Singularity-free stable black holes, holding the baryon conservation law in the periodic waveguided multiverse

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Abstract. Black holes (BHs) are three-dimensional (3D) singularity-free macroscopic defects in the superfluid-crystal-like four-dimensional (4D) periodic waveguided multiverse (PWM) concept by the author, like edge-dislocations in 3D smectic-A liquid crystals. The PWM-co-emergent intrinsically identical ordinary matter (OM), antimatter (AM), dark matter (DM), dark antimatter (DAM) arise in the nearest 3D-waveguides-3D-universes with the co-emergent special relativity, weak Newtonian gravity, the expanded equivalence principle—the expanded general relativity (PWM-GR) foundation, predicting gravity mass symmetry—matter-antimatter antigravity. The PWM-BHs have identical Schwarzschild radii, outer gravity potentials as the GR-BHs, but flat-singularity-free gravity potentials inside. Microscopic PWM-fermions—singularity-free defects-holes in the weightless superfluid PWM-vacuum-medium—form singularity-free, intrinsically physically identical macroscopic defects: OM-BHs, DM-BHs, AM-BHs, DAM-BHs in the nearest 3D-waveguides. The smallest free PWM-BHs have 4.3 solar masses (excluding microscopic Hawking’s GR-BHs never experimentally detected), they are stable—too heavy for gravitational Schwinger-like virtual electron–positron pairs decoupling—unable emit gravitationally repulsive virtual positrons; they also unable emit repulsive PWM-antiphotons, electrostatically confined in the gravitationally polarized PWM-vacuum, preserving its decay, holding the fundamental baryon number conservation law, prohibiting Hawking’s-GR-BHs evaporation. Only plasma-eating, growing PWM-BHs emit thermal positrons, simultaneously absorbing attractive virtual particles. The dominating PWM-DM-pulsars explain relativistic galactic positrons flows excess over electrons.

1. Introduction
The concept of black holes (BHs) arose in 1916 in the framework of Einstein’s general theory of relativity (GR) [1], when Schwarzschild found a very simple exact solution of the GR equations for a spherical collapsing non-rotating star [2]. The GR-BH has a very compact spherical boundary, so called event horizon with Schwarzschild radius depending only on its mass. The GR-BH can have almost any mass, from microscopic to many solar masses. It can grow, attracting and absorbing matter, but nothing (and even light) can escape from it, therefore the space-time inside a black hole looks literally like a hole in our space. Moreover, there is a theoretically unrecoverable singularity in the center of this sphere, where gravitational field strength has a clearly unphysical–infinite value. There are yet unresolved basic problems of BH physics: the GR-BH singularity problems; stability problems of isolated GR-BH, broken by...
the contradictory BH evaporation mechanism by Hawking; the BH-information-loss paradox [3]. There are long theoretical efforts to solve them, for example referred to the string theory (ST) or to the loop quantum gravity theory to eliminate the GR-BHs singularities, but only deeply inside their event horizons [4], or referred to some hypothetical assumptions of yet unknown theory of quantum gravity, or to hypothetically stable Planck mass black holes, or to the modified GR—modified at curvatures below Planckian curvature [3].

Non-singular BHs naturally arise in the periodic waveguided multiverse (PWM) structure, proposed by the author, where the novel—pure three dimensional (3D) waveguided PWM-gravity mechanism emerges (independently of the GR by Einstein) for classically quantized 3D-massive normal 3D-waveguided modes in the PWM. The special relativity (SR), quantum mechanics (QM) and the expanded equivalence principle (EP), the expanded PWM-GR basis, are all united—co-emergent on a deeper physical level in it—as different sides of the same four dimensional (4D) wave dynamics in equal quasi-flat 3D-waveguides. Notably, if two 3D-boundaries of the flat 3D-waveguide—3D-universe are thin strained quasi-flat elastic 3D-membranes, then exactly weak attractive Newtonian gravity emerges [5,6]. The PWM-structure reminds common structures of smectic liquid 3D-crystals with flat two-dimensional (2D) layers. This very simple periodic 4D-PWM-structure predicts antigravity between ordinary matter (OM) and antimatter (AM)—gravity charge symmetry—arising between two adjacent 3D-waveguides with the inevitably expanded equivalence principle (EP)—basis to the expanded PWM-GR. Now it becomes compatible with the robust weightless–composite (Cooper-like) superfluid PWM-vacuum concept, where our matter and antimatter particles are elementary holes and anti-holes in it. The PWM-concept underlies the corresponding large-scale universe model recently developed together with Trigger and Rukhadze, providing united explanations of the large-scale universe structure (the flatness, homogeneity, voids, etc nature), without need on the hyperinflation hypothesis), discloses the hidden (pure 4D-multiversal) dark energy (DE) nature with zero cosmological constant and the dark matter (DM) nature, plus restores cosmological matter–antimatter symmetry [5–10].

So, there must be an awaited correspondence and difference between the GR black holes (GR-BHs) and the PWM-BHs. Indeed, they have identical Schwarzschild radii and gravity potentials above these radii; but the PWM-BHs are singularity-free, have a constant gravity potential inside these radii, they are macroscopic, singularity-free edge-dislocations—3D-monolayered defects in the smectic superfluid 4D-PWM-crystal. The free PWM-BHs cannot be microscopic, these can arise only inside very dense and massive stars, like neutron stars, created by the hollow—singularity-free (stable, robust) elementary baryons and all free PWM-BHs are estimated to be above 4.3 solar masses [5, 6].

The rest of the text is organized as follows. Section 2 describes the PWM concept; section 3 contains the expanded GR-equations by Einstein with gravity and antigravity in the PWM-GR; section 4 contains the PWM-BHs concept; section 5 presents estimations of the minimally possible isolated PWM-BH, which is above 4.3 solar masses; section 6 shows that neutron stars with masses between 2.4 and 4.3 solar masses have hidden black holes inside; section 7 describes the stable (or only growing) massive PWM-BHs, contrary to the prediction of evaporating GR-BHs by Hawking; section 8 discusses the coexisting PWM-OM- and PWM-DM-pulsars in our galaxy and explains the excess of relativistic galactic positrons over electrons; section 9 shows the first sensational confirmation of the 4D-spatial dimensionality, supporting the 4D-PWM-concept.

2. The periodic waveguided multiverse concept
The PWM is assumed as an endless periodic, hyperspatially ordered, n-chain of quasi-flat co-adjacent 3D-waveguides—3D-universes, where each 3D-waveguide \( W^n \) has its individual natural number \( n \) in this periodic chain. They are literally parallel, (intrinsically identical) quasi-flat
SM-like universes—3D-waveguides. Each 3D-waveguide $W^n$ physically behaves as the standard model (SM) like, (roughly) 3D-spatial quasi-flat universe, confining its SM-like elementary particles in a thin 4D-dimensional bulk inside the 3D-waveguide, with thickness 23 orders bigger than of hypothetical branes and walls in the ST [5, 6]. These identical 3D-waveguides are divided (framed-formed) by parallel, quasi-flat, double-sided very thin 3D-boundaries—elastic, very strongly strained quasi-flat 3D-membranes $M_n$, $L_0$-periodically placed in global Euclidean 4D-space (where our 3D-universe $W^0$ is shaped by two quasi-parallel strained 3D-membranes $M_0$ and $M_1$, the nearest adjacent antiuniverse $W^1$ is shaped by two 3D-membranes $M_1$ and $M_2$ and so on).

