

The Intrinsic Derivation of the Hubble Constant H in Cosmology

T. G. M. Gerlitz^{1,2,3,4,5,*}

¹Universidad Tecnológica de Panamá

²Departamento de Matemáticas

³Vía Puente Centenario

⁴Campus Metropolitano Víctor Levi Sasso

⁵Panamá, República de Panamá

*Corresponding author: qgerlitz@gmail.com

Received May 25, 2024; Revised June 26, 2024; Accepted July 02, 2024

Abstract A special relativistic procedure forms the basis of a theory for the exact derivation and detailed representation of the Hubble constant. The results allow statements to be made about the three cosmological topologies for a universe and a clear comparison of these types to one another. The result obtained is based exclusively on natural constants and shows the meaningful value in supporting experimental observations and their conclusions. From the extensive mathematical presentation a good understanding of the matter emerges including the amounts of distances between small and respective large masses in cosmos together with the associated time intervals. An imagined model is supplemented by the possibility of a negative, anti-universe. The phenomena in the difference topic to passive gravitational or respective heavy mass and inertial mass is discussed.

Keywords: time reversal, charge conjugation, gravity, classical mechanics, relativity

Cite This Article: T. G.M. Gerlitz, "The Intrinsic Derivation of the Hubble Constant H in Cosmology." *International Journal of Physics*, vol. 12, no. 4 (2024): 147-163. doi: 10.12691/ijp-12-4-3.

1. Introduction

In general, the universe is assumed be homogeneous and isotropic. This means the "tiny little dots" called galaxies and stars are evenly distributed in space. However, the universe or respective cosmos is subject to a certain kinematics and dynamics resulting in a non-static state being the theme of the present investigation. Such an idea is reinforced in the observations showing as an example the galaxies have no orientation in space whereby no direction or angle is distinguished as favored in their orientation in space.

An age of about 14 billion years is predicted from the Hubble' law via the constant $H_0(r)$ [1,2,3]. In form of that meaning at the current rate of expansion it takes a billion years for an unbound structure to grow in 7% in good agreement with the best-estimate of 13.8. Admittedly, this law does not match the speeds of the observable farrest galaxies. As always with all fundamental constants, such as Λ , G , and $\hbar$, the question of temporal constancy arises. In a certain way, the law is always confronted with the belief in a big bang, BBT, and many scientists cling on an $\mathcal{A}$ and Ω , which corresponds to human experience. A deviation in real

factors could mind rather than a few percent. Then, time-dependent Hubble parameter

$$H(t) = \frac{\dot{a}(t)}{a(t)} \quad (1)$$

describes the expansion rate and is the time-dependent derivative of the scale factor $\dot{a}(t)$. The today's value of this H parameter is designated the Hubble's constant

$$H_0 = H(t_0) \equiv \dot{a}(t_0) \quad (2)$$

with the world age t_0 . The measured value of the H provides the initial condition for solving the Friedmann equations [4] entailed from

$$H^2 = \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3} \cdot \rho - \frac{\kappa c^2}{a^2} + \frac{\Lambda c^2}{3}; \quad \kappa = -1, 0, 1 \quad (3)$$

Further, the expansion history depends on the density of the universe, Ω corresponding to the ratio of the matter density to the critical density for a matter dominated universe,

$$\rho = \rho_m(a) = \frac{\rho_{m_0}}{a^3}; \quad m_{\text{cosm}} \text{ dominate} \quad \text{and this depends on the distance,}$$

$$\rho_m(t_1) > \dots > \rho_m(t \rightarrow \infty) \sim \frac{1}{V_{\text{cosm}}}(t_1) > \dots > \frac{1}{V_{\text{cosm}}}(t \rightarrow \infty) \quad (4)$$

Then, an "acceleration" curve shows the trajectory of the scale factor for a universe with dark energy. The ratio of the H parameter to today's value is given as the expansion factor and can also be determined based on the respective total density $\rho(t)$. This connection are the Friedmann's equations in general form [4] as a set of equations in physical cosmology governing the expansion of space in homogeneous and isotropic models of the universe within the context of general relativity [5]. They base on the Einstein's field equations of gravitation for the Friedmann–Lemaître–Robertson–Walker, FLRW metric [6,7,8,9],

$$ds^2 = -c^2 dt^2 + (R(t))^2 \left\{ \frac{dr^2}{1-k \cdot r^2} + r^2 \cdot (d\vartheta^2 + \sin^2 \vartheta d\varphi^2) \right\} \quad (5)$$

$$k = (+1, 0, -1) \leftrightarrow (\Omega > 1), (\Omega = 1), (\Omega < 1)$$

$$R = R(t, k, \Lambda_{\rho(E-\text{dark})}) \text{ yielding a perfect fluid with}$$

a given mass density ρ , and pressure p . The equations for negative spatial curvature were given, too [10]. The above expressions show a series of constants which can be obtained or estimated in a very uncertain way, and rather require a simple theory allowing eventually more insights.

A uniformly expanding universe causes the objects be arranged along a straight line through the origin [2] and report linear relationship between the distance of galaxies (extragalactic nebula) and their redshifts [2, 3]. The image of the object must be resolved so well no light from other objects distorts the measurement result. This becomes increasingly difficult as the distance increases. Data used in the first Hubble diagram reached out to a distance of about 2 Mpc. Almost a century later measurements up to around 700 Mpc are possible [11]. This makes it possible to provide a much more reliable indication of the H . The homogeneous process of expansion, the Hubble flow, and H are measured in systematically recording the distance and apparent speed of astronomical objects in relation to an observer. Since these must be distant astronomical objects, the measurements are complex and subject to large uncertainties compared to other natural constants, i.e., the results very fragile. A large distance means – anticipating the theoretical part of the current investigation – a predominance of the centrifugal force, $F_{\text{centr}}(r)$ compared to a short distance, where the attractive force, $F_{\text{attr}}(r)$ becomes essentially weak, $F_{\text{centr}}(r_{\text{centr}}) > F_{\text{attr}}(r_{\text{attr}})$. The “point” ($F_{\text{attr}}, F_{\text{centr}}$) where change $v_{\text{attr}} \rightarrow v_{\text{centr}}$ takes place separating the two properties affecting an m -element does not really happen in a discrete manner or respective through a jump. Such behavior would only correspond to idealization: it is rather fluidly and continuously. So it is not a true clear point rather smooth transition and does not happen suddenly. Therefore, the

distinct spiral property in the near movement $R_{\text{galaxy}}^{\text{attr}}$ is not immediately a complete given up, more maintained in an increasingly weakened form until with increasing distance D or respective R , $R_{\text{galaxy}}^{\text{centr}}$ the trace of the movement asymptotically approaches the shape of a straight line (Figure 1).

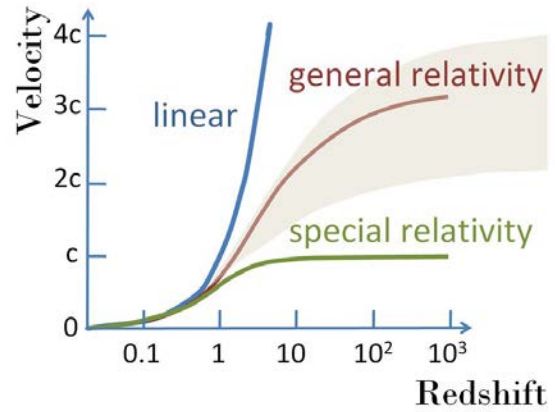


Figure 1. A variety of possible shapes from theories related to special and general relativity in linear presentation at low redshifts [18]

Admittedly, the measurement results vary considerably and the most recent detected show

$$H_{\text{exp}} = 68 \frac{\text{km/s}}{\text{Mpc}} \leftrightarrow 74 \frac{\text{km/s}}{\text{Mpc}}$$

Since galaxies not follow cosmic expansion, alone but rather also show their own movements of typically several hundred km/s, many galaxies have to be examined over a sufficiently large-range distance separating the two effects $R_{\text{centr}}, R_{\text{attr}}$ separated in a strict border mentioned above (Figure 2). The speed $v_{\text{cosmic}}(R) = z_{\text{corr}} \cdot c$ caused from cosmic expansion and the cosmological red shift have different origins rather than a proper (Eigen-) velocity v_{eigen} and the red or blue shift associated with it through the Doppler effect.

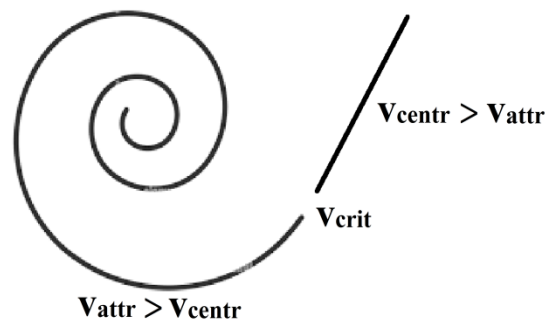


Figure 2. A snail illustrates the locally possible stations in an object observed in space in connection with the associated velocities with the distance from the observer

From datae of the Spitzer-Space Telescope based on observations in the 3.6 μm (mid-infrared) range to

recalibrate the Cepheid distance scale [12] the 'Carnegie-Hubble Program' scientists obtained new and highly accurate values for H . This means to now determining more precisely in factor 3 analogous an uncertainty of only three percent [11],

$$H_0(\text{SWT}) = 74.3 \pm 2.1 \frac{\text{km}}{\text{s} \cdot \text{Mpc}} \quad (6)$$

Depending on the universe's content of normal (baryonic) matter, say dark matter and dark energy, the expansion can be delayed or accelerated, and there exists a relationship between a world time t_0 or respective world age and the Hubble time, *e. g.*, [13]. The reciprocal

$$\frac{1}{H_0} = t_{\text{Hubble}} \left[\frac{\text{s} \cdot \text{Mpc}}{\text{km}} \right] \rightarrow [\text{s}] \quad (7)$$

is called the Hubble's time, precisely

$$t_0 = \frac{2}{3H_0} \quad (8)$$

with

$$H_0 \rightarrow v_{\text{Hubble}} = \frac{\omega_{\text{Hubble}}}{2\pi} \left[\frac{\text{m}}{\text{s} \cdot \text{Mpc}} \right], [\text{Hz}] \quad (9)$$

it would be equal to the age of the world of around 14 billion years concerning uniform expansion in an empty universe, *i. e.*, the time that has passed since the Big Bang, BB. This results in a Hubble time t_{Hubble} of 14.561 billion years while the actual world age zero is approximately 13.844 billion years [2].

In accordance to the Hubble's law the distance D is to be distinguished from the relative expansion in moving distances being the rate of change in scale factor $\dot{a} = H \cdot a$ it is mostly talked about this scaled expansion. Consistent with the BBT as the expansion of the universe slowed after the initial inflation and during the first billion years of its existence. Since then, the relative rate of expansion has increased. The explanation of this observed accelerated expansion was subject of actual research and has led to the concept of dark energy. The absolute expansion speed, in turn, continues to be slowed down from gravity and, according to the concept of dark energy asymptotically approaches a constant final value. Since galaxies not only follow cosmic expansion, but also show their own movements of typically several hundred km/s, many galaxies have to be examined over a sufficiently large range distance separating the two effects in centrifugal and attractive forces $R_{\text{centr}}, R_{\text{attr}}$ separated at strict border. $(R_{\text{galaxy}}^{\text{crit}}, v_{\text{galaxy}}^{\text{crit}})$ (Figure 2).

