Unified Physics and Cosmology: the Theory of Everything.

Subhajit Waugh

Raja Ramanna Centre for Advanced Technology (RRCAT),

Dept. of Atomic Energy, Govt. of India

Email: subhajit_waugh@rrcat.gov.in, sub2007waugh@gmail.com

[This paper is devoted to my mother (late) Mrs. Basanti Waugh, my father (Shri Lalji Vittal Waugh), and to my 'Jathamosai' (uncle), who had seen this day coming through his prophetic vision before he left].

Abstract

Copernicus broke with 1300 years of tradition, and revolutionized science by moving from earth-centric to sun-centric view. But, moving the viewpoint to the true center of our expanding universe explains the origin of time itself! From this God's view, Relativity and Quantum Mechanics (QM) are two sides of the same coin. Relativity is inside the light cone phenomena (since nothing can travel faster than light), while Quantum Mechanics is outside the light cone phenomena (allowing instant communications in 'quantum entanglement' experiments). Both are dictated just by the scale (i.e. whether we use classical/human scale or sub-atomic scale). General Relativity makes things a bit tricky since it involves curvature/warping of spacetime, but it does not become incompatible with Quantum Mechanics. General Relativity and Quantum Mechanics are the two pillars of modern Science. Reconciliation of the two greatest theories in physics leads us to 'Theory of Everything'.

Physics and cosmology are intimately linked. Consequently, our level of understanding of one of them strongly affects our depth of knowledge of the other.

On the one hand, the greatest challenges facing cosmology today are dark matter, dark energy, information loss (paradox) due to black hole singularity etc. which are just the relics of our misinterpretation of General Relativity (GR) of physics. GR is mathematically sound, but is based on a faulty assumption of '4 dimensional spacetime continuum', which is a 'block universe' view in which there is no distinction between the past, the present and the future, and all three simultaneously coexists! All those above-mentioned problems magically vanish when we realize that GR is just the viewpoint of a 'trapped being', which is an inside view (hence there is no concept of 'outside' in GR). That is exactly why GR can't predict the global structure of the universe, nor can it accommodate 'external field effect' (which has now been **confirmed to 11 Sigma accuracy** in galaxies and galaxy clusters). Don't worry: we will **not require** a fifth dimension to see beyond the trap.

On the other hand, without the correct model of our universe, physics appears to be broken. Quantum Mechanics and General Relativity (which are our two greatest theories in physics, and the two pillars on which our modern physics rests) seem to be utterly incompatible. [For details click here.]

Let me repeat: Obtaining the true model of our universe is crucial for unified physics as well. Therefore, the following sections are not only for astronomers/cosmologists, but equally crucial for physicists as well.

Before I continue with the title of this paper, it is necessary to shake the very mathematical foundation of spacetime physics. Unlike real numbers, imaginary numbers **cannot** be taken as an independent axis. [For details Click here]. Imaginary number **i** enters through the temporal dimension, and makes the spacetime metric **(-, +, +, +)**. The equation $ds^2 = (\boldsymbol{i}c\ dt)^{\ 2} + dx^2 + dy^2 + dz^2 = \ (\boldsymbol{i}c\ dt)^{\ 2} + \ dr^2$ (which explains all of special relativity, including time dilation, length contraction, and relative simultaneity) is **not** a statement for 4d spacetime continuum (since imaginary **i** cannot be used as an independent axis). Einstein & Minkowski made that mistake, and assumed a block universe view. This view is in stark contrast to our everyday experience, as well as with an astonishing number of observations in the whole of science. In fact, an entire book has been written to highlight this fallacy. [*The arrow of time: the quest to solve science's greatest mystery***;** *Peter Conveney, Roger Highfield (Flamingo-an imprint of HarperCollins publishers)*].

We must go back to Special Relativity, where the mistake of 4d spacetime continuum (block universe view) started, and rectify it. The concept of block universe is due to our faulty understanding of relative simultaneity. We have wrongly used the analogy of a 'loaf of bread' that can be sliced at different angles. The logic is: if the observers are in motion then the spacetime loaf would be cut at an angle meaning that an observer's "now" would be significantly different from each other. This analogy leads to the Rietdijk–Putnam paradox (Andromeda paradox) which rather than supporting the viewpoint, actually exposes how ridiculous it is!

A much more appropriate analogy would be the 'printer cartridge' analogy. Although the cartridge moves to and fro on an 1d metal rod, still it is able to print any slanting line (of any angle tilt) on a 2d paper, because the paper is moving. It could also do the same if the 2d paper were held still, and the metal rod moved upwards as the cartridge moved sideways.

The equation $ds^2 = (\boldsymbol{i}c\ dt)^{\ 2} + dx^2 + dy^2 + dz^2 = \ (\boldsymbol{i}c\ dt)^{\ 2} + \ dr^2$ represents a dynamic **3d hypersheet** (composed of fields & particles. Therefore I'll refer to it as **Field-Particle Hypersheet**, or **3d FPHS**) **moving with a velocity c in the 4th dimension** in an embedding 4d hyperspace. This is very easy to see. Let us take any observer, located anywhere in 3d space (3d FPHS), and moving with any possible velocity. Relative to itself, the observer does not move through space (dr=0). Hence, the above equation becomes (putting dr=0):

$$ds^2 = (ic\ dt)^{\ 2} + dx^2 + dy^2 + dz^2 = \ (ic\ dt)^{\ 2} + \ dr^2 = (ic\ dt)^{\ 2}$$

Therefore, **ds/dt = i.c**

Therefore, every frame of reference reaches the same conclusion. The presence of **i** clearly shows that everyone is moving with a velocity **c** in a perpendicular direction to all three x,y and z axis (which is an impossible direction for every observer trapped in this 3d FPHS. Why impossible direction? Well, just try to point your finger towards the future or towards the past. That direction is perpendicular to every

direction we can point our finger at). The lack of understanding about **i**=sqrt(-1) had led scientists to conclude that the velocity is imaginary (and hence discouraged from digging deeper). They simply concluded that our spacetime is very peculiar (hyperbolic), without questioning why this peculiarity arises after all.

But every frame of reference can reach the same conclusion only if the **entire** 3d FPHS is moving in the same direction. That's why I emphasized 3d FPHS (instead of 3d space). A 3d space moving through 4d hyperspace doesn't make any sense! But a 3d FPHS moving (at velocity c) through 4d hyperspace does make sense.

The sharpest minds of the last century had smartly figured out that we are all moving at the velocity c (speed of light) through space-time. But they failed to reach the correct conclusion, which is: **every observer (or every frame of reference) is moving with a velocity c in one single direction (the real-time/universal time direction) irrespective of its location or velocity in the 3d FPHS.** We are all travelling at 1079 million kilometers per hour! (That's right. It is 670.6 million miles per hour). That's how fast we are all moving through (hyper) space.

If we ignore the dynamic nature of the 3d FPHS (which seems natural to trapped 'flatlanders' like us), then our world indeed appears 3 dimensional and Euclidean $ds^2 = dx^2 + dy^2 + dz^2$ just as Euclid himself thought.

As an immediate consequence of making the (4d spacetime vs dynamic 3d FPHS) correction, one dimension got freed up (which we were reserving unnecessarily). Kaluza's miracle of obtaining Maxwell's equation in addition to Einstein's field equations seemed to demand a heavy price: a 5th dimension was required as an embedding space. Actually, 4 dimension is sufficient (and we get electromagnetic phenomena as a bonus!). In fact, the implications of freeing up a dimension is much more profound, and solves the requirement of a fifth dimension popping up everywhere in physics (but stringent limit on the number of dimensions set at four from experiments & observations simply won't allow that).

Since every star and planets and even ourselves are ultimately made up of particles (which are mere excitations/resonances in the 3d FPHS fields), therefore, every bit of matter is eternally trapped in this 3d FPHS, and is getting dragged with it. Every particle is guided by its own pilot wave generated in widely spread field (as correctly guessed by deBroglie and Bohm) and the collective pilot wave fields create this 3d FPHS. Gravity is not a warping in 4d spacetime, but a stretching of this 3d FPHS (by massive objects) in the 4th dimension. Every normal baryonic matter has a natural tendency to move towards the future (away from the center of the universe). This 3d FPHS behaves just like a stretched rubber membrane, and all massive objects nearby stretch this membrane in a single direction, thus enormously amplifying their collective stretching. This magically solves all dark matter related issues as we will later see. [For more details Click Here]

It is also necessary to shake the mathematical foundation underlying our belief of a (3d) **flat** universe. We **cannot measure** the curvature of a 3d (hyper) surface using summation of angles in a triangle. That works for a 2d surface curving in the 3rd dimension. But for our present requirement, we need the sum

of solid angles i.e. we need a tetrahedron, and not triangle. This has been explained in detail in this paper (Click Here). The 'sum of angles of the triangle' checkup which we had applied to CMB spots is bound to show it is flat! Neither can we measure the curvature of our universe using critical mass/energy density method of General Relativity (which will become clear very soon).

We have another piece of the jigsaw puzzle: The 3d HS is also getting stretched (**Hubble's law**) as it moves in the 4th dimension. From previous discussion, and this clue, two models of our universe are easily possible. [Click here]

Here is another piece of clue which finally nails it: Our universe does have has a Centre (although the Centre does not lie anywhere in our 3d space or 3d FPHS). This can be easily proved:

The Centre of Mass equation is a powerful equation.

$$c.m. = \frac{\sum_{i=1}^{n} m_i \, r_i}{\sum_{i=1}^{n} m_i}$$

In the vastness of our cosmos, we can consider each galaxy (or maybe a galaxy cluster) as a point mass. Even as n tends to infinity ($n \rightarrow \infty$) we are still left with a single point center of mass. Simply invoking infinity isn't going to help us escape from the conclusion that there is indeed a Centre. And what's more, the above formula works irrespective of the number of dimensions, or whether all the point masses are located on a flat surface, or a curved surface (or even an irregular shaped corrugated surface).

Applying pure logical reasoning we can construct the true model of the universe: an expanding (hyper) balloon universe. For details, observational evidences etc. [Click here]

The theoretical Hubble constant value **(71.002 km/s/Mpc)** matches very well with accepted values (between **69.8 km/s/Mpc and 74 km/s/Mpc). [**For checking calculations **Click here].**

Objections which might be raised against this model all fail miserably. Here are some objections:

1) Measured flatness of universe from Cosmic Microwave Background CMB using summation of angles of a triangle. [Already explained that we need a tetrahedron, not a triangle]

2) Accelerated expansion of universe rather than constant rate of expansion. [**Explanation**: Recent studies using much bigger dataset actually favor universe's constant rate of expansion over accelerated expansion. Why the illusion of accelerated expansion arises have also been explained. This solves the problem of dark energy: we don't need dark energy, since we don't have to account for acceleration. (Click Here)]

3) Observable universe is itself 94 billion light years across, and hence entire universe must be much bigger. [Explanation: This argument fails too. (Click Here)]

The radial expansion velocity **c** of the universe introduces the concept of rest-mass momentum (p=m.c) which greatly simplifies and unifies physics. [Haug E.; **Better Quantum Mechanics? Thoughts on a New Definition of Momentum That Makes Physics Simpler and More Consistent.** Preprints 2019,

2019010042 (doi: 10.20944/preprints201901.0042.v2)]. In fact, it also explains the origin of rest-mass energy (E=mc2), since the energy (E) and momentum (p) are always related as **E=p.c** (as shown by the author Haug E.)

From the center of our universe (the point where the Big Bang happened) we have absolute simultaneity as demanded by the Sagnac effect (because the universal time elapsed since the Big Bang is simply a function of universe's radius), and absolute universal time (as Quantum Mechanics demands. **This solves the 'time problem'** in Quantum Mechanics which stubbornly resisted all attempts to reconcile it with General Relativity).

Physics and cosmology are intimately linked (e.g. conservation laws of Physics arise from symmetry of our universe, as per Noether's theorem). We can directly see from this simple structure of our universe, why those symmetries (e.g. homogeneity and isotropy) arises in the first place.

