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Article

On the Illusion of the Geometry of Spacetime and the Dynamic Vacuum Theory of Gravitation

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Abstract: Gravitation is a fundamental phenomenon experienced every moment of our existence, and yet we have not been able to decipher its profound functioning at the quantum and cosmic levels of the universe. The current general relativistic interpretation through curved spacetime, guided by the metric tensor, among others, in Einstein's equations, combined with the search for quantum gravity, creates insurmountable obstacles to the unification of spacetime with quantum fields, oscillating based on the vacuum energy. Therefore, the dynamic vacuum concept is introduced, allowing the integration of quantum fields and spacetime (as emergent) into a single logical framework in the future modified QFT, and the new explanation of gravitation as the thermodynamic tendency of compact, energy-denser systems to follow gradients in the vacuum, tending to the state of least energy difference. The emphasis is on conceptual and intuitive cause-and-effect reasoning and the theory of gravitation as a continuum resulting from the slight modifications of Kepler's third law. Consequently, all the content of the universe — baryons, radiation, dark matter and dark energy, as well as gravitational effects, are unified in one energy content, eliminating the need for dark sector, leading to simplifications in resolving mysteries like the core-cusp anomaly, Bullet cluster case, the cosmic coincidence and cosmological constant problems, and others, including the strange connection between MOND's acceleration and the Hubble's constants. This unification frame is mathematically validated by deriving Hubble's law directly from the new gravitational formula, laying the groundwork for a new model of cosmology.

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1. Introduction to the Current Understanding of Gravitation

The current definition of gravitation is at the crossroads of the conflict between two remarkably successful, yet fundamentally conflicting theories, general relativity (GR) and quantum field theory or QFT (Khrennikov 2017; Deser 1957). GR explains gravity as the curvature of spacetime caused by mass and energy (Price 2016). QFT uses quantum fields (Bogolyubov and Shirkov 1973) and the concept of zero-energy vacuum (Saunders 2002) in a fixed background of spacetime (Hollands and Wald 2015; Brown et al. 1986), described by, among others, a metric tensor $g_{\mu\nu}$ (Kersting and Steier 2018; Thorne 1985; Bourguignon 1981; Sobczyk 1981), while forces are mediated by the particles exchange: photons; chromodynamics (Schmitz 2022; Velan 1992). Newtonian physics explains gravitation as an attractive force at distance between masses. Although useful in everyday contexts, they are fundamentally flawed because none of them clarify the deep physical reasoning and conceptual logic, leading to failures in answering what deeply is spacetime in the first place, physical mechanisms of curvature dynamics or why gravitation is astronomically weaker than other forces (Will 2018).

QFT itself requires certain assumptions. Its vacuum state is determined with respect to the metric $g_{\mu\nu}$ and there is a single, well-defined vacuum state shared by all observers, meaning it treats spacetime as a static classical backdrop (DeWitt 1975). In current understandings, with spacetime conceptually continuous, separate and dynamic, there is a possible shift in the basis for defining energy and particles — the very concept of vacuum changes (Ford 1975). This distinguishes spacetime as a separate, preexisting entity whose foundation is directly conflicted with the QFT's assumptions, whose quantum fields are discrete entities defined over a fixed vacuum (Overduin and Fahr 2001).

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This dichotomy creates a profound challenge because quantising gravity using QFT creates infinities irremovable by renormalisation (Falk et al. 2010). On the other hand, the GR equations break down in extreme space conditions where the excessive spacetime curvature leads to mathematical singularities and require 95 % of the energy content to be in the fully-unknown dark sector (matter and energy), to be maintainable in most of space.

Throughout the last century, the main trend has been the search for a quantum gravity theory (Carlip 2010). String theory (shaping cosmological ideas like Tseytlin and Vafa 1992), the first candidate ahead of quantum loop gravity, introduces strings (instead of point particles) with different vibrational modes in at least 10-dimensional space (superstring theory — Schwarz 1982), with the possible existence of many universes, and spacetime emerging as a product of string dynamics. Graviton mode (like in Damour and Polyakov 1994) is predicted, albeit never detected experimentally. However, both attempts have a number of flaws. They use abstract, multidimensional mathematics, and introduce non-falsifiable, highly speculative concepts. They do not provide a logical background to gravitation (conceptual *why*) based on known intuitive physical concepts, rather mathematical *how*.

Alternative attempts in the form of holographic theory (derived from the AdS/CFT correspondence), or entropic, thermodynamic gravity (derived from abstract information components of spacetime) are largely theoretical constructs, lacking observational evidence. The holographic model is additionally extremely idealised, requiring anti-de Sitter space, which is mostly in contrast to our universe, while the entropy theory does not offer any quantitative, matching data, without *ad-hoc* additions. As conceptual models, they do not offer intuitive explanations of degrees of freedom, as independent variables or fundamental components of spacetime, except as "information bits on a boundary" (holography) or "microstates of the system" (Verlinde 2011; Caroll and Remmen 2016).

Modifications of gravitation, such as MOND (Milgrom 2015), do not offer a solid theoretical basis behind the introduction of a new acceleration scale and cannot directly explain gravitational lensing, galaxy cluster dynamics and, like all before, do not offer at all a framework that would bring GR and QFT closer to reconciliation (Dodelson 2011). The current deadlock in resolving this fundamental question consumes a lot of time and finances, and therefore the solution is possible only if our understanding of gravitation undergoes a significant shift in the interpretation of relationship between spacetime and quantum fields (Carlip 2010). To untangle from the current century-long impasse, a deep and concise clarification of the foundations of gravitation, through rethinking of existing logical frameworks, is necessary.

2. Dynamic Vacuum for the Stability of the Universe

2.1. Definition of Vacuum and Energy Distribution Asymmetries

Empty space, contrary to classical intuition, in QFT is governed by the laws of Heisenberg's uncertainty principle, which states that position and momentum cannot be precisely defined at the same time (Busch et al. 2007), causing fluctuations in quantum fields and the existence of the lowest energy state, zero-point energy, the irreducible energy of a system at absolute zero temperature. It is imagined like harmonic oscillator, with energy levels quantised by the expression $E_n = (n + \frac{1}{2})\hbar\omega$, where n is the quantum number, ω natural frequency of the oscillator and $\hbar$ Planck's reduced constant, with the ground state requiring $n = 0$ (Schwartz 2014). The Casimir effect, where quantum fluctuations of the electromagnetic field induce an attractive force between closely spaced conducting plates (Bordag et al. 2001), exposes it is not just a mathematical model, but reality. QFT describes the vacuum through the quantum field $\phi(x, t)$ expressed as a superposition of creation ($\hat{a}_{\mathbf{k}}$) and annihilation ($a_{\mathbf{k}}$) operators acting on harmonic oscillators. It sums all modes k in three-dimensional space (indirectly from Schwartz 2014):

$$\phi(x, t) = \int d^3k \left[a_k e^{-i\omega_k t} + \hat{a}_k e^{i\omega_k t} \right]$$

Taking into account the conversion factor from the well-known relation $E = mc^2$, it becomes clear that celestial objects with mass, even the size of a subatomic particle, localise an enormous

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amount of energy in a small space due to non-relativistic velocities, contrary to the relativistic and non-localising behaviour of massless, non-stationary particles. It is not difficult to agree that the most thermodynamically stable state for energy would be the geometry of the Euclidean arrangement, in such a way that there is exactly the same amount of energy in every point of the universe. Such a state is indeed the most stable, and was present initially in our universe, until symmetry breaking was established. Consequently, due to this and the law of mass-energy convertibility, the universe is organised in such a way that in point locations, like stars, there is a disproportionately concentrated amount of energy compared to the very wide surroundings of mostly empty space, which is so pronounced that in some stars there can be more concentrated energy, than in many light years in the surrounding. Therefore, mass, as a localiser of trillions, sexdecillions or any number of particles, causes a thermodynamically strong "strain" of energy into very small and dense energy clusters, which is, according to the tendencies of thermodynamics (Müller and Weiss 2005; de Groot and Mazur 1984; de Abreu and Guerra 2012), extremely imbalanced. The strong force, chemical bonds and Higgs mechanism asymmetry (wider subject on CMB anisotropies in Hu and Dodelson 2002) prevent their tendency to uniformly equalise with an emptier wider environment into a uniform universe.

2.2. Distortion of the Euclidean Settings

Apparently, this organisation of the universe seems strongly tense and at the peak of disequilibrium, so it is wise to ask what is the role of the vacuum here. In the current postulates of QFT (Schwartz 2014), the vacuum is predominantly posited as a uniform energy substrate spanning the vastness of the cosmos. However, in theory, except for the need for mathematical formalism and the adjustment of wave equations, the vacuum can theoretically be set up differently. Moreover, that is already taken into account, to a limited extent, in the application of QFT in curved spacetime (QFTCS), thermodynamic analyses of black holes through the effects of Hawking radiation and some initial stages of the evolution of the universe (Jacobson 2005). The theory here therefore starts from the assumption that the currently theorised organisation of the universe, with the uniform vacuum, is not ideal, since it confronts the local energy extremes from the dense clusters into sudden and sharp contact with the completely opposite nature of the emptiness of the universe. This creates maximally steep, stair-like borders on contact, contrary to nature's tendency to reduce the imbalance at every step. This situation puts the vacuum itself in a disadvantageous position, which is, if really uniform, in some places in direct contact with the astronomically dense energy, in others not.