In the local universe, *i. e.* over small distances $D_{\text{galaxy}}, R_{\text{galaxy}}$ compared to the radius of the observable universe $R_{\text{galaxy}}^{\text{obs}} < R_{\text{galaxy}}$ the Hubble constant is the proportionality constant of the approximately linear relationship between the distances D of galaxies and the redshifts measured from their spectra

$c \cdot z \approx H_0 \cdot D$. Important here is consequently the consideration and determination of the critical point. The product $v_H = c \cdot z$ is often approximately interpreted as the recession velocity in terms of the Doppler effect, $v_{\text{Doppler}}^{\text{rec}} = H_0 \cdot D$. The exact relationship between cosmological redshift and distance is nonlinear and truly requires integration over the time course of the scale factor $a(t)$. Though, exact relationship between cosmological redshift and distance is nonlinear and requires integration over the time course of the scale factor good approximation within the quasi-linear-velocity part is possible [14,15]. In this, arguments regarding the speed of faster than light, superluminality [16,17] should not be ignored [18], (Figure 1).

It is true limit galaxies not follow cosmic expansion, alone: they rather show their own movements of typically several hundred km / s, *e., g.*, their (eigen-) proper rotation [19]. This obliges many galaxies be examine over a sufficiently large range of distances to separate the two effects. The cosmological red or respective blue shift differ from proper velocity, and a critical point be bolden between linear and non-linear description.

In physical cosmology dark energy, DE as a hypothetical form of energy permeates all of space to become the most accepted explanation. In this regard, there are of course a number of important parameters those predominate when describing the expansion of the universe and, *e., g.*, energy density and curvature are contributions to the overall evaluation in density leading to expressions as fractions of the critical density. Moreover, investigations claim the positive cosmologic constant Δ is equivalent to DE with respect to the cold matter model, CDM. Some theories on expansion, even deal with superluminality and negative mass to find application due to DE and dark matter, DM; creation of matter is discussed on the question to the remain of in this leaving mass, ΔM [20]. One approach to identification of DE is found in modifying Robertson-Walker spacetime [6] It was suggested pressure causes the spatial expansion, a theory referring to the Schwarzschild's metric allowing mathematical prove on an inversely proportional relationship between H and cosmic density [21]. Another possibility is found on the completeness given from comparison of shrinkage vice versa expansion [22]. With the option part you can also make statements, at least approximately, about the parameters mentioned [21].

From unifying gravity and electromagnetism an investigation suggested a concept entailed from redshifts connected to the Planck's h changeable over time. It was shown the magnitude of h increases with increasing cosmic time as this quantum of enrgy gradually increases as well during cosmic evolution. From indepth formalism the dependence of H_0 to $h(t)$ becomes evident and related to a rotating universe [23], and compare the results could manifest agreement with experimental observations [24]. In this paper the H constant could be shown emerged from the finestructure constant α . This is a very profound statement, as it could also lead to gravitoelectromagnetism, GEM.

As a consequence the experimental results are subject to great uncertainty, the desire arises for a plausible,

clearly understandable, yet comprehensive theory and becomes the task of the current work.

2. Theory

1. General considerations and facts about geometry

In spacetime nothing is at rest, in accordance to the uncertainty in quantum mechanics, QM [25,26] It should be mentioned according to the findings from the Lambda cold dark matter, Λ CDM theory the universe is assumed be globally flat ($\Omega \gtrsim 1$), arguably uncurved with infinite extension *e.*, *g.*, [27,28] This does not result in any contradiction to the current work as not ignoring spherical distribution; justification will rather become obvious throughout the text in theory. The conditions are presented applying to a space using quasi introductory elements as this comes closer to understanding.

An initial idea of the assumed spherically symmetric distribution of mass, m respective M in the cosmos is well comparable to the spherical propagation of ions located around an electrically charged center in an electrochemical model [29]: in particular, the ions near the center are subject to the attraction of the central ion, whereas the bodies seem to experience repulsion as the distance R from the center increases. An analogue to gravitational attraction and centrifugal forces can be seen here. A description of the location of the mass objects m , which do not change internally and are initially assumed be constant [30], obeys mathematically spherical coordinates (Figure 3, Figure 4).

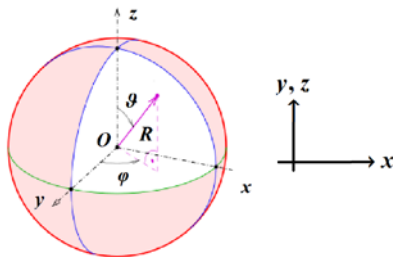


Figure 3. Spherical coordinates compared to Cartesian for highlighting the exposed x-direction [60]

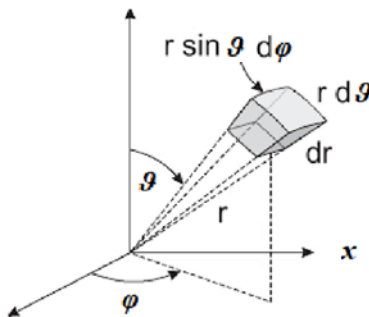


Figure 4. A spherical space element in three spherical coordinates with the observation direction x [60]

In the work presented here space is handled 3-dimensionally in Cartesian coordinates. A later orientation

of the universe within a 5-dimensional hyperspace $\mathbb{R}^5$ [31] will just be discussed later. The direction of observation is the x -direction, driving forces basically go back to y and z . In spite of all a 3-dimensional overall space, first is assumed the calculation essentially take place in the $x-y$ plane or, equivalently $x-z$ (Figure 4). All the vector compounds in y and z render the fundamental in determining the variables radius r , active mass m , velocity v , and angle velocity ω . It should also be noted the velocity or dealed speed v appears in vector character clearly to obey when and where its components occur. All of these variables are linked to one another.

As will be explained below, a negative space relates to a positive space exactly transposed-conjugated, not just mirrored. So the fraction $S_-^{\text{hyper}} = r_-^{\text{hyper}} / (2\pi)$ in the first case contradicts the (usual) product $S_+^{\text{sphere}} = R_+^{\text{sphere}} \cdot (2\pi)$ in the second, as will become clear further below (Figure 5).

From both approximations termed week-field and slow-motion the Einstein's Field Equations, EFE reduce to the Newton's gravitation law to determine this G in the EFE, *e.*, *g.*, [32]. In the present theory consequently, the conditions in this aspect are already simplified to fields occurring very low as are the velocities from the outset due to the initial condition.. If the conditions in real space exhibiting both very large distances and tremendous M had been assumed immediately, this simplified form would not be considered true. It is true the entire system seems unreal and too simple, but immediately provides insight into degree and amount of the variables to allow later transfer to the real cosmic system. It is noted parenthetically the present study can completely sufficient be based on Cartesian coordinates, which in a simple sense is already justified from the appearing small angles themselves.

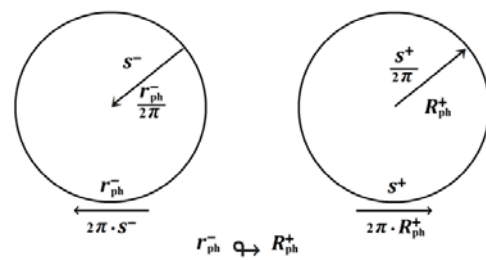


Figure 5. Schematic illustration of the assignment and contrast in transference circumference S to radius r in hyperbolic and spheric spaces

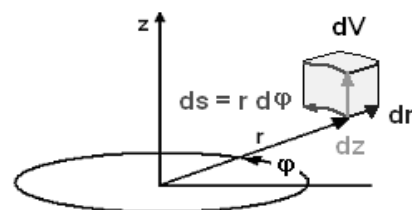


Figure 6. Effect of a rotation from the origin of a space on a volume element

2. Principles of the model

Figuratively speaking the central event is a disk rotating at angular velocity ω on which, at the beginning there is a mass, m element attached (Figure 6, Figure 7). As the object rotates, this object slides more and more outwards on the disk due to the centrifugal force acting on it. Finally, the influence of the attractive force on the disk decreases until it fades and is replaced from the centrifugal force increasing with rising distance r from the center (Figure 7). This is neither a complete disappearance of the first force nor the complete and exclusive predominance of the second (lat.: *natura non facit saltus*). Both forces remain, they are omnipresent in weaker or stronger. At the critical point of transition, $r_{\text{crit}} (F_{\text{attr}}/F_{\text{centr}})$ there is no strict, abrupt end of one and the beginning of the other but rather continuous and flowing change, merely sometimes one wins over the other (Figure 8).

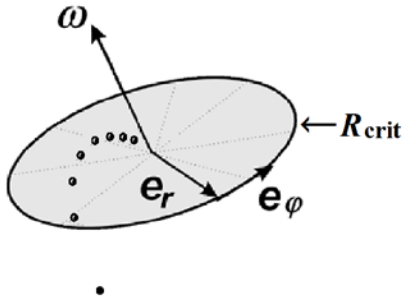


Figure 7. A rotating disk causes the centrifugal force F_{centr} on an m -object in space

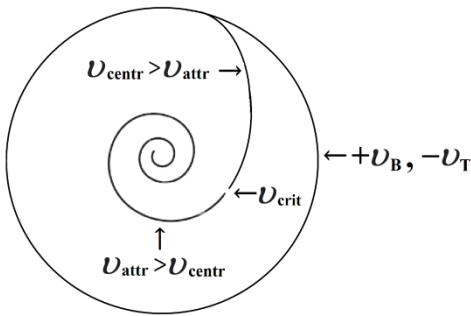


Figure 8. Differences in the trajectory figured from the observed object depending on the varying speeds as function associated to F_{attr} and F_{centr}

The opening of the mathematical process seems bit strange, but it will become clear, immediately. For description of a space like the universe five variables are necessary. These are the radius r , R connected to diameter d , D , mass m , M , velocity v of any object in space, and the angular or circular velocity ω of the entire system. Further, the real cosmos certainly reveals flat curvature ($\Omega \approx 1$) [33] and a, then 2-dimensional representation of the real universe in Cartesian coordinates coming into question here is sufficient and does not need be justified. Albeit, the cosmos claims flat in its manifestation the entire treatment should always be universal. A spherical system with positive curvature ($\Omega < 1$) as a general result poses difficulties with regard to the variables in this open system obliging the calculation begin with a closed ($\Omega > 1$) anti-respective nega-verse [31] as exhaustively discussed

elsewhere for a spatial distribution of negative curvature, e., g., [9,10,28,33,35].

A closed space can be compared to the size of subjects in atomic range exposing the feature be stable in figure. This $\bar{r}_{\text{atom}} \leftrightarrow \bar{R}_{\text{cosm}}$ offers the advantage determine its r contrasting the description of open and not necessarily stable spaces keeping free to expansion.

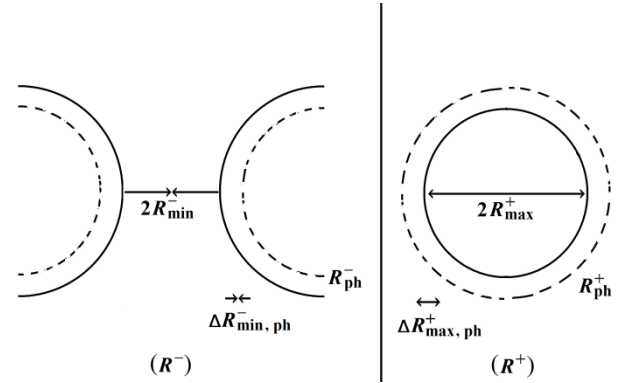


Figure 9. Schematic representation of the relationships between the photon radius (pH, dashed lines) and the "true" outer negative radius R^- (left) respective inner positive radius R^+ belonging to their distinct spaces

A stable and unchanging state is of course possible as well in open systems restrictedly appearing between the two mechanical forces attractive and centrifugal exactly at the point $r_{\text{atom}}^{\text{max}} \leftrightarrow r_{\text{crit}}$, alone. A transition

$\vec{F}_{\text{attr}} \leftrightarrow \vec{F}$ occurs smoothly and continuously, not abruptly in a regular replacement of one force by the other. Here, both forces are omnipresent and must always be included at the same time, even if as the distance from the observer increases and F_{centr} predominates to a large extent while F_{attr} fades into the background, so to speak. This is obviously an important boundary between non-linear and quasi-linear behavior (Figure 1) in the (experimental) measurement of distances between two m or M from each other using redshifts. Thereupon, direct determination of the $^+R_{\text{cosm}}$ as required for the

calculation of type open in its geometry, such as that of the universe, is difficult and limited to uncertain measurements or even estimates. For clarification be emphasized a nega-verse is directed inward with a vector

$\bar{r} \equiv \bar{R} = -|\bar{R}|$ correctly located and ending at its "center" $\bar{r}_{\text{max}}^{\text{hyp}} \triangleq \bar{r}_{\text{inside}}^{\text{hyp}} \rightarrow 1/(-\infty)$ of this hyperbolic space (Figure 9), even if it sounds strange. The opposite $^+R_{\text{max}}^{\text{sph}} \triangleq R_{\text{out}}^{\text{sph}} \rightarrow (+\infty)/1$

is true for a posi-verse be mind in detail during treatment [26]. A way across negative space is argued the only possibility for exact working, alone. Following these remarks, the attention will, first be turned to this mini-structure with r and the acquired expressions will then be transferred via reversal process into the "larger" space R , the universe. It is, then a reverse "inside-out". In the view

of the above indices should be noted, as will become clear further down in the text, this index mentioned it is not exactly the outermost spherical shell in positive space being compared; it is rather the photon radius used for work on the technique (Figure 9).

