide's spatial structure! "The

things" arise as the 3D-waveguides, 3D-membranes and quasiparticles, etc. This structure, being the *L*-hyper-periodical, composes the nongravitating vacuum superfluid, etc., with the Multiversal-DE&DM cosmology and with the surprisingly so easily reincarnated Cooper-like SUSY nature. This periodical hyper-concept not only solves simultaneously some fundamental, unsolvable before physical problems, interesting only for physicists – it opens something more beautiful for our lonely Civilization, that goes fare beyond interests of physical science itself – a miracle windows to myriads of *physically equal*, coupled Subuniverses and correspondingly myriads of their Sub-Civilizations, unexpectedly super-densely surrounding us in the 4*D*-hyperspace.

Mental "things", which are full of life and associative poverty, are sufficiently visual-nonverbal by their psychological nature; they create potentially very rich – *endless worlds of structural-spatial associations*, operating with the global and very dense informational flow, common for the right brain hemisphere of human being. On the contrary, the left-brain hemisphere operates with also necessary, but local, rigid-logical associations - "by function", etc. Endless pictorial associations are able to create radically *new pictorial insights*, compatible with the "pictorially" designed Nature; these associations could be indeed revolutionary - unpredictable in frames of the previous paradigms (where new revolutionary vision could be typically "strictly forbidden" by a dominating logic). They function in the right brain hemisphere, dealing with the holistic-global compositions of things. Visual-nonverbal sources of human creative abilities and creative imagination indeed connect great creators like Newton, Einstein, Planck, de Broglie, Dirac, Feynman, Sacharov, etc. (see research paper about the neuropsychological nature of creative thinking, based on brain functional asymmetry studies, (Gribov 2002)).

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