Additionally, Pauli exclusion principle asserts that two fermions, visible matter particles with half-integer-based spins, cannot simultaneously occupy the same quantum state, which results from the asymmetry of fermionic wave functions, which becomes zero if two fermions have identical quantum numbers (Altunbulak and Klyachko 2008). Essentially, this prevents maximum localisation of most fermions, so Earth is not in much smaller volume, than it could be, but has a current 3D shape. Precisely, before the Higgs mechanism (Lyre 2008) in space, quantum fields were, since other redistribution mechanism is unknown, arranged by the most symmetric Euclidean geometry. It can be stated that the appearance of this mechanism, and consequently the mass, potentiated Pauli principle, distorting primary uniform field energy distribution. To understands why the dynamic vacuum is thermodynamically much more preferable and stable in such evolution, the following reverse engineering example is given.

One could consider a universe with (1) the Higgs mechanism and (2) the Pauli principle abruptly turned off and (3) the consequent mandatory disappearance of the strong force, with a focus solely on the energy evolution. (2) would lead to the immediate cessation of the Euclidean settings distortion and the reestablishment of the fields' equality everywhere. The mass of fermionic matter in the observable universe is estimated at 1.45×10^{53} kg, as 1.3×10^{70} joules of energy. Even in the most extreme assumptions of dark energy, it implies that in less than 5 % of any fermionic field volume is located more energy than in over 95 % of the remaining volume of vast voids. Without (3), all this now forcibly localised energy would lose its physical strongpoint of containment and, as released and unbound energy, would equalise throughout space, to reach initial equal density equilibrium. By suddenly

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releasing mass in this way, the vacuum energy would be modified and its current value would have to be significantly increased in these 95 %. Thought experiments can be performed similarly in many ways, always indicating that the actual state of the vacuum background, if more dynamic and loose, will alleviate disequilibrium of the unequal distribution of energy. It will be able to set a gradational transition between differences, rather than a rough, stepped demarcation, currently inescapable.

It can be further stated that currently extremely localised energies like stars had to have the source of this astronomical densification, by pulling energy out from the the rest of fields, producing ultradense clusters of accumulated energy in themselves, capturing it from fields of widespread area, leaving these areas in a form of what we deem as empty space or near-vacuum vastness, an energy-rarefied interstellar base. The "vacuum" thus could be redefined as an all-encompassing substrate initially containing all energy capacity of the universe, primordially equalised uniformly in space. Appearance of (1), (2) and (3) violated this Euclidean evenness and stability by imposing asymmetrical disequilibrium of energy distribution, pulling most of energy inside celestial bodies, leaving them to float in the rarefied parts of vacuum (fields) background sea. In the context of such an evolution, it is preferred to treat the vacuum as an adaptable, active substrate that maintains the maximum stability allowed by the fact that (1), (2) and (3) hold point-like and structurally inflexible celestial bodies like glue, while quantum fields around are spatially wider and unrestrainedly flexible. There are no thermodynamic benefits which would prefer the vacuum and fields to be highly insensible and static to enormous energy density shocks at star-surroundings collisions. They possess prerequisites for self-sustaining dynamism, without the need to be guided by an added entity like spacetime, of unclear origin and meaning, as will be shown in 2.3.

Considering further that the spatial size of dense stars is astronomically smaller, yet vigorously energetically denser in comparison with the empty space, the star-surroundings volume and density ratio will adjust the vacuum, if flexible, in a manner it must concentrate its capacity much stronger near stars, and fall quickly towards the zero-point further, reminding of inverse-square-law (ISL) distribution. For now, it can be inferred that the vacuum always tends towards Euclidean uniform distribution, without gradients, and to maintain it as much as possible, it gradually smooths star-surroundings boundary, to avoid cliff-like level borders and pronounced thermodynamic tensions with current interpretations at contacts. This is perfectly consistent with CMB maps, since more than 95 %. of the universe is filled with voids between the bubbly structure of filaments of galaxies (Lares et al. 2017), maintaining the general picture of the highly uniform universe, without anisotropy and inhomogeneity. Certainly, ways to test this theory will be offered in the following sections.

2.3. Vacuum Distribution at Cosmic Levels

Such a dynamic vacuum forces us to set following postulates. First, (1) the vacuum is viewed as a flexible substrate of the universe, whose gradient slopes are influenced by compact bodies distribution and (2) it represents the initial source of the entire energy content in the universe prior to the Big Bang. The vacuum thus expectedly and continuously dilutes due to constant expansion of its volume. Therefore, it is to be considered that (3) the initial energy of the vacuum, although astronomically high, was limited and preset, and not constantly added as a property of expanding spacetime, which will soon lead us to very interesting discoveries. (4) Through evolution, through the introduction of asymmetric patterns, the vacuum has undergone diversification, where large parts of it have been consumed by compact bodies for their significant mass-energy needs. This tied energy has completely lost its flexibility due to the binding processes from 2.2., while the vacuum has not, allowing it to adapt to celestial bodies and maintain a thermodynamic optimum as much as allowed. By observations of the universe, two extremes can be set up as to how compact bodies affect the vacuum. On the one hand, there is (6) the basic state of vacuum energy, described by uniformity, flatness and the absence of gradients. We observe the same in the mentioned 95 % of space because these are mostly too large voids excessively distant from the influence of masses. We can speak of a zero or base vacuum gradient. On the other hand, completely opposite is (7) the very contact with compact bodies. In these zones, the logically maximum possible distortion of the gradient is expected, following the ISL (2.2.).

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The ISL sharp gradient therefore occurs in a volume-negligible, rare space cases, where our planet is incidentally located. Such places, adjacent to celestial bodies, have an energy concentration often higher than the surrounding volume of light-years wide. Our Sun, for example, accounts for 99.9 % of the mass-energy content of the entire system (more on the wider topic in Weidenschilling 1977; Desch 2007), sometimes estimated at a diametre of 200,000 AU. All other cases are (8) between the base and ISL gradients, as two opposing limits on both sides of “spectrum”.

(9) It can be argued that the slope of the vacuum gradient is directly related to the density of the compact bodies distribution. Here we will notice the difference between galaxies and clusters. Namely, (10) the constituents of galaxies, mainly stars, are more densely distributed than clusters. These gaps are still huge and sufficient to significantly soothe the gradient away from the ISL. In the galactic clusters (11), the distances between the constituents are significantly larger, which will allow the vacuum gradient to almost approach the base scenario from (6) in the background of these structures and finally equalise to the zero base further away from the cluster, since distances from compact masses get critical and immense. It can be finally claimed that the dynamic vacuum will have the greatest possible gradient distortion, which is the ISL, in the restricted zones around compact celestial bodies, meaning mostly in stellar systems, while the same drop will be significantly alleviated by vast interspaces and overlapping with the influences of other bodies, which also stretch the preset amount of vacuum base towards themselves. Therefore, the background within the galaxies will have a much milder gradient than the ISL, while it will be even milder in the cluster background due to the cosmic distances and enough space for levelling. Levelling will achieve full extent, in the form of (6), only with even greater distances, noticeable in voids with a fully levelled standard without gradients and oscillations.

(12) In general, the density of the arrangement of compact constituents directly determines the relative oscillations in vacuum energy, with Earth evolving in one of the most rare and extreme scenarios, that of (7). It will be soon explained as a main reason for many flaws in our current grasp of gravitation and gravity. A partially useful analogy is the flexible ground, with preset amount of material, on which we grip the surface with three fingers and squeeze it into small mounts. We will create a local hill, and the base around it will rise very far from that hill, according to a principle that would already remind us of the ISL curve. However, if around that hill we start to create similar elevations in several distant places with our fingers, the situation becomes interesting — each hill has expectedly its own ISL zone, while the space between them becomes more and more elevated compared to far voids, which are fully flat references. But as we crumple more and more hills with our fingers, it will be noticed that we are not only raising the space inside the galaxy, but more and more the space further away from it. If the density of hills is bigger, space between them is smaller, and thus the ISL fall will be alleviated less, than if the density of hills is enormous, which will make background much closer to zero-base scenario from (6).

2.4. Quantum Fields and Spacetime Curvature

Postulates presented in 2.1.—2.3. established the existence of the self-sustainable dynamic field-vacuum background, intrinsically reactive to the locations of massive compact bodies. If such a background, with gradients of energy shaping it, were to offer a conceptual framework that would explain complete gravitational dynamics of celestial bodies in space at all levels, and additionally conceptually retain relativistic effects, what would happen to the idea of spacetime? All these presumptions would be indeed shown immediately in the next section 3., but if taken in advance here for this thought, the conclusion is straightforward — spacetime as an entity would lose its role, meaning and purpose to exist. This theory aims to resolve the conceptual obstacle that has blocked the full reconciliation of the classical and quantum universe for a century, by completely redefining the basic concepts and their relationship. Therefore, distinctions in the concepts of quantum fields and vacuum are completely erased and blurred here. Vacuum should not require a rigid, strict all-pervading uniformity, not be ignorant of the continuous movements of mass in the vastness of space and not viewed distinctly from fermionic particles with masses. Until now, spacetime was viewed as a deterministic

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and smooth manifold curved in response to matter, providing the basis for the quantum world to follow these changes and only then unfold its laws. Oppositely, QFT prefers fixed and flat spacetime background, and its probabilistic framework additionally confronts two sides.

Then, how would the introduction of the dynamic vacuum-field substrate, aside from its thermodynamic preferences, resolve the conflict? The answer lies in the following statement — *it should not be "spacetime" that regulates the quantum background, but quite the opposite — the quantum background, with its inherent flexibility and automatic all-time reaction to the unequal distribution of mass-energy in the asymmetric system—regulates "spacetime"*, as an illusion of its dynamism. This huge conceptual shift will make it clear why quantum gravity has been unfeasible, both mathematically and conceptually, for many decades. The mechanism of how the universe functions was turned upside-down, and an excessive term was introduced. In other words, the full dynamism of the vacuum-field substrate is unnaturally taken away and transferred to be reliant on the (here) illusory concept of spacetime, which introduces an additional entity intrinsically strange to the universe, insurmountably complicating the situation, since the highly dynamic manifold (again, with deeply unknown and abstract nature) needs to be reconciled with the additional field-vacuum dynamic nature. They cannot agree who will lead the initial position, since both start with the opposite settings. Fields are constrainedly forced to constantly coordinate their dynamic nature and actions with the manifold, which has a problem with independently-behaving and probabilistic fields, and thus we endlessly spin in a loop — which can only be cut by a dynamic vacuum, if such a structure can replicate gravitation at all scales, better than GR and without introducing an additional invisible, dark sector. That would directly indicate and showcase that the quantum field-vacuum base can essentially independently imitate all behaviours now incorrectly assigned to excessive term named "spacetime". To avoid procrastination, we will directly shift our thoughts in the section 3. to finally verify such claims about spacetime and how this approach leads us to gravity alternatively, outmatching competing frameworks and their deficiencies.