3. Mass m in small space r

Given the entitlement of the present task an m is sought which can, if possible, be introduced without the help of existing quantities other than natural constants. Such a foundation is achieved from comparing the elementary electric charge e to a gravitational elementary m , $e_{\text{el}} \rightarrow m_{\text{gr}}$.

A first approach is to generate a gravitational m via comparing to electrostatics. As a consequence of this finding and especially with regard to the gravitational interactions discussed here, an alteration of the two phenomenae mentioned is desirable as they depend mutually on each other. First step is an equating of the interaction forces in the Newton's law [36] disclosing

$$F_{\text{el}} = \frac{1}{(4\pi\epsilon_0)} \cdot \frac{(-e) \cdot (+e)}{r^2}, \quad F_{\text{gr}} = \frac{G}{1} \cdot \frac{(-m_0) \cdot (+m_0)}{r^2} \quad (10)$$

$$\frac{1}{(4\pi\epsilon_0)} \cdot \frac{e \cdot e}{r^2} = \frac{G}{1} \cdot \frac{m_0 \cdot m_0}{r^2} \leftrightarrow \frac{1}{(4\pi\epsilon_0)} \cdot \frac{(e)^2}{r^2} = \frac{G}{1} \cdot \frac{(m_0)^2}{r^2}$$

$$\frac{1}{(4\pi\epsilon_0)} \cdot \frac{e^2}{r^2} = \frac{G}{1} \cdot \frac{(m_0)^2}{r^2}$$

$$m_0 \equiv m_{0,1} = m_{0,2} \quad ! \quad \leftrightarrow \quad \vec{m}_0 \equiv +\vec{m}_{0,1} = -\vec{m}_{0,2}$$

$$m_0 \equiv m_{\text{el,gr}} = \pm \left\{ \frac{e^2}{(4\pi\epsilon_0) \cdot G} \right\}^{1/2} \quad (11)$$

to finally show the gravito-electrostatic m value non-relativistic at rest of absolute amount

$$m_0^{\text{el,gr}} \stackrel{\Delta}{=} \pm 0.206864(89) \cdot 10^{-9} \text{ kg}, \quad m_0^{\text{el,gr}} = m_{\text{rest}}^{\text{el,gr}} (v=0)$$

in arbitrary direction.

An almost infinitesimal small value of a subject m can, of course, never compete or respective compared to an M within a theory dealing with interactions of entire galaxies demonstrating their tremendous huge properties in a "usual" real cosmos (posi-verse). This ascertainment takes up that fact mentioned at the beginning and leads over to the ensuing section processing huge M located in a vast space with almost infinite radii r and diameters d in the small (Figure 9, Figure 10). Clear, the r in the anti- or nega-verse is directed inwards, i. e. is negative, whereas the positive R in the real posi-verse points outwards

labeling extremae $^-R_x^{\min}$ and $^+R_x^{\max}$. As long as is truly kept about 1 to 2 percent below C it is essentially obvious the classical and non-relativistic m can be used (Figure 10, Figure 11). Throughout the theory applies $m_{0,T}(v=2c) = -m_{0,B}(v=0)$ and $\Delta t_{0,T}(v=2c) = -\Delta t_{0,B}(v=0)$, i. e., CPT.

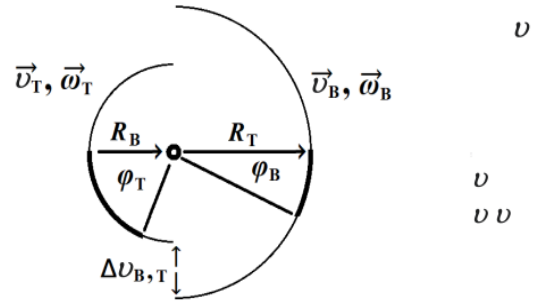


Figure 10. The specific influence of bradyon V_b and tachyon V_t velocities on their distinct track distances s to the "driving" difference speed $V_{T,B}$ together with their related angles ϕ and angular velocity ω

Clear, use in any calculation with subject electrodynamics care will be taken with respect to eventual shielding, but such an m_0 should representatively denote the two m gravitationally interacting with each other. In the case the limit speeds are not reached their decisive effect as universal fades and the model is negated the reason, among other things separate consideration of v is excluded finally or accentuated in other ways. The term $m' = m \cdot \sqrt{G}$ incorporates the gravitational constant in $\sqrt{G}$ [37], strictly speaking, actually belongs to any m itself. If there appears no counter- m in the space under consideration, i. e., m_{rest} is unaccompanied it will show no weight, $m_{\text{rest}} = 0$. If "rest" is canceled by an accelerated movement $\vec{a}$ the m is identified inertia (see below). Light as electromagnetic wave, EMW exists through its movement, alone,

$$m_v^{\text{lum}}(v=c) = m_v \cdot \exp[\vec{k} \cdot \vec{r} - \vec{\omega} \cdot \vec{t}] \neq 0, \quad m_v^{\text{lum}} \rhd \text{const} \quad (12)$$

with variables and constants unveiling vector characters.

In view of a "turn over" via reverse small m into large M a problem arises. Due to the transition from extremely tiny dimensions $^-m_{\text{micro}}^{\text{cosm}}$ to an actually enormously large space $^+M_{\text{macro}}^{\text{cosm}}$, simply making use of the principle $^-m_{\text{micro}}^{\text{cosm}} \propto ^+M_{\text{macro}}^{\text{cosm}}$ in mathematical reciprocal of the above result, in a first view could never lead to a consistent result. Of course, such consideration is apposite in some aspects, but rather requires clear

comparison. More, some kind of dimensionless transformation should expediently take place.

So, 5 variables are linked to each other, and a statement cannot be made independently be free. A first step is therefore taken to work out a reliable, real radius for a (mini-) nega-cosmos. Due to the later reverse process, the mini-universe into the real one, the $\mathbf{m}$ will of course also change significantly [38]

4. Elements for the small radius $\mathbf{r}$ touching the angular frequency ω

or also angular speed. As mentioned above, all variables in the model are linked to one another. In contrast to the last statements these two subjects cannot be treated independently in separation of each other. In this section rotation of an entire small object comes to the fore introduced before as an anti- or nega-verse. In perception one $\mathbf{m}$ runs alternating between the two states Bradyon B and Tachyon T also an EMW as light can be described [39]. Decisive are the two v ought to match these limit speeds (Figure 10)

$$\begin{aligned}
 v_B &= 0.99\,997\,30\,178\,4 \cdot c \\
 v_T &= 1.00\,002\,69\,821\,5 \cdot c \\
 v_B &= 0.29\,978\,43\,689 \cdot 10^{+9} \text{ m/s} \\
 v_T &= 0.29\,980\,05\,470 \cdot 10^{+9} \text{ m/s} \\
 v_B &= (1 - \alpha^2)^{1/2} \cdot c, \quad v_T = [2 - (1 - \alpha^2)^{1/2}] \cdot c \\
 \alpha &= \frac{e^2}{2h\varepsilon_0} \\
 v_{T,B} &\equiv v_{\text{gap}} \equiv (v_T - v_B) \\
 &\equiv 2[1 - (1 - \alpha^2)^{1/2}] \cdot c = \alpha^2 \cdot c \\
 v_{T,B} &\stackrel{\Delta}{=} c \cdot 53.964\,26 \cdot 10^{-6} \text{ [m/s]} \\
 &= 16.17\,807\,81 \cdot 10^{+3} \text{ m/s}
 \end{aligned} \tag{13}$$

[40,41] confirmed experimentally, e. g., [37,38,39,40] originated

$$v = \frac{(2h\varepsilon_0 c / q^2)}{\sqrt{1 + (2h\varepsilon_0 c / q^2)^2}} \cdot c, \quad \frac{c}{v_B} = \frac{v_T}{c} \tag{14}$$

fundamental for discussion of the kinetics in space (Figure 10) [16,17,40,41]. Then, the idea is directed to an object

$\mathbf{m}$ descriptive a track $\mathbf{S}_{B,T} \equiv \mathbf{S}(\Delta v \leftrightarrow v_{B,T})$ around circumpherencing with $v_B \lesssim c \lesssim v_T$ a fictitious center, the required v near close $\mathbf{c}$. The latter

formula is an unconditional requirement for the system to strictly be adhered, which is why a path

$$\mathbf{S} := \mathbf{S}(\Delta v \leftrightarrow v_{B,T}); \quad \mathbf{S} \parallel (\mathbf{y}, \mathbf{z}), \quad \mathbf{S} \perp (\mathbf{x}, \mathbf{r}) \tag{15}$$

and at the same time a bring-forth distance $\mathbf{d}$ repective $\mathbf{r}$ should be precisely defined. This is in order to fulfill the conditions allowing to later make a correct statement about this effect and its influence on what is happening. Such an intended project is complicated in terms of the two $\mathbf{r}_B$ and $\mathbf{r}_T$ of each other regarding the space circle (Figure 10). The distances to the fictitious center are certainly not clearly distinguishable, since $\mathbf{m}_T$ moves faster than $\mathbf{m}_B$ to evoke

$$\frac{v_B}{v_T} \equiv \frac{r_T}{r_B}; \quad v_B < v_T, \quad r_B > r_T \tag{16}$$

At this point be emphasized once again this model is the description of the movement of a single, albeit real and not "artificial as in EMW" [39], $\mathbf{m}$ breaking up into a pair of twins

$$\begin{aligned}
 \vec{m}_0 &= \vec{m}_B \leftrightarrow \vec{m}_T \\
 m_0 &= +m_{0,B} \leftrightarrow -m_{0,T}
 \end{aligned} \tag{17}$$

due to the special effect used here [16,17]. Both $\mathbf{m}$ in this idea result 'per se' from one single

$$\vec{m}_B \equiv +m_B, \quad \vec{m}_T \equiv -m_T; \quad \|m_B\| \stackrel{!}{=} \|m_T\| \tag{18}$$

intrinsically, alone changing in state between sub- and superluminal and only exists when in motion respective directly bordering their critical speed limits – similar to a light wave. If these two twins, twin (m_B/m_T) , be avoided here, were to meet, it would mean mutual annihilation to void – not even a death cry would be the result,

$$\begin{aligned}
 E &= -(i\hbar c \alpha \nabla - \beta m_0 c^2) \psi(\mathbf{r}, t) \\
 + \frac{E}{2E} &= \frac{+(i\hbar c \alpha \nabla - \beta m_0 c^2) \psi(\mathbf{r}, t)}{0 \quad \psi(\mathbf{r}, t)}
 \end{aligned} \tag{19}$$