We humans experience 3+1 spacetime dimensions, where the 3 spatial dimensions are curved lines (drawn on the surface of a hyper balloon). However each tiniest point in the wall of the balloon universe becomes (1+3) timespace **[i.e. Quaternion/superluminal]** when viewed from the center of our (hyper) balloon universe, since there is only one real spatial dimension (i.e. the radius of the universe) from the center of the universe to that point. As explained later, temporal dimension is that dimension along which any movement can be ignored. For example, we can easily ignore the tremendous velocity with which we are travelling along the radius of the universe. In a similar manner, nature/universe ignores movement along the wall of the balloon whether we travel to the moon or to the sun or to the Andromeda galaxy, because the moon, the sun, and Andromeda galaxy are all equidistant from the true center of the universe.

But why does the transition from Relativity to Quantum Mechanics happens with decreasing size scale? That's because, this is what is happens to spatial and temporal dimensions at different scales:

3+1 (Classical regime) $\Leftrightarrow$ 2+2 (Compton regime) $\Leftrightarrow$ 1+3 (Planck regime)

Superluminal phenomena (which gives rise to 'strangeness' of QM) is not possible in our human scale, since the Minkowskian coordinate system (3+1) we use simply won't allow velocity greater than velocity of light (Click here). However nature uses superluminal communications all the time (which allows Quantum entanglement's 'spooky action at a distance' which challenges Einstein's causality and relative simultaneity restrictions). Our mistake was to assume that nature will continue to use our 3+1 spacetime even at the smallest scale.

Relativistic Quantum Mechanics uses the Compton scale lying intermediate between (3+1) and (1+3), and has a spacetime dimension of 2+2 as proved by Ord [G.N. Ord; **Fractal space-time: a geometric analogue of relativistic quantum mechanics**. 1983 J. Phys. A: Math. Gen. 16 1869].

Relativity is inside the light cone phenomena (since nothing can travel faster than light), while Quantum Mechanics is outside the light cone phenomena (allowing instant communications in strongly confirmed 'quantum entanglement' experiments, and instant 'wavefunction collapse'). Both are dictated just by

the scale (i.e. whether we use classical/human scale or sub-atomic scale). This recent paper ['**Quantum principle of relativity**'; Andrzej Dragan, Artur Ekert, New. J. Phys. 22 (2020) 033098] has shown that every exotic Quantum effect like superposition, entanglement, probabilistic behavior, multiple paths etc. can be explained just by allowing superluminal possibility. (Click Here) The 'inside the light cone' phenomena, and the 'outside the light cone' phenomena together span the entire region within the space and time axes. Only in unison they complete the entire picture. We failed to realize that the same spacetime is getting split into 'space like' and 'time like' regions based on scale. And the reason behind this is **not** the magical (**?**) speed of light. That would have turned both relativity and quantum mechanics into mere branches of electromagnetism. It turns out that the **c** is the radial expansion velocity of our universe.

Quantum Mechanics (QM) and Special Relativity (SR) are like two sides of the same coin. But understanding the relation between QM and General Relativity (GR) is a bit tricky, because according to GR, gravity is the warping/curvature of the 4 dimensional spacetime itself. SR's big brother GR only complicates things a bit, but **does not** become inconsistent with QM altogether. The only difference between the warped spacetime of GR, and the flat spacetime of SR is very similar to the difference between a stretched rubber membrane (RM), with and without a metal ball placed on it. Rather than taking this as an analogy, we should take it quite literally (because the 3d field particle hypersheet or 3d FPHS behave just like a stretched RM). Gravity is **not** a true force (as correctly guessed by Einstein) but arises due to stretching of this 3d FPHS in the 4^{th} dimension by massive objects. Kindly note that this stretching of the dynamic 3d FPHS also predicts the same gravitational time dilations as predicted by GR (although now it is due to the resolution of temporal component into sin (θ) and cos (θ) components depending on the slope at various points on the stretched 3d FPHS). We don't need to quantize gravity, as we have already achieved all the necessary quantizations (for Q. Electrodynamics, Q. FlavorDynamics and Q. ChromoDynamics) of the 3d field-particle hypersheet. Unfortunately all modern research towards unifying QM and GR are intensely focused on 'Quantum Gravity'. The effect of freeing up one dimension is extremely profound. Gravity and (other 3 forces) were fighting unnecessarily. Now gravity gets one extra dimension! Rather than taking the rubber membrane as an analogy, we must take it literally.The RM has already achieved all 3 necessary quantizations. Rather than quantizing gravity, let's just focus on the mechanism which stretches it in the 4th dimension. Let me repeat: gravity is not a true force, and arises due to mere stretching of '3d field-particle hypersheet', and that's exactly why it is so incredibly weak (hierarchy problem) compared to the three (true) forces of nature.

Quantum Mechanics (QM) and General Relativity (GR) have been spectacularly successful, but limited to their own domains (i.e. for the tiniest and largest scales respectively). The reason for their limitations lies hidden within the words 'tiniest and largest scales'. Special Relativity is based on constancy of speed of light for any observer. By basing his theory on this postulate, Einstein unknowingly selected a scale: the classical/human scale and above (i.e. astronomical scale), which uses 3 spatial coordinates and one time coordinate. However, for Planck scale objects, there is only one spatial dimension and three temporal dimensions (i.e. nature's viewpoint prevails). That's exactly why physicists like Dirac and Feynman were so amazed at how finely tuned Quaternions (which uses 1 real number and 3 imaginary numbers and hence best represents 1+3 spacetime structure) are in describing the physics of the very

small. It has been explained in detail (Click here). Both QM & GR have a common origin, which can be understood only through the correct model of our universe (which is **not** the presently accepted model).

There are however other serious issues to deal with (like the '**time problem**' since quantum mechanics require universal and absolute time, whereas general relativity regards the flow of time as malleable and relative) before any meaningful reconciliation of QM and GR are possible. It will be shown that clock time is associated with imaginary number, while absolute universal time is associated with real number. Mathematically, it is not challenging; but accepting both 'relatively flowing time' due to movement of observers (i.e. time dilation) and absolute universal time is psychologically very challenging. To digest this concept, let's visit the 'twin paradox' again, but now without the usual rocket journey. [Click Here]

It was a historical mistake to assume that the physics of the very large (General Relativity) and the very small (Quantum Mechanics) are completely decoupled. The largest and the smallest in the universe are tightly linked as highlighted by the 'large numbers hypothesis (LNH)' proposed by Hermann Weyl, Eddington, Dirac et al. But due to the unavailability of knowledge regarding the exact size and shape of our universe, those ratios/relations could not be shown to be exact. The aforementioned tight link manifests itself in IR/UV mixing, and also manifests itself in the 'unnaturalness' of the mass of Higgs Boson.

As expected, the reconciliation of our two best theories improves every aspect of modern Physics [e.g. 'Principle of Least Action' which comes closest to the 'theory of Everything' in physics, and from which, all known laws of physics can be derived, arises as a direct consequence of the better model of the universe as proposed in this paper.

The list of achievements in this paper is simply too long to be detailed here in the **Abstract** (which is already too long. I beg your apology. But this paper concerns our entire universe, and every span of physics and cosmology. I thank you for your patience). For example, the Black Hole information loss paradox also gets resolved. [Click here]

Thus, a better understanding of imaginary numbers lets us realize that our 'clock time' is imaginary. It also explains the true meaning of Wick rotated, Euclidean time (wrongly called 'imaginary time') which is so ubiquitous in physics. It becomes crystal clear why Physicists like Dirac & Feynman were so puzzled that 'imaginary time seems more real than real time'! In fact, many more problems/paradoxes gets resolved together.

From this model, we can see that there are two viewpoints involved. From our viewpoint, locality is absolute, while from the center of the universe viewpoint (nature's viewpoint) simultaneity is absolute. We can finally decipher nature's deepest secret. Nature does not use two separate rule books, but two different viewpoints. Everything, from the tiniest quark to the Galaxy clusters is telling one single story. Relativity and quantum mechanics both have a common origin. Entire Physics & Cosmology is united.

My aim in this paper is to show that the pillar is the leg of the elephant, the pointed spear is its tusk, the rope is it tail, and the rubbery mattress is its ear.

[**NB** I'll be adding many more sections in this paper very soon].

Introduction

Our physics is derailed, and our cosmology is facing a series of crisis.

How then does nature manage to run everything so smoothly? Perhaps the better question to ask is: when nature is running everything without a hitch, how did we manage to mess up our physics and cosmology so badly?

Modern physics rests on two pillars: Quantum Mechanics and General Relativity. However they seem to be utterly incompatible.

Here are some reasons why Quantum Mechanics and General Relativity don't seem to fit together:

The problem of time is a conceptual conflict between general relativity and quantum mechanics in that quantum mechanics regards the flow of time as universal and absolute, whereas general relativity regards the flow of time as malleable and relative.

In general relativity, events are continuous and deterministic, meaning that every cause matches up to a specific, local effect. In quantum mechanics, events produced by the interaction of subatomic particles happen in jumps (i.e. quantum leaps), with probabilistic rather than definite outcomes. In quantum field theory, forces act locally through the exchange of well-defined quanta.

The general relativity does not have a propagator of force. As such gravity is not quantized. All other forces are quantized.

Special relativity demands a locality principle (no instantaneous action at a distance). Locality implies Bell's theorem and quantum mechanics violates Bell's inequality, therefore, quantum mechanics contradicts relativity.

(Return back to **Abstract**)

But nature simply can't afford to make Quantum Mechanics and General Relativity incompatible! Although physicists have made intense efforts towards unification, nobody cared to dig deeply to see why exactly our two best theories become incompatible. As a result, over eight decades have passed since physicists realized that the theories of quantum mechanics and gravity don't fit together, and the puzzle of how to combine the two remains unsolved.

We have made a series of mistakes, in our mathematics, and in our understanding of physics as well as cosmology. Consequently, we failed to decipher the deepest secret of nature: Nature does not use two separate rule books, but two different viewpoints. Everything, from the tiniest quark to the Galaxy clusters is telling one single story. Relativity and quantum mechanics both have a common origin. Entire Physics & Cosmology is united.

The greatest challenges facing physics/cosmology today are dark matter, dark energy, information loss (paradox) due to singularity inside black hole etc. which are relics of mistakes in our understanding of General Relativity, whose spacetime metric $ds^2 = (ic\,dt)^2 + dx^2 + dy^2 + dz^2 = (ic\,dt)^2 + dr^2$ is

based on the same metric as special relativity, although the mathematics is based on tensor calculus. To understand how exactly our mistake started, we need to investigate the true meaning of imaginary numbers. Before proceeding with the discussion, I would like to add a quote from D. Merritt:

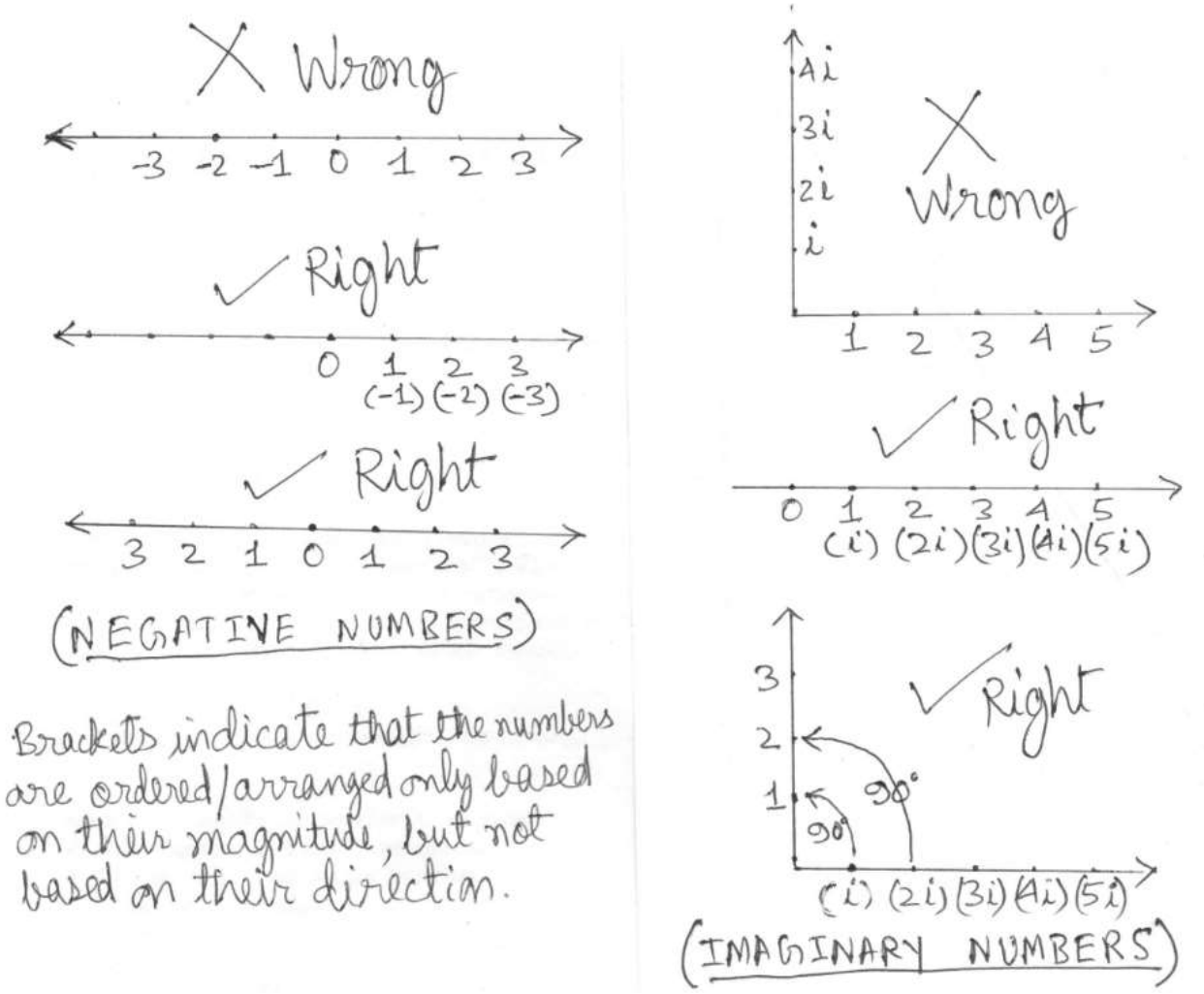
"*We need to scientifically understand why* ***the dark-matter based model, being the most falsified physical theory in the history of humankind****, continues to be religiously believed to be true by the vast majority of the modern, highly-educated scientists. This is a problem for the sociological and philosophical sciences and suggests a breakdown of the scientific method*" ["A Philosophical Approach to MOND: Assessing the Milgromian Research Program in Cosmology" Merritt, D., 2020, Cambridge University Press, ISBN: 9781108492690, 2020].

Discussion

Imaginary numbers are crucial for Quantum Mechanics, Relativity & other branches of Physics.

Let's begin by rectifying a mistake (please scroll below to the next page):

Imaginary numbers don't create an additional (perpendicular) axis/dimension, until a Wick rotation is performed. [Return back to abstract]



There is a misunderstanding about negative numbers & imaginary numbers. To explain this, let me start with negative numbers. Suppose I have taken one thousand dollars from the bank and spent it. Then I will **either** say "I am in a debt of 1000 dollars", **or** else I will say "I own -1000 dollars". But I **must not** say "I am in a debt of -1000 dollars". The negative sign is automatically telling the direction (since debt is in the opposite direction of owning). Therefore, if negative numbers are used (i.e. along with the minus sign), then we should use the positive x-axis (i.e. in the same direction of positive numbers). If we don't use the minus sign, then we should use the negative x-axis (in the opposite direction of +ve x-axis from the chosen origin). But we should never use both at the same time. Positive and negative signs automatically keep track of the direction. The negative sign is nothing but a multiplication with **-1**, and acts as an operator, which reverses the direction. But, as long as minus (**-**) sign is present, it is in the same direction as the positive (+ve) numbers i.e. along the positive x-axis.

I guess, we have been making this (unnoticeable) mistake due to our impulsive desire for ordering the numbers (based on their magnitude) on the number-line (say x-axis). Suppose we begin with 2. We compare 2 with 1. Since 1 is less than 2, we place it to the left of 2. Then we compare 1 with 0, and place 0 to the left of 1. Next, we compare 0 and -1, and find that -1 is less than 0, and therefore place -1 to the left of 0.

We conveniently forget one important fact: We have the origin at zero. Till now, placing at the left was bringing us closer to origin. But now, placing them more and more towards the left will move them away from the origin. The rule has flipped.

i.e. till we were using positive numbers (like 2,3, 12 etc.) for ordering purpose, we were following the rule: smaller numbers closer to origin, larger numbers further away. But when arranging negative numbers (in the conventional way) we are following the rule: larger number closer to origin, smaller number further away!

Therefore such ordering works only if we had **no origin** on the number line. Such a number line may be of interest to mathematicians (as a fancy ordering tool), but we don't need it for physics. For nature, the origin is definitely at zero (it is the terminus). After all, nature doesn't use negative numbers (or even imaginary numbers). They appear only in our mathematical description of physical laws. Negative/imaginary numbers are just a mathematical convenience tool. They don't exist in nature. How can I have -4 cows? (Here -4 is meant quite literally, which begs the question "How does a negative cow look like?"). And that is exactly why mathematicians were so reluctant to accept negative and imaginary numbers. They are not physical. Additionally, we certainly need an origin when dealing with dimensions. After all, we need an intersection (criss-cross) point between X and Y axes (or maybe even Z-axis). it is difficult to imagine how a number line without any origin can be used for creating a XYZ frame of reference.

Alert readers would have noted one difficulty. Even if we use the positive x-axis for ordering negative numbers (as shown in the figure), we still run into difficulty. While the positive numbers follow the rule: larger number closer to origin, smaller number further away, the rule get reversed for negative numbers. That's exactly why the negative numbers are shown in brackets in the diagram. We cannot order the negative numbers similar to the positive numbers. This problem becomes more pronounced when we go to imaginary numbers. That is because **i=sqrt(-1)** is neither less than zero, nor greater than zero, nor equal to 0. But if we have access to another perpendicular axes (luckily in this case the y-axis), then i=1.i represent (real) 1 on the y-axis. Since 1 on the y-axis don't lie anywhere on the x-axis, normal ordering won't work. However, the focus is not where on the x-axis the imaginary numbers should be placed (they are just mathematical convenience anyway). **The focus is that they represent real quantity on a very real axis.**

"Why then don't we use an additional axis instead of resorting to imaginary numbers?" That's certainly a good question. If x-axis is not sufficient, then we can add y-axis. If we require still another dimension, we can use the z-axis. But then we are stuck. We can't go beyond. And here is the shocking part: we certainly need another dimension, to which we have no access. We are flatlanders! This fact was

realised by Einstein and Minkowski (but they missed the true picture and created a mess with a block universe view).

The same conclusion (about an axis perpendicular to all three x,y, z axes) can also be reached independently. This is what this reference **[Imaginary Numbers are not Real (the Geometric Algebra of Spacetime); Stephen Gull, Anthony Lasenby, Chris Doran]** says: *We have now reached the point which is liable to cause the greatest intellectual shock. We have played an apparently harmless game with the algebra of 3-dimensional vectors and found a geometric quantity **i** which has negative square and commutes with all multivectors.*

While we had correctly identified that imaginary numbers means a rotation of 90° **[**see tutorial**: A Visual, Intuitive Guide to Imaginary Numbers, https://betterexplained.com/articles/a-visual-intuitive-guide-to-imaginary-numbers/],** we failed to recognize that **i=sqrt(-1)** acts as an operator. If we use **i**, then we should **not** use a perpendicular axis (y-axis) explicitly. All the imaginary numbers should be represented on the positive x-axis (in the same direction as real number axis). If we explicitly use a y-axis to highlight a 90° rotation, then we **should not** use the imaginary (**i**) sign. **The operator i=sqrt(-1) has already done its job.** That's exactly what a Wick rotation does. We should then only use real numbers on the y-axis. This also means that when **i** is present, then no additional dimension has been created. [**N.B**. An additional dimension/axis clearly means that it should not have any dependence to other dimension/axis. Only 90 degree (perpendicular) to all existing axes qualifies as additional dimension].

Imaginary number have rotational property (90° rotation) inbuilt in them. It is crucial to remember: **Imaginary numbers have the rotation rules baked in**.

[Return back to **abstract**] [Return back to '**Deeper meaning of the Minkowskian SpaceTime**']

Clock Time is imaginary

The equation $ds^2 = -c^2dt^2 + dx^2 + dy^2 + dz^2$ which represents Minkowski spacetime, and explains all of Special Relativity (including time dilation, length contraction & relative simultaneity) can always be written (without altering anything) as

$$ds^2 = (ic\,dt)^2 + dx^2 + dy^2 + dz^2 = (ic\,dt)^2 + dr^2 .$$

Where t is the time as measured by a clock. Clearly, clock time is imaginary. Imaginary **doesn't mean** something cooked up in our imagination. It is simply mocking at our face at our inability to access the 4th dimension, which is very much real. **Clocks don't lie** (only humans are capable of telling lies). **But it doesn't tell the complete truth either.** It tells us the measurement (of actual movement), but not the direction. That direction is in fact an impossible direction for us. That direction does not even exist in our 3d space. Just try pointing your finger towards the past or towards the future. That direction is in fact perpendicular to every possible direction we can point our finger at. And that is exactly why we need an imaginary numbers. Failure to realize this fact has led to several physicists questioning the "reality of time".

The presence of **i** clearly shows that it has **not** yet done its job of creating an extra dimension/perpendicular axis. Time (t) in the above equation $ds^2 = -c^2dt^2 + dx^2 + dy^2 + dz^2$ merely acts as a parameter and not as additional dimension, since it is still associated with **i.** It is this (imaginary) time which is measured by clock, and gets dilated with increasing velocity. Imaginary time is process time (since we can't directly measure it using a yardstick, but must depend on some process like radioactive decay or swing of the pendulum to measure it). Imaginary time should not be confused with absolute universal (A.U.) time (with a directional arrow) which is obtained after Wick rotation. Quantum Mechanics relies on A.U. time. It provides absolute simultaneity, as quantum entanglement demands (as explained later, there are two viewpoints involved: One from which simultaneity is absolute, and the other from which locality is absolute).

In a recent paper titled **'Is time the imaginary number?' [Nature and Science, 4(1), 2006, Arnold Carbajal]** the author has made a bold claim: *I recommend that time should be substituted for the imaginary number in all calculations, in scientific disciplines, that use an imaginary number to make the math come out correctly. This could lead to all sorts of new equations in all of these fields, and show how time itself is entering into the function of the real world in these scientific disciplines.*

True meaning of Wick rotation

Wick rotation (or Euclidization) creates an additional dimension (perpendicular axis), and is therefore the viewpoint of a higher dimensional being (e.g. nature or universe). It certainly gives us a divine view, but unfortunately doesn't give us access to the higher dimension (we still can't move forwards & backwards at our will along that direction in a similar manner as we can do with space dimensions, but must get dragged along it like a mere passenger on a train). **Let me remind:** if we perform an actual 90 degree rotation to create an additional dimension, then **the imaginary sign must go away** from time (i.e. imaginary 'clock time' becomes real 'universal time')

Wick rotation **should not** be called **imaginary transformation**. In fact, it does just the opposite.

This simple fact has profound implications, and lets us understand a host of phenomena, from relation of cyclic (imaginary?) time and inverse temperature to the transformation from 'Principle of Least Action' in Lagrangian dynamics to 'Principle of Least Energy' (of a stretched spring) in static equilibrium. What we have been calling imaginary time is actually Wick rotated (Euclidean) real time. In fact, it is the clock time which is imaginary, and it turns into a real, absolute time after Wick rotation. And that's exactly why Physicists were so puzzled that "imaginary time seems more real than real time".

The simple transformation $\mathbf{i.t = t_{abs.}}$ (where **i=sqrt(-1)** and $\mathbf{t_{abs.}}$ is absolute/universal time) is the magical key which opens a treasure chest for us **[The Mysterious Connection Between Cyclic Imaginary Time and Temperature;** Marco Tavora Ph.D., https://towardsdatascience.com/the-mysterious-connection-between-cyclic-imaginary-time-and-temperature-c8fb241628d9 **]** The 'Wick trick' also finds

uses in connecting quantum mechanics with statistical mechanics and in certain cosmological theories, and in some approaches to special relativity and quantum mechanics.