3. Cosmic Dance According to Thermodynamic Rules

3.1. Planetary Systems and General Concepts

One can follow thermodynamic postulates (Müller and Weiss 2005; de Groot and Mazur 1984; de Abreu and Guerra 2012) and their application on a man imagined and positioned 150,000 km from Earth. (1) Man is, as a form of considerably high energy, subject to these rules. (2) His background is the vacuum with a gradational nature theorised in 2.3. (3) Man is a compact energy package "glued" together by the strong force and chemical bonds, having a non-dissipating nature. (4) As a compact system (2.2.), he is prevented from exchanging energy through heat transfer, dissipation, convection, radiation or conduction, except in an negligible percentage. (5) The vacuum environment in surroundings is not an air-like medium, energy exchanges from (4) are also impossible. (6) Albeit flexible in terms of adapting to energy asymmetries, the field-vacuum substrate is thermodynamically fixed, not subject to equalising convections with neighbouring areas, like heat is. It repositions based on compact bodies distribution. Now, according to the 2$^{\text{nd}}$ thermodynamic law, energy naturally tends to redistribution that maximises entropy or minimises Gibbs free energy according to $G = H - TS$ (H enthalpy, T temperature, S entropy) to balance energy and disorder. Also, T is not decisively significant because it is on average low for the majority of gravitational "settings" in space.

The mentioned law imposes that energy tends to disperse into a more uniform distribution (entropy maximisation) as permitted by the preconditions in the system. The latter is precisely limited through (4) and (5) and that is why this man must fulfil this law as much as feasible because of (3). As an energy hotspot from (1), due to (3) and striving for the most stable allowed equilibrium, he will begin to follow the direction to a next point where *energy density difference between the environment and him is lower and lower*. Since he lies in the field vacuum, which we described as a slope-like with a gradual increase in energy content in the direction of energy concentrating and distorting bodies (like the Sun, which condenses 99.9 % of the system's mass-energy; Desch 2007), the 2$^{\text{nd}}$ law will direct the body towards Earth. This is because in that direction the smoothing of the energy differences (gradient)

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brings him closer to increased equilibrium, the difference of man's and surrounding vacuum energies becomes smaller and thus more stable. Since the vacuum gradient 150,000 km from Earth is "slanted" almost imperceptibly due to the huge distance from Earth as a main energy concentrator in the local area, the displacements towards Earth will be extremely slow there, and only closer to Earth will the vacuum gradient become more expressed, leading to quicker movements in the Earth's vicinity. Since the contact of accumulator (the Sun) and surroundings is such that accumulator effectively in one point gathers almost whole energy of the system, in comparison to disproportionally more voluminous and low-energetic emptiness, ISL effects are expected (explained in 2.1., 2.2., 2.3.), leading us towards observations of Newtonian dynamics in stellar systems as specific zones of the universe.

A ball that we release from our hands will fall towards the Earth's surface with an acceleration significantly greater than that of a human at 150,000 km because the vacuum gradient at the Earth's surface is (in relative terms) strongest due to direct contact with Earth, as a dense accumulation of mass-energy. Thermodynamics would even drag the ball below the surface, but the Pauli exclusion principle prevents this, causing effects of gravitation. The same ball will not move in the opposite direction from Earth with normal dynamics because it would enter a region of increasing difference between itself and the surrounding vacuum (instability rises). But if we give it a significant amount of kinetic energy with a swing of our hand, it will go in that unfavourable direction upwards, albeit slowly wasting the transferred kinetic energy (even if there would be no atmosphere) and when it depletes that by-hand-added kinetics, it will fall into the influence of thermodynamics and follow the vacuum gradient oscillations, back to the surface. This also serves as another sign of the independence and elasticity of the vacuum, which at all times actively participates in energy exchange cycles.

3.2. Stellar Systems

The same principles extend to the celestial bodies of stellar systems, since like in planetary systems, here we have again an extreme central compactor directly confronted with wider energy-insignificant volume (preconditions for uttermost ISL scenario described in 2.1., 2.2., 2.3.). Bodies closer to the Sun, therefore in a greater vacuum gradient zone, will need greater kinetic energy (orbital speed) to resist the stronger attraction of the gradient, which is why the orbital speed of Mercury is about 47 km s^{-1}, and that of Jupiter only about 13. If these bodies suddenly halt, they would lose their resistance energy and head directly towards the Sun by gradients. If they gain additional energy by some mechanism, they would achieve escape velocity, by overriding the thermodynamic pull. This then entails that even moving through the pure vacuum takes part of the kinetic energy and that celestial bodies cannot orbit empty space forever with constant speed, even if there were no gravitational interference from other planets, tidal attractions or collisions with asteroids. Bodies like Earth are enormous and therefore this kinetic loss is noticeable significantly only in geological epochs or eons. Nevertheless, the theory suggests that any massive body, without exception, should not be able to move or rotate infinitely, even in a theoretically "frictionless" isolated vacuum, meaning even if the Moon, Jupiter or similar disturbances would not target Earth at all. The very contact of a moving mass body with a pure vacuum, with external factors eliminated in theory, must itself affect the kinetic capacity of the body, although this is hardly noticeable in the case of giants like planets.

Since the gradational arrangement of vacuum-fields is geometrically a distortion of the initial Euclidean symmetry (2.2.), the angles and paths in such a non-Euclidean geometry must prevent the orbiting body from ever closing the loop by pure mathematical expectations (more on coordinate systems in curved spacetime in Kopejkin 1988), not contradicting observations of planetary precessions. It is crucial to remember that the gradient in a vacuum is not mapped on a set background, but rather strongly dynamically adapts to the dynamics of matter, effectively preventing bodies from hitting exactly the same trajectory of orbits after each cycle. The vacuum and bodies are constantly influencing each others dynamics and distribution, effectively imitating the curved geometry. In zones of more extreme dynamism closer to the Sun, this mathematical effect will be obviously more pronounced, even without the need for space to be curved by unknown mechanisms. This approach also intuitively accepts two-body systems (in Damour and Nagar 2015 explained with the effective-

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one-body approach) where two bodies both affect the vacuum gradation in the interspace exactly or almost equally, preventing one to sway towards the other swiftly, causing prolonged, near-continuous orbiting. It can be noted that this interpretation imitates gravity without flaws in stellar systems, not contradicting the appearance of what GR claims to be curved-spacetime effects, or basic Newtonian dynamics. However, highly interesting and significant changes occur at cosmic scales, as follows.

3.3. Galaxies and Galactic Clusters

3.3.1. Thought Experiment with the Rogue Earth

As a start, one can conduct a thought experiment, with Earth imagined as a rogue planet, positioned and isolated somewhere outside the Solar system from its inceptions, on the galactic edges, without the Moon. Scientists would at one point notice that there are effects that keep us in a specific orbit around the extremely distant galactic core, but due to the absence of a nearby celestial body, some other Newton probably might not have mathematically understood this "force" through the today universally known formula of gravitation. Namely, the ISL effect would be difficult or impossible to notice in such a position of imagined Earth, since we would not have solid references like the Sun, Moon, and other planets that follow ISL dynamics and directly led us to the specific tenets of gravitation, allowing it to be directly related to free fall on Earth. Without all this, the first ideas about gravitation would not have been formed in such a context, but rather in the fact that our isolated rogue planet was just following the vast galactic dynamics mathematically closer to *1/r* relationship. Newton's idea with the apple was successful precisely because of his knowledge of the movements of the Moon and other bodies of the Solar system. In this thought, our initial explications of gravitation would be centred around a flat rotation curve effect (Corbelli and Salucci 2000 on the M33 example), observed with the invention of telescopes. Stellar systems would probably be discovered much later, when the general idea of gravitation would have taken root in a different direction than it does today.

In those circumstances, we would conclude that ISL dynamics are something that only occurs in rare, peripheral and edgy zones of the universe, in the very vicinity of stars, although it is questionable whether we could ever determine such dynamics precisely from a distant rogue. Therefore, we would declare ISL behaviour and free fall of an apple as anomalous phenomena, trying to adapt them to the new reality, completely opposite to what we do today. Instead of adding huge additional dark mass like now, in such a scenario we would probably search for opposite mechanisms that annihilate excessive mass in planetary system. It is not wrong to observe that our understanding of gravitation would have developed in opposite directions, depending on the position of Earth in space. Consequently, a legitimate question is whether our entire cosmology is based on an attempt to forcefully adapt the vastness and complexity of the complex universe to our small local cosmic backyard, which puts us in the strange situation where we need to theorise 95 % of the space volume through an dark sector in order for our models not to collapse completely. Even worse, gravitational modifications such as MOND repeat same patterns, again taking Newtonian gravitation as a starting reality, to which modifications are subordinated through a rough setting of a_0. We could play with similar thoughts in many more interesting ways, but we always get the same paradox. The only way to untangle this knot and make it fitting to all perspectives of an imagined Earth is to understand gravitation as a continuum, without forcibly imposing the situation in one structure on all others.