We fix the thickness $L_0$ of the standard 3D-waveguide-module near 2 pm (Compton length of electron), starting from the minimal normal mode, classically quantized minimal-gaped rest mass energy, corresponding to the electron mass. In this case, some basic features of our 3D-mass particles and physical laws become united—simultaneously co-emergent in the frames the effective, (experimentally testable) low-energy PWM-physics.

Feynman mentioned some miraculous properties of flat 2D-waveguides, which waveguided EM-dynamics unites the simultaneously emergent (as pure EM-waveguided) SR- and QM-like features [11]. The PWM concept is based, following Feynman, on the quasi-classical, expanded Maxwellian 4D-electromagnetism (EM) in the correspondingly expanded flat 3D-waveguide and the correspondingly 4D-expanded concept of 3D-photon by Einstein, confined in the 3D-waveguide. Notably, in this case the pure 3D-waveguided–dynamically quantized elementary 3D-massive fermions, together with the 3D-SR and 3D-QM, weak Newtonian 3D-gravity and the expanded EP (basis of the expanded GR) are simultaneously co-emergent and physically united. Feynman discussed in his lectures the so-called electro-mechanical 2D-membrane analogy 2D-(EMMA) and noted, this 2D-analogy could be also correctly expanded to the 3D-membrane properties (to the 3D-EMMA) [11]. We expanded this analogy to the quite similar 3D-gravito-mechanical membrane analogy 3D-(GRAMMA). The 3D-(EMMA-GRAMMA) combination with the 3D-waveguide geometry in the PWM is fundamentally crucial for unification of weak Newtonian gravity and electrostatic potentials, possible on the quasi-flat both-sided 3D-membrane [5]. Weak Newtonian gravity and antigravity—gravity charge symmetry, naturally arising together with the common electrostatic charge symmetry in the PWM, dictates the correspondingly emergent-enlarged PWM-EP, all arising totally independently of the GR by Einstein. The EP is the pure empirical basis of the GR, so the PWM-EP emergence sufficiently deepens and expands the GR-paradigm nature as the PWM-GR, incorporating the matter–antimatter antigravity in it. This provides (for the first time in physics) the non-contradictory formation of the hidden (weightless–composite–frictionless) superfluid PWM-vacuum–medium concept, filling 3D-waveguides [5, 6].

The 4D-PWM-order discloses the pure multiversal matter and antimatter nature, (hidden behind the SR and Diracian algebra) with the inevitably emergent $\pm M_{gr}$ and the geometrically obvious CPT-like symmetry for two adjacent—SM-coupled $W^{2n}$ and $W^{2n+1}$ flat 3D-waveguides, realizing emergence of the novel—periodic repulsive matter–antimatter universes–antiuniverses (as the extensively searched-hidden dark energy phenomenon nature) [5, 6].

Moreover, gravitationally attractive dark matter phenomena also arise in the PWM for each (even or odd) pair of the electrostatically separated (SM-decoupled) $W^{2n}$ and $W^{2n+2}$ universes and $W^{2n+1}$ and $W^{2n+3}$ antiuniverses which are mutually dark, but still gravitationally attractive as dark matter does [5, 6, 12–14]. So, the gravity charges symmetry and repulsive gravity also exist between the adjacent DM–DAM counterparts in the PWM [5, 6].

The defect-free superfluid PWM vacuum–medium is a Bose–Einstein condensate, consisting of densely packed, very robust Cooper-like atoms—composite bosons—coupled pairs of massive fermion–antifermion. These extremely robust, electrostatically coupled pairs have exceptional properties—they are weightless, chargeless spinless scalars and have positive (double) inertial
mass and zero gravity mass while they have opposite gravity masses. These pairs exist in a 3D-waveguide as identical co-phased–robust wave-dynamic 4D-light vortices—fermionic 4D-spherinders (expanded 3D-cylinders) [6]. Axes of all these hollow spherinders are normal to boundaries (framing 3D-membranes) of the 3D-waveguide and they fill each 3D-waveguide as a monolayer of parallel spherinders—parallel rods, acting on two framing 3D-membranes as normally orientated confined light springs, behaving like compressed hollow mechanical springs. Matter particle and antiparticle arise always pairwise as the decoupled fermion–antifermion atom (decoupled massive spherinder and anti-spherinder). This creates two stable elementary massive holes with positive inertial masses, but opposite gravity masses. They live in two adjacent 3D-waveguides and only these holes–anti-holes can mutually annihilate, restoring the defect-free robust superfluid PWM-vacuum tissue.

Pairwise coupled (hollow rod-like) 4D-spherinders and antispherinders build composite atoms of the weightless PWM-superfluid, they are robust and have form of normally orientated coaxial, robust double-rods, densely filling the 3D-waveguides, forming the periodic layered superfluid—4D-PWM-multiverse-crystal [5,6], like 2D-monomers of normally orientated rods-like molecules fill periodically placed 2D-monolayers of common smectic-A phase liquid crystals [15–17].

The PWM-expanded quantum field theory (QFT) provides zero cosmological constant under the predicted matter–antimatter gravity charges symmetry, creating the physically realistic—weightless, chargeless, spinless, etc quantum PWM-vacuum–medium [6], very similar to the spinless $^3$He-A superfluid [18], providing our weightless flat universe on the large scale and restores the PWM-expanded unbroken baryons–antibaryons symmetry for OM–AM, AM–DM and DM–DAM [5–10].

Importantly, the totally inverted (vacuum–medium, particle–hole) paradigm is unavoidable in the PWM, because only this inversion simultaneously unites dark energy and dark matter phenomena, emergent in the PWM between two intrinsically physically equal adjacent universes, and the appearance of dark matter properties (gravitational attraction between two the nearest even (odd) mutually dark universes (antiuniverses).

Massive fermionic matter-hole live in even $W^{2n}$ matter universes, where our matter universe is $W^0$ by convention and antimatter-holes in odd $W^{2n+1}$ antiuniverses.

Our $W^0$ particle-hole obviously involves a triplet of three monolayers—three universes ($W^{-1}, W^0, W^1$), with the massive particle-hole in the middle one. This hole has two positive gravitational half-charges $M_{gr}^0/2 + M_{gr}^0/2$ created by normal pressure of two coaxial hollow springlike anti-spherinders, living in two the nearest adjacent odd ($W^{-1}$ and $W^1$) antiuniverses.

These coaxial springlike anti-spherinders symmetrically press into the $W^0$ hole from below and above of it and create two positive gravitational half-charges, arising around this particle-hole as two tiny symmetric static $1/r$-deformations of two elastic 3D-membranes $M_0$ and $M_1$, framing the $W^0$ 3D-universe [5,6].

So, the attractive OM–OM gravity potentials for our particles-holes, living in our universe $W^0$ are provided by two the nearest symmetrically placed 3D-waveguides $W^1$ and $W^{-1}$.