For safe description of the situation is emphasized $\mathbf{r}(v_s)$ and $\mathbf{m}(v_s)$ to not describe a steady state from the outset, because the distances to their center are different for bradyon, B and tachyon, T from their unique orbit $\mathbf{s}$ they belong to (Figure 11). The original two $\mathbf{m}$ are of opposite sign demonstrate still and always the same absolute amount. Consequently, the absolute amounts $\mathbf{m}$ remain constant keeping the same amount while the two $\mathbf{r}$ separately refer to distances $\mathbf{r}(v_s)$ feeding in adjustment. Both options underwrite the same

[31,39,46,47]. It has to be respected precisely $R_x^{\text{obs}} \perp (s, y, z, v_{y,z})$ only $R_x^{\text{obs}} \parallel v_x$ as

$v_s \equiv v_{y,z}$ is the key for the orbiting m drawing a

route S in its only path connected to r in question. Special about the twin couple is the two partners are always of the same absolute amount as a result of the basis statement: if one object changes in any way, the other will change to exactly the same extent, the mirroring appears [16,17], valid in case of no tricky and awkward influences. Such a statement is limited, strictly speaking it applies exclusively to systems be undisturbed from the outside. This is generally true for external influences in the sense of other m -objects, i., e., in the view of the real universe strong impact from neighboring galaxies "left and right" of the observation line R_x^{obs} . Such a disturbance from

outside this measurement direction can confidently ignore this because of the enormous effect on the current system considered to later become obvious. Since a real $m_0 \leftrightarrow m_0^{\text{rest}}$ permanently exists for any $v \lesseqgtr c$, their being is not the consequence due to the fundamentals of the relativistic derivation to the uniformly the same orbital speed: the reverse is proper, and the m_0 , themselves have not be relativistically adjusted as a consequence of their fast $v \lesseqgtr c$, say $v_{B,T}^{\text{omni}} \stackrel{\Delta}{=} \Delta v$. This has already been indicated above via the factor α [40, 41] turning up

$$m_B^{\text{rest}}, m_T^{\text{rest}} \stackrel{\alpha}{\rightarrow} m_B^{\text{rel}}, m_T^{\text{rel}} \quad (20)$$

only to become important when considering distances exceeding the Hubble limit (Figure 1, Figure 2),

$$R_{\text{obs}}(v \lesssim v_{H_0}) \equiv R_{\text{obs}}(v \lesssim v_B) \xrightarrow{\text{jump}} R_{\text{obs}}(v \gtrsim v_{H_0}) \equiv R_{\text{obs}}(v \gtrsim v_T) \quad (21)$$

The theory is only correct if $v_{B,T}^{\Delta \text{limit}}$ can be achieved, mean the respective maximum (limit) $v^{\text{limit}} \rightarrow v_B, v_T$ must be true and perpetuated. As fact, this section concerned with finding and defining a location where these conditions are fully met, and this can never be merely estimated because of the demands; it is the only requirement in the model together the extremely achievable proposed for this. Parenthetically, it is important to have clear indexing in order to draw attention to the facts and not to increase confusion in the text. A bradyon, for example, can move at 10 km / h or not at all, but this means it has reached a v but still far from reaching a limit speed.

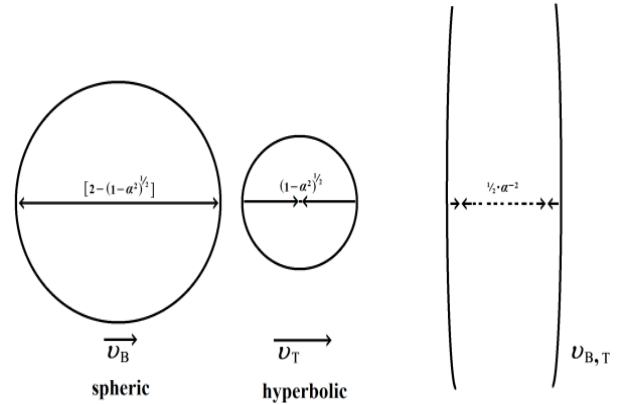


Figure 11. The influence of the different forces entailed from the assigned distances r_B, r_T clearly represented in the bloated result from the dimensionless factor α for a (negative, hyperbolic) mini-space

5. Indepth assessment of r

Crucial is the finding a concise place as the boundary of the (two) space models. It is conclusive this point be concluded for two reasons: the first is the predicted shrinking respective expansion, in which the universe $-r_{\text{mini}}^{\text{shrink}}(v_B, v_T), +R_{\text{large}}^{\text{exp}}(v_B, v_T)$ (Figure 10, Figure 11) under consideration ultimately expands at almost the speed of light, that is v_B, v_T , from which the limit is to be determined; the other is, to a certain extent, the reversal of the first, namely this limit point of expansion is again reliably determined from the first-mentioned maximum speeds v_B, v_T . Both arguments are for that linked to one another, certainly well founded for justification of this decision.

Including the balance as "weighting" the distance d between the two objects on their conjointly spherical orbit [31,39], (Figure 12, Figure 13, Figure 14) is

$$\begin{aligned} r_{\text{mini}}^{\text{balance}} &:= r \equiv \frac{r_B + (-r_T)}{r_B - (-r_T)} \cdot \frac{r_{\text{free}}}{2} \equiv \frac{\Delta r_{B,T}}{r_B + r_T} \cdot \frac{r_{\text{free}}}{2} \\ &= \frac{r_{B,T}}{d_{\text{free}}} \cdot \frac{r_{\text{free}}}{2} \\ r &= \frac{r_{B,T}}{4}, \quad r_{B,T} \stackrel{!}{\ll} r_B + r_T \end{aligned} \quad (22)$$

From replacing the highlighted variables those separate the event per the above relations and yields with $r_{\text{mini}}^{\text{balance}} := r$

$$\begin{aligned} r &= r_{\text{free}}^{\text{unbal}} \cdot \frac{1}{2} \frac{\{[2 - (1 - \alpha^2)^{1/2}] - (1 - \alpha^2)^{1/2}\}}{\{[2 - (1 - \alpha^2)^{1/2}] + (1 - \alpha^2)^{1/2}\}} \\ &= \frac{[1 - (1 - \alpha^2)^{1/2}]}{2} \end{aligned}$$

$$r = \frac{1}{2} [1 - (1 - \alpha^2)^{1/2}] \cdot r_{\text{free}} \equiv \frac{1}{4} \cdot \alpha^2 \cdot r_{\text{free}} \text{ [m]} \quad (23)$$

$$\alpha = \frac{e^2}{2h\epsilon_0}$$

$$r \stackrel{\Delta}{=} 13.31\,283\,86\,3\,(20) \cdot 10^{-6} \cdot r_{\text{free}}^{\text{unbal}} [\text{m}]$$

still undetermined, since no $\mathbf{m}$.

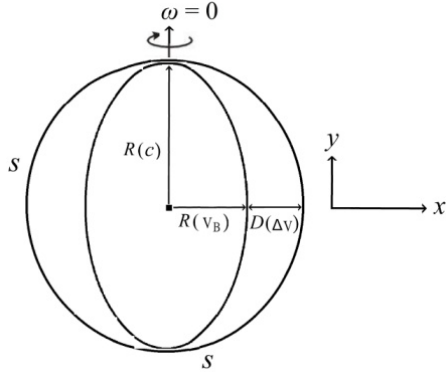


Figure 12. The separate effect of F_{attr} at on a room at rest and $\omega = 0$ creates an ellipsoidal shape

So far the principle for a perfectly spherical system, and now a suitable $\mathbf{m}$ must be chosen. Such a project once again requires a precise decision among the possible values for it, which is why the possible options are given. In order to achieve the actual numerical value a first attempt is using classical Newton's laws of gravity. It is, hence (Figure 12)

$$\vec{F}_{\text{attr}}(m, r) = \frac{G}{1} \cdot \frac{\vec{m}_1 \cdot \vec{m}_2}{|\vec{r}|^3} \cdot \vec{r}_{1,2} \quad (24)$$

$$\vec{F}_{\text{centr}}(m, r, v) = \frac{\vec{m}_1 \cdot (\vec{v})^2 \cdot \vec{m}_\infty}{(\vec{r})^2} \cdot \vec{r}_{1,\infty}$$

$$\vec{m}_\infty = m(F_{\text{centr}}) \quad (25)$$

(Figure 12). These two expressions describe two forms of forces emphasizing $\mathbf{m}$ enters into the first equation only once, its "counterpart" is formed from rotation. Both formulae must be taken into account together within one representation alone, mind the equation of the attractive force $\vec{F}_{\text{attr}}(m, r)$, although receding at high speeds, is omnipresent. The word omnipresent points out with an $r_{\text{crit}}(F_{\text{attr}}, F_{\text{centr}})$ the contribution of the one force does not suddenly disappear but rather is completely always incorporated together with the influence of the other. A comparison in equate

$$\frac{G}{1} \cdot \frac{m \cdot m}{r^2} = \frac{m \cdot v^2}{r} \rightarrow \frac{G \cdot m}{r} = \frac{v^2}{1}$$

$$m = m_1 = m_2 \quad (26)$$

permits non-vectorial notation. Since this v is related to the circumference S the factor (2π) must be included. When calculated the result it opens up several possibilities for insight into the model, now keeping in mind the comments on the hyperbolic character (Figure 5),

$$\frac{G}{1} \cdot \frac{(2\pi)^2}{1} \cdot \frac{m \cdot m}{r^2} = \frac{2\pi}{1} \cdot \frac{m \cdot v^2}{r} \rightarrow \frac{2\pi G \cdot m}{r} = \frac{v^2}{1}$$

$$r(m, v) = \frac{2\pi G \cdot m}{v^2}, \quad m(r, v) = \frac{r \cdot v^2}{2\pi G}, \quad v(r, m) = \frac{2\pi G m}{r} \quad (27)$$

with $r_x \perp (m_s \parallel v_s)$. It is, first

$$r^{\text{pure}}(m, v) = \frac{2\pi G \cdot m^{\text{pure}}}{(v^{\text{pure}})^2} \quad (28)$$

Due to the theory of the v [16,17], $\mathbf{m}$ remains unaffected in terms of magnitude, since this is already taken into account relativistically, whereas $\mathbf{r}$ must be adjusted to a relativistic basis in this sense (Figure 11),

$$r_{\text{crit}} \equiv r_{\text{crit}}^{\text{adj}}(m, v) \equiv \frac{2\pi G \cdot m^{\text{non-adj}}}{(v^{\text{adj}})^2}$$

$$= \frac{2\pi G \cdot m_0}{(v_{B,T})^2}$$

$$r_{\text{crit}} \equiv r = \frac{G \cdot m_0}{c^2} \cdot \frac{2\pi}{\{1/2[1 - (1 - \alpha^2)]\}^2}$$

$$= \frac{G \cdot m_0}{c^2} \cdot \frac{32\pi}{\alpha^4}$$

$$r = \frac{G \cdot m_0}{c^2} \cdot \frac{32\pi}{\alpha^4} \equiv \pm \frac{16 \cdot e \cdot \sqrt{\pi G}}{\alpha^4 \cdot c^2 \cdot \sqrt{\epsilon_0}} \quad (29)$$

$$r = 5.44\,615\,(18) \cdot 10^{-27} \text{ m}.$$

manifesting a perfect and flawless sphere or circle, why this demonstrates the only determining point for a perfect reflection of the angular speed or rotation ω of the space under consideration. This can be referred to as the influence "just outside the spinning disk" (Figure 6, Figure 7), say not adhering at least mat on it. The property as kinetic force is generally higher compared to the pure and static attractive one; it occurs precisely at this point the two twin $\mathbf{m}$ should fulfill exactly the conditions stated, more expressly required, and exclusively at this point. The force due to rotation, then applies further in and further out. The space under consideration is very clearly

transferred from one ellipsoid to another ellipsoid, with the first appearing to be compressed and squeezed in the x direction from gravitational attraction, whereas initially both effects seem to cancel out at the critical distance. After that, now the centrifugal force also creates an ellipsoid but appearing squeezed in y-z direction (Figure 13). In addition, in order to be complete, it should not go unmentioned a strong relativistic effect then, is very fragile when viewed.