3.3.2. Dynamics at Cosmic Scales

In line with the above, the hypothesis here is that our current attempts to grasp gravitation are all excessively humanocentric and inflexible, intrinsically halting us from seeing the dynamics of the entire universe through the same eyes. Combining the dynamic vacuum according to 2.2., its expected distribution from 2.3. and gravitational dynamics that follows gradients and the basic thermodynamic instructions from 3.1., it follows that for a universal understanding of gravitation it is mandatory to focus on the density of the distribution of compact masses in the selected system (the Milky Way case in McMillan 2017). Gravitation is not modified and does not change throughout the universe, it is always, on a basic level, based on the logic in 3.1. The reason why we interpret it through the ISL

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version is exclusively the peculiar distribution of baryonic mass, which in the systems surrounding us is such that almost all the baryonic mass is in a small central point of the wider space (Earth-Moon system). Thus, this theory claims that gravitation, at the deepest perception, is not the only direct relationship between masses and their distances as posited several centuries ago.

To fully grasp the concept, one should be aware of the strength of dynamism in such a vacuum background. A simple piece of hot iron dropped into ice water with its following aggressive reaction can be imagined. Oppositely, a less hot iron into hot water will produce less violent dynamics. As a conclusion, energy contacts of greater differences create more turbulent kinetics in any system. Because of the vacuum distribution described in 2.3., it will generally be true that the absolute value of the vacuum is the highest in stellar systems. This is intuitively explicable if we understand the relationships figuratively — a cluster is like a lowest base layer of snow, a galaxy is an additional local snow plateau on it, and the stellar system is even additional smaller hill on the plateau, as a constituent of both. This makes the relative energy base beneath a star system greater than that of a galaxy, and even greater than that of a cluster (in selected spatial point "drillhole"). This is crucial since we can now look at *body / background energy ratio* (further BBER) per each.

This indicator is by far the highest in clusters, since there we have in direct contact the biggest differences (galaxy cluster cores overview in Hogan et al. 2017). On the one hand, it is the vacuum gradient, which is due to 2.3. and huge distances, almost leveled with zero-gradient voids, thus having the lowest absolute values of energy compared to galaxies and stellar zones (remind example of snow). On the other side, constituents "floating" in this energetically-rarefied vacuum — galaxies — represent structures of significantly higher masses than those inside single galaxies or stars. Therefore, according to this theory, it would be expected in clusters to have pronounced velocity dispersion (observational examples in Fadda et al. 1996) measurements. Moving further, BBER in galaxies is much lower, than in clusters. There we confront vacuum, with expected higher absolute energies and gradient inclination, with constituents, which are mostly stars here. Finally, BBER is expected to be even lower in stellar systems, where the low-energy entities like planets reside in the vacuum with highest absolute and relative energy expectations, explained by snow example. The speeds of stars in our galaxy are about 220 to 250 km s^{-1} in the disk ($\sigma(r)$ profiles additionally available in Dehnen et al. 2006 for the Milky Way), while galaxies in some clusters can move thousands of km s^{-1} near cores (Fadda et al. 1996). This velocity scaling *clusters→galaxies→stellar systems→planetary systems* is consistent with this application of fundamental thermodynamic reasoning, without logical inconsistencies.

Additionally, within these individual systems, the vacuum exhibits a localised gradient behaviour, whereby a denser concentration of baryonic bodies in, for example, the core, compared to the edges, will cause the slope of the energy density to decrease towards the edges and away from them, so in the cores of clusters we observe more active dynamics, as observed. Finally, this falling vacuum does not stop suddenly at the boundaries of structures and places where masses gather, but continues to fall far outside the system until it completely equalises the base state in some void in the distance (2.2., 2.3.). Now we will switch to the mathematical formulation, but it should already be noted that this last conclusion steadily leads us to the intuitive replication of the dark-matter-halo effect far around large structures, without any need to introduce an invisible mass, sometimes even hundreds of times more numerous than the baryonic content. This is even the more questionable since ΛCDM model has not yet resolved even the elemental nature of dark matter (axions, WIMP or even wave-like as in Hui 2021), and some of its explanation attempts are based precisely on that choice, introducing speculativeness, insecurity and constrained conditions to falsify it.

3.3.3. Derivation of Hubble's Law from Gravitation

(1) Gravitation, in a way defined by Newton, as the conceptual basis of our entire cosmology and GR today, is based on ISL universality, but the thought experiment in 3.3.1. designated such a view as humanocentric and intrinsically incomplete, with ISL being actually only an extreme, rare case in the zones in the exact vicinity of the compact bodies. This concept gradually and progressively changes and reaches the opposite extreme, which is when the vacuum becomes uniform in the full sense, and

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its gradients completely "flat", losing the possibility to impose gravitational attraction, which happens in zones critically far from the nearest compact masses, mostly in voids. (2) Everything else in space is thus in between these two extremes. This implies that gravitation exhibits the nature of the continuum, which should be directly correlated with the average distance from the nearest compact masses of at least comparable order of magnitude, marked further as d. (3) The parametre d therefore directly correlates the vacuum gradient. In ISL zones, as almost negligible space volumes next to the stars themselves (stellar systems), local influences dominate due to 2.2. and 2.3. As d increases towards galactic and cluster values, the density of compact bodies is decreasing, meaning there is more and more empty space between them, which creates preconditions for the vacuum gradient to become more "smooth", all until d reaches critical value where flattened vacuum emerges.

(4) This vacuum-based approach imposes a significant separation from GR. Here, only compact massive bodies (like planets around stars or stars in galaxies) of appropriate sizes can create gradients in surrounding vacuum energy of their area. Even if there were gas in the Solar system with a mass 100 times greater than the system itself, its influence on gravity would be fully negligible, because its non-compact structure would not be able to fulfil the conditions for gradients from 2.2. and 2.3. This idea will be further strengthened in 3.6.1. on the example of the Bullet cluster. (5) Parametre d is a crucial variable that must be added in calculations, since it determines how much interspace will be available between neighbouring compact bodies, and thus how strongly the gradient can be smoothed and deviate from the ISL as a reference. So, when examining the Sun's dynamics, as a constituent in the Milky Way, it is necessary to take into account its average distance from the surrounding stars, since this tells us how much it was able to depart from ISL. This is currently completely ignored (3.3.1.), yet is essential for the thermodynamic approach (3.1., 3.2.). Since (2) takes place at cosmic scales, we might express d in megaparsecs (Mpc).

(6) We can begin to shape the idea from Kepler's third law, consequently flawed in this theory. The relation T^2 (the square of a planet's orbital period) $\propto r^3$ (the cube of the semi-major axis) gives $T^2 = kr^3$, where k is a constant for unit conversion, which needs to account for d. We can notice that d is inversely proportional to T — while larger r means larger T, larger d imposes the opposite effect, requiring

$$T^2 = \frac{kr^3}{f(d)}, \tag{1}$$

where *f(d)* represents the function of d which we will soon try to generalised. Following the standard derivation of the law of gravitation, we start from the centripetal force F, which is

$$F = \frac{mv^2}{r}, \tag{2}$$

where v is orbital velocity, which is given by

$$\begin{aligned} v &= \frac{2\pi r}{T}, \\ \textit{leading to } v^2 &= \frac{4\pi^2 r^2}{T^2}, \end{aligned} \tag{3}$$

and by implementing the starting expression from eq. 1, we get

$$v^2 = \frac{4\pi^2 r^2}{\left(\frac{kr^3}{f(d)}\right)} = \frac{4\pi^2 f(d)}{kr}. \tag{4}$$

After substituting this into starting F, we come to

$$F = \frac{m}{r} \cdot \left(\frac{4\pi^2 f(d)}{kr}\right), \tag{5}$$

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while standard Newtonian assumptions about masses and renaming of k to G give

$$F = \frac{G\, f(d)\, m_1 m_2}{r^2}. \tag{6}$$

(7) The function *f(d)*, in accordance with the aforementioned Kepler's law, should be determined observationally. We can do this by going through the profile of standard galaxies (Milky Way) and clusters (Coma) and for a few selected points, along selected radii in the profile, we create x-y pairs *(x, y)*, where x will represent the average distance from the nearest compact bodies, which in practice is d (3), and y should be the now known "missing mass" factor. This is because this theory claims that gravitation is a continuum and the missing mass problem is just a consequence of not recognising this fact. That is, the missing mass factor should, due to (3), (5), 2.2. and 2.3., be directly correlated with d in a particular zone of the galaxy or cluster, which is why in the Milky Way, for example, the missing mass problem becomes more pronounced towards the edge of the disk, since d itself increases in that direction. The same applies to clusters because we need to take into account (4) — only compact baryonic celestial bodies affect the gradients. The ICM, albeit ten times more massive than stars, has zero influence. For this reason, when calculating the missing mass factor for *(x, y)* pairs, we put the total mass that the current cosmology requires due to "dark matter", on the one hand, and on the other the visible mass, but only a compact one with the ICM eliminated from calculations because of (4) and 3.6.1. Finally, the curve should be fitted to the obtained *(x, y)* points.

But what is the relation between d and the missing mass factor (MMF)? We will set it here with the intention of capturing the generalised trend. We note that in galaxies d increases unevenly (non-linearly). In the core, baryons are extremely dense and the interspace is by far the smallest, imposing very small d. This is where the MMF is also by far the smallest and close to 1.0. However, moving away from the core, the baryon density decreases exponentially, leading to an accelerated growth of d towards the edges, with MMF also increasing at the similar accelerated rate, from slightly more than 1 or 1.5, to (a common universal estimate) around 5 at the edges of the disk. In clusters (remember, the ICM must be put aside) compact baryons also decrease strongly away from the centre, causing the same change rate of d. MMF increases, too, because the current concept of dark matter requires that its mass decreases much more slowly (NFW profile) than stellar material towards the edges, consequently enforcing an increase in MMF.