Matter–antimatter antigravity arises between our positive $M_{gr}^0 > 0$ and negative $M_{gr}^{-1} < 0$. $M_{gr}^1 < 0$ gravity masses, emergent in the nearest to us adjacent antiuniverses $W^1$ and $W^{-1}$. These matter–antimatter particles are electrostatically, etc (the SM-coupled to our matter) because they have joint electrostatic 3D-membranes $M_1$ and $M_0$ with our universe $W^0$.

The attractive OM–DM half-gravity and mutual darkness arise between our OM-universe $W^0$ with ($M_{gr}^0 > 0$) and two DM-universes $W^2$ and $W^{-2}$, where $M_{gr}^2 > 0$ and $M_{gr}^{-2} > 0$. They are separated of our universe $W^0$ by the antiuniverses $W^1$ and $W^{-1}$ correspondingly and are dark for us (the SM-decoupled), because they have no joined electrostatic 3D-membranes, carrying joined electrostatic charges of our matter and dark matter, but yet attract us half-gravitationally by two overlapped–joined 3D-waveguides $W^{-1}$ and $W^1$, realizing two joint attractive gravitational DM-half-potentials with our universe. The DM-universes $W^2$ and $W^{-2}$ have no mutual SM
and gravitational interactions, because they have no joined 3D-membranes and overlapped 3D-waveguides.

Notably, all other $W^n$ universes with $(n < -3; n > 3)$ have no joined 3D-membranes and overlapped 3D-waveguides with our triplet $(W^{-1}; W^0; W^1)$, they are the SM-decoupled (dark for us) and have no direct gravity interactions with our OM-universe $W^0$, contrary to common gravity theories, where only gravity field leak fare away into additional hidden spatial dimensions and becomes very weak for us [19].

PWM-DM is composite–mixed in any (OM + DM) cosmic cluster—contains two (mutually SM and gravitationally) decoupled $(DM^2 + DM^{-2})$ components, mixed in different proportions. This explains why the observed cosmic DM–DM collisions show some controversial results, such as the complete absence of any non-gravitational DM–DM interactions or its particular presence, common for OM–OM collisions [5].

Exactly the same attractive half-gravity and darkness exist for all odd pairs of mutually dark antiuniverses $(W^{2n+1}; W^{n+3})$, because they also have only one overlapped 3D-waveguide $W^{2n+2}$.

Thus, the PWM-concept predicts existence of (OM + DM) galactic clusters and equally presented on the large scale gravitationally repulsive (OAM + DAM) antigalactic clusters, providing totally gravitationally neutral universe concept [5, 6, 9, 10].

Remarkably, the superfluid PWM-vacuum resembles the old idea of an ether, which Einstein initially rejected it in the SR, but after the GR creation returned back to the ether idea [20]. The proposed superfluid PWM-vacuum concept, as the consistent weightless superfluid vacuum theory (SVT), reanimates this old idea and also fully confirms a novel paradigm about the emergence of fundamental physical laws (Anderson, Laughlin, Pines) [21, 22].

The predicted matter–antimatter gravity charges symmetry establishes the weightless, chargeless, spinless, etc PWM-vacuum–medium, similar to the $^3\text{He-A}$ superfluid, but now it expands the GR by Einstein and provides the totally weightless flat universe on the large scale with the unbroken baryons–antibaryons symmetry for OM–AM, AM–DM and DM–DAM, etc [5, 6].

3. The expanded GR-equations by Einstein with gravity and antigravity in the PWM

GR is based on the SR and the pure empirically motivated equivalence principle (EP). The SR and the expanded EP are co-emergent in the PWM [5, 6], so we can surely apply the PWM-expanded GR equations to the PWM gravity. Moreover, in the sufficiently corrected PWM-QFT via the PWM-predicted novel gravity mass symmetry [5, 6, 10], the cosmological constant becomes exactly zero and we use the common short GR-equation by Einstein

$$G_{\mu\nu} = R_{\mu\nu} - (1/2)Rg_{\mu\nu} = (8\pi G/c^4)T_{\mu\nu},$$

where $R_{\mu\nu}$ is the Ricci curvature tensor, $R$ is the scalar curvature, $g_{\mu\nu}$ is the metric tensor, $G$ is Newton’s gravitational constant, $c$ is the speed of light in vacuum, and $T_{\mu\nu}$ is the energy-momentum tensor.

The GR energy-momentum tensor $T_{\mu\nu}$ gets its novel narrowed physical sense as the (gravity charge–momentum) tensor in the PWM; it is positive for matter and negative for antimatter gravity masses, whose inertial masses are both positive.

Indeed, with absence of matter, equation (1) is $G_{\mu\nu} = 0$, e.g., it corresponds to compensated energy-momentum tensors, if particle and its antiparticle are placed at the same spatial point, creating zero gravity mass, where $T_{\mu\nu\text{OM}} + T_{\mu\nu\text{AM}} = 0$, or $T_{\mu\nu\text{OM}} = -T_{\mu\nu\text{AM}}$. It is obvious, that physically intrinsically identical PWM-universes in the periodic chain DAM$^{-3}$; DM$^{-2}$; AM$^{-1}$; OM$^0$; AM$^1$; DM$^2$; DAM$^3$, etc obtain intrinsically identical—common Einsteinian attractive gravity (the identical GR$^n$-gravity equations), corresponding to the GR equation (1).
The intrinsically identical Einsteinian GR\textsuperscript{n}-equations (1) are transformed into the PWM-GR equations (2)–(8) if OM-particles, AM-antiparticles, DM-particles and DAM-antiparticles, living in the nearest gravitationally interacting PWM-universes, are presented.

For OM\textsuperscript{0} and AM\textsuperscript{1} (we obtain the GR\textsuperscript{0:1} antigravity; \(T_{\mu\nu}^0 > 0, T_{\mu\nu}^1 < 0\))

\[ G_{\mu\nu} = R_{\mu\nu} - (1/2) R g_{\mu\nu} = (8\pi G/c^4)(T_{\mu\nu}^0 + T_{\mu\nu}^1). \]  
(2)

For OM\textsuperscript{0} and DM\textsuperscript{2} and DM\textsuperscript{−2} (we obtain the GR\textsuperscript{0:2}, GR\textsuperscript{0:−2} half-gravity; \(T_{\mu\nu}^0 > 0, T_{\mu\nu}^{2:−2} > 0\))

\[ G_{\mu\nu} = (8\pi G/c^4)(0.5T_{\mu\nu}^0 + 0.5T_{\mu\nu}^{2} + 0.5T_{\mu\nu}^{−2}). \]  
(3)

For DM\textsuperscript{2} and DAM\textsuperscript{3} (we obtain the GR\textsuperscript{2:3} antigravity; \(T_{\mu\nu}^2 > 0, T_{\mu\nu}^3 < 0\))

\[ G_{\mu\nu} = R_{\mu\nu} - (1/2) R g_{\mu\nu} = (8\pi G/c^4)(T_{\mu\nu}^2 + T_{\mu\nu}^3). \]  
(4)

For AM\textsuperscript{1} and DM\textsuperscript{2} (we obtain the GR\textsuperscript{1:2} antigravity; \(T_{\mu\nu}^2 > 0, T_{\mu\nu}^1 < 0\))

\[ G_{\mu\nu} = R_{\mu\nu} - (1/2) R g_{\mu\nu} = (8\pi G/c^4)(T_{\mu\nu}^2 + T_{\mu\nu}^1). \]  
(5)