In fact, what we think of as imaginary time (created through Wick rotation) is actually a real dimension for the universe. Through Wick rotation, the above Minkowskian equation becomes Euclidean (which is natural compared to an 'unnatural' spacetime distance **ds** in Minkowskian geometry).

Deeper meaning of the Minkowskian SpaceTime

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Special relativity can be formulated both in 3d and in 4d. Physicists have been debating (even till today) whether Minkowskian SpaceTime is 3 dimensional or 4 dimensional (**see appendix: Is Minkowski SpaceTime 4 dimensional or 3 dimensional?**).

Actually neither view is fully satisfactory.

The equation $\boldsymbol{ds^2 = -c^2dt^2 + dx^2 + dy^2 + dz^2}$ is not a normal equation. Physicists have repeatedly raised strong objections to Minkowski spacetime, and about the mathematical structure of the above equation (**see appendix: Objections to Minkowski spacetime**).

The above equation is **not** wrong. It is absolutely right, as confirmed by numerous experiments.

[**Warning!** If you haven't read the section '*Imaginary numbers don't create an additional (perpendicular) axis/dimension, until a Wick rotation is performed*' then before proceeding further click here]

So, what is actually happening?

The equation $ds^2 = (ic\,dt)^2 + dx^2 + dy^2 + dz^2$ is rightly mocking us in our face at our inability to access the absolute (universal) time direction. We have to accept our inability. We can only use 3 mutually perpendicular axis (x, y and z), but the universal time axis is perpendicular to all these axes, thus forcing us to use imaginary numbers. **We are indeed trapped inside a 3d hypersurface/hypersheet**. [But please don't jump to the conclusion that I am supporting the accepted version of 3d space & an evolving time, in which time doesn't play the role of dimension at all, but is just a measure of changes]

I deliberately used the term 3d hypersurface/hypersheet (**HS**) instead of 3d space. It is **very important** to note that we have mistaken the 3d **HS** (which is composed of gravity field/Bohm's quantum field, and particles, which are resonances in that field) as 3d space. Every particle is guided by this information field/pilot wave-field (as correctly guessed by Louis de Broglie and David Bohm) which keeps them eternally trapped inside this 3d field-particle hypersurface/hypersheet (**3d FPHS**). All planets & stars are ultimately made up of particles, and hence are also eternally trapped. Kindly note that

this is a 3d trap-field, and hence every star & every galaxy is very thin when looked from the 4th dimension. That's why it is referred to as 3d hypersheet rather than 3d volume. While we are already well aware that our entire 3d space (which we also call 'vacuum') is filled with fields, which is brimming with energy (in which particles can pop in and out of existence), we never figured out that it is this 3d FPHS which has made our geometry 3 dimensional! That is a big trick by nature, since the geometry of universe/nature is 4 dimensional (i.e. 4d hyperspace). Space (actually, hyperspace) is nothing but 4d geometry (true vacuum) which embeds this 3d FPHS. Just imagine a 2d creature moving on the surface on a rubber sheet (**RS**). If the RS is absolutely transparent/invisible, and offers no resistance to its movement (unless it changes is velocity), the creature will assume that the RS is space/geometry of the universe itself. It'll treat the **RS** so synonymously with space that it will treat the distance between two visible dots on the RS as the spatial distance. Even if it is somehow aware of the existence of the (almost imperceptible) **RS**, it will ignore its presence, and will hardly ever acknowledge that it is a trapped creature. I can say this with confidence that this indeed is the case!

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This section between the starred lines contains further crucial clarification, and glimpses of topics to come.

Einstein had a crucial insight that matter bends/warps spacetime. What he failed to realize is: space can't bend; it is pure geometry. What actually gets bent/warped (actually stretched in the 4th dimension, as we'll soon see) is this **3d FPHS**. He had mistaken this 3d FPHS as spacetime. [Mistaking this 3d FPHS as 3d space would have been a mistake enough. But he went one step further! He mixed space with time (which is nothing but duration-an emergent phenomena, appearing due to the motion of 3d FPHS). He failed to recognize that space-time mixing is just a feature of Minkowskian mathematical structure. Any creature trapped in this dynamic/moving 3d FPHS is liable to make that mistake.

The mistake of assuming geometry (instead of gravity fields) getting bent is highlighted in this paper:

[**What Einstein did not consider about Gravity**; D. Rowland, OSP Journal of Physics and Astronomy, Volume – 1, Issue – 1, July 05, 2020]

Geometry is the mathematics which describes the properties and relations of points, lines, and surfaces-as well as the relative locations of objects. Mathematics is an abstract form of measurement and not a physical thing. As such, geometry can neither cause nor be influenced by anything that exists in physical reality.

The same point is again highlighted in this paper:

[**Physics as space-time geometry**; Vesselin Petkov, chapter 8, Springer Handbook of space-time (Springer, Heidelberg 2014) pp 141-163]

(Page 22/34) *although the term 'gravitational field' is widely used in General relativistic literature, its correct meaning is to describe the geometry of space-time and nothing more. It is not a physical field that can be quantized. As there is no physical entity which is represented by the term 'gravitational field' in general relativity it* ***does*** *follow that there is no energy and momentum of that non-existent physical entity.*

It was Einstein who first tried to insert the concept of gravitational energy and momentum forcefully into general relativity (since he represented it by a pseudo-tensor, not a tensor as it should be) in order to ensure that gravity can still be regarded as some interaction.

The simple fact that Einstein had mistaken this 3d hypersheet as fabric of space-time itself becomes very clear when we investigate the 1995 proposal by the American theoretical physicist Ted Jacobson that Einstein's gravity equations can be derived from thermodynamics. This suggests that Gravity is just an average of the behavior of unknown "atoms" of Spacetime (well, not space-time, but field-particle HS). This implies that Einstein's equations can be viewed as an equation of state, a thermodynamic equation relating variables describing the state of matter (such as, for example, the ideal gas law). Since we can associate a temperature and entropy to regions of spacetime, it is not unreasonable to suppose that their properties may have some similarities to the properties of matter at the macroscopic scale.

It should be noted that if we derive the Einstein equations using arguments from thermodynamics, **we cannot interpret the equations geometrically (as it is usually done)**. If we assume gravity is, by nature, a thermodynamic phenomenon, the Einstein equations must be interpreted using thermodynamic concepts. ## All these confusions arises because of failure to distinguish between pure geometry, and a 3d trap field. We should start asking serious questions like "why should properties like permittivity and permeability (which strongly hints at a substance like nature) appear in pure vacuum?" ##

Several other recent papers do highlight the fact that gravity is **not** due to bending/warping of pure geometry. It is indeed associated with gravity field which gets bent/warped (gravity field has a strong intimate connection to quantum field, as well as electromagnetic field, as modern researches have shown. In fact, weak forces & strong forces gets unified through Quantum Field Theory QFT. It is this unified field whose stretching causes gravitation). In fact it gets stretched just like a rubber membrane (which happens to be a 3d membrane of fields rather than 2d one), along the direction of universal time. The slowing down of (imaginary) clock time is simply because the gradient of imaginary time varies at different points of the stretched membrane (depending on the slope of the membrane, the imaginary time can be resolved into cos (θ) and sin (θ) components). This turns a part of the purely temporal (imaginary) into spatial component. In case of black hole, the membrane (gravity fields) gets so stretched that temporal turns spatial, and space and time exchanges roles (just as general relativity predicts). **General Relativity regards the flow of time as malleable and relative whereas quantum mechanics require universal and absolute time, thus causing the 'time problem'.** We can clearly see that it is the 3d FPHS which gets bent. Fields can easily bend, which can be demonstrated by Michael Faraday's 'magnet iron filings' experiment.

I'll soon cover all these things in detail.

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Now that I have clarified the difference between 3d space, and 3d hypersurface of gravity (trap) field, the next question which arises is: "why is time (**t)** entering the equation at all? If our world is really 3 dimensional, then wouldn't the metric have been simply: $ds^2 = dx^2 + dy^2 + dz^2$?"

The answer is: **it is not a static equation, but a dynamic equation!**

This is very easy to see. Let us take any observer, located anywhere in space (3d FPHS), and moving with any possible velocity. Relative to itself, the observer does not move through space (dr=0). Therefore the above equation becomes (putting dr=0):

$$ds^2 = (ic\ dt)^2 + dx^2 + dy^2 + dz^2 = (ic\ dt)^2 + dr^2 = (ic\ dt)^2$$

Therefore, **ds/dt = i.c**

Therefore, every frame of reference reaches the same conclusion. The presence of **i** clearly shows that everyone is moving with a velocity **c** in a perpendicular direction to all three x,y and z axis (which is an impossible direction for every observer trapped in this 3d FPHS). The lack of understanding about i=sqrt(-1) had led scientists to conclude that the velocity is imaginary (and hence discouraged from digging deeper). They simply concluded that our spacetime is very peculiar (hyperbolic), without questioning why this peculiarity arises after all.

But every frame of reference can reach the same conclusion only if the **entire** 3d FPHS is moving in the same direction. That's why I emphasized 3d FPHS (instead of 3d space). A 3d space moving through 4d hyperspace doesn't make any sense! But a 3d FPHS moving (at velocity c) through 4d hyperspace does make sense.

The sharpest mind of the last century had smartly figured out that we are all moving at the velocity c (speed of light) through space-time. But they failed to reach the correct conclusion, which is: **every observer (or every frame of reference) is moving with a velocity c in one single direction (the real-time/universal time direction) irrespective of its location or velocity in the 3d FPHS.**

If we ignore the dynamic nature of the 3d FPHS, then our world indeed appears 3 dimensional and Euclidean $ds^2 = dx^2 + dy^2 + dz^2$ It appeared 3 dimensional and Euclidean when Euclid formulated his geometrical theory. It appeared that way, the day Jesus Christ was born, and also the day when Isaac Newton died.

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Rest-mass momentum

One immediate consequence of dynamic 3d space (3d FPHS) is the concept of 'rest-mass momentum' given by $p_{rest} = m.c$

This makes physics simpler and more consistent (and leads to unification of momentum concept so that we don't have to resort to two different rules books).

This concept was suggested (without clarifying why) by E.G. Haug [**Better Quantum Mechanics ? Thoughts on a New Definition of Momentum That Makes Physics Simpler and More Consistent**; E.G.

Haug, doi:10.20944/preprints201901.0042.v2]. But for a dynamic 3d FPHS (moving with velocity c) and dragging every matter along with it, this concept is inbuilt and integral part. We never thought about **'rest-mass momentum'** because we are also travelling along with the mass (we are considering) at the same velocity & in the same direction (hence relative velocity is zero). But from nature's point of view, the mass m is travelling with velocity c. Therefore momentum = mass X velocity =m.c [And as explained by E.G. Haug, the energy is always E= momentum X c. Therefore rest mass energy E = mc.c = mc^2 . That's the true reason for the origin of rest mass].

We might not have believed in the concept of rest mass energy (E= mc^2) if we had not observed nuclear reactions. The shocking thing is that above-mentioned paper by E.G. Haug couldn't even get published in a peer reviewed journal. Scientific community is determined to accept only the views of authors who fall in line with presently accepted views. How can science really progress?

The possibility of a dynamic 3-space was explored by Reginald T. Cahill, and he supported it with some solid reasoning.