It is also noticeable that this general growth of the MMF in clusters occurs at values of d that are drastically higher in absolute terms (only a few pc in the galaxy, as opposed to tens and hundreds of thousands pc in clusters). Accordingly, we expect a modified power law trend for *(x, y)*, meaning *(d, MMF)* points on the graph, where the power law exponent should slowly and progressively decrease, to cause the power-law curve to flatten and be parallel with the x-axis. It is important to remember that the gradients do not go to infinity, but with a critically high d they "stretch" enough to level out with the rest of the non-affected, "flat" vacuum. For this reason, the final part of the power-law curve must at some point become fully parallel to the x-axis (thus linear and constant), because after a critical d, there are no more gradients and therefore neither gravity, the influence of compact masses, nor the addition of IMF. Consequently, we claim the following generalised expression:

$$f(d) = k\, d^{a(d)}, \tag{7}$$

where k is again the scaling constant of the power law, and a exponent, but described through *a(d)*, as a gradually decaying exponent from some starting value a_0, with $a_0 \in (0, 1)$ — decays towards 0. Note that *f(d)* should be unitless because it represents a kind of scaling factor that explains how gravity is stronger than Newtonian expectations as d increases — hence, since d is in Mpc, the unit for k must be Mpc^{-1}. Further, *a(d)* could be

$$a(d) = a_0\, e^{-sd}, \tag{8}$$

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where s is additional constant needed to shape the non-linear relation. It is crucial to keep in mind here that this article does not intend to determine *a(d)* finally, but leaves this to further consensus and detailed determination by the entire scientific community — with reason. This is because the exact intensity of the exponent's decaying needs to be agreed observationally, and the problem is obvious. Although a general trend exists (and we will show soon that, very interestingly, we can derive the law of the expansion of the universe from it), it should be kept in mind that the precise determination of *(d, IMF)* remains for discussion and agreement among scientists, since the values of both d and MMF at chosen points in galaxies and clusters depend on the model used to determine the change in the density of baryons and dark matter across the profile (and there are many of them, like NFW, Einasto...), observations, selected papers and databases, causing the numbers to be not straightforward and finalised once for all.

For this reason, this part is determined at the trend level, while the community is transparently invited to reach a precise consensus for the rate of change of *a(d)*. In eq. 8, the exponential decay of the initial a is given, with the idea of making it gradually approaching 0 as d increases. Although the approach is asymptotic, in practice it gets 0 meaningfully at some d. To ensure smoothness in decay and gradual saturation for eq. 7, we should additionally choose an integral-based approaches for total accumulated value. If at some d the value of a is 0.5, and *f(d)* 50 (numbers are just for presentation), we want to be ensure in the next step d+n (with n being the smallest step to move along) the value of a, which could in that point decay to 0.49, is applied to the *f(d)* of 50, meaning to the exact last point where the curve of the graph was before we applied the previous operation. In conclusion — the final formulation requires an agreed fitting of the curve from which it is then possible to determine eq. 8 and then apply integrals to it to achieve the smooth saturation.

Instead of using the expression *a(d)* in a power-law format, we can also write it in a form in which we would separate d as an independent variable, exponent-free, just multiplied with some new variant parametre x that replicates the same result as eq. 7 did:

$$f(d) = xd \tag{9}$$

where x (since *f(d)* has no unit and for d it is Mpc, the unit of x must be Mpc^{-1}) behaves as progressively-with-d changing variable. But this change for $a>0$ part of the graph is non-linear, because we have to constantly multiply d by a different scaling factor x, since d and a do follow each other through a non-linear modified power law. But after a reaches 0 on the graph (no gradients), we have concluded that the curve afterwards is a horizontal line parallel to the x-axis, meaning from that point a and d follow each other linearly. That is, in $a=0$ x can be described as

$$x = nd, \tag{10}$$

where we represent x as the product of d and some new constant n, which is permissible because the relationship is linear for these conditions. The unit of n must be Mpc^{-2}, since x is Mpc^{-1} and d in Mpc. Substituting such x into the initial *f(d)*, we come to

$$f(d) = nd \cdot d = nd^2. \tag{11}$$

The formula for orbital velocity is known as

$$v^2 = \frac{GM}{r}, \tag{12}$$

which, applying the gravitational rules from eq. 6, with implemented *f(d)*, becomes

$$v^2 = \frac{Gnd^2M}{r}. \tag{13}$$

For points $a=0$ gravitational effects cease because the vacuum is there flat, therefore the influence of M/r becomes negligible, since $d >>> r$. There are no more gravitational gradients to prevent

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tendency of objects to spread apart, which is inherent and initial due to the processes we discuss more extensively in section 4. Thus, there *M/r* logically must become just a pure universal constant, no more dependent on the localised influence of masses and radii as that is for *a>0*, where gradients do exist. Consequently, the product of G, n and *M/r* gives some new constant h, since all G, n and *M/r* are constants, which leads to

$$v^2 = hd^2. \tag{14}$$

Since the root of a constant is also a constant, it finally comes to

$$v = hd. \tag{15}$$

To find out the unit of h, we can skip back to eq. 13 and remind on what gave rise to h. It was the square root of G, n and *M/r*, multiplied together. Now, we will derive something deeply meaningful and interesting, the unit for h being

$$h_{(\mathrm{unit})} = \sqrt{\frac{GnM}{r}} = \sqrt{\frac{\mathrm{m^3\,kg^{-1}\,s^{-2}\,Mpc^{-2}\,kg}}{\mathrm{m}}}, \tag{16}$$

$$h_{(\mathrm{unit})} = \sqrt{\frac{\mathrm{m^2}}{\mathrm{s^2\,Mpc^2}}} = \frac{\mathrm{m}}{\mathrm{s\,Mpc}} \rightarrow km/s/Mpc \tag{17}$$

The expression just written in eq. 15, it is easy to notice, is equivalent of Hubble's law — the product of the constant and the distance from the nearest point in relation to which the recession velocity is monitored. We have just shown that this law can be derived naturally from this dynamic vacuum and gradient-based gravitation. That is, dark matter, dark energy, gravitation, baryons and radiation are directly linked to the acceleration of the universe, and all are form of a single, unified energy content (see 4.). This is not just a mere coincidence, as noticeable by following the units of measurement throughout these derivations — the unit of the constant h is exactly equal to the Hubble constant (km/s/Mpc in eq. 16 and eq. 17). Gravitation is therefore only a specific case of the expansion of the universe, one in which gradients are imposed by too many compact bodies in the area, and where such vacuum suppresses the inherent expansion and repulsion in all directions, which is what everything in the universe tends to do when these gradients and their thermodynamics from 3.1. and 3.2. are absent. Much more on this topic, still in its introductory stage, is available at section 4., and 3.6., 3.7., 3.8. (following).

Finally, this approach to gravity is additionally perfectly compatible with the core-cusp anomaly, a mysterious mismatch between observed and predicted distribution of dark matter in galactic cores per CDM model, imposing serious questions on the validity of current dark matter cosmology, since galactic centres show smooth cores, instead of significantly denser cusps, required by Navarro-Frenk-White (NFW) profile. Since gravity here is a continuum, based on a progressive deviation from the ISL, it is clear that d in the centres of galaxies is considerably smaller compared to the galactic disk, let alone clusters. These are the zones of the sharply high densities, at smaller cosmic scales, which means there the deviation from ISL would be the lowest, gradually shifting from ISL zones with "missing mass" factor of 1, towards higher values, but due to the small space to develop higher d, this factor would be only gentle, lacking prerequisites to jump sharply, opposing cold dark matter nature, which would require a pronounced dense accumulation and a sudden jump in this factor. Symbolically, on the one hand, pure Newtonian dynamics has an excessive problem with MMF there, and while MOND follows a good trend, it does so insufficiently because the MOND regime activates "too slowly" based on a_0 (refer to 3.8.). On the opposite side, cold dark matter should "overshoot" observed MMF, which makes this concept right in the desirable middle ground between MOND and CDM, required to adopt the core-cusp "problem" as a standard path in the continuum of gravitation, rather than anomaly, as in CDM.

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3.4. Explanation of Dynamics Deviations in Galaxies

Notable deviations in galactic dynamics are cases of rare galaxies that do not follow flat rotation curves. Namely, some predominantly dwarf galaxies, from the low surface brightness (LSB), ultradiffuse (UDG) and ultrafaint (UFG) groups (Calabrese and Spergel 2016), show dual behaviour, because some of them have a profile more or less close to Keplerian dynamics. ΛCDM cosmology relies on the possibility of an uneven distribution of dark matter (Cooper et al. 2010) and offers many explanation attempts like in Foot 2015. However, the aforementioned problems with such ideas remain — the difficult falsifiability, speculative nature and foundations on the chosen type of dark matter particles without experimental confirmation of it, or even its existence at all. At most, ΛCDM treats dark matter haloes as necessary gravitational wells without which the evolution of galaxies is problematic to understand, accumulating many disputes over time. The situation is even more critical for MOND, since it is major obstacle to provide convincing physical argumentation to justify sudden oscillations in already modified low-acceleration regimes (Dodelson 2011). But the new theory here bypasses many of these confusions, in a manner stated in 3.3.3. In that context, it should be noted that galaxies highlighted here sometimes hold only a million or less stars, often red dwarfs (more on dwarf galaxies' stellar haloes in Minniti and Zijlstra 1996), highly scattered (Mihos et al. 2015 — UDGs in the Virgo cluster), sometimes over areas larger than the Milky Way. With such low masses, it is enough to have only one average supermassive black hole (SMBH) in the very centre, that can shift the mass concentration skewness to a critical value in the core, and consequently nature shifted to ISL patterns, by making interstellar distances smaller at wider areas (reference 3.3.3.).