For AM\textsuperscript{1} and DAM\textsuperscript{4} (we obtain the GR\textsuperscript{1:3} half-gravity; \(T_{\mu\nu}^1 < 0, T_{\mu\nu}^3 < 0\))

\[ G_{\mu\nu} = (8\pi G/c^4)(0.5T_{\mu\nu}^1 + 0.5T_{\mu\nu}^3). \]  
(6)

For AM\textsuperscript{1} and AM\textsuperscript{−1} (we obtain the GR\textsuperscript{1:−1} half-gravity; \(T_{\mu\nu}^1 < 0, T_{\mu\nu}^{−1} < 0\))

\[ G_{\mu\nu} = (8\pi G/c^4)(0.5T_{\mu\nu}^1 + 0.5T_{\mu\nu}^{−1}). \]  
(7)

Separate branches of the gravitational interaction between pairs of parallel universes (listed above) were written for clarity. For example, the superposition of all such direct gravitational interactions with our matter OM\textsuperscript{0} is the superposition of its direct gravitational interaction within the chain of 5 the nearest 3D-universes with DM\textsuperscript{−2}; AM\textsuperscript{−1}; OM\textsuperscript{0}; AM\textsuperscript{1}; DM\textsuperscript{2}, we get the full Einstein equation for this superposition

\[ G_{\mu\nu} = (8\pi G/c^4)(T_{\mu\nu}^0 + 0.5T_{\mu\nu}^{2} + 0.5T_{\mu\nu}^{−2} - T_{\mu\nu}^1 - T_{\mu\nu}^{−1}). \]  
(8)

The tensor signs in (8) are positive for even (matter) W\textsuperscript{2n} and negative for odd (antimatter) W\textsuperscript{2n+1} PWM-universes correspondingly.

Notably, the 3D-waveguided quasi-optical dynamics directly corresponds the least-time principle by Huygens-Fermat in the expanded 4D-optics and discloses the pure 3D-waveguided nature of the basic mechanical Lagrangian and Hamiltonian principle of the least action [5,6].

Figure 1(a) shows how two slightly non-parallel 3D-boundaries—3D-membranes create a pure 3D-waveguided weak Newtonian-like gravity acceleration along the 3D-waveguide (3D-universe); figure 1(b) shows the emerging three-dimensional antigravity in two identical adjacent 3D-waveguides, where accelerations have opposite directions for matter W\textsuperscript{0} and antimatter W\textsuperscript{−1} living in these adjacent 3D-waveguides [5,6]. The double-sided elastic 3D-membrane M\textsubscript{0}, on the right side, separating two adjacent waveguides W\textsuperscript{−1} and W\textsuperscript{0}, will bend upward under the action of some normal force from below (gravitational charge in W\textsuperscript{−1}), and in the same way bend down under the action of the same force acting on it from above (gravitational charge in W\textsuperscript{0}). Thus, the sign of the shape of the gravitational potential (the 3D-membrane deformation) changes and these intrinsically identical gravitational charges naturally acquire the opposite sign—the gravity charge symmetry in the PWM [6].

The robust superfluid PWM-vacuum concept clearly supports and expands the unbroken fundamental baryon number conservation law, conserved for all PWM-particles-holes and the vastly dominating superfluid PWM-vacuum system, which cannot be broken for the PWM-BHs, living inside this mediastial system. They cannot evaporate (via BHs-escaping photons, etc) and totally lose their baryon number, accumulated and conserved in BHs, contrary to the controversial Hawking’s BHs-evaporation concept, where all these baryons once disappear in the universe and the baryon number conservation law is dramatically broken [23].
Figure 1. The $LX$-cross-section of the quasi-flat 3D-waveguide (a) shows the longitudinal ($OX$) weak 3D-waveguided gravity acceleration mechanism, emergent between slightly non-parallel 3D-membranes $M_0$ and $M_1$, directed in a tiny opening of this 3D-waveguide; (b) shows the $LX$ cross-section of two quasi-flat co-adjacent 3D-waveguides with the oppositely directed equal 3D-waveguided openings, created by the slightly turned 3D-membrane $M_0$, with the resulting opposite gravitational accelerations for gravity masses $(+M_{gr})$ and $(-M_{gr})$, living in two co-adjacent 3D-waveguides.

4. The PWM black holes concept

The multilayered waveguided hyperspace in the PWM is filled by the multilayered composite–weightless superfluid vacuum medium, equally filling each 3D-waveguide, where our common mass particles are elementary holes in our 3D-waveguide.

Figure 2(a) shows $(L, X)$ cross-section of the PWM-OM-BH as a mono-layered 2D-spherical-edge dislocation in the 4D-PWM crystal; figure 2(b) shows $(Z, X)$ cross-section of its 3D-analogy as a local mono-layered circular 1D-edge dislocation in smectic-A liquid 3D-crystals [16].

Figure 3(a) shows a small neutron star with a mass below 2.4 solar mass without the framing 3D-membranes contact; figure 3(b) shows the point-like PWM-BH arising inside neutron stars about 2.4 solar mass; figure 3(c) shows the PWM-BH, hidden inside neutron stars with masses between 2 and 4.3 solar masses; figure 3(d) shows the bare PWM-BH arising as the minimal free PWM-BH with mass about 4.3 solar masses.

It is very important to note that our concept of a cellular vacuum and its elementary particles of matter as 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 analogs with the Maxwell’s electromagnetic theory, the Einsteinian 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, it was essentially developed, considering the elastoplasticity of crystals and could show a very close analogy with the SM physics [24, 25].

Similarly, the elasticity of the strained–quasi flat, framing–dividing 3D-membranes in our multilayered 3D-waveguide superfluid vacuum creates corresponding fields, where weak gravity field is the simplest field—Newtonian gravity potential corresponds to the smooth 3D-surface of the slightly deformed 3D-membrane, and this is a very important property in our waveguided
Figure 2. (a) PWM-BH \((L, X)\) cross-section as a mono-layered 2D-spherical-edge dislocation in the smectic-A-like liquid 4D-PWM crystal; (b) its 3D-analogy—\((Z, X)\) cross-section of a local mono-layered circular 1D-edge dislocation in smectic-A liquid 3D-crystals.

physics [5, 6]. Essentially, in the theories of defects in crystals, an elastoplastic material plays the role of a kind of an anisotropic ether for the defects in direct analogy to our gravitationally weightless–composite double-cellular vacuum–medium, which simultaneously has enormously big positive inertial mass density and is the weightless 3D-isotropic superfluid.