[**Unravelling Lorentz Covariance and the Spacetime Formalism**; Reginald T. Cahill; PROGRESS IN PHYSICS, Volume 4, October, 2008]

Abstract: *We report the discovery of an exact mapping from Galilean time and space coordinates to Minkowski spacetime coordinates, showing that Lorentz covariance and the spacetime construct are consistent with the* ***existence of a dynamical 3-space, and "absolute motion". We illustrate this mapping first with the standard theory of sound, as vibrations of a medium, which itself may be undergoing fluid motion****, and which is covariant under Galilean coordinate transformations. By introducing a different non-physical class of space and time coordinates* ***it may be cast into a form that is covariant under "Lorentz transformations" wherein the speed of sound is now the "invariant speed".*** *If this latter formalism were taken as fundamental and complete we would be lead to the introduction of a pseudo-Riemannian "spacetime" description of sound, with a metric characterised by an "invariant speed of sound". This analysis is an allegory for the development of 20th century physics, but where the Lorentz covariant Maxwell equations were constructed first, and the Galilean form was later constructed by Hertz, but ignored. It is shown that the Lorentz covariance of the Maxwell equations only occurs because of the use of non-physical space and time coordinates. The use of this class of coordinates has confounded 20th century physics, and resulted in the existence of a "flowing" dynamical 3-space being overlooked. The discovery of the dynamics of this 3-space has led to the derivation of an extended gravity theory as a quantum effect, and confirmed by numerous experiments and observations.*

Planck's constant & Fine Structure constant

[**Photon – the minimum dose of electromagnetic radiation**; Tuomo Suntola, SPIE Conference 5866, The nature of light: What is a photon? San Diego, CA, August 1-2, 2005]

Abstract: *A point emitter like an atom can be regarded as a dipole* ***in the fourth dimension****. The length of such dipole is measured in the direction of the line element cdt, which in one oscillation cycle means the*

length of one wavelength. For a dipole in the fourth dimension, three space directions are in the normal plane which eliminates the factor 2/3 from the energy expression thus leading to Planck's equation $E_\lambda = hf$ *for the radiation emitted by a single electron transition in an atom. The expression of the Planck constant obtained from Maxwell's equations leads to a purely numerical expression of the fine structure constant* $\alpha \approx 1/137$ *and shows that the Planck constant is directly proportional to the velocity of light. When applied to Balmer's formula, the linkage of the Planck constant to the velocity of light shows, that the frequency of an atomic oscillator is directly proportional to the velocity of light. This implies that the velocity of light is observed as constant in local measurements.* ***Such an interpretation makes it possible to convert relativistic spacetime with variable time coordinates into space with variable clock frequencies in universal time, and thus include relativistic phenomena in the framework of quantum mechanics.***

Introduction: *Emission of electromagnetic radiation from atoms as small point sources could not be quantitatively explained in the framework of Maxwell's equations. When an atomic source is described as an electric dipole emitting electromagnetic radiation, the displacement of the charge resulting in electric dipole momentum is considered as being of the order of atomic size, about* 10^{-10} *m, which is orders of magnitudes smaller than the wavelengths of radiation emitted. The situation, however, is radically changed if we consider a point source a dipole in the fourth dimension, in the direction of line element cdt, which in one oscillation cycle means the displacement of one wavelength — regardless of the emission frequency from the source.*

Interpretation of a point source as a dipole in the fourth dimension suggests a fourth dimension of metric nature. Displacement of a point source by one wavelength in a cycle requires motion of space at velocity c in the metric fourth dimension. Such an interpretation is consistent with spherically closed space expanding in a zero energy balance of motion *and gravitation in the direction of the 4-radius. A consequence of the conservation of the zero energy balance in interactions in space is that all velocities in space become related to the velocity of space in the fourth dimension*

Conclusion: *The* ***successful interpretation of a point source as a dipole in the fourth dimension suggests the interpretation of space as three dimensional environment moving at velocity c in a fourth dimension*** *with metric nature. In such an interpretation the rest energy of mass appears as the energy of motion mass possesses due to the motion of space. Conservation of total energy in space means that all velocities in space become related to the velocity of space in the fourth dimension. As a further consequence, the local rest energy of mass appears a function of local motion and gravitation, which means that the energy states and the characteristic emission frequencies of atoms become functions of the local motion and gravitation. In fact, the effect of motion and gravitation on locally "available" rest energy converts Einsteinian spacetime with proper time and distance to dynamic space in absolute time and distance.*

The solution given by Maxwell's equations for the energy of a single oscillation cycle of a unit charge in a dipole in the fourth dimension gives a natural interpretation to the nature of a quantum as the minimum dose of electromagnetic radiation. The interpretation of a point source as a dipole in the fourth dimension becomes obvious if we give the fourth dimension a metric meaning instead of considering it a time-like dimension of the Einsteinian spacetime. A fourth dimension of a metric nature ***makes it possible to describe three-dimensional space as a closed "surface" of a 4-sphere expanding at velocity c in a zero-energy balance*** *with the gravitation of the structure in the direction of the 4-radius.*

Spherically closed dynamic space converts Einsteinian spacetime in dynamic coordinates to dynamic space in absolute coordinates. The dynamic perspective to space became quite natural since the observations of Edwin Hubble which were not available in early 1900's when the spacetime concept was created. Also, many contemporary questions related to atomic clocks and GPS satellites are easier to tackle and understand *on the basis of the dynamic approach studied in detail in the Dynamic Universe theory.*

The Dynamic Universe theory actually introduces a paradigm shift comparable to that of Copernicus when he removed the center of universe from Earth to the Sun. In the present perspective, the universe is revealed to be a four dimensional entity which orders space to appear as the surface of a four dimensional sphere. This sphere, the three-dimensional space, is not held static by the famous cosmological constant, but it is expanding because of an overall zero energy balance *between motion and gravitation.*

In addition to the nature of quantum as the minimum dose of electromagnetic radiation, Mach's principle, the nature of inertia, and the rest energy of matter, this comprehensive framework gives precise predictions to recent observations on the redshift and magnitude of distant supernova explosions without a need to postulate dark energy or accelerating expansion of space. It also explains the Euclidean appearance of distant space and the apparent discrepancy between the ages of oldest stars obtained by radioactive dating and the age of expanding space, which has remained a mystery.

[Further references (suggested reading): 1. Tuomo Suntola, **Theoretical Basis of the Dynamic Universe**, ISBN 952-5502-1-04, 290 pages, Suntola Consulting Ltd., Helsinki, 2004

2. Tuomo Suntola, "**Dynamic space converts relativity into absolute time and distance**", Physical Interpretations of Relativity Theory IX (PIRT-IX), London, 3-9 September 2004

3. Tuomo Suntola, "Observations support spherically closed dynamic space without dark energy", SPIE Conference "The Nature of light: What is a Photon? (SP200)", San Diego, 2005

4. Tuomo Suntola and Robert Day, "Supernova observations fit Einstein-deSitter expansion in 4-sphere", arXiv / astro-ph/0412701 (2004)]

But how could the greatest minds fail to reach the correct conclusion about the core equation of relativity? Very closely related is the question: why can't anything move faster than the velocity of light?

That topic is discussed in detail quite soon. **The simple answer is:** the peculiar structure of our Minkowskian space-time confuses us from judging the actual velocity of other moving observers, or other frames of references (having a relative motion w.r.t our frame of reference). It is very easy to see why Minkowskian's claim that we are travelling at velocity c through space-time was taken so lightly (without bothering about the profound implication). Travelling either in spatial direction or in the time direction at velocity **c** doesn't make much sense. What does travelling through time even mean? For most people, time is something intangible. To add to the confusion, many texts simply imply an equivalence between second and meter. Therefore I guess most people assume 'travelling through time' to mean travelling at one second per second.

But let's look very carefully at the equation:

$$ds^2 = (ic\,dt)^2 + dx^2 + dy^2 + dz^2 = (ic\,dt)^2 + dr^2$$

It is not i.dt but i.(c.dt).

The moment we multiply time with velocity, we get unit of distance, which is very much tangible. Distance can be measured directly using a scale or rod. And as emphasized above, we are all travelling at velocity c through (hyper) space in one particular direction. So we can't ignore this or take it lightly any more.

To summarize: Our entire 3d hypersurface is embedded in a 4 dimensional hyperspace, and is moving in the 4th dimension with a velocity c , which happens to be 299792458 metres per second, or 1079 million kilometers per hour! (That's right. It's 670.6 million miles per hour). That's how fast we are all moving through (hyper) space.

The static 4d hyperspace is absolute, and its metric is (as it should be), perfectly Euclidean rather than pseudo-Euclidean or Minkowskian. In effect, we have created an absolute (background) Euclidean 4d hyperspace. This solves one of our biggest problems: How you can tell that your driver has put his foot on the gas/accelerator, with your eyes closed, but have to look outside to confirm if it is moving at a constant speed? In other words, why velocity is relative, but acceleration is absolute? It answers the profound physics question regarding the origin of inertia which is problematic in relativity (if everything is relative, then how do you even measure inertia?)

Minkowski assumed acceleration as bending of worldtube (that was his theory. There is another, and better explanation for inertia). Taking his theory as true, actually it should be the bending in a thin section of world-tube (wild coin). Imagine a partially rigid tube. Bending it produces stress even in a thin cross-section of the tube. Hence it resists bending (that is, resist acceleration or deceleration). Another explanation for inertia comes from the fact that when we try to solve the stretched string/spring in imaginary time, the elastic energy of the string becomes kinetic energy of the particle. Since inertia is related to acceleration (or to the change of kinetic energy) therefore inertia is also related to the elastic energy of gravity field (this will become clear when I explain the true meaning of principle of least action, in which the stretched gravity field plays a crucial role).

[The moving 3d space (3d FPHS) just a portion of even bigger picture: the 3d hypersurface is just a small region of an inflating balloon universe. But let's not get ahead of ourselves].

Why is the velocity of light (c) constant? Why can't anything travel faster than the speed of light?

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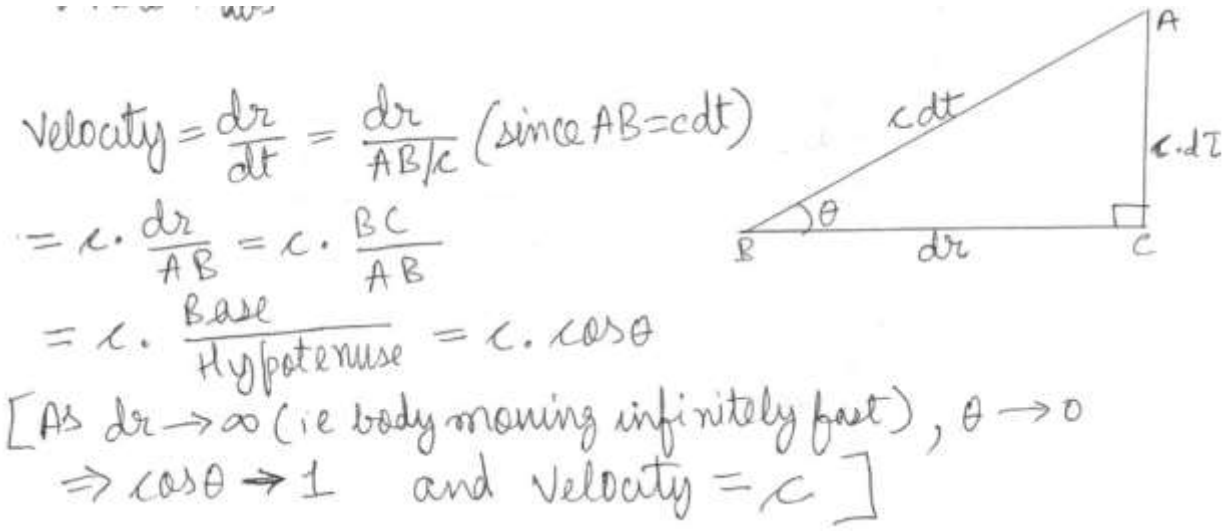
Special relativity (SR) is based on the experimental fact that light travels with a constant velocity **(c)** irrespective of the motion of the reference frame.

SR does not explain what causes this postulate to appear. As a result, even after a century special theory of relativity is just a principle theory and there is no constructive theory.

Besides, it begs the question: is light somewhat magical? Is relativity is just a branch of electromagnetism? What causes the gravity waves to travel at the same speed of light?

The real reason is: it is a peculiarity of Minkowskian (hyperbolic) structure!



So here is the actual reason, while nothing can travel faster than the speed of light (which is actually, the velocity of expansion of our universe)

By using the definition of velocity as: constant X (Base/Hypotenuse) we have made sure that we choke (put an upper ceiling to) any possible velocity at c. As the base (distance covered by the particle) gets larger, the hypotenuse gets larger as well (time dilation), since by Pythagoras theorem, the base of the triangle contributes to the hypotenuse.

In other words, due to this peculiar geometry, for a sufficiently fast moving frame of reference, we start counting the spatial distance as temporal distance. We inevitably mixes space and time.

There is in fact no speed limit in the universe (photons can travel at infinite speed). In fact, if we use the formula for proper velocity, we can quite easily verify that.

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From the above discussion another important fact comes to focus. As already mentioned, imaginary numbers cannot be taken as an independent axis. Special relativity does exactly that, and as a consequence, the time axis, which we assume as an independent axis begins to tilt as the velocity of the observed object increases. Only a perpendicular axis (which has no dependence on the other axes) qualifies as a full dimension. However in this case, time axis has dependence on the other axes, and can only be regarded as a partial dimension. The dimension of the time axis will be less than or equal to 1. This has very unexpected outcome.