After this interim result for the (mini-) nega-verse, which is reminiscent of atomic sizes, the ongoing investigation turns to the

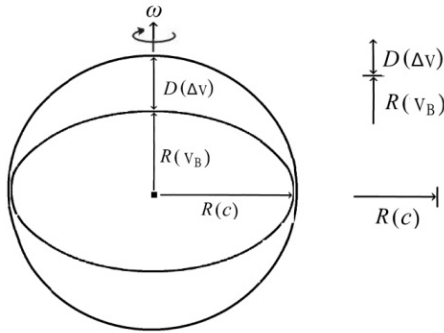


Figure 13. Separate effect of F_{centr} on a rotating room at $\omega \neq 0$ entailing an ellipsoidal shape

6. Real dimensions in the universe

From a mathematical point of view the entire investigation is not complicated, but a precise and in-depth observation, even figuratively speaking, is somewhat demanding; in this sense, knowledge about black holes may be important [48,49].

The mathematical derivation of an idealized Hubble's law for a uniformly expanding universe is fairly an elementary theorem of 3-dimensional Cartesian coordinate space considered a metric space. If assumed properties did not vary with location or respective direction it would be entirely homogeneous and isotropic. This not exactly hold true, albeit the results at very long distances correspond to good approximations. Before the implementation, which basically refers to philosophical aspects and is quasi-provoking in relation to large stretches, is discussed in more detail at this point, reference should be made to the discussion part; this is squarely indicated to say.

In mental imagination the innermost point, the centre as place of the observer in the real, *i. e.*, posi-verse of, initially simplified, spherical shape ($\Omega > 1$) touches the "outermost" place of the anti- or nega-verse of hyperbolic shape ($\Omega < 1$) (Figure 5, Figure 9). In the reversed space a particle runs vectorially towards $1/(-\infty)$ infinity, meaning inverse direction in shrinking space, whereas its pendent shows the reverse $(+\infty)/1$. This idea is not new, and a series of works discuss this true possibility [9,33,34,35,38,50,51,52,53,54]. Following this aspect is important ensure the dimensions are taken into account meticulously in such a reversal technics, so this task must be carried out in a substantially dimensionless manner. In addition, the theory is intended to show whether any corrections are necessary withstanding every doubt of its generality. Albeit, certain studies of this type already exist

[31,39] the task would be decide which of those results obtained from them could eventually drawn near to directly raise the phenomenon for the Hubble's theory.

The class and amounts be presented, named, and defined as essential parts of a clear mathematical construction of the model: maximal radius R_{max} , photon radius R_{ph} , radius and distance in cosmic space R ; just the same for a principle mathematical processing as for small spaces. A very important aspect is electrodynamics, especially electrostatics with long-range effect and shielding, whereas gravity is limited to short distances and contrasting no shielding occurs.

In this section the proper idea is tracked down. As R offers the junction invert, like

$$-r_m(-m_0) \rightarrow +R_M(+M) \rightarrow r_- \rightarrow R_+ \rightarrow r \rightarrow R \quad (30)$$

the labeling omitted. In indexing the respective object related photon radius, "ph" and the outer sphere "out" will be postulated principally

$$R_{+ \text{ inside}}^{\text{max}} \propto r_{- \text{ out}}^{\text{min}} \leftrightarrow R_{\text{ph}}^{\text{max}} \propto r_{\text{ph}}^{\text{min}} \leftrightarrow R_{\text{ph}} \propto r_{\text{ph}} \quad (31)$$

if units are ignored. This opens the onset

$$f^{(-,+)} \equiv \frac{R_{\text{ph}}}{r_{\text{unit}}} = \frac{r_{\text{unit}}}{r_{\text{ph}}} \rightarrow R_{\text{ph}} = \frac{(r_{\text{unit}})^2}{r_{\text{ph}}} [\text{m}] \quad (32)$$

A commencement thorough investigation will show the validity. The comparison of the two radii, small and huge, is carried out by means of executing a suitable point for reciprocal "mirroring", *i. e.*, conjugate-transponated. A rational basis settles on both two spaces, *i. e.*, spheric, closed ($\Omega > 1$) and hyperbolic as open ($\Omega < 1$), reservatedly spoken touching each other at their photon radii. This means the sphere $R_{+ \text{ ph}}^{\text{max}}$ lying outside

$R_{+ \text{ inside}}^{\text{max}}$ of the real positive space with $r_{- \text{ ph}}^{\text{min}}$, lying inside $r_{- \text{ out}}^{\text{min}}$ associated the tiny negative with inside directed space. Both types, the expanding space with the shrinking show reversal of their properties,

$$R_{+ \text{ ph}}^{\text{max}} > R_{+ \text{ inside}}^{\text{max}}, \quad r_{- \text{ ph}}^{\text{min}} < r_{- \text{ out}}^{\text{min}} \quad \text{also}$$

here, which corresponds to spherical with hyperbolic behavior. This faces almost a singularity associated to the positive space. It is seen, however a ring-similar point inside (Figure 9) applies. In complying the relative spacing a^*, b^* between both of the respective two sphere- / ring-printouts give

$$a^* = \frac{R_{\text{ph}} - R_{\text{inside}}}{R_{\text{inside}}}, \quad b^* = \frac{|r_{\text{out}}| - |r_{\text{ph}}|}{|r_{\text{out}}|} \quad (33)$$

$$a^* \approx 1.47 \, 615 \, 81 \quad \leftrightarrow \quad \frac{1}{a^*} = b^* \approx 0.67 \, 743 \, 421 \, 25$$

$$R_{+ \text{ out}}^{\max} = a^* \cdot R_{+ \text{ ph}}^{\max} \leftrightarrow R_{+ \text{ ph}}^{\max} = \frac{1}{a^*} \cdot R_{+ \text{ out}}^{\max}$$

$$a^* \simeq \frac{R_{+ \text{ out}}^{\max}}{R_{+ \text{ ph}}^{\max}}$$

$$R_{+ \text{ obs}}^{\max} = \pm \frac{b^* \cdot a^4 \cdot c^2 \cdot \sqrt{\varepsilon_0}}{16 \cdot e \cdot \sqrt{\pi G}} [\text{m}] , \quad b^* = 0.6774342125 \quad (37)$$

For clarification was stated here this is the maximum radius, which corresponds to a minimum extension in the mini-cosmos. To first provide some supportive insight the first step yields from replacing

$$R_{\text{ph}} \equiv \frac{(r_{\text{unit}})^2}{r_{\text{ph}}} [\text{m}]$$

$$\underline{\underline{= \frac{1 \text{ m}^2}{5.44615(18) \cdot 10^{-27} \text{ m}}}} \quad (34)$$

$R_{\text{ph}} = 0.183615(89)10^{+27} \text{ m}$ for the further inside located sphere. A (–inside) relate (+out) → (both ph) sounds comprehensive (Figure 8) and more substantiating is

$$\frac{a^* \cdot R_{+ \text{ inside}}^{\max}}{1} \equiv \left\{ \frac{R_{+ \text{ out}}^{\max}}{1} \right\} \equiv \frac{(r_{\text{unit}})^2}{r_{- \text{ inside}}^{\min}}$$

$$\equiv \frac{(r_{\text{unit}})^2}{a^* \cdot r_{- \text{ out}}^{\min}} [\text{m}]$$

clarifying the observer

$$\frac{a^* \cdot R_{\text{obs}}^{\max}}{1} \equiv \left\{ \frac{R_{\text{ph}}^{\max}}{1} \right\} \equiv \frac{(r_{\text{unit}})^2}{r_{\text{ph}}^{\min}}$$

$$\equiv \frac{(r_{\text{unit}})^2}{a^* \cdot r_{\text{obs}}^{\min}} [\text{m}] \quad (35)$$

This is not to confuse with

$$R_{+ \text{ out}}^{\max} \stackrel{!}{=} R_{+ \text{ ph}}^{\max} , \quad \text{real space: outer sphere} \leftrightarrow \text{photon radius}$$

but yields

$$R_{+ \text{ inside}}^{\max} = b^* \cdot R_{+ \text{ out}}^{\max}$$

$$\underline{\underline{= (0.6774342125) \cdot (0.183615(89)) \cdot 10^{+27} [\text{m}]}} \quad (36)$$

$$R_{+ \text{ obs}}^{\max} = (0.124387(68)) \cdot 10^{+27} [\text{m}]$$

Hence, the end formula appears

$$R_{+ \text{ inside}}^{\max} = \frac{b^* \cdot R_{+ \text{ out}}^{\max}}{1} \leftrightarrow \frac{b^* \cdot R_{+ \text{ ph}}^{\max}}{1} \equiv \frac{b^* \cdot (r_{\text{unit}})^2}{r_{\text{ph}}} [\text{m}]$$

$$R_{+ \text{ obs}}^{\max} = \frac{b^* \cdot a^4 \cdot c^2}{32 \cdot \pi \cdot G \cdot m_0} \equiv \pm \frac{b^* \cdot a^4 \cdot c^2}{32 \cdot \pi \cdot G} \left\{ \frac{(4\pi \varepsilon_0) \cdot G}{e^2} \right\}^{1/2} [\text{m}]$$

with a recognizable relativistic correction of the classic **S-R** ratio in **a**.

Before the actual cause of an expansion of the real universe is discussed, a result should be provided for the experimental astronomer. A distance measurement of galaxies is done based on the speed of light **C**, which is why it is sufficient to simply do the approach from

$$t = \frac{r}{c} \rightarrow t_{\text{obs}} = \frac{R_{\text{obs}}}{c} = \pm \frac{b^* \cdot a^4 \cdot c \cdot \sqrt{\varepsilon_0}}{16 \cdot e \cdot \sqrt{\pi G}} [\text{s}]$$

$$t_{\text{obs}}^{\max} = \pm \frac{b^* \cdot a^4 \cdot c \cdot \sqrt{\varepsilon_0}}{16 \cdot e \cdot \sqrt{\pi G}} [\text{s}] \underline{\underline{= 0.414912(65) \cdot 10^{+18} \text{ s}}}$$

and the invert value can't hurt, either

$$(t_{\text{obs}}^{\max})^{-1} = \pm \frac{16 \cdot e \cdot \sqrt{\pi G}}{b^* \cdot a^4 \cdot c \cdot \sqrt{\varepsilon_0}} [\text{s}^{-1}] \underline{\underline{= 2.41014(58) \cdot 10^{-18} \text{ s}^{-1}}} \quad (38)$$

Such values are usually depicted in cosmological units via

$$(t_{\text{unit}})^{-1} \underline{\underline{= c \cdot \frac{0.108107611592569 \cdot 10^{-30}}{\text{Mpc}}}}$$

$$= 1 \frac{\text{km/s}}{\text{Mpc}} = 32.40779289960431 \cdot 10^{-21} \text{ s}^{-1}$$

to display

$$(t_{\text{obs}})^{-1} \underline{\underline{= 74.36935(29) \frac{\text{km/s}}{\text{Mpc}}}} \quad (39)$$

commonly referred to as the Hubble's constant. *Quod erat demonstrandum.*

7. Examination of the angular velocity ω and M in real space

Such a constant would have been expected an exclusively positive sign. This property, originating from the root in the formula **m** can be assigned an oscillating behavior.