The inverted vacuum–particles concept creates radically novel—singularity-free (intrinsically identical) PWM-BHs and white holes (WHs): OM-BHs, AM-WHs, DM-BHs, DAM-WHs, etc phenomena in the PWM, shortly the PWM-BHs, and PWM-WHs [5, 6]. Notably, they have identical spherical structures and the same Schwarzschild radii \(R_S\) of their event horizons in the PWM as it is in the GR by Einstein, but they become now totally free of the GR-singularity—
Figure 3. (a) Neutron star below 2.4 solar mass have no contact of the framing 3D-membranes; (b) the point-like PWM-BH with the point-like 3D-membranes contact, arising inside neutron stars with 2.4 solar mass; (c) the macroscopic PWM-BH, hidden inside neutron stars with masses between 2.4 and 4.3 solar masses; (d) the bare PWM-BH with minimal PWM-BH-mass about 4.3 solar masses.

moreover, they have strictly flat gravity potential inside their $R_S$ where the gravity field strength is zero [5]. The coincidence of the Schwarzschild radii of the PWM-BHs with the GR-BHs is not surprising, since the 3D special relativity and the expanded EP, basis of the 3D-GR, are simultaneously dynamically co-emergent in the thin quasi-flat 3D-waveguide in the PWM [5,6].
Our definition of BHs is very simple and natural for the 4D-multi-layered superfluid multiverse crystal: The macroscopic PWM-BH arises as a local symmetric contact of two strained elastic boundaries of the 3D-waveguide in its middle 3D-plane $L_0/2$, if there are too many particles-holes, gravitationally collected inside this 3D-waveguide. In this case, the boundaries of the 3D-waveguide will be symmetrically deformed under symmetrical outside pressure of two the nearest 3D-waveguides, working similarly as a multilayered spring mattress.

We will derive the PWM-Schwarzschild radius from our basic equation [5,6] for gravitational acceleration in the slightly deformed quasi flat 3D-waveguide with very a small angle $\beta(x) \simeq 0$ between its two framing 3D-membranes, where $L_0$ is the waveguide thickness and $c$ is the speed of light in vacuum,

$$g_x \simeq (dL_0/dx) c^2/L_0 \simeq \beta(x) c^2/L_0,$$

and equation $g_x = \Delta U/\Delta x$, where $U = \Delta L_0 c^2/L_0$. From these two equations we derive gravity potential on the PWM-Schwarzschild sphere $R_{SPWM}$, where $\Delta L_0 = -L_0/2$. In this case we derive the PWM-Schwarzschild radius from our basic PWM-gravity field equation above and constant (flat) gravity potential $U \propto L_0(r)$ inside Schwarzschild radius in the PWM-BH

$$U = (L_0/2)c^2/L_0 = -c^2/2,$$

where $L_0$ is the 3D-waveguide thickness and $c$ is the light velocity in vacuum.

PWM-gravity potential $U(r)$ for the PWM-BHs identifies it with the arising 3D-membrane surface geometry $U(r) = \Delta L_0(r)$ and it becomes a quasi-Newtonian ($U \propto 1/r$) gravity potential outside the Schwarzschild sphere

$$U(r) = -GM/r = -\Delta L_0(r)c^2/L_0,$$

where $G$ is the Newtonian gravity constant and $M$ is spherical gravity mass of the PWM-BH. So, we derive the PWM-BH-Schwarzschild radius $R_{SPWM}$:

$$R_{SPWM} = 2GM/c^2.$$

So $U_{SPWM} = -(L_0/2)c^2/L_0 = -c^2/2$ is identical to the gravity potential on the Schwarzschild sphere of the GR-BHs. Using equation for Newtonian gravity potential $U_{gr} = -GM/R_{SPWM} = -c^2/2$, we derived the PWM-Schwarzschild radius $R_{SPWM} = 2GM/c^2$, identical for the PWM-BHs and GR-BHs.

The proposed macroscopic monolayered defects—PWM-BH cannot have GR-singularity in the quasi-crystalloid periodical waveguided hyperspace, since the $\Delta L_0(r)$ newer can be deeper as $L_0/2$, corresponding to the lowest gravity potential $U(r < R_{Sch}) = -c^2/2 = \text{const}$, equal inside all possible PWM-BHs.

This is exactly the same BH-Schwarzschild radius predicted by Einstein’s GR, but there is also a significant difference between GR-BHs and PWM-BHs, because the GR-BHs could exist of any small mass, as it is assumed for point-like mass particle approximation in the GR, with always endless (physically wrong) point mass density—with commonly unavoidable classical GR-singularities in the GR-BHs-centers), obviously impossible in the PWM-BHs [5,6].

Assuredly, PWM-BHs cannot be microscopic, because the elementary massive baryons that simultaneously arise in PWM are extremely robust and are empty—singularity-free relativistic vortexes—empty tubes with definite radii in order of their 0.1 Compton wavelength. They behave gravitationally (and electrostatically) and not like point particles. These relativistic vortexes have a form of hollow robust 4D-spherinders and cannot be compressed together to enormously high densities [6], necessary to create free microscopic and free relatively massive macroscopic PWM-BHs below 4.3 solar masses even by neutron stars density [5]. The traditional microscopic GR-BH-concept automatically arises only in the case of the classical GR-BHs in the GR by Einstein, where our elementary mass particles are classically assumed to be point-like objects with singularity. Only in this (obviously physically unrealistic) case can arise microscopic
GR-BHs of almost any small masses. Contrary, the singularity-free robust fermion-holes can build the PWM-BHs only inside very massive dense stars like neutron stars.

5. The minimal possible mass of the isolated PWM-BH is above 4.3 solar masses
Let us estimate the minimally possible mass of the PWM-BH (as a collapse of the waveguide $W^0$ thickness $L_0$ and consolidation of its framing membranes $M_0$ and $M_1$, using the densest bulk matter known in nature—neutron stars. Neutron stars have overall densities between $10^{17}$ and $10^{18}$ kg/m$^3$, comparable with the huge density of an atomic nucleus of $3 \times 10^{17}$ kg/m$^3$ [5]. It is known that if the star accumulates matter at the 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 solar masses, $M_{\text{sun}} = 2 \times 10^{30}$ kg. The smallest known black hole was recently discovered by Shaposhnikov and Titarchuk [26], it has the mass near 4.3 solar masses and the diameter $D$ about $D = 2.4 \times 10^4$ m, i.e., $R_{\text{BH}} = D/2 = 1.2 \times 10^4$ m. This tiny PWM-BH could be described naturally as a baby-PWM-BH, aroused from the neutron star with the maximally possible mass about 4.3 solar masses and transition from neutron stars with hidden PWM-BHs inside into free bare black holes.

Indeed, with an increase in the neutron star mass $M_{\text{ns}}$, its spherical neutron shell will be completely absorbed when the growing flat contact of 2 framing 3D-membranes ($U_{\text{gr}} = c^2/2$) reaches its spherical boundary $R_{\text{ns}}$ and the gravitational potential $U_{\text{gr}}$ on its spherical surface $R_{\text{ns}}$ will be $U_{\text{gr}} = -GM_{\text{ns}}/R_{\text{ns}} = -c^2/2$. From this equation, using the approximate density of the non-compressible liquid neutron star near $10^{18}$ kg/m$^3$, we obtain the minimal mass of the resulting bare BH, which is near 4.3 solar masses.

This neutron star density and the above estimated average density of the very small BH ever found in observations are quite the same. We derive here practically the same Schwarzschild radius $R_{\text{BH}} = 12.7 \times 10^3$ m, corresponding to the PWM-BH mass near 4.3 solar masses.