[**Quantum Behavior Arises Because Our Universe is a Fractal**; Yong Tao, Reports in Advances of Physical Sciences, Vol. 1, No. 2 (2017) 1750006, DOI: 10.1142/S2424942417500062]

If the dimension of time axis is slightly less than 1, then Planck's energy quantum formula will naturally emerge. In this paper, we further show that if the dimension of time axis is less than 1, Heisenberg's

Principle of Uncertainty will emerge as well. Our finding implies that fractal calculus may be an intrinsic way of describing quantum behavior. To test our theory, we also provide an experimental proposal for measuring the dimension of time axis.

Based on our previous calculation, the dimension of time axis should approach $\boldsymbol{1 - 10^{-59}}$ *, while the dimension of a space axis equals 1. It coincides with Horava–Lifshitz gravity model, which assumes that space and time are not equivalent (anisotropic) at high energy level.*

##Several authors have made similar observations. G.N. Ord had already proved that relativistic quantum mechanics arises from 2+2 dimension fractal space-time. However, fractal nature itself arises when two opposing forces are locked in a battle. e.g. constant battle between buyers and sellers in a stock market create the fractal nature of price. The constant battle between land and water creates the fractal coastline. Similarly, everything we see around us is a battleground between two opposing viewpoints: 3+1 Minkowskian space-time (our viewpoint), and 1+3 Planck Time space (nature's viewpoint). This constant battle, and transition from 1+3 to 3+1 and vice versa, passes through the broken (fractal) geometry.##

The sky dome/bowl analogy of Minkowski spacetime

Imagine you are standing on the grass plain of Mongolia, under a starry sky. The dark sky above your head looks like a dome (or a bowl if you like) dotted with shining stars. Even though you are aware that the stars are thousands or perhaps even millions of light years away and therefore can't be located on the surface of a dome whose edge meets the horizon just a few miles away from you, you simply can't believe that this might be an illusion. [Actually ancient civilizations seriously thought that the stars are located on the surface of a glassy sphere].

After spending the night in a Mongolian tent, you wake up in the morning to see a blue dome above your head. You start riding your bike. Something very strange happens. The dome follows wherever you go. You write faster and faster, but you were surprised to find that the dome always keeps pace with you.

Some months later you're standing in the midst of Sahara Desert. Again you see the blue dome above your head. You start wondering whether the dome has followed you even here in the midst of nowhere. You start thinking whether your friend back in Mongolia is still seeing the blue dome above his head.

A few years later, you are standing in in the prairie fields of America. Even here you see the blue dome above your head.

Then you realize that every person everywhere on Earth is seeing a blue dome above his head.

You hop in a hot air balloon and rise up in the air. Only then you realize that the individual blue domes start merging and the locus of all the zenith's (top points of the domes) form the curved blue atmospheric layer of the Earth.

Nature is playing a similar trick through constancy of the speed of light. Imagine two observers standing side-by-side. There is a source of light in between them, which is emitting light in pulses.

The light pulses will spread out as growing spheres (due to isotropy). The radius of the wavefronts produced in this way will grow with speed c. Now let us suppose one observer starts moving very fast. Since velocity of light is independent of the speed of the observer, the fast moving observer will also be at the centre of the growing sphere. Just as the Sky dome split and followed both observers, the light sphere appears to be following both observers, even though there is a single source of light. Nature has given a private (expanding) light sphere to every observer.

Reply to Petkov's argument (printer cartridge example)

Petkov had argued that none of the relativistic features like length contraction, relative simultaneity etc. are impossible in 3d space.

Actually all those features of relativity are possible if the equation

$$ds^2 = (ic\ dt)^2 + dx^2 + dy^2 + dz^2 = (ic\ dt)^2 + dr^2$$

is satisfied. We have already seen that it is indeed the case for a dynamic (moving) 3d hyper surface. But still, to remove any (psychological) doubt, consider this example:

Think of a printer ink-cartridge. It just moves back & forth on a thin metal rod (1 dimensional movement). But still it is able to print on the whole of 2d paper. That's because, the paper is itself moving. In this case it is just the reverse: imagine the metal rod sliding upwards (or downwards) on the paper sheet while the cartridge just moves to and fro.

……..

Consequences of Minkowskian space-time for General Relativity (GR)

General relativity **(GR)** is based on the same metric as Minkowskian space. Failure to recognize that although GR is absolutely correct mathematically, it is only an inside view (of a trapped creature in 3d FPHS, as the entire FPHS moves in one direction), and consequently can't predict the global structure of the universe, nor can it account for **external field effect (which has now been confirmed to 11 Sigma accuracy** in galaxies & galaxy clusters). GR leads to 'Dark Matter' specter, Black Hole singularity (along with information loss paradox) etc.

Instead of taking the rubber membrane model of general relativity (**GR**) as just an analogy to explain gravity and bending/magnification of light etc. we should take the model quite literally. Explanation of all Dark Matter related features becomes a cakewalk.

That's because the Einstein's equations are in fact the equations of (a moving/dynamic) 3d hypersurface in an embedding 4d hyperspace. As mentioned earlier, Einstein concluded that matter can bend

spacetime (actually he mistook the dynamic gravity field for space-time). It is indeed very flexible, and can be stretched by matter in the absolute (universal) time direction, towards the future. Every matter has a natural tendency to move towards the future.

General Relativity is still our best theory of gravity. This paper **[Universality of free fall from the orbital motion of a pulsar in a stellar triple system; Anne M. Archibald, Nina V. Gusinskaia, et al in Nature Letter Nature volume 559, pages73–76(2018)]** offers a very accurate test of Strong Equivalence Principle, and strongly defends **GR**.

Letting **GR** accommodate for external field effect (**EFE**) by taking the rubber model literally, works like wonder. Then we can easily explain the enormous gravitational effect of normal baryonic matter, the unexpectedly large gravitational lensing etc. EFE was a prime advantage for MOND ('Modified Newtonian Dynamics' Theory) over GR, but ironically EFE doesn't belong to linear Newtonian gravity (where subsystems can be decoupled). It was a forced marriage. Or, to put it even better: it was a marriage with GR's eloped girlfriend.

To summarize, we have proved that our assumed 4d spacetime continuum is just 3d hypersurface composed of matter & fields (which we call 3d space) moving in a 4d hyperspace. [**NB** There is no concept of **'outside'** in general relativity, and a block universe view is assumed. This of course is a wrong view because the dynamic 3d FPHS has an embedding 4d hyperspace. In general relativity, any curvature of space-time is assumed to be intrinsic, while in this theory, the curvature of the universe, as well as the curvature due to presence of massive objects (i.e. stretching in the fourth dimension) is extrinsic]

5th dimension (Consequences of Minkowskian space-time).

We have simply mistook a 3d hyper surface (composed of fields and particles) as a 4d space-time continuum, by wrongly assuming imaginary (clock) time as the 4th dimension. In other words, we are wrongly and unnecessarily counting one extra dimension! That is exactly why Theodor Kaluza's 'miracle' (obtaining the Maxwell's equations in addition to Einstein's field equations) seemed to require a 5th dimension. Actually what he needed was only 4 dimensions. And it wasn't a 'miracle' really. He was doing something right, and nature agreed.

In other words, our 3d space (3d FPHS) is embedded in an extra spatial dimension, which we have mistaken as the 5th dimension (because we have already reserved the 4th dimension for imaginary clock time). To see the **profound achievement** of freeing up one dimension, and hence allowing the 5th dimension to appear in Physics (without ever violating the severe restriction/limit of dimensions set by nature at 4), please **see the appendix: "We don't need a 5th dimension".**

……

Other consequences of Minkowskian space-time

[**About chirality in Minkowskian space-time**; Michel Petitjean, Symmetry 2019, 11(10), 1320; https://doi.org/10.3390/sym11101320]

We also show that the composition of parity inversion and time reversal is an indirect isometry, which is the opposite of what could be expected in Euclidean spaces. It is expected that the extended

mathematical definition of chirality presented here can contribute to the unification of several definitions of chirality in space and in space-time, and that it helps clarify the ubiquitous concept of chirality.

Before proceeding further, let me stress that the following section is not only about astronomy or cosmology. Getting the correct geometry and structure of our universe, is absolutely crucial for getting our physics right. The Noether's theorem which form the bedrock of modern physics is all about the conservation laws of physics, and the symmetry of our universe. Also, we could relate the principle of maximum ageing in proper time, and the principle of least action through a better model of our universe (space-time).

Let's rectify the **second** mistake:

We can't measure the curvature of the universe using the sum of angles of a triangle.

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Please note that the triangle method of adding up the sum of angles and checking whether it is 180° or not, will work fine for a 2d surface curving in the 3rd dimension (example: surface of a ball). However, we are talking of 3d hyper-surface curving in the fourth dimension. What we need is a tetrahedron, and we have to check the sum of solid angles, rather than the angles on the faces.

Please let me elaborate: let's go down one-dimension and take the curved surface of the earth as an example. Let a person starts from point A on the North Pole, move southwards till point B on the equator. Then he moves an equal distance along the equator to reach point C. Now he turns 90°, and faces the North direction. He continues his journey and reach point A. Now each of the angles at A, B and C are 90°. Therefore the total angles in the triangle add up to 270°.

Now he repeats his journey from point A (North Pole) and again reaches point B on the equator. But now he travels just a few steps and turned 90° again. He continues his journey to reach point A. Now the angles formed at points B and C are 90° each, while the angle formed at A is almost 0°. The sum of the angles now almost add up to 180°.

Therefore as the triangle shrinks into a line (i.e. point C comes closer and closer to point B, and ultimately merges), it loses its detecting power. We need a 2d object (like triangle) and not a 1d object (line) to measure the curvature of 2d surface. The same phenomena happens in one higher dimension. A triangle is nothing but a tetrahedron whose apex/peak point has merged with the base. Hence a triangle is useless for measuring curvature of the universe.

It was a mistake to use triangulation method (using CMB temperature spots) to conclude that our universe is 3d flat.

In the near future we might send four satellites (with very sensitive equipment) each of them a million miles apart from the other three to form a tetrahedron structure in deep space. Using laser beams, we might calculate the sum of 4 solid angles and compare it with theoretical values for 3d flat space. That way we can directly measure the curvature of our universe. Apart from directly measuring the size

(radius) of the universe, we can also settle the Hubble constant value debate (since we know the value of **c** precisely).

N.B. Using General Relativity's critical mass concept to predict curvature is bound to fail (as GR is only a blind ant's view. It can't even anticipate the completely opposing roles played by matter in shorter and longer length scales. Matter provides both the attractive gravitational force, as well as the reason for universal expansion). Any amount of mass is capable of inflating the balloon universe.

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[**An hypersphere model of the Universe - The dismissal of dark matter**; Jose B. Almeida, https://doi.org/10.48550/arXiv.physics/0402075]

Abstract: *One can make the very simple hypothesis that the Universe is the inside of a hypersphere in 4 dimensions, where our 3-dimensional world consists of hypersurfaces at different radii. Based on this assumption it is possible to show that Universe expansion at a rate corresponding to flat comes as a direct geometrical consequence without intervening critical density;* ***any mass density is responsible for opening the Universe*** *and introduces a cosmological constant.*

In the latter portion of this paper, I show that we have grossly overestimated the size of the observable universe. Now, if our estimate of the mass content in this observable universe is correct, but the observable universe turns out to be much smaller, then our estimate of critical mass density needs to be drastically revised.

It must be stressed that even the slightest positive curvature of our universe can have drastic consequences. A positively curved universe is necessarily closed.

[**Islands in closed and open universes**; Raphel Bousso, Elizabeth Wildenhain; physical review D, 105, 086012 (2022)]

Arbitrarily small positive curvature guarantees that the entire universe is an island.

We will soon see that this plays a crucial role for quantum entanglement (net momentum of the entire universe is absolutely conserved. Nature indeed keeps track of every single atom in the entire oceans. Once we come to terms with nature's efficiency in accounting, it won't be difficult to grasp that nature has to keep track of every particle in the entire universe, and must maintain 'net zero' balance).##

Which model is more appropriate?