Even without a SMBH, it is enough to disrupt skewness with an enhanced activity of the birth of younger, pronouncedly massive stars in the bulge. Or, simply the pure concentration of smaller stars in a more critical number in that zone. This is all further reinforced because they themselves, and thus even more their internal structures, are barely noticeable with telescopes due to their dispersive nature. The tidal strippings (Jackson et al. 2021) can also explain the critical skewness by pulling edge baryons out of the already low and scattered mass system, imposing a pronounced bulge concentration. A similar hypothesis is attempted through ΛCDM, but once more with unverifiable assumptions about the nature and behaviour of dark matter, so principles like Occam's razor would give priority to the theory here, since its base is merely on the well-known baryonic matter. The new model also offers a straightforward intuition for the wider question of huge mass-to-light ratio of these galaxies. The answer is tied to the dispersive nature itself, which leaves compact masses at extended gaps and spatial separations, than in many larger galaxies. According to 2.3. this creates conditions for a stronger leveling of the vacuum substrate, approaching the base void-like state, which due to 3.3.3. can create the impression of the presence of an unusually large additional dark mass, if we interpret the situation with a flawed Newtonian logic.

3.5. Gravitational Lensing

The light path bends (black hole example in Bozza 2010; local versus global bending distinctions in Ehlers and Rindler 1997) according to GR when a massive object warps spacetime, introducing effects which magnify, distort or create multiple images of the background object, measurable by deflection angles. This is commonly used for, as an example, weak lensing mass mapping, showing us that the deflection angle is unexpectedly pronounced in galaxies, while the effect in clusters is even more drastic. Currently, this is considered as one of the fundamental evidences for the necessity of dark matter (Schneider 1996). But the theory here bypasses the idea of curved spacetime by pointing towards the non-uniform vacuum (2.3.), unlike in QFT, and thermodynamic postulates of 3.1., 3.2., 3.4. and 3.5. which directly helps us to intuitively understand why we observed deflection angles as we do at cosmic scales. Light, approaching the Sun, enters its region of a more pronounced vacuum energy gradient, with enough potential to redirect its trajectory slightly closer to the Sun, because all energies, including photons, when behaving as particles, tend to be in a zone with smaller energy differences and cannot just pass by, ignoring gradients.

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Although gradients in galaxies, and especially clusters, are much weaker (2.3., snow example in 3.3.2., also skip to 3.6.1.), they are still not "flattened". Crucially, galaxies are much larger spaces in absolute dimensions than stellar systems, while the situation with clusters is even more extreme. Photons, on long travels near clusters, are subjected to weak cluster gradient attempts to deflect them, during all the path. This might not be noticeable locally, but effects will accumulate, due to prolonged and constant exposure to the weak gradient around the cluster. The distances within the Solar system are so small compared to clusters that we cannot detect even a trace of this prolonged thermodynamic effect. It is as if we have one very strong man who can deflect a block (hovering straight line aside) one metre away of block's trajectory, while another weaker man can merely one centimetre. However, if a sufficient number of weaker men stands in sufficiently long line, at some point they will manage to overcome that one meter, cm-by-cm. We can imagine that the gradient acts like these men — in stellar systems the men are stronger, but numerically limited, while in clusters it is the opposite. Consequently, all mathematical expressions describing gravitational lensing based on the Newtonian approach need to implement the same, additional variable — distance from the nearest compact body, following the logic in 3.3.3., leading us towards the explanation why we observe deflection angle values incompatible with Newtonian and GR expectations.

3.6. The Bullet Cluster Phenomenon

3.6.1. The Bullet Cluster Structure

The Bullet cluster (1E 0657-56) is critical for fully explaining the connection between gravity and light bending. In the midst of the impact shock heating collision at a possible speed of possibly 5000 km s^{-1}, a clear separation appeared between the ultramassive central hot gas intracluster medium (ICM), with many times more mass, and the neighbouring clusters with galaxies. Gravitational lensing mapping, however, allocates most of the mass precisely in the galactic zones, which is often interpreted in favour of the dark matter idea (Paraficz et al. 2016) and tremendous impediment for MOND-like theories, forcing them to aggressively fine-tune explanations by invoking specifically massive neutrinos, which can add struggles to match observations in other scenarios. The question is — can the theory here offer solutions to this final obstacle? Decisively, the answer is confirmative, but let's grasp it through conceptual intuition, again without hard-to-understand abstract solutions or arbitrary addition of invisible matter. To do so, the crucial move is to recall 2.3. Gravitational dynamics depends on the vacuum gradational nature. No gradients — no attraction.

In the same chapter, but also in most others so far, the concept of "compact bodies/masses" was mentioned repeatedly, for good reason. Such ompact sources of enormous localised energies are the only chance for the vacuum to accomplish “slopes” and gradient descent around the contact *high-energy compact body—low-energy empty surroundings*. The Sun, based on such a contact, creates a strong ISL gravitational effect in our system. However, if we were to disperse all its energy uniformly throughout the entire Solar system, the system would generally still have a large mass-energy potential, but this is where GR and MOND-like approaches radically diverge from this theory in 3.1. and 3.2. Even such a dispersed, imagined Sun would still have more-or-less strong gravitational influence according to GR, while in our approach it would become negligible or minor. This is because a compact Sun creates extreme astronomical differences in energy with its surroundings, which is the only basis for a strong gradient. But a uniformly dispersed Sun distributes its energy with equal density at every point in the system. More precisely, it loses ability to impose gradients, despite the still high energy. And without a gradient, there is no gravitation. Exactly this divergence leads us to the Bullet cluster.

The key is in the ICM nature, such that its density is even lower than the Earth's atmosphere, fully lacking any traces of compactness and spreading over immense volumes measured occasionally in a few megaparsecs. As such, its influence on gradients in vacuum energy is imperceptible, poor and for practical purposes absent. On the left and right sides of the Bullet cluster are two smaller clusters, which contain their inner, compact galactic skeleton of visible baryonic content. Albeit around ten times less massive than ICM, their structures are diametrically opposite to ICM and therefore influence on the vacuum energy gradations is straightforward. So, our approach would impose the biggest

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gravitational strength in the Bullet cluster sidewards, in two smaller left and right clusters. Exactly what we measure by weak lensing mass mappings and observations, and we can achieve this without any unknown dark matter or neutrino particles.

It is highly important, for even additional clarifications, to keep in mind that although the ICM may have higher densities and faster cooling in the cluster cores, the uniformity is still not impaired, because zones of higher density do not change the fact that the gas there is still not a compact mass, but still enormously dispersed, lacking spatial solidification. Further, the extreme temperatures of ICMs, which can reach over 100 million K, are not necessarily the product of merely gravitational collapse. In most clusters, ICMs will be inside cores with a vacuum gradient imposed by galaxies, which will create a strong gravitational field for them, that they did not prepare themselves, despite their many times greater mass, increasing their kinetic energy and consequently explaining such temperatures. In situations like for 1E 0657-56, where the gas is outside main gravitational zones, but still extremely hot, the main reasons lie in shock waves due to the main collision and previous constant galactic mergers. Many such gases are remnants of primordial heating of hot plasma from early cosmic processes, and in general their cooling, especially in outer regions, is inefficient thermal inertia that can prolong the cooling over billions of years. Additional obstructions could be somewhere caused by constant energy injections via active galactic nuclei (AGN) mechanisms, possible cooling delays by magnetic turbulence or the influence of surrounding gravitational zones (two of which are on the left and right sides of the Bullet cluster). To conclude, this theory's reasoning neatly fits this major logical obstacle for many other attempts.

3.6.2. The Cosmological Constant

The same principles can be used to relieve the current cosmological constant Λ problem (Weinberg 1989), which represents a significant gap in the understanding of the relationship between QFT and GR, since QFT predicts an absolute vacuum energy up to 10^{120} times greater than the observational/GR expectations from supernovae and CMB. According to GR-based approaches, the theoretical estimate in practice should lead to an exponential expansion of the universe (positive energy) or a rapid collapse (negative). However, this currently unsolvable problem becomes less problematic in this theory, at least for the question of the stability of the universe. As gravitation relies on the strength of the impact on the vacuum gradients as in 3.6.1., the absolute value does not matter for it, but only the relative, so even if QFT is correct, it would not impose any catastrophe here, contrary to GR framework, since this massive energy is radically uniform and has zero possibility to create gradients. Additionally, the dynamic vacuum would enforce QFT to undergo modifications stated in the section 5. (future works, based on 2.2., 2.3., 2.4., 3.3.) and the finalised result might resolve the discrepancy between QFT and GR's Λ. This is because, contrary to current cosmology, dark energy in this theory is a concept unified with regular and dark matter and radiation, with one and the same evolution (skip to 3.7., 3.8. and 4.). After completion, this radical conceptual shift could impose redistribution (of now predicted large energy) between compact bodies and the vast voids, as now evolutionary connected, but nevertheless, even Λ per current QFT assumptions is acceptable. In GR, it creates a catastrophe and shakes the basic tenets of curved-spacetime ideas.

3.7. The Cosmic Coincidence Problem

The cosmic coincidence problem (Velten et al. 2014) represents a significant obstacle in ΛCDM model. Namely, dark energy (example of reconstruction in Sahni and Starobinsky 2006) density ρ_Λ in it is considered uniform, constant and a property of spacetime itself, while matter ρ_m, including dark from the current ΛCDM, is rarefied by $1/a^{-3}$, with a being the scale factor of the universe. Their values are obtained by calculating the critical density $\rho_c = 3H_0^2/8\pi G$ where H_0 is the Hubble constant in $km/s/Mpc$ (more on Hubble tension in Riess 2020; Mörtsell and Dhawan 2018) and G gravitational constant. Density parametres for both, Ω_m and Ω_Λ , are determined observationally, and the general expression $\rho = \Omega\rho_c$ is used to obtain the final densities of both sides. They are in the same order of magnitude (10^{-27} kg/m^3), which is quite strange considering the completely conceptually different

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evolutionary paths, imposing a notable confusion for ΛCDM (Velten et al. 2014). Be that as it may, this theory can solve even this question in a simple and intuitive manner. In 3.6. it was mentioned that the redefinition of the vacuum completely changes our understanding of what is currently deemed to be dark energy.