It is easy to show that angles ($\beta(x) \approx 0$) between framing quasi-flat 3D-membranes of the 3D-waveguide, as the condition of their linear gravitational deformations, take place even for the minimal PWM-BH mass, living inside this 3D-waveguide. Indeed, simple estimations give an infinitesimal (near $10^{-16}$) non-parallelism, maximal at $R_{\text{Sch}}$ for the smallest PWM-BH with the mass of about 4.3 solar masses, where $\beta(x) = L_0/2R_{\text{Sch}}$.

6. Neutron stars with masses between 2.4 and 4.3 solar masses have hidden black holes inside
Simple estimations of the Newton-like gravity potential inside a spherical liquid (incompressible homogeneous) neutron star shows that the gravity potentials $U_{\text{ns}}$ inside interval $0 < r < R_{\text{ns}}$ is a parabolic function $U_{\text{ns}} \propto r^2$ and outside the star for $r > R_{\text{ns}}$ it is usual Newtonian potential $U_{\text{ns}} \propto -1/r$.

Gravitational potential $U(r)$ of a homogeneous ball of mass $M_{\text{ns}}$ and radius $R_{\text{ns}}$, corresponding to a liquid incompressible neutron star, is expressed by the well-known formula for $r < R_{\text{ns}}$:

$$U_{\text{ns}} = GM_{\text{ns}}(r^2 - 3R^2_{\text{ns}})/2R^3_{\text{ns}}.$$

For a certain mass of the neutron star, a point contact of two symmetric parabolas occurs at the point $r = 0$, exactly in the middle of the 3D-waveguide, where formula (12) gives

$$U_{\text{ns}}(0) = -3GM_{\text{ns}}/2R_{\text{ns}} = -c^2/2.$$

Here we derive $R_{\text{ns}} = 10^4$ m and $M_{\text{ns}} = 2.37$ solar mass, where the point-like embryo-PWM-BH with zero radius and zero mass arises. This means that very small embryo-like PWM-BHs are quite possible, but they can arise only inside massive and extremely dense neutron...
stars. Obviously, they cannot exist as free independent microscopic PWM-BHs—without huge pregnant mother-star [5].

If the mass of a neutron star grows above 2.4 solar masses, it will have the correspondingly growing spherical BH-mass inside with an expanding area of the minimally possible planar gravitational potential \( U = -c^2/2 \) inside the hidden PWM-BH and a simultaneously decreasing thickness of the outer surrounding spherical neutron layer. When this neutron star reaches 4.3 solar masses, the hidden BH totally absorbs its neutron shell and turns into the isolated—independently existing bare BH with a minimal possible mass of about 4.3 solar masses, because the elementary PWM-baryons are singularity free and they are known as so robust and stable baryon particles that even such a huge gravitational pressure inside neutron stars cannot compress them [6].

So, even the extreme (nuclear) incompressible neutron star density needs neutron star mass about 4.3 solar masses to create the smallest free PWM-BH.

It is interesting that the PWM-BH formally looks as a very thin massive spherical surface with Schwarzschild radius, homogeneously accumulating its full mass on this sphere and is empty-like inside—with the exactly flat classical gravity potential \( U_{BH} = -c^2/2 = \text{const inside} \), obviously always the same for all different PWM-BHs masses. So, the full PWM-BH-mass is formally distributed on the 2D-spherical surface of its Schwarzschild radius. Figure 3(a) illustrates our estimations—neutron stars with masses below 2.4 solar masses cannot have hidden PWM-BHs inside; figure 3(b)—the mass near 2.4 solar masses has the point-like embryo-PWM-BH; figure 3(c) shows neutron stars with masses from 2.4 to 4.3 solar masses, which contain the hidden macroscopic PWM-BHs; figure 3(d) shows the maximal PWM-neutron-star with the radius near \( 12.7 \times 10^3 \) m and the inevitable transition to the smallest free bare PWM-BH with 4.3 solar masses.

The PWM-BHs analysis reveals unexpected simplicity in solving the yet unresolved GR-BH-singularity problem and discloses the completely new structural features of neutron stars and black holes that were previously incognito.

The PWM-BHs have surprisingly smooth (Newtonian-like) gravity potentials—deformations of 3D-membranes. It is easy to see that the PWM-BHs, placed in the even dark matter waveguides \( W^{-2} \) and \( W^2 \)—the nearest DM-universes to our \( W^0 \) waveguide, rapidly develop parallel PWM-BHs, gravitationally attracting our \( W^0 \)-BHs, creating pair-wise gravitationally coupled multiversal PWM-BHs-columns, gravitationally repulsive to the PWM-WHs-anti-columns [5].

Figure 4 schematically presents the not yet contacting 3D-boundaries of the 3D-waveguides with the intrinsically identical OM, AM, DM, and DAM elementary particles.

Figure 5 shows the scheme of gravitationally interacting OM-BHs, AM-WHs, DM-BHs, DAM-WHs, living in different 3D-waveguides and illustrates 3D gravitational interactions between them in the PWM, (from left to the right).

Figure 6 shows a pairwise gravitationally bounded PWM DM-BHs, \( 2L_0 \)-periodically placed in the fourth spatial dimension \( L \). The PWM-BH works as a restless vacuum trash-exhauster, accumulating defects—elementary microscopic matter holes living in its 3D-waveguide. The PWM-BHs look like a kind of a macroscopic topological 3D-defects in the initially quasiflat waveguided 4D-structure, like a stable, gravitating scar on the healthy body of our 3D-monolayered cellular vacuum structure. This macroscopic topological 3D-defect is a spherical volume inside Schwarzschild radius, cut-off from our 3D-space (our 3D-waveguide) and is similar to a cut-off 2D-disc from 2D-plate or from 2D-sheet of paper—we cannot fly inside this hole where our 3D-waveguided spatial structure, providing our physical being, does not exist anymore, we can only fly around this hole. These radically new topological PWM-BHs-properties were also totally hidden in the GR-BHs theory, and now popular ideas of the GR-BHs-wormholes totally lose their sense.
Figure 4. This PWM \((L, X)\) cross-section presents few the nearest gravitationally interacting 3D-waveguides with the similar elementary mass particles–defects with (a) OM–OM gravity, (b) OM–AM antigravity, (c) OM–DM \((1/2)\)-gravity and (d) absence of OM–DAM gravity interaction.

Figure 5. This schematic PWM-structure shows few the nearest 3D-waveguides with similar BHs with (a) the OM-BH–OM-BH gravity, (b) the OM-BH–AM-WH antigravity, (c) the OM-BH–DM-BH \((1/2)\)-gravity and (d) the absence of OM-BH–DAM-WH gravity interaction.
7. The stable (or growing) massive PWM-BHs, contrary to Hawking’s prediction of microscopic evaporating GR-BHs

The traditional microscopic GR-BH-concept automatically arises only in the case of the classical GR-BHs in the GR by Einstein, where our elementary mass particles are classically assumed to be point-like objects with singularity. Only in this (obviously physically unrealistic) case can arise microscopic GR-BHs of almost any small masses. Contrary, as we showed above, the singularity-free robust PWM-fermion-holes can create the PWM-BHs only inside very massive dense stars like neutron stars and even neutron stars need mass about 4.3 solar masses to create free macroscopic PWM-BHs [5]. So, fantastic and very popular Hawking’s assumption about very quickly evaporating micro-GR-BHs [23] is excluded in the PWM, because the micro-PWM-BHs cannot be created at all. Indeed many experimental searches of these hypothetically rapidly radiating micro-BHs, which could be created and immediately evaporate in modern accelerators, where never successful [27].