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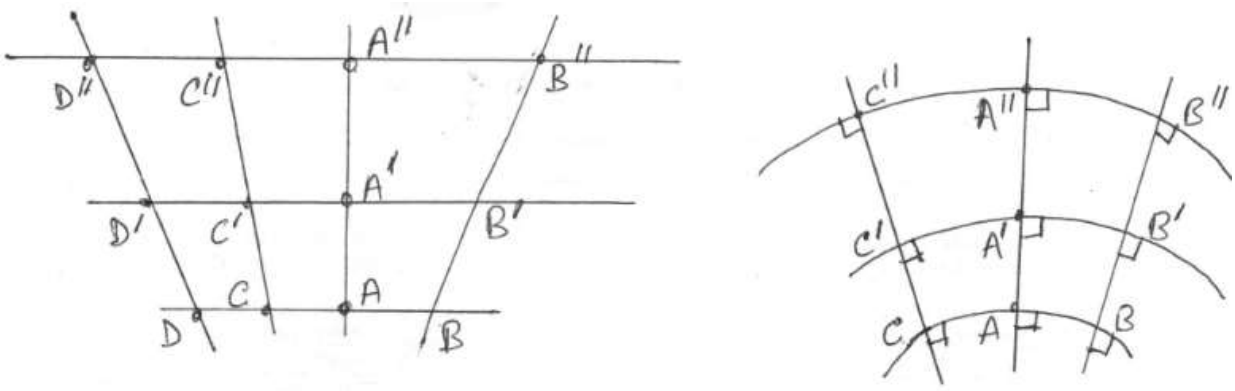
So we have two pieces of a jigsaw puzzle:

1) Entire 3d FPHS is moving in one direction
2) from Hubble's law, we know that every Galaxy is moving away from every other Galaxy. This implies that the entire 3d FPHS is getting stretched.

From this two facts, two models of universe are easily possible (which satisfy above two conditions)

1) a balloon universe (in one higher dimension than a normal balloon)

2) 3d flat universe (expanding grid model)



Above figure shows 3 moving hypersheets in both diagrams. In both cases, the hypersheets gets elongated/stretched as it moves upwards. In 1st case, it remains 3d flat, while in the other case it resembles a section of expanding balloon.

It is standard assumption in present cosmology that our 3d space (actually 3d FPHS) is flat (3d flat) and the size of 3d FPHS is effectively infinite.

Now if both conditions are satisfied, then from the 1st diagram, only one Galaxy will move straight upwards (and will have no sideways movement as the 3d FPHS continues to stretch, and move upwards). Here upwards represent the fourth dimension.

In fact, the Hubble's law guarantees that any Galaxy lying further than Hubble's distance from point A, will move sidewise at velocity greater than the velocity of light c

the equation $ds^2 = -c^2dt^2 + dx^2 + dy^2 + dz^2$

tells that for any Galaxy which is not locally moving (dr=0) satisfy $ds = i.\mathrm{c}.dt$

or, $\frac{ds}{dt} = i.\mathrm{c}.$

This clearly says, that it has only a velocity of c in the fourth (inaccessible) direction, and no sidewise velocity component.

But except Galaxy A, all other galaxies will violate this equation (since they will inevitably be moving sidewise as well. Further the galaxy is from point A, greater will be its sidewise velocity, and which may far exceed the speed of light for greater distances).

The other option left is balloon universe, where all galaxies can satisfy both conditions 1 & 2 simultaneously, as well as the equation $ds^2 = -c^2dt^2 + dx^2 + dy^2 + dz^2$

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Let's rectify **another** mistake:

Our universe does have has a Centre

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Our universe does have has a Centre (although the Centre does not lie anywhere in our 3d space).

The Centre of Mass equation is a powerful equation.

$$c.m. = \frac{\sum_{i=1}^{n} m_i \, r_i}{\sum_{i=1}^{n} m_i}$$

It works for two-dimensional distribution of particles. In this case the vectors are two-dimensional. It also works for three-dimensional distribution. Now the vectors are three-dimensional. Similarly it will also work for four dimensional distribution.

This equation will also work if the particle lies on a (hyper)surface, which may be curved in any shape. But the vectors will be of one higher dimension.

In the vastness of the universe, we can treat galaxies like point particles with mass. Let's take a few hundred galaxies in our immediate neighborhood and find the Centre of Mass. It will be a single center. Let us start adding more and more distant galaxies and let the number n increase. We still get a single center (although the Centre might have shifted from the original one. But that doesn't matter. We are only interested to see if it creates a single point center. **And it does!**).

Now let's add thousands and millions of galaxies and continue this process. Still it produces a single center. Even as n tends to infinity ($n \rightarrow \infty$) we are still left with a single point center. Simply invoking infinity isn't going to help us escape from the conclusion that there is indeed a Centre.

In fact the big bang itself needed a single point (in 4d hyperspace). Although it looks like the big bang had happened everywhere, that is strictly our viewpoint. The big bang rests on at least three pillars: the cosmic microwave background, Hubble's law and nucleosynthesis. If the big bang had happened everywhere (in an in finitely extended space), could the initial amount of matter have provided the required temperature and density for the observed ratios of elements in nucleosynthesis?

[Since there is very negligible net flow of matter in the universe along the hyper surface (the movement of matter being limited to outward flow due to the expansion of the balloon universe), the point of the big bang and the present Centre of mass of our universe might actually coincide or lies close to each other].

Now the question is whether the point of big bang lies anywhere in our 3d space? It can't be.

In the ordinary three-dimensional space the big bang would be a great explosion producing matter, throwing it in all directions and generating galaxies with different velocities. Seen globally, the cosmos would be an irregular structure composed of an empty central region, the "crater of the explosion," an intermediate region containing the galaxies and an external part containing only radiation. No structure in the three-dimensional space, born from an explosion occurring 13.8 billion years ago, could resemble the universe we observe today. In fact the big bang is not really an explosion of matter. It was an explosion of space.

Above observations guarantee that our universe is closed, and round balloon shaped. This naturally fit with the Planck satellites' result of positive curvature of the cosmos (which implies a closed universe).

[1) **Curvature tension: Evidence for a closed universe**; Will Handley, Phys. Rev. D 103, L041301 – Published 5 February 2021

2) **Planck evidence for a closed Universe and a possible crisis for cosmology**; Eleonora Di Valentino, Alessandro Melchiorri & Joseph Silk, Nature Astronomy volume 4, pages196–203 (2020)],

'Expanding Balloon universe' model removes the problem of 'extreme fine tuning' of the density of matter and energy in the universe (less than 10^{-62} at the Planck era) to keep the universe flat. This problem arises in GR because it is an inside view, whose curvature is intimately linked to mass-energy content of the universe.

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We'll soon see that the equivalence between a moving particle and stretched string (in imaginary time) implies that the 3d FPHS (gravity field) is stretched just like a rubber membrane. Closed universe means, we won't need any (hypothetical) metallic frame at infinity to keep it stretched anymore. 3d FPHS membrane can curve and join back on itself to form the expanding/inflating 'Cosmic Balloon'. But then the question arises: what is keeping the balloon inflated (and even more bizarrely) and expanding? Shouldn't it contract just like a balloon if its air pressure is missing? I'll answers this questions a little later.

Checking the balloon universe model

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Before proceeding further, let us do a quick check if this model is a good fit.

[Please note that the circumference of a circle (for a given radius) is $2\pi r$. When we move one dimension higher, then the circumference of the great circle drawn on the spherical surface is still $2\pi r$. This is true because the spherical surface of a sphere can be obtained just by rotating the circle about a line passing through the center, and intersecting the circle at two points. This should also hold if we move one dimension higher still].

If we take the radius of this hypersurface as 13.8 billion light years (i.e. age of the universe), and assume that the radius is increasing constantly at the speed of light (c) then we can calculate the expansion rate of our universe.

Let the radius of this hypersurface at one instant (t_1) be r, and at instant (t_2) be R.

Speed (rate) at which the circumference of this hypersurface is increasing = $(2.\pi.R-2.\pi.r)/(t1-t2)$

$= 2.\pi.(R-r)/\Delta t = 2\pi c$ (obtained by taking the limit $\Delta t \rightarrow 0$)

Total length of the circumference of this hypersurface $=2\pi R$

For calculating the rate of expansion of this hypersurface per unit distance on the hypersurface, we should take the ratio (K_0) $= \frac{2\pi c}{2\pi R} = \frac{c}{R}$

where R = 13.8 X 10^9 X (365 X 24 X 60 X 60) X **c**

Therefore $\frac{c}{R}$ = [13.8 X 10^9 X (365 X 24 X 3600)]$^{-1}$ = 22.978 X 10^{-19} s^{-1}

But 1 megaparsec (1 Mpc) = 3.09 X 10^{19} km. Multiplying this value with the value of $\frac{c}{R}$ we get

K_0 = (22.978 X 10^{-19}) X 3.09 X 10^{19} = 71.002 km/s/Mpc

This value (71.002 km/s/Mpc) lies between the presently assumed Hubble's constant values (found by different methods) of 69.8 km/s/Mpc and 74 km/s/Mpc

This model agrees with other observations also:

1) It agrees with the cosmological principle that our (3d) universe is homogeneous & isotropic, which guarantees that Noether's theorems are satisfied. The surface of a hypersphere is 3d and unbounded (we haven't found an edge to our universe), just like our own universe.
2) It seems there is no center to the universe (although there is indeed a center) and also Big Bang seems to have happened everywhere! This model explains naturally why Big Bang wasn't an explosion of matter in 3d space, but like an explosion of space.
3) Stuffs like galaxies & galaxy clusters in our universe are not moving through space (on an average), it is moving with space. Of particular importance is the form of Hubble's law which shows that everything is moving away from everything else as if they are at the center.

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The value of Universe's radius obtained from above calculation is

R = 13.8 X 10^9 X (365 X 24 X 60 X 60) X 2.99792458 X 10^8 = 1.30468718385 X 10^{26} m. This agrees with the value of the '**Apparent** Radius of Curvature of the Universe' value of 1.28 X 10^{26} m, [**Calculation of the Mass of the Universe, the Radius of the Universe, the Age of the Universe and the Quantum of Speed; Claude Mercier; Journal of Modern Physics , 10, 980-1001**] calculated using various methods like **a)** as a Function of the Hubble Constant **b)** as a Function of the Classical Electron Radius **c)** as a Function of the Electron Charge **d)** as a Function of the Rydberg Constant.

As mentioned earlier, general relativity is just an inside view. There is no concept of outside in general relativity. GR fails to provide a satisfactory answer to the question: if our universe is expanding, what is it expanding into? GR assumes that the metric tensor is changing (an analogy is a three-dimensional grid, where the spacing between each grid is increasing). But this is illogical! Distance between each point is increasing without the overall space (containing all those points) actually expanding into anything!! This

present model satisfactorily answers the above question. Our balloon universe (the term universe is used only for the 3d balloon surface) is expanding into a four dimensional hyperspace which might actually extend infinitely in all 4 directions. i.e. hyperspace (emptiness) is possibly infinite, while matter and fields (3d FPHS) is finite in extent and forms a closed hypersurface.

[This model also lets us speculate what must have happened just after the big bang. The universe (matter and fields) turned from a very tiny 4-ball to a 3-sphere. In other words, a bubble appeared at the Centre of the four dimensional hypersphere, and turned it into a three-dimensional surface of a 4d hypersphere, much like turning from a solid cricket ball to a hollow football. This broke the perfect symmetry which existed moments after the big bang (several theoretical and explains the studies strongly points to a transition from perfect symmetry to broken symmetry).

But this model immediately brings us into conflict with two accepted facts:

1) The size of the observable universe is 94 billion light-years.

2) Accelerating expansion of the universe (since the rate of outward expansion is **c** in this model, therefore the expansion can't be accelerating).

I'll firmly deal with both these objections shortly.

Observational evidences (for constant rate of expanding universe):

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1) [J. T. Nielsen, A. Guffanti & S. Sarkar ; Scientific Reports volume 6, Article number: 35596 (2016)]
*We find, rather surprisingly, that the data (Type Ia supernovae) are **still quite consistent with a constant rate of expansion of the universe**.* [Kindly note that this inference is drawn using a much bigger database of supernovae than the ones which claimed accelerating expansion of universe].