Dark energy is no longer an isolated concept linked to spacetime, but part of the same energy content that is the source of both baryonic matter and radiation (2.2., 2.3.), and such a vacuum incidentally covers the effects for which current cosmology needs dark matter (3.3.2., 3.3.3.), as well as the expansion of the universe (skip to 3.8. and 4.), and all this with the conceptual exclusion of spacetime, which becomes only a secondary emergent from the processes described in 2.4., 3.1. and 3.2. Energy of the vacuum and fields becomes the initial core of the universe. This unified energy content began to expand with the Big Bang as a uniform structure, until the symmetry breaking (2.1., 2.2.) did not redirect part of its energy content into bound masses, while the unbound rest continued to expand undisturbed until today (thermodynamic reasoning in 4.), incidentally influencing the dynamics of the massive bodies in it (3.2.) and successfully imitating the full effect of gravitation (3.3.3., 3.5., 3.6.1.).

It can be written that this unified basis simultaneously determines both the gravitational dynamics and the expansion of the universe. That is, while ΛCDM tries to explain the current cosmology with separate, fully-unknown and questionable terms, such as dark matter, dark energy, and additionally irreconcilable spacetime and the quantum world (with a separate evolution for all these concepts), our theory unites and explains all these effects through one structure, with one evolution. Consequently, the density of matter (both baryonic and illusory “dark”) halts to be separated and distinguished from “spacetime” and “dark energy”, forcing them to always remain be in the same order of magnitude over the cosmic history, due to the same-source relation. This effectively eliminates the need for speculative anthropic principle-based reasoning, inseparable from ΛCDM.

3.8. Hubble Constant and MOND’s Acceleration Scale

In MOND, the acceleration scale a_0 was empirically determined with the aim of explaining galactic dynamics and later set to a value of approximately $1.2 \times 10^{-10}\,\mathrm{m\,s^{-2}}$, which became particularly strange when it was shown to be of the same order of magnitude as the product of the Hubble constant and the speed of light ($a_0 \sim cH_0$). It is also valid that $cH_0 \sim c/t_H$, where t_H is the Hubble time (the age of the universe), or $1/H_0$. Although this may be yet another strange coincidence, alternatively it can imply some deep connection between local gravity, the expansion of the universe, and global properties of the entire universe, where the latter might directly drive local dynamics, which seems extremely strange in the ΛCDM model. Although it is claimed here that MOND is fundamentally wrong in its deep attempt to explain gravitation, its successful application to galaxies shows that at least in this part there is a "lucky hit" and therefore these mathematical connections could have some hidden logic, and based on 3.7., they seem to do so. To support and strengthen the possibility even more, it can be noticed that, by following interpretations in 3.3.3., near-*1/r* dependence stems out as a part of wider gravitational continuum based on the compact bodies density (distances), which is why MOND’s a_0 can be understood as an incomplete and flawed attempt to notice this continuity.

As will be introduced in the section 4., the expansion of the unified universe energy background, besides causing gradients near compact masses, will continuously lead to a decrease in the density of that same vacuum everywhere by time, since its enormous total value was preset and limited prior to the Big Bang, not continuously added through imagined spacetime expansion. The BBER indicator from 3.3.2. would thus be affected in every point of the cosmos, as time flows. BBER changes would gradually affect the dynamics of the bodies described in 3.1. and 3.2. Because of this, our theoretical framework directly demands of us that the expansion of the basic vacuum background must simultaneously gradually govern the strength of the gravitational dynamics. Because the smaller the universe volume (the older universe), the absolute energy of the vacuum is expected to be denser and with higher absolute values, causing a shift in the value that MOND describes as a_0 with time. Consequently, a_0 must be directly tied to the expansion of the universe, due to the unification of dark energy and dark matter with other energy, which strongly suggests that the unusual coincidence in

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the relationship between a_0 and H_0 is not just a random chance, especially when connected with the incidence problem inspected in 3.7.

4. Dark Sector Variability (Conceptual Introductory Notes

The following section is intended only to provide an abbreviated and conceptual introduction to the role of (what is known as) dark energy from ΛCDM in this new theory, not trying to set the comprehensive or finally sufficient development of the idea, but only the most basic raw postulates, just enough adequate for the testability purposes proposed in 5.2. One should be aware that this initial article targets primarily gravity, and the full accomplishment of the new cosmological foundations, with previous models as benchmarks, could easily require many years. Therefore, this section provides only starting postulates, to more quickly convey the ideas which the author is currently working on and inform the rest of the scientific community to the direction of model's developments, to accelerate its progress without delays.

(1) To start with, all mechanisms in the universe are unified in this framework, linking dark matter, dark energy, baryons, radiation and even gravitation into only one energy content, bypassing current ΛCDM's and GR's fragmentation, and yet achieving better strongpoint for gravitation (3.1., 3.2., 3.3.2., 3.4., 3.5., 3.6.1.). (2) With reinterpreted notions of spacetime and quantum world (2.4.), the field-vacuum background energy itself becomes the expanding medium, rather than illusional, emerging spacetime. (3) When it comes to why would this energy begin to expand into volume, this question is not fully understood even within GR's frame (Bojowald 2007), but since all cosmology dynamics is based here on simple thermodynamics, it offers interesting and simpler explications. If initial energy content was, prior to the Big Bang, in the initial singularity point (to simplify it for now), that exact point had to be surrounded by something we can conditionally call "nothing" (not in the sense we use it for the vacuum in current QFT, but complete absence of quantum rules which are spreading into the “nothing” in the full meaning; out of the maximum limits of expanded space). Although we do not know almost anything about this "nothing", it certainly had one property we can confidently assume, an energy value of 0 — the complete absence of energy, fields and vacuum.

(4) With such contact of astronomically high and dense energy in one point, with the surroundings of no energy at all, pure thermodynamic tendencies of our known energy would force it to expand into the volume, as never-ending attempt to reduce the sharp differences between expanding zones ($E_1 > 0$) and surrounding ones ($E_2 = 0$), constantly searching for equilibrium by trying to make $E_1 - E_2$ reaching 0. Despite the unknown nature of "nothing", the dynamics of our energy is always unchanged and driven by the search for equilibrium, without exceptions (Müller and Weiss 2005; de Groot and Mazur 1984; de Abreu and Guerra 2012), which should explain what triggered the Big Bang. For the future, the question what contained such huge energy in the initial singularity remains open.

(5) In the first moments of the universe, the energy difference between the singularity ($E_1 = max$) and its surroundings (always $E_2 = 0$) was the most extreme possible. Interestingly, this could unexpectedly and reasonably explain why cosmic inflation occurred so early at all, without extremely speculative inflaton (remains to be mathematically covered in the near future). After such a rapid radical expansion, the differences at the contact would become smaller in just a tiny part of a second, stoping cosmic inflation, but the expansion and constant “rarefaction” of the vacuum background would continue since now, because $E_1 - E_2$ is still not equalised to 0, although with slower rates. (6) The expanding vacuum energy background is the base of quantum fields today, unified with all energies per (1), and its value is, although astronomical, preset and thus limited prior to the Big Bang, meaning $E_1 = const$. The recession of galaxies and clusters is a separate concept, driven inside this spreading background, by following “internal” gravitational rules as in 3.3.3. (7) The expanding substrate at some moment experiences symmetry breaking and other evolutionary changes described in 2.1.—2.3., leading to mass, forces, particles and subsequent QFT rules. Mass “collects” enormous energy form the unified, previously symmetric and uniform base in (1), additionally rarefying the field-vacuum energy, together with its continuous expansion from (5) and (6).

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(8) Continuous vacuum rarefaction in (7) causes compact masses, with glued and thus constant huge energies, to "float" in this time-variant vacuum energy background, which density decreases with time flow. (9) Now one could recall 3.3.2., which claims *bigger BBER, stronger the dynamism and moving velocities*. (10) Further, we also recall another rule from 3.3.3., no vacuum gradients, no gravitation — thermodynamical nature (2.3., 3.1., 3.2., 3.3.2.). If the vacuum is flattened and has no gradients, like in the most of the universe far enough from masses in the vicinity, like voids, spreading away takes over, since gravitational rules cannot impose gradient-based attraction and gathering in these circumstances. Gravitation is thus merely a special case caused by gradational vacuum, resisting the overall tendency to spread everything apart based on (7).

(11) Consequently from (10), in combination with (8) and more (9), it would mean that the idea of uniformly dense dark energy like in GR is utterly impossible. Dark-energy effects should, according to our model, show variant nature over time, increasing the speeds of galaxy and cluster recession as the universe gets older, in continuum. It is so because BBER continuously increases over time, since background dilutes in parallel, while compact masses remain, affecting the recession to also increase on the same path. It would impose major aftermath on our understandings on the universe expansion, paving the road to finally intuitively explain the Hubble tension mystery and why the universe seems to accelerate more today than predicted by CDM, successfully avoiding claims on systematic errors in the measurements of early conditions in CMB, or in local Cepheids or supernovae. This further can be backed even stronger by the natural explication of the connection between the Hubble constant and MOND's acceleration scale (3.8.) and the cosmic coincidence problem (3.7.).