Due to the properties shown for the (negative) anti-space as well as for its positive counterpart, respective pendant [10] it is of course also righteous to open a visual comparison, when the facts (lat.: *natura non facit saltus*?) downrightly invites to do so. As already briefly introduced above, there should be no obstacle to implementing the results into a torsion. Although, the vector image was largely avoided in the text the two spaces show exactly reciprocal behavior to each other, in analogy to the two maximum speeds. While the mini-, i.e. nega-verse impresses with an almost gigantic expansion (Figure 10) hardly be compensated for per relativistic influence, a real -structure is visible in the other with to a certain extent compressed structure; here their shapes interchange from

negative (hyperbolic) curvature to positive (spheric), $\mathbf{H}^3 \leftrightarrow \mathbf{S}^3$ in mind the above expressions straightly involve the space between both the respective two (fragile photon-) circum-ferences. It is proper not just the size ratios being of considerable importance also their signs are as already been discussed in advance.

So now the driving forces would claim in principle

$$\begin{aligned}\vec{\omega}^+ &= (2\pi) \cdot \vec{v}_s^+ \equiv (2\pi) / \vec{t}_s^+ \\ \vec{\omega}^- &= \vec{v}_s^- / (2\pi) \equiv (2\pi) \cdot \vec{t}_s^- \quad (41)\end{aligned}$$

and the difference is immediately clear: in the first (spheric) space an expansion will prevail, whereas the second (hyperbolic) illuminates contraction or shrinkage (Figure 5),

$$\begin{aligned}\vec{\omega}_{\text{hyp}} &= -\omega_{\text{hyp}}, (\Omega < 1) \\ \vec{\omega}_{\text{sph}} &= +\omega_{\text{sph}}, (\Omega > 1) \\ \vec{\omega}_{\text{flat}} &= \mp \omega_{\text{flat}}, (\Omega \gtrsim 1)\end{aligned}$$

First, the circumferences are established in

$$\begin{aligned}s_{\text{obs}}^- &= \frac{r_{\text{free}}^-}{2\pi} \equiv \frac{1}{(2\pi)} \cdot \frac{G \cdot m_0}{c^2} \cdot \frac{\alpha^4}{32\pi} \\ &= \frac{G \cdot m_0}{c^2} \cdot \frac{\alpha^4}{64 \cdot \pi^2} \\ s_{\text{obs}}^- &= \mp \frac{\alpha^4 \cdot e \cdot \sqrt{G}}{128 \cdot c^2 \cdot \sqrt{\pi^5 \cdot \varepsilon_0}} \\ &\stackrel{\Delta}{=} (-) 6.19\,832\,(29) \cdot 10^{-48} \text{ m}, \text{ no } b^* \quad (42) \\ s_{\text{obs}}^+ &= \frac{2\pi \cdot b^* \cdot R_{\text{free}}^+}{1} \equiv \frac{(2\pi)}{1} \cdot \frac{b^* \cdot c^2}{G \cdot m_0} \cdot \frac{32\pi}{\alpha^4} \\ &= \frac{b^* \cdot c^2}{G \cdot m_0} \cdot \frac{64 \cdot \pi^2}{\alpha^4} \\ s_{\text{obs}}^+ &= \pm \frac{128 \cdot b^* \cdot c^2 \cdot \sqrt{\pi^5 \cdot \varepsilon_0}}{\alpha^4 e \cdot \sqrt{G}} \\ &\stackrel{\Delta}{=} (+) 0.10\,929\,3\,(15) \cdot 10^{+48} \text{ m}, \text{ incl } b^* \quad (43)\end{aligned}$$

and of course, it must be referred to an "effective" circumference, which, according to what has been said,

does not consist of $s_{\text{free}} = 2\pi \cdot r_{\text{free}}$; especially in the positive space there seems to be an extraordinary "bloat" (Figure 11) based on the factual differences between its active routes. From here it is only a short walk to the driving testimony of the two spaces. First of all, the respective circulation time with

$$v_{\text{T,B}} = \alpha^2 \cdot c \stackrel{\Delta}{=} 16.17\,807\,81\,5 \cdot 10^{+3} \text{ m/s} \text{ becomes}$$

$$\begin{aligned}t_s^- &= \frac{s_{\text{obs}}^-}{-v_{\text{B,T}}} \equiv \pm \frac{1}{-\alpha^2 \cdot c} \cdot \frac{\alpha^4 \cdot e \cdot \sqrt{G}}{128 \cdot c^2 \cdot \sqrt{\pi^5 \cdot \varepsilon_0}} \\ t_s^- &= \frac{s_{\text{obs}}^-}{-v_{\text{B,T}}} \equiv \pm \frac{1}{-\alpha^2 \cdot c} \cdot \frac{\alpha^4 \cdot e \cdot \sqrt{G}}{128 \cdot c^2 \cdot \sqrt{\pi^5 \cdot \varepsilon_0}} \\ &\stackrel{\Delta}{=} (-) 0.38\,313\,0\,(98) \cdot 10^{-51} \text{ s} \quad (44)\end{aligned}$$

$$\begin{aligned}t_s^+ &= \frac{s_{\text{obs}}^+}{+v_{\text{B,T}}} \equiv \pm \frac{1}{+\alpha^2 \cdot c} \cdot \frac{128 \cdot b^* \cdot c^2 \cdot \sqrt{\pi^5 \cdot \varepsilon_0}}{\alpha^4 e \cdot \sqrt{G}} \\ &\stackrel{\Delta}{=} (+) 6.75\,563\,(25) \cdot 10^{+42} \text{ s} \quad (45)\end{aligned}$$

making the apparent break in total symmetry noticeable. Sure, the mini-space rotates around almost infinite times while the real universe figures an eternity for a single turn,

$$\begin{aligned}t_{\text{cosm}}^{\text{circ}} &\stackrel{\Delta}{=} + 6.75\,563\,(25) \cdot 10^{+42} \text{ s} \\ &= + 0.21\,421\,9(70) \cdot 10^{+27} \text{ billion years}\end{aligned}$$

The such low speeds that occur justify a quasi-classical treatment. It is, finally

$$\begin{aligned}\omega_{\text{mini}}^- &\stackrel{\Delta}{=} (-) 2.61\,007\,(35) \cdot 10^{+51} \text{ s}^{-1} \\ \omega_{\text{cosm}}^+ &\stackrel{\Delta}{=} (+) 0.14\,802\,4\,(63) \cdot 10^{-42} \text{ s}^{-1} \quad (46)\end{aligned}$$

neither showing anything unusual nor (directly) necessarily superluminal, apart from the basis. If the alternating sign, $\pm$ is ignored, indicating an oscillation, then, figuratively speaking, the negative or positive snail behaviors will be obvious. While the mini-cosmos "screws inwards" over time, the real one has a screw-like movement outwards (Figure 2, Figure 7, Figure 8) with circular times of the related space types.

In both cases there is a limit to this seemingly strict behavior, as has been drawn above as a certain transition to linearity (Figure 2, Figure 8). Although a hyperbolic system is not easy insightful, the limit can be found near a kind of center (no singularity), i., e., with very high negative exponents [31]. In positive space the reverse is true and would correspond to a limit of the observable (!) universe. In this utterance there should be no burying to hide this difference if the Newton's laws were used again, even seeming simple. This still emerges strengthening the

true picture to the impact mentioned figuratively, $\vec{a}_{\text{attr}} = \mp(m \cdot G \cdot \hat{r}) / |r|^3$, $\vec{a}_{\text{centr}} = \pm(\vec{r} \cdot \omega^2)$ as the driving mechanism for rotation of the two different spaces, since the choice where to put the respective force is free, and the two equations are factual, even though the results reveal opposite behavior.

$$\begin{aligned}
 0 &= (-)\vec{F}_{\text{attr}} + (+)\vec{F}_{\text{centr}} \\
 &= \frac{(-)m \cdot G \cdot m \cdot \hat{r}}{|r|^3} + \frac{(+m \cdot r \cdot \omega^2)}{1} \\
 0 &= (-)\vec{F}_{\text{centr}} + (+)\vec{F}_{\text{attr}} \\
 &= \frac{(-)m \cdot r \cdot \omega^2}{1} + \frac{(+m \cdot G \cdot m \cdot \hat{r})}{|r|^3} \quad (47)
 \end{aligned}$$

Finally and lastly two things still need to be discussed in order to round off the entire text. The first may sound ridiculous as is the question of an M in the real universe emerging from the analogy of both systems. The value is of course just a consequence of mathematics, because the results obtained cannot be achieved using the method presented here due to the enormous distances in a real posi-verse due to the associated interaction be based on $\mathbf{C}$. Since $\mathbf{r}$ and $\mathbf{m}$ are linear to each other a relation $\mathbf{m}$ to $\mathbf{M}$ can be found via

$$\begin{aligned}
 f^{(\text{mini}/\text{real})} &:= \frac{r_-}{R_+} = \frac{m_0}{M} \rightarrow M = m_0 \cdot \frac{R_+}{r_-} \\
 M &= m_0 \cdot \frac{b^* \cdot \alpha^8 \cdot c^4 \cdot \varepsilon_0}{256 \cdot e^2 \cdot \pi \cdot G} \equiv \frac{b^* \cdot \varepsilon_0}{\pi \cdot G} \left(\frac{\alpha^4 \cdot c^2}{16 \cdot e} \right)^2 \quad (48)
 \end{aligned}$$

$$M \stackrel{\Delta}{=} 4.72\,470\,(19)10^{+42} \text{ kg}$$

For the G a comparison from $\sqrt[3]{G_{\text{pass}}} = \sqrt[3]{G_{\text{grav}} - G_{\text{inert}}}$ uncovers [32]

$$G_{\text{pass}} = 66.49\,054\,43\,158\,72\,830 \cdot 10^{-12} \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}$$

$$\sqrt[3]{G_{\text{pass}}} \approx 8.2 \cdot 10^{-6} \frac{\text{m}^{3/2}}{\text{kg}^{1/2} \cdot \text{s}}$$

$$G_{\text{grav}} = 79.05\,691\,49\,302\,32\,002 \cdot 10^{-12} \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}$$

$$\sqrt[3]{G_{\text{grav}}} \approx 8.9 \cdot 10^{-6} \frac{\text{m}^{3/2}}{\text{kg}^{1/2} \cdot \text{s}}$$

$$\begin{aligned}
 G_{\text{inert}} &= 12.56\,637\,06\,143\,59\,172 \cdot 10^{-12} \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2} \\
 \sqrt[3]{G_{\text{inert}}} &\approx 3.5 \cdot 10^{-6} \frac{\text{m}^{3/2}}{\text{kg}^{1/2} \cdot \text{s}} \quad (49)
 \end{aligned}$$

and the influence of the inert component is not negligible with regard to the other root results.

2. Results

The solution of the Einstein's field equations as a global chart is homeomorphic to the $\mathbb{R}^4$. In the theory developed here the entire universe rotates in an ellipsoidal shape and far away from the observer embedded in a hyperspace $\mathbb{R}^5$, since itself claims be described in the $\mathbb{R}^4$. The H constant reads $(t_{\text{obs}})^{-1} \stackrel{\Delta}{=} 74.36\,93\,5(29) \frac{\text{km/s}}{\text{Mpc}}$ including the recommended values of α and G [50], whereas including theoretically obtained values result in a slightly lower value of about 7 percent. Due to the low speeds compared to c and the slight m in the initial version, which allow and justify the treatment of a mini-space, the results are trustworthy and do not require any complaints due to a lack of general relativistic discourse.