Figure 7 shows a 4D-PWM-system of odd OM–DM galaxies and even AM–DAM antigalaxies with three visible for us OM (W^0), AM (W^1), and AM (W^−1) universes; all other more L-distant ones are dark for us (the SM-decoupled of OM). Super-massive singularity-free PWM-BHs and WHs are schematically shown in the galactic and antigalactic centers, where framing 3D-membranes become symmetrically L-so-pressed adjoined and flat. Importantly, these flat spherical areas (with the exactly flat gravity potentials) inside the PWM-BHs or PWM-WHs have \( -L_0/2 \) gravity potential levels and exactly the same—Schwarzschild radii, as it is in the GR by Einstein [5].

So, the free bare PWM-BHs are always very massive (have as minimum 4.3 solar masses) [5], they are surrounded by inertially very dense composite-weightless, cellular superfluid vacuum medium, where an integral number of the extremely robust OM-baryons–holes and OM-baryons-cells in the superfluid baryon–antibaryon PWM-vacuum is strictly controlled and conserved. So, the OM-baryons–holes numbers can disappear only via direct symmetric baryons–antibaryons annihilations; they both are equally presented but widely spatially separated by the mutual antigravity in the PWM on the large-scale 3D-universe) [5, 6, 9, 10]. This very simple but the SM-fundamental argument about breaking the law of baryon numbers conservation was usually ignored and replaced by the vague problem of information loss after hypothetical evaporation of
Figure 7. The present, large-scale PWM is formed of the mutually gravitationally repulsive 4D $L$-columns and $L$-anti-columns, respectively, built of gravitationally pairwise coupled galactic clusters (even $W^{2n}$ universes) and—antigalactic clusters (odd $W^{2n+1}$ antiuniverses). The PWM-BHs and WHs without singularity are shown in the galactic and antigalactic centers, where framing 3D-membranes become adjoined and flat. Our Milky-Way galaxy is confined in our $W^0$ universe, only three (transparent) universes are visible—our OM-galaxies and two AM-antigalaxies. All other periodic universes and antiuniverses are SM-decoupled of our $W^0$ universe and are dark.

black holes, Hawking [23] and the GR-BHs simulations in the laboratory where connected with absolutely different by the physical nature objects—artificial BH-horizons [28].

Recently [29], Hajdukovic assumed the hypothetical OM–AM antigravity and discussed the corresponding novel quantum vacuum properties, related to the GR-BHs, which have the unavoidable singularity. Hajdukovic (as also some other physicists before) hypothesized the SM massive particles have positive and antiparticles negative gravity masses with the resulted particles–antiparticles antigravity (as it was emergent—predicted in the PWM-concept). He estimated the critical BH mass $M_{cr}$, which creates the Schwinger-like gravitational mechanism of virtual electron and positron separation in quantum vacuum by very strong gravitational fields arising near Schwarzschild radius, attracting virtual electrons and repulsing virtual positrons. His estimation gives $M_{cr} < 10^{14}$ kg—all isolated GR-BHs with higher masses cannot create this separating effect and cannot emit these decoupled free positrons in the vicinity of their Schwarzschild spheres, but all smaller GR-BHs masses are allowed for the GR-BHs [29].

One solar mass is about $10^{30}$ kg and the smallest possible PWM-BHs mass is something like 4.3 solar masses, 16 orders above the maximal critical mass in Hajdukovic’s estimations, so all possible free PWM-BHs masses cannot decouple and emit virtual positrons in the vicinity of their Schwarzschild spheres, because of gravity fields near these heavy PWM-BHs are too small.
to create the Schwinger-like gravitational mechanism of virtual electron and positron separation in the surrounding quantum vacuum, keeping its stability.

However, Hajdukovic predicts, using the concept of GR-BHs with a singularity, that BHs with higher masses as the critical mass $10^{14}$ kg still can emit almost the entire spectrum of gravitationally repulsive virtual antiparticles (positrons, antiprotons, etc), now created—decoupled inside GR-BHs Schwarzschild radii under endlessly growing decoupling gravitational forces inside the GR-BHs event horizons. He predicts that these (repulsive for antimatter) extending gravity fields inside the GR-BHs event horizons must decouple more and more different types of virtual antiparticles and they will be antigravitationally ejected from the GR-BH [29]. The tremendous prediction by Hajdukovic is totally excluded for the singularity-less PWM-BHs with strictly flat gravitational potentials and zero gravity field strength inside their Schwarzschild radii [5]; his prediction also strongly contradicts recent cosmic observations, where practically only massive galactic flows of positrons and electrons are observed [30, 31].

Many theoretical physicists tried to avoid the so hard GR-BHs singularity problem. Recently Chamseddine and Mukhanov proposed the GR-BHs-singularities are hypothetically cut-off somewhere deeply inside event horizon of these BHs [3]. The latest article on the subject by Ashtekar, Omelo and Singh applied the loop quantum gravity theory to eliminate the GR-BHs-singularities, but also only deeply inside their event horizons [4].

These two and some other similar theoretical approaches become unnecessary to solve the GR-BHs-singularity problem because this problem simply disappears for the singularity-free PWM-BH. They formally behave as surprisingly empty Schwarzschild spheres, if all PWM-BHs-singularities are uniformly distributed on their 2D-spherical Schwarzschild surfaces [5].

The PWM-BHs can be only very heavy, starting from few solar masses. There are two typical natural states for them.

An unstable PWM-BH eats surrounded space plasma falling on its Schwarzschild horizon and its mass grows. Such PWM-BHs are too heavy to separate virtual electrons and positrons, as it was mentioned above, but the falling surrounding cosmic plasma becomes extremely hot and can itself create separated electron–positron pairs, which positron fraction will be gravitationally ejected off its Schwarzschild horizon.

A stable isolated PWM-BH behaves differently: PWM-BH surrounding by superfluid PWM-vacuum–medium remains a stable system—isolated BHs cannot gravitationally separate virtual electron-positron pairs in the surrounding superfluid PWM vacuum and emit positrons. We assume they also cannot emit gravitationally repulsive virtual antiphotons [5, 6, 10], because these repulsive antiphotons together with attractive virtual photons will be confined—trapped between two gravitationally induced spherical concentric electrostatic polarizations—stable charged spherical positrons–electrons layers in vacuum around the PWM-BH, like common photons, confined between two coaxial spherical mirrors.

Thus, the isolated PWM-BHs in vacuum become stable—behave purely classically, without a break of the fundamental baryon number conservation law—without emitting virtual mass particles and radiation—as a black body at zero temperature, contrary to the Hawking prediction [23]. Some exotic physical proposals with BHs below 4.3 solar masses limit [32, 33] are surely excluded in the PWM and were never observed [26], also was observationally disfavored Hawking hypothesis of plenty small primordial BHs as dark matter candidates [34, 35].