(12) More interestingly, we can extend our thoughts even further to dark-matter effects and ask what happens with them over time, if "dark energy" varies and both are parts of the same energy content as seen in (1)? Since dark matter is no more than gravitational effect in 2.3., 3.1. and 3.2., and the vacuum substrate is time-dependently diluting according to (8)—(11), it would impose that *the slope of gradients should become flatter as time passes*. This is straightforward, since as fixed vacuum-field energy from (5) to (7) expands into volume and redistributes over it, its amount at the edges of galactic and even more cluster structures gets rarefied, making the possibility of gradients to be sharp at edges lower, since volume "stretching" aims to make them gradients also "stretched" and so flatter. A comparable analogy is a hill of snow with steep slopes. If that given, limited amount of snow (unified energy content) began to stretch (expand) into the surrounding volume ("nothing"), the slopes of the snow hill (gradients) would become gradually less steep, tending to become completely flat and horizontal after sufficient expansion.

Effectively, this enforces something interesting. Through the cosmic history, (12) would cause dark-matter-halo effects to gradually get weaker than expected if dark matter would behave as constant like current cosmology assumes. This is the obvious consequence of gradients (imitating haloes) are getting increasingly stretched and flatter, making the gravitational attraction in clusters slightly weaker with time flow, since steeper gradients are a prerequisite for stronger clumpiness and gravitation. This makes this theory a major shift from ΛCDM. This is mostly matching the S8 tension question. Thus, it is expected soon (maybe even in just a few years) that at least one of many projects, which currently extensively explore dark matter and energy, would reach the 5σ threshold confirmation of both the Hubble and S8 tensions, forcing the community to confront the insurmountable shortcomings of ΛCDM and focus on this model, as the only one currently offering variability of the whole dark sector, with additional precise explications of gravitation and its many anomalies. But as told at the beginning of this section, this is a huge set of topics that will require years and many articles to fully develop the final new cosmology, piece-by-piece.

5. Discussion

5.1. Future Works

Unification of the quantum and classical universe and field equations. By redefining the roles of quantum fields and vacuum in the universe (2.2., 2.3., 2.4., 3.1., 3.2.) as dynamic substrate in contrast to emerging

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illusionary spacetime, thus eliminating the theoretical blockages from 2.4. by following assumptions there, the situation is reduced conceptually merely to mathematical formalism, albeit not simple one, in the sense of modifying QFT to facts that the vacuum is expected to be spatially dependent on the distribution of compact baryonic mass, with its energy content which is gradational, and without separated terms of dark matter and dark energy (3.7., 3.8., 4.). This should require extensions of the approach in 3.3.3. with field equations. If Einstein's are chosen as a starting point, this could be done by changing the energy-momentum tensor in a way it incorporates ideas from 3.4. — only compact bodies influence gradients, ICM-like structures not. On the other side of equation, the Ricci tensor could be redefined so it represents gradient logic (3.1., 3.2., 3.3.), not pure curvature which fits only stellar systems, either by some constant or variable attached on it, or recreating it from scratch with mentioned aims. Nevertheless, since QFT will need to be also modified to accept dynamic vacuum, there is a possibility to include the mentioned ideas directly here. Relativistic postulates like gravitational lensing from 3.5., or gravitational waves (Cai et al. 2022; Einstein and Rosen 1937) — anticipated when fields try to redistribute sudden disequilibrium and imbalance of enormous excessive energy abruptly released after cataclysmic events like neutron stars collisions — would prefer this approach. It is because here QFT requires much more independent dynamics (2.2., 2.3., 2.4.), since spacetime is no longer the first level. Important note: for the possibility of still using Einstein's equations and their modifications, see paragraph *Derivation of Einstein's equation from modified QFT* in 5.2. This work is currently in progress.

The compatibility of the theory with CMB spectrum and BAO. A special separate extensions will need to address compliance of this dark-matter-free approach with the measured temperature fluctuations as the early universe reflections of the density variations, and also with periodic BAO ripples in the galactic distribution, which track the large-scale structure growth over time. Additionally, other focused astronomical observations of internal structures and dynamics of galaxies and clusters could be carried out in detail, to extend, confirm or correct part of this framework, if needed.

Finishing the new cosmological model based on this theory. With this nature of gravitation, GR seems to be an incomplete theory. Continuing on the section 4., the finalisation of already briefly preset and introduced concepts, related to the new interpretations of dark energy, requires completion, which could become a multi-year task. The same applies to cosmological constant, cosmic coincidence, cosmic history and evolution, and other ΛCDM shortcomings, designing the novel cosmological model free of now increasing amount of tensions. The emphasis should be more on the mathematical descriptions, which have already got strong conceptual guidelines in this article.

5.2. Testability

More observations of larger structures lacking dark matter. Postulates here suggest that dark matter is fully replaceable at all levels (3.3.2.) by the abandonment of current humanocentric misconceptions (3.3.1.), which is completely opposite of ΛCDM where the evolution and maintenance of cosmic structures is inseparably tied to dark matter gravitational wells. Without them, the early universe structure formation interpretation would face significant theoretical barriers. By paying more attention to the deeper monitoring of the large galactic dynamics, in the near future we should expect the discovery of dozens structures bigger maybe than the Milky Way whose dynamics indicates very little or no dark matter, but are compatible with 3.3.3. compact baryon's density and average distances. Such observations would be highly paradoxical to incorporate in ΛCDM, since tidal strippings explanation would be insufficient, unlike for dwarf galaxies, because ΛCDM deeply requires dark matter to cover evolution at such scales.

Core-cusp anomaly solution. The significance of the anomaly has already been covered extensively in 3.3.3. Accordingly, a broader and more comprehensive confirmation of such a solution is possible, with a special elaboration on the critical shortcomings of the dark matter approach with this anomaly, strengthening the plausibility of the whole theory. It is advisable to wait for the completion of the field equations as proposed in 5.1., which would allow for an even more nuanced control.

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Enormously massive, but uniform structures with weak gravitation. Scrutiny of the Bullet cluster situation (3.6.1.) explained that, contrary to GR, extremely large masses can have a minor gravitational effects because the emphasis is on the gradients and not the absolute value *per se*. It is possible to try to find comparable clusters that are almost identical in baryonic mass, distribution and size, but differ in a way that one has a massive ICM and the other does not. If their gravitational strengths would still be detected as similar, this would directly strike current understandings of gravitation and point towards 3.6.1. and rethinking the influence of (un)compact structures to attraction.

Mass distribution skewness in galaxies with dynamics deviations. According to 3.4., some smaller galaxies may show deviations from the flat-rotation-curve pattern, which is usual in this theory due to the continuous character of gravitation according to 3.3.3., depending on the density and distances of celestial bodies. A direct indication of the thesis would be the confirmation that dwarfs close to Newtonian dynamics, unlike their opposite dwarf counterparts, have on average a denser, more compact arrangement of bodies, showing shorter average distances. Alternatively, the same effect could be achieved with pronounced baryonic distribution skewness, if central regions are radically crowded in the core, combined simultaneously with disks unusually dispersed.

Gradient differences in vacuum energy. In cooperation with experimental scientists and available finances, direct attempts (at least in future) to conduct some imitations of the Casimir effect-like tests or similar newly proposed innovative ideas could be tried, to affirm that there are indeed detectable vacuum differences on the surface of the Earth and, for example, the ISS, or anywhere in space.

The quantum-classical unification theory, after completion. With the finalised shape of the modified QFT (5.1.), with implemented dynamic and reactive roles of field-vacuum background (2.2., 3.1., 3.2.) over the cosmic distribution as in 2.3. and conceptual separation from the notion of spacetime (2.4.), a new linked framework will open up in the near future (currently in progress), enabling many new insights amenable to experimentation of this idea, which is presented here in its introductory stage. Most of the rules from the Standard Particle Model should not be affected, preventing the introduction of theoretical chaos, while continuing to follow the principles of energy, momentum and charge conservations, Lorentz symmetries, causality and others. It should be noted that special review of unitarity (and its possible redefinition) will need to be made, but this is an extensive, advanced topic that will require probably many articles after this one.

Derivation of Einstein's equation from modified QFT. Although this theory claims that the curvature of spacetime is not the deepest mechanism behind the functioning of our universe, but rather the dynamic vacuum, Einstein's equations can still be used, especially in well-tested zones such as black holes or the Solar system, just as Newton's formulas continued to be used after the advent of relativity. Therefore, since according to 2.4., 3.1. and 3.2. the curvature of spacetime is to be considered as an extreme edge case of the ideas in 3.3.3., after the completion of the modified QFT in 5.1., there is an expectation that Einstein's equations should be derived from such a new framework. This would directly prove that the ideas of spacetime are indeed just a secondary effect of an underlying dynamic vacuum theory.

Variable nature of dark energy and dark matter over cosmic history. By relying to the introductory notes in 4., it is predicted that some of the ongoing or following dark matter and/or energy exploration projects would soon reach the 5σ threshold confirmation of both the Hubble and S8 tensions, undoubtedly eliminating the last lifeline for ΛCDM through some systematic errors in measurements, affirming the issues with the entire cosmology. The core aim is to find insights that will confirm concepts from 4., most of all those proving that dark matter shows until now inexplicable variability over time, since ΛCDM cannot imbed such behaviour, without aggressive fine-tuning lacking easy-to-grasp physical mechanism.

6. Summary and Conclusions

Gravitation here is an emergent phenomenon resulting from the fact that the arrangement of high-energy structures (mostly masses as celestial bodies) in vacuum-field background causes an

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extreme disequilibrium in the energy distribution. To reduce radical and unfavourable contacts (steep and sharp demarcations) of these bodies with low-energetic surroundings, the dynamic vacuum continuously adapts in a way that shapes more stable gradational transitions between them. Then, massive bodies try to reach their stable positions at any moment, by relocating where the difference between their and environment energies are decreasing, following entropic rules. Such a theory has been shown to effectively explain gravitation at all scales without dark matter and offers promising insights into many other mysteries of the universe where current cosmology is stuck. This paper is a part of broader theoretical researches of the reality of the universe and will need to strive towards more extensions on both classical and quantum perspectives.

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