The driving force for the rotation of the entire universe runs out

$$\omega_{\text{cosm}}^+ \stackrel{\Delta}{=} (+)0.14\,802\,4\,(63) \cdot 10^{-42} \text{ s}^{-1}$$

Albeit, only a very small segment of the area is covered, this comparatively tiny part is sufficient to constitute the required centrifugal force. Furthermore, the theoretical track s to be covered around the center claimed of the observer shows

$$s_{\text{obs}}^+ \stackrel{\Delta}{=} (+)0.10\,929\,3\,(15) \cdot 10^{+48} \text{ m}$$

Given the length of time a thought-objects will take, this distance will certainly not be able to be covered as this will take longer than the universe that exists today. An

$$M \stackrel{\Delta}{=} 4.72\,470\,(19)10^{+42} \text{ kg}$$

analogous to the $\mathbf{m}$ in the anti- (mini-) universe could be determined via comparing the two radii $\mathbf{r}$ and $\mathbf{R}$. According to the theory such an M is not to be viewed as a single $\mathbf{m}$ -packet, but rather this value is figuratively speaking spread and filled in a ring shaped torso or tube (Figure 15) around the fictitious center of the universe, i., e. the observer's point of view.

Finally, a contribution related to G could help to verify a possible deviation from the experimental found Hubble's

constant H , explained in the current investigation, around 7 per cent,

$$\sqrt{G_{\text{pass}}} \approx 8.2 \cdot 10^{-6} \frac{\text{m}^{3/2}}{\text{kg}^{1/2} \cdot \text{s}}$$

$$\sqrt{G_{\text{grav}}} \approx 8.9 \cdot 10^{-6} \frac{\text{m}^{3/2}}{\text{kg}^{1/2} \cdot \text{s}}$$

$$\sqrt{G_{\text{inert}}} \approx i \cdot 3.5 \cdot 10^{-6} \frac{\text{m}^{3/2}}{\text{kg}^{1/2} \cdot \text{s}}$$

If the (also maximum) expansion respective shrinking speed of an $m, m_0 \neq 0$ in the observable universe is assumed different the speed of light,

$$v_{\text{expand}}^{\text{max}} = v_B : c \gtrsim v_B \gg 0$$

$$v_{\text{shrink}}^{\text{min}} = v_T : c \lesssim v_T \ll 2c$$

then the end of this space is not reached from the expansion at C but rather at the natural limits

All the latter points affect the distance D and the path or respective track s as the time t as well demonstrating small deviation from the figure of a perfect circle, say any circle-like movement of an m object in space is slightly bruised; it does not fulfill a perfect circle rather will describe an elipsoid-shaped trace (Figure 13, Figure 14) regardless of the truly dominant forces discussed

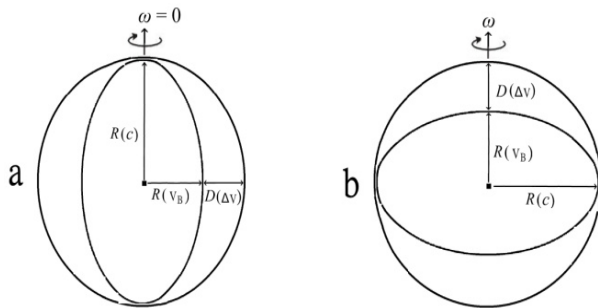
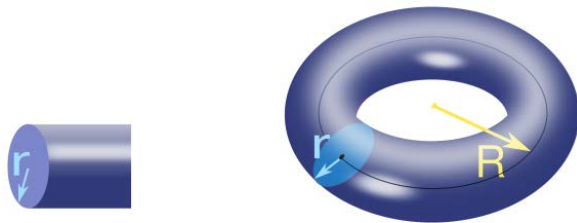


Figure 14. Comparison of the two distinct effects from both forces on the spatial shape



$$\varrho_M = \frac{M}{2\pi^2 r^2 \cdot R}$$

Figure 15. Supporting image for density distribution "smearing" M in filling a torso located in space around an observer in the center

3. Discussion

As the equivalence principle, EP is the hypothesis the observed equivalence of gravitational and inertial mass be a consequence of nature. Notwithstanding highly precise experimental tests of the EP limit possible deviations from it be very small, eqs. (49). Nevertheless, it is necessary to take a closer look at those constants, *e.*, g ., G that experience has shown be meaningful and to include the weaker, and uncertainly determinable, if not difficult to estimate, components only as possible corrections

There is no widely accepted single theory that explains the sets of gravitational phenomenae separately attributed to dark energy, DE, dark matter, DM [56,57], also with regard to weakly interacting massive particles, WIMP [58] and experimental investigations, *e. g.*, [27]. Though, these results enable further additional interpretation of the facts, they keep certainly fragile due to the complexity of the conditions in the cosmos, but are not doubtful as significant contribution. So, there occurs a dichotomy within gravitational science [34]. The FLRW theory of an expanding universe without spatial curvature at very large scales, but through its determinations of spatial expansion [59], continues to be affirmed from observations. Based on the entire discussion to verify a true and plausible reason for expansion fails because of the variables determining the cosmos and still point back to estimates.

A work clearly taking into account the gravitational influence was presented through a basis on dimensionless unification of the fundamental interaction [60]. In this interpretation, real expressions of Archimedes' constant are formed using the fraction of "e" as Euler's number and the exponential Gerford's constant allowing development into an arithmetic series. Then, these series to explain the strong-couplin constant were created in turn open the way to a geometric-graphitative treatment. Reference is made to the fine structure constant presented be correctly incorporated into the obtained final expressions via the 'golden angle' $\phi = 1.618$ respective cosmic spiral for a gravitational structure. A reference to real sizes of proton and electron mass does not stand in the way of unification; rather, when considering the rotation of ideas means a reference to actual conditions. From unification between micro- and maxi-cosmos referenced to Planckian dimensions and based on the cosmological constat Λ the author obtained the actually exact value for H .

Although the actual paper bases the results found on a comparatively simple theory, these statements can still be assessed as very powerful, without belittle or even disparage investigations presented in other publications.

Sure, according the Hubble's law the escape velocity $v_{H0} \stackrel{\Lambda}{=} 7\,000 \text{ km/s}$, conformed in the current study in $\pm v_{T,B}$, is sparse a magnitude despite applying quite well at a distance $D_{\text{obs}} \stackrel{\Lambda}{=} 10\sqrt{2} \text{ Mpc}$, in very good agreement to the results in the actual theory. The Andromeda Galaxy, in turn is only about 2.2 million light years respective 0.7 Mpc away mean the H-law not be applicable at small galactic scales. An verification based

on this document, not explicitly shown, can confirm this on its own, as well. So it would be worthwhile to describe the missing 4 elements of the Einstein's tensor in order to supplement the 6 already existing for, *e.*, *g.*, black holes, BH [19,48,49] for unmitigated description. In view inside and about a BH [31,46,47,50] this would favor an expansion in the distance though, this argument seems strange. For example, other results show a much more pronounced distance of the universe, as shown by a (once again) reversal of the conditions in a BH. Then, the observable universe is a roughly spherical region extending 46.5 billion light-years in all directions from any observer: in this case a theory similar to Hubble's actually behaves linear. If else it were a BH to actually mean singularity, compare [61]. Sure, the research presented in this work could question the BBT granting an alternative to cosmic inflation [61] as well as the justification for expansion suggested from dark energy $R = R(t, k, \Lambda_{\rho(E-\text{dark})})$ and further justifications.

It seems bit strange to base the theory presented on a certain anti- or negative universe, which is however supported from the density parameter Ω as a constant everywhere in space.

Generally, scientists think the smallest BH are as small as just one atom [31]. These are very tiny but have the mass of a large mountain. M respective m is the amount of matter, or "stuff," in an object. Actually all those traces are embedded in the standard model [6,7,11] as mathematically self-consistent. Despite gravity as perhaps the most familiar fundamental interaction it is not described due to contradictions arising when general relativity, GR the modern theory of gravity, and quantum mechanics [62], QM is tried to combine: gravity is that weak at microscopic scales it is essentially unmeasurable. If assumed properties did not vary with location or respective direction it would be entirely homogeneous and isotropic *e.*, *g.*, [34], which according to this work is not exactly true, albeit at very long distances the results correspond to good approximations (Figure 1, Figure 2).

In view about the shape of the universe, the expanding property first, could be ignored; entailing separate the shape from time pretending it is not. When studying those investigations mentioned, the formulations in the present work may no longer sound absurd, although the execution is based on a single statement [16,17]. This, however, takes into account the possibility of superluminality, a circumstance strictly reduced to absurdity from a number of scientists as well as time recersal, which is expressly possible [16,17,18,19,63,34,65]. Such an idea reporting in modern physics the paradoxi troubled astronomers not laid to rest ancient times until nowadays. This perspective may contradict the special theory of relativity, SR but absolutely permissible as a recognized aspect in the general, GR [19]

The idea of a negative universe [10] is no more new than the idea of a reversal of space respective space-time [9,33,34,35,51,52,53,54] and is linked to views on BH. A kind of total reversal in the properties of a space using CPT-symmetry leads to a solid basis in the presented investigation and is no stranger to such considerations.

A final question is the linearity in measuring and evaluating the results

[1,14,15]. The key idea is less a question of a theory rather appropriately representing the facts and more of an interpretation of a cosmos as essentially void, but large distances show optical influences through the summation of the density units [58]. In the case of cosmic distances this knowledge is taken into account; uncertainty in the aforementioned assumed "homogeneity and isotropy" of space remains the major challenge.

With regard to the objective the theory presented here is meaningful. Leaving aside the basis, neither high speeds nor large masses appear, and complex instruments of the GR can certainly be neglected. Certainly it seems strange to suggest a "rotation" of the entire universe as an explanation for its expansion, because of course the very long time span for a single complete rotation compared to the anticipated age sounds strange. It can be credibly admitted this work has more of a connection to philosophy. An embedding the 4-dimensional universe in a 5-dimensional hyperspace [57,58] as meaningful can be confirmed.

4. Conclusion

The theory presented consists of the intrinsic derivation of the Hubble constant H . As basic requirement serves a rotation ω of the space under consideration, offering the advantage of a constancy of the overall space swept, in contrast to a specific speed v that varies with the radius r respective R . Starting from the tiny counterpart of quasi atomic size to a real universe a first statement can be created to understand the conditions in a space that can initially be assigned to shrinking. A reference to the creation of these preparations is necessary, because here the mathematical requirements can be found in an initially spatial-limited system; this is the only possibility, alone.

After determining the boundary conditions via the two light speeds, *i. e.*, sub- and superluminal, the sizes together with the size ratios can be transferred sensibly and appropriately per folding in a complete reversal the small space into a large, real one. The knowledge gained in this way, then allows the exact determination of circumference, radius measured from the observer's location and the associated time period. From there, this time interval then leads to the exact statement and thus the exhibits evidence of the Hubble constant H . Further results can also be derived from this, like a torsus at the respective distance containing the mass density ρ and the associated mass M in a space describing the universe. In addition to the H constant, the theory also allows conclusions to be drawn about possible deviations caused by the gravitational constant and properties of the states inherent in the masses.

An indication of validity for a galaxy and the outlook on what will happen when the limit of the universe is crossed opens up good prospects for new questions, and maybe there is a gravitational bye-bye of masses leaving the observable universe into another in the form of emitting gravitational waves many billion years of age ago, who knows?

ACKNOWLEDGEMENT

The thanks are due to Ms. Catherine Carmen Beatrice de la Rue to support aspects in terms of linguistically semantics on the text.