8. The coexisting galactic OM-pulsars and DM-pulsars explain the cumulative excess of the relativistic galactic positrons flow

The growing–unstable PWM-OM-BH, absorbing plasma, could work as the (gravitationally repulsive) positrons and antiphotons factories in the galactic centers for all heavy unstable PWM-BHs, but resulting kinetic energies of these gravitationally emitted positrons will be enough small.
The recently observed isotropic flow of relativistic positrons and electrons in our galaxy were sensationally assumed to be the result of DM annihilation, existing in the large DM-halo around the visible part of our galaxy and experimenters hoped to detect a relativistic energy peak, corresponding to this annihilation [36], but the expected (DM-annihilation) peak was never detected after long observations and later analysis strongly favors OM-pulsar as the sources of the relativistic cosmic-ray positrons and electrons [36]. Nonetheless, the observed unexpected excess of relativistic positrons over relativistic electrons remains without explanation [36].

This explanation arises in the PWM-frames [5]. According to the PWM-DM concept, very stable cosmic DM-particles are intrinsically identical to our very stable OM-particles and consist mostly of invisible for us DM-protons, DM-electrons. We assume the PWM-DM pulsars and DM-BHs number, existing in the large DM-halo around our galaxy, dominate visible PWM-OM pulsars and OM-BHs, as all galactic dark matter does.

It is naturally expected, our galactic OM-pulsars, must create and emit (via relativistic electron–positron pairs creation) an equal quantity of the relativistic electrons and positrons, thus, the observed relativistic positrons excess remains highly unexpected observation [36].

Our galactic PWM-OM pulsars, living in our W^0 universe, also must create and emit equal quantities of visible for us cosmic relativistic electrons and positrons (half of these visible positrons is created via the AM^1-positron channel and half via the AM^−1 channel).

The PWM-DM-pulsars live in two the nearest even, gravitationally attractive to us parallel 3D-universes W^2, and W^−2. So, the dark DM^2-pulsars similarly create and emit equal quantities of invisible for us relativistic DM^2-electrons with half of invisible for us DAM^3-positrons and half of visible for us relativistic AM^1-positrons.

The dark DM^−2-pulsars similarly create and emit equal quantities of invisible for us relativistic DM^−2-electrons with half of invisible for us DAM^−3-positrons and with half of visible for us relativistic AM^−1-positrons.

If there are about five times more DM-pulsars as OM-pulsars in our galactic center, they together will naturally provide the definite observed relativistic positrons fraction excess in the PWM-predicted composite (OM–DM)-galactic centers, where DM have about 5 times excess over OM [5].

9. The first sensational confirmation of 4D-spatial dimension supports the PWM-concept

Bloch et al [37] recently reported on the first sensational confirmation of 4D-spatial topology, hidden behind our commonly 3D-space geometry—4D-basis of the proposed above 4D-PWM-concept [5, 6]. They observed a bulk response with intrinsic 4D topology and the measurement of the associated second Chern number, by implementing a 2D topological charge pump with ultracold bosonic atoms in an angled optical superlattice, realizing a dynamic version of the 4D integer quantum Hall effect [37]. This discovery clearly indicates that the size of this optically detectable fourth dimension must be many orders larger than the Planck scale commonly proposed in various popular theories with additional space dimensions, including the string theory (ST).

The Compton electron length for the fourth dimension interval, postulated in PWM [5, 6], is the most suitable for the optical detectability–sensitivity to the 4D-interval of the hidden fourth dimension [37], in comparison to the too-small—never detectable—Planck length scale, usually postulated in the ST, in the loop quantum gravity or in some superfluid vacuum theories.

Notably, masses of some SM-particles, as muon and tau leptons, pions, intermediate bosons of weak interaction W^+, W^−, Z_0 are formally derived from electron and proton masses as excitations in the hypothetical (electron–positron) and (proton–antiproton) superfluids [38], that supports the PWM-vacuum concept, but superfluids in [38], and some similar theories, are built directly from our usual, immediately annihilating particle–antiparticle pairs creating...
a tremendously unstable—immediately decaying vacuum, contrary to the extremely stable 4D-PWM-vacuum-superfluids, based on the inverted vacuum–particle paradigm, where only our particles-holes and anti-holes can annihilate [5, 6].

The intrinsic gravitational energy density of the vacuum and the corresponding cosmological constant by Einstein become exactly zero in the modified—gravitationally symmetric, multiversal 4D-PWM quantum electrodynamics (QED) [5, 9], what reminiscents the simplest multiversal (double-universe)—zero cosmological constant solution, proposed by Linde [39].

10. Conclusions
The present author’s PWM-concept discloses a deeper—spatially 4D—3D-waveguided (4D-wave-dynamic) physical roots of the SR, QM and the expanded EP—the expanded GR, predicts the OM–AM, DM–DAM antigravity and the OM–DM, AM–DAM gravity, described above in 7 additional (novel–multiversal) PWM-GR-equations. The PWM-predicted matter–antimatter antigravity will be soon directly tested at CERN in the antihydrogen gravity tests [40, 41].

The 4D-PWM concept is supported by the first confirmation of 4D-spatial topology, hidden behind our commonly 3D-space geometry [6].

The proposed PWM-structure belongs to the smectic-A phase, common in layered liquid 3D-crystals [16], where the OM-BHs, AM-WHs, DM-BHs, and DAM-WHs are emerged as macroscopic spherical edge-dislocations, free of singularities, predicting the minimal free PWM-BH mass limit near 4.3 solar masses, but neutron stars from 2.4 to 4.3 solar masses contains a hidden smaller spherical PWM-BH inside.

The growing PWM-BHs eat an overheated plasma, creating decoupled electron–positron pairs and behave as positrons and antiphotons factories; isolated PWM-BHs remain stable, contrary to the Hawking prediction [23].

The cosmic mixture of physically identical PWM-pulsars (OM-pulsars plus dominating DM-pulsars) in our galaxy explains the still unexpected excess of isotropic galactic relativistic positrons over electrons flows and supports the proposed PWM-DM-nature [5].

The PWM-concept can be experimentally verified [6, 12, 13], this could open a door to the epoch of the 4th Copernican—multiversal revolution, disclosing three natural global illusions: our physical universe is alone; our vacuum is emptiness and our matter particles are fullness; the matter-antimatter asymmetry in our universe, but if we live inside our very huge (OM–DM) cluster, repulsive to distant (AM–DAM) anti-clusters, this will stop cosmic signs of mutual annihilations [5, 6, 9].

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Appendix A. Abbreviations
Abbreviations are used as follows: DE—dark energy; DM—dark matter; SM—standard model; PWM—periodic waveguided multiverse; 2D—two-dimensional; 3D—three-dimensional; 4D—four-dimensional; BHs—black holes; WHs—white holes; EM—electromagnetism; CPT—charge-parity-time; QED—quantum electrodynamics; QFT—quantum field theory; GR—general relativity; EP—equivalence principle; OM—ordinary matter; AM—antimatter; DM—dark matter; DAM—dark antimatter; EMMA—electro-mechanical membrane analogy; GRAMMA—gravito-mechanical membrane analogy; ST—string theory; SVT—superfluid vacuum theory; QM—quantum mechanics.

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