References

- [1] Hubble, E. P. Cepheids in spiral nebulae. *The Observatory* **48** (1925) 139 – 142.
- [2] Hubble, E. Relation between Distance and Radial Velocity among Extra-Galactic Nebulae. *Proc. Nat. Acad. Sci. U. S. A.* **15** (1929) 168 – 173.
- [3] Hubble, E. The observational approach to cosmology. *The Clarendon Press*, Oxford (1937).
- [4] Friedmann, A. (1922). "Ueber die Krümmung des Raumes. *Z. Phys.* **10** (1922) 377 – 386.
- [5] Einstein, A. On a Stationary System With Spherical Symmetry Consisting of Many Gravitating Masses. *Ann. Math. Sec. Ser.* **40** (1939) 922 – 936.
- [6] Robertson, H. P. Kinematics and World-Structure. *Astrophys. J.* **82** (1935) 284 – 301.
- [7] Robertson, H. P. Kinematics and World-Structure 3. *Astrophys. J.* **83** (1936) 257 – 271.
- [8] Walker, A. G. On Milne's theory of world-structure. *Proc. Lond. Math. Soc.* **2**, **42** (1937) 90 – 127.
- [9] Ellis, G. F. R.; van Elst, H. Cosmological models (Cargèse lectures 1998). Marc Lachièze-Rey (ed.). Theoretical and Observational Cosmology. *NATO Science Series C.* **541** (1999) 1 – 116.
- [10] Friedman, A. Ueber die Möglichkeit einer Welt mit konstanter negativer Krümmung des Raumes. *Z. Phys.* **21** (1924) 326 – 332.
- [11] Freedman, W. L.; Madore, B. F.; Scowcroft, V.; Burns, C.; Monson, A.; Persson, S. E.; Seibert, M.; Rigby, J. Carnegie Hubble Program: A Mid-Infrared Calibration of the Hubble Constant. *Astrophys. J.* **758** (2012) 24 – 33.
- [12] Leavitt, H. S. 1777 Variables in the Magellanic Clouds. *Ann. Harvard. Coll. Obs.* **LX** (1908) 87 – 111.
- [13] Friedman, A. Ueber die Krümmung des Raumes. *Z. Phys.* **10** (1922) 377 – 386.
- [14] Kirshner, R. P. Hubble's diagram and cosmic expansion. *Proc. Nat. Acad. Sci.* **101** (2003) 8 – 13.
- [15] Harrison, E. The redshift-distance and velocity-distance laws. *Astrophys. J.* **403** (1992) 28 – 31.
- [16] Gerlitz, T. G. M. Superluminality and Finite Potential Light-Barrier Crossing. *Int. J. Res. Pure and Appl. Phys.* **5** (2015a) 19 – 24.
- [17] Gerlitz, T. G. M. Superluminality and Finite Potential Light-Barrier Crossing. *Phys. J.* **12** (2022a) 1 – 9.
- [18] Davis, T. M.; Lineweaver, C. H. Superluminal Recession Velocities. *AIP Confer. Proc.* **555** (2001) 348 – 351.
- [19] Goedel, K. An Example of a New Type of Cosmological Solutions of Einstein's Field Equations of Gravitation. *Rev. Mod. Phys.* **21** (1949) 447 – 450.
- [20] Farnes, J. S. A Unifying Theory of Dark Energy and Dark Matter: Negative Masses and Matter Creation within a Modified Λ CDM Framework. *Astronomy Astrophys.* **620** (2018) A92.
- [21] Holland de Barcellos, J. C. Derivation of Hubble's Law and its relation to dark energy and dark matter. *J. Math. Theor. Phys.* **2** (2019) 29 – 32.
- [22] Wu, E. T. H. Hubble's Law Derived from Wu's Spacetime Shrinkage Theory. *IOSR J. Appl. Phys.* **11** (2019) 3 – 7.
- [23] Seshavatharam, U. V. S.; Lakshminarayana, S. An Outline Picture of a Growing and Rotating Planck Universe with Emerging Dark Foam. *Asian J. Res. Rev. Phys.* **2** (2019) 1 – 13.
- [24] Seshavatharam, U. V. S.; Lakshminarayana, S. An Integrated Model of a Light Speed Roating Universe. *Int. Astronomy Astrophys. Res. J.* **2** (2021) 282 – 290.
- [25] Heisenberg, W. Ueber den anschaulichen Inhalt der quantentheoretischen Kiematik und Mechanik. *Z. Phys.* **43** (1927) 172 – 196.
- [26] von Neumann, J. Wahrscheinlichkeitstheoretischer Aufbau der Quantenmechanik. *Nach. Gesellsch. Wiss. Goettingen; Math.-Phys. Kl.* **245** – 272 (1927).
- [27] Spergel, D. N.; Bean, R.; Doré, O.; Nolte, M. R.; Bennet, C. L.; Dunkley, J.; Hinshaw, G.; Jarosik, N.; Komatsu, E.; Page, L.; Peiris, H. V.; Verde, L.; Halpern, M.; Hill, R. S.; Kogut, A.; Limon, M.; Mever, S. S.; Odegard, N.; Tucker, G. S.; Weiland, J. L.; Wollack, E.; Wright, E. L. Three-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Implication for Cosmology. *Astrophys. J. Suppl. Ser.* **170** (2007) 377 – 408.
- [28] Cornish NJ, O'Beirne L.; Taylor SR.; Yunes N. Constraining Alternative Theories of Gravity Using Pulsar Timing Arrays. *Phys. Rev. Lett.* **120** (2018) 181101.
- [29] Debye, P.; Hueckel, E. Zur Theorie der Elektrolyte. *Phys. Z.* **9** (1923) 185 – 206.
- [30] Lemaître, G. (1927). Un Univers homogène de masse constante et de rayon croissant rendant compte de la vitesse radiale des nébuleuses extra-galactiques". *Ann. Soc. Scient. Brux.* **A47** (1927) 49 – 59.
- [31] Gerlitz, T. G. M.; Walden, W. An Idea to a World inside a Black Hole. *Int. J. Phys.* **5** (2017) 171 – 180.
- [32] Clark, S. J.; Tabbotucker, R. W. Gauge symmetry and gravito-electromagnetism. *Class. and Quant. Grav.* **17** (2000) 4125 – 4157.
- [33] Lachièze-Rey, M.; Luminet, J.-P. Cosmic topology. *Phys. Rep.* **254** (1996) 135 – 214.
- [34] Liddle, A. An Introduction to Modern Cosmology. John Wiley and Sons, (eds.) 2nd ed., (2003).
- [35] Ojeda, P.; Rosu, H. Supersymmetry of FRW barotropic cosmologies. *Int. J. Theor. Phys.* **45** (2006) 1191 – 1196.
- [36] Newton, I. *Philosophiae Naturalis Principia Mathematica* ("Mathematical Principles of Natural Philosophy"). S. Pepys (ed.). London (1687).
- [37] Walden, W.; Gerlitz, T. G. M. The Intrinsic Derivation of the Gravitation Constant G. *Int. J. Phys.* **10** (2022) 252 – 261.
- [38] Landsberg, P. T. Mass Scales and the Cosmological Coincidentes. *Ann. Phys.* **496** (1984) 88 – 92.
- [39] Gerlitz, T. G. M.; Walden, W. An Approach to an Element of Order Number Zero in the Periodic System. *Int. J. Phys.* **8** (2020) 134 – 146.
- [40] Gerlitz T. G. M. The Mysterious Finestructure Constant α in Quantum Mechanics. *Adv. Eng. and Appl. Sci.: An Int. J.* **5** (2015b) 79 – 82.
- [41] Gerlitz, T. G. M. The Mysterious Constant Alpha (α) in Quantumphysics. *Int. J. Phys.* **10** (2022b) 59 – 63.
- [42] Agafonova, Yu, N.; et al. Measurement of the velocity of neutrinos from the CNCS beam with the Large Volume Detector. *Phys. Rev.* **76** (2007) 072005.
- [43] Agafonova, Yu, N.; et al. Measurements of the velocity of neutrinos from the CNCS beam with the Large Volume Detector. *Phys; Rev. Lett.* **109** (2012) 07001.
- [44] Adamson, P. Neutrino Velocity: Results and prospects of experiments at beamlines other than CNCS. *Nucl. Phys. B: Proc. Suppl.* **235** (2013) 296 – 300.
- [45] Adam, T.; et al. Measurement of the neutrino velocity with the OPERA detector in the CNCS beam using 2012 dedicated data. *J. High Energ. Phys.* (2013) 153.
- [46] Gerlitz, T. G. M.; Walden, W. A Constant Rotating Kerr-Newman Black Hole with No Net Electrical Charge. *Glob. J. Sci. Frontier Res.* **A 17** (2017) 5 – 14.
- [47] Gerlitz, T. G. M.; Walden, W. A Constant Rotating Kerr-Newman Black Hole with No Electrical Net Charge. *Int. J. Phys.* **6** (2018) 1 – 8.
- [48] Schwarzschild, K. Ueber das Gravitationsfeld eines Massepunktes nach der Einsteinschen Theorie. *Sitz. Ber. Koen. Preuss. Akad. Wiss.* **7** (1916a) 189 – 196
- [49] Schwarzschild, K. Ueber das Gravitationsfeld einer Kugel aus inkompressibler Fluessigkeit nach der Einsteinschen Theorie. *Sitz. Ber. Koen. Preuss. Akad. Wiss.* **18** (1916b) 424 – 434.
- [50] Pathria, R. K. The Universe as a Black Hole. *Nature* **240** (1972) 298 – 299 — Good, I. J. Chinese universes. *Physics Today* **25** (1972) 15.
- [51] Penrose, R. Singularities and Time-Asymmetry. General Relativity: An Einstein Centenary Survey. *Cambridge University Press*, Stephen Hawking, Werner Israel (eds.) (1979) 581 – 638.
- [52] Poplawski, N. J. Cosmology with torsio: An alternative to cosmic inflation. *Phys. Lett. B* **694** (2010) 181 – 185.
- [53] Poplawski, N. J. Radial motion into an Einstein-Roden bridge. *Phys. Lett. B* **697** (2010) 110 – 113.
- [54] Gambini, R.; Pullin, J. A First Course in Loop Quantum Gravity. Oxford University Press (2011).
- [55] Tiesinga, E.; Mohr, P. J.; Newell, D. B.; Taylor, B. N. The 2018 CODATA, Committee on Data for Science and Technology, Recommended Values of the Fundamental Physical Constants. *J.*

- Baker, M. Douma, S. Kotochigova (Database dev.) National Institute of Standards and Technology, Gaithersburg, MD 20899, U. S. A. (2020).
- [56] Poincaré, H. The Milky Way and the Theory of Gases. *Popular Astronomy* 14 (1906) 475 – 488.
- [57] Carr, B. J.; Clesse, S.; García-Bellido, J.; Hawkins, M. R. S.; Kuhnel, F. Observational evidence for primordial black holes: A positivist perspective. *Phys. Rep.* **1054** (2024) 1 – 68.
- [58] Timmer, J. No WIMPS! Heavy particles don't explain gravitational lensing oddities. *Ars. Technica* (2023) JHEP08 (2007)077.
- [59] Abbott, B. P.; Abbott, T. D.; Abraham, S.; Acernese, F.; Ackley, K.; Adams, C.; Adhikari, R. X.; Adya, V. B.; Affeldt, C. A. Gravitational-wave Measurement of the Hubble Constant Following the Second Observing Run of Advanced LIGO and Virgo. *Astrophys J.* **909** (2021) 2018 pp.
- [60] Pellis, S. Unification Archimedes constant π , golden ratio ϕ , Euler's number e and imaginary number i . *SSRN Electr. J.* **10.2139/ssrn.3975869** (2021).
- [61] Poplawski, N. J. Nonsingular, big-bounce cosmology from spinor-torsion coupling. *Phys. Rev. D* **85** (2012) 181 – 18.
- [62] Jérôme, M. Everything you always wanted to know about the cosmological constant problem (but were afraid to ask). *Compt. Rend. Phys.* **13** (2012) 566 – 665.
- [63] Bondi, H.; Gold, T. The Steady-State Theory of the Expanding Universe. *Month. Not. Roy. Astron. Soc.* 108 (1948) 252 – 270.
- [64] Gold, T. The Arrow of Time. *Am. J. Phys., AAPT* **30** (1962) 403 – 410.
- [65] Price, H. Time's arrow & Archimedes' point: new directions for the physics of time. *Oxford University Press US* (1997) pp. 81 – 82.



© The Author(s) 2024. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).