2) [**OUR WORLD AS AN EXPANDING SHELL**; M. GOGBERASHVILI, COSMO-99, pp. 465-471 (2000)]

*It seems that the model where Universe considered as an expanding bubble in five dimensions [5] do not contradict to present time experiments [6] and is **supported by at least two observed facts. First is the isotropic runaway of galaxies, which for close Universe model is usually explained as an expansion of a bubble in five dimensions. Second is the existence of a preferred frame in the Universe where the relict background radiation is isotropic.** In the framework of the close-Universe model without boundaries this can also be explained if the Universe is 3-dimensional sphere and the mean velocity of the background radiation is zero with respect to its center in the fifth dimension.*

##While expanding shell idea is okay, we don't need a fifth dimension ##

3) [**Implications of an Absolute Simultaneity Theory for Cosmology and Universe Acceleration**; Edward T. Kipreos; PLOS ONE, DOI:10.1371/journal.pone.0115550 , December 23, 2014] *Adjusting for the effects of time contraction on a redshift–distance modulus diagram produces a linear distribution of supernovae over the full redshift spectrum that is **consistent with a non-accelerating universe**.*

I'll return back to this paper after discussing about absolute simultaneity.

The **constant expansion of the universe (rather than an accelerating expansion)** has been brought to focus by Fulvio Melia in his model R_H = c.t universe.

[**1) The Rh=ct universe** ; F. Melia, A. S. H. Shevchuk, Monthly Notices of the Royal Astronomical Society, Volume 419, Issue 3, January 2012, Pages 2579–2586, https://doi.org/10.1111/j.1365-2966.2011.19906.x

2) Cosmic chronometers in the Rh = ct Universe ; Fulvio Melia, Robert S. Maier, Monthly Notices of the Royal Astronomical Society, Volume 432, Issue 4, 11 July 2013, Pages 2669–2675.

3) A COMPARATIVE ANALYSIS OF THE SUPERNOVA LEGACY SURVEY SAMPLE WITH ΛCDM AND THE Rh=ct UNIVERSE; Jun-Jie Wei, Xue-Feng Wu, Fulvio Melia, and Robert S. Maier, The Astronomical Journal, Volume 149, Number 3]

ABSTRACT *The use of Type Ia supernovae (SNe Ia) has thus far produced the most reliable measurement of the expansion history of the universe, suggesting that ΛCDM offers the best explanation for the redshift–luminosity distribution observed in these events. However,* ***analysis of other kinds of sources, such as cosmic chronometers, gamma-ray bursts, and high-z quasars****, conflicts with this conclusion, indicating instead that* ***the constant expansion rate implied by the Rh = ct universe is a better fit to the data****.*

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Let's rectify another mistake:

We've overestimated the size of the observable universe.

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The logic given for the observable universe to be larger than Hubble Sphere:

1) the Hubble constant decreases with time (this is true)
2) In this way the Hubble distance gets larger (this is also true).
3) As it does, like that was initially outside the Hubble distance and receding from us, come within the Hubble distance.

This is where the problem starts. Imagine a Galaxy G1 sitting just on the surface of the Hubble sphere at an early epoch. Imagine another galaxy G2 lying further beyond.

At a later time, the Hubble distance has increased. But the distance between us and the Galaxy G1 has also increased in the exact same proportion due to stretching of space (therefore the galaxy G2 has still not entered the Hubble sphere). Using my balloon model of the universe it is easy to see that the Hubble radius always remains equal to the actual radius of the universe. Also, logically it makes sense: let the age of our universe be T. Since our universe is expanding at a rate c, present radius would be c.T.

As we have seen, the Minkowskian structure of space-time, limits the value of speed of light at c. Therefore distance travelled (Hubble distance)=c.T [here I have ignored the fact, that our universe was opaque right after the big bang due to strong coupling of radiation and matter. It became transparent some 380000 years later, so that limits the farthest we can see. But 380000 years is quite small compared to the age of the universe].

A Hubble distance on the hyper surface of the balloon universe always substance an angle of 57.2956 degrees at the center of the universe (BBC).

This is the explanation offered in this (University of California, Los Angeles) website:

https://www.astro.ucla.edu/~wright/cosmology_faq.html#DN

If the Universe is only 14 billion years old, how can we see objects that are now 47 billion light years away?

This is the formula for the radius of observable universe

$$\int_0^{t_\circ} (t/t_\circ)^{-2/3} c\, dt = 3\, c\, t_\circ$$

*Explanation offered: Another way of seeing this is to consider a photon and a galaxy 42 billion light years away from us now, 14 billion years after the Big Bang. The distance of this photon satisfies D = 3ct. If we wait for 0.1 billion years, the Universe will grow by a factor of (14.1/14)2/3 = 1.0048, so the galaxy will be 1.0048*42 = 42.2 billion light years away. But the light will have traveled 0.1 billion light years further than the galaxy because it moves at the speed of light relative to the matter in its vicinity and will thus be at D = 42.3 billion light years, so D = 3ct is still satisfied***.**

 # Consider a photon emitted by that galaxy towards us. After 0.1 billion years, the Galaxy will be 42.2 billion light-years away from us. In the meantime the photon will have travelled 0.1 billion light-years towards us, and hence will be at a distance of 42.1 billion light-years away from us.

It started with a distance of 42 billion light-years, and after 0.1 billion years is now 42.1 billion light-years away from us. As more time passes, the distance will keep on increasing.

Forget the claim of further and further galaxies entering this observable sphere! At this rate, can the photon ever reach us?

The radius of the observable universe has to be less than 14.78 billion light-years (I am talking of the cosmic background radiation sphere, which is a photograph of our infant universe after the Big Bang, when matter and radiation decoupled, and hence gases became transparent).

[Li, X. , Longzhou, S. and Genzon, L. (2022) The Cosmic Radius of Observable Universe. Journal of High Energy Physics, Gravitation and Cosmology, 8, 1-13. doi: 10.4236/jhepgc.2022.81001.]

Abstract

This paper introduces three cosmic expansion models with constant, decelerating and accelerating speed of expansion respectively. Then characters of these cosmic expansion models are compared. Based on these cosmic expansion models, the thresholds of observable universe are calculated via simulations, where the earliest observable cosmic radius $R(t_{earliest})$ *is always 0.368R (R is cosmic radius at current universe time) for any cosmic expansion models.*

And finally, let's not forget that our assumption of accelerating (expanding) universe rests on observations of distant observations and our understanding of redshifts (Doppler, Cosmological etc.) Presently, serious doubts are being raised about our understanding of redshift itself. Please see **appendix: redshifts (Doppler, Cosmological etc.).** In hindsight, future generation physicists will be amazed that Nobel Prize was awarded in 1907 for measuring a constant rate of expansion of the universe (though they hadn't actually realized it then), as well as it was awarded in 2011 for measuring accelerating expansion of universe.

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Consequences of balloon universe

Absolute simultaneity & Universal Time

The special theory of relativity has failed to address the most fundamental paradox "how can any object in the universe, whose constituent stuff ultimately originated during the **same** moment of Big Bang, can ever have different ages when they meet?"

Taking the big bang Centre (BBC) of the universe as reference point, the concept of universal time is very simple. The total time that has elapsed since the big bang (13.78 billion years) is simply related to the present radius of the universe, and the expansion rate (c). Universal time can be derived from the simple formula:

Distance= velocity X time

Universal time = radius of the universe/velocity of expansion (**c**)

It is the expansion of the universe (coupled with the concept of increase in entropy as it expands) which gives rise to the concept of time. The rate of expansion of universe (velocity) is more fundamental concept, and time is an emergent phenomena. If there had been no expansion of the universe and consequently no change in entropy, then the concept of time would have lost its meaning.

The concept of **absolute simultaneity** is also very simple. All parts of the universe, which are at the same distance from the BBC (at that particular instant) can be said to exist simultaneously. Kindly note that mentioning 'at that particular instant' is actually not required; it is redundant. That's because the length of the radius of the universe depends on the duration elapsed since the Big Bang, and all parts of the universe (i.e. all points on the surface of the hyperballoon universe) which have the same value for radius of the universe exist simultaneously.

It must be noted, is that since our universe is expanding (and not contracting), therefore, the radius of the universe is increasing, and consequently universal time has a direction (arrow). It is only because we are trapped, and assume everything is relative, the problem of arrow of time arises.

[**The "arrow of time" problem is unique to SR-based relativistic physics**; Eric Baird, December 2018]

It has been widely assumed that the "arrow of time" problem is a general one, and appears in all classical models. A previous paper has shown that the problem does not appear in C19th Newtonian theory. We now show that, within the range of potential relativistic solutions, the "arrow" problem only arises with special relativity.

The "arrow of time" problem, apparently named by Eddington in 1928, compares the assumed time-symmetrical nature of classical physics equations with the observation that, in real life, timeflow has an obvious direction. How can this apparent disagreement be explained?

"Something must be added to the geometrical conceptions comprised in Minkowski's world before it becomes a complete picture of the world as we know it … Objection has sometimes been felt to the relativity theory because its four-dimensional picture of the world seems to overlook the directional character of time".

Arthur Eddington, "The Nature of the Physical World", Chapter 4, 1928

The presence or absence of arrow of time has far-reaching consequences. As we have seen, the universal time has an inbuilt arrow (since the universe is expanding and its radius is ever increasing and never decreasing). The free energy content of the universe is forever decreasing, and the net entropy content is ever increasing. The concept of arrow of time has so much importance, that I would suggest reading:

The arrow of time: the quest to solve science's greatest mystery; Peter Conveney, Roger Highfield (Flamingo-an imprint of HarperCollins publishers).

It must be noted that a reversible process does not mean that time itself is reversible. Even reversible process have the concept of universal time (with an arrow) inbuilt into it.

Let's take an example. Newton's law predicts that a planet can revolve clockwise or anticlockwise around a star (and we won't be able to tell whether time is running forward or in reverse).

But in this (dynamic) 3d FPHS model, the difference is very clear. Every object in the universe is just kind to be confined in this 3d hypersurface, irrespective of the type of spatial movement it is making. Let us take a sheet of paper. Imagine one particle is moving in a circular and clockwise direction on the paper, while its counterpart is making a circular but anticlockwise movement. In the meantime, the paper is moving upwards. Visualized in 4d, both are making a helical spring-like movement. But, both the springs are increasing in only one direction.

We trapped creatures cannot distinguish between **+i.t** and **–i.t** because both of these quantities satisfy the Minkowskian space-time equation. (As already mentioned, Einstein's relativity ignores dynamic movement of 3d FPHS, and assumes a block universe view i.e. it mistakes a dynamic 3d for an ever existing 4d spacetime). However, for a divine being (having full access to 4d), both these quantities are not the same. They differ in the direction.

This fact also explains matter antimatter asymmetry. According to Feynman, antimatter is time reversed matter. The universal time in only one directional, but we make the mistake that clock time is flowing in both positive and negative directions (giving us the impression that our universe is running in positive time direction and its twin universe is running in the opposite time direction. Both **+i.t** and **–i.t** are taking place simultaneously). While it is true, that pair production results in production of a particle as well as its antiparticle (matter & antimatter), we ignore the effect of unidirectionality of universal time. Do the antiparticles really survive so well as their particle counterparts (especially when, the time considered is of cosmological magnitude)?

Unidirectionality of time (violation of T symmetry) solves the CPT problem. The most successful physical theories of all are the quantum field theories that describe each of the fundamental interactions that occur between particles, along with General Relativity, which describes spacetime and gravitation. And yet, there's one fundamental symmetry that applies to not just all of these physical laws, but for all physical phenomena: **CPT symmetry**. And for nearly 70 years, we've known of the theorem that forbids us from violating it.

But we know that CP symmetry is broken/violated. If CPT holds & CP is violated, it implies T is violated. And that's good, because CPT symmetry is saved.

Let us return back to the paper:

[**Implications of an Absolute Simultaneity Theory for Cosmology and Universe Acceleration**; Edward T. Kipreos; PLOS ONE, DOI:10.1371/journal.pone.0115550 , December 23, 2014].

AST (absolute simultaneity theory) implies universal time dilation: *The convention in cosmology is to use a comoving universe coordinate system that expands in sync with the Hubble expansion* [**Ryden BS** (2003) **Introduction to cosmology**. San Francisco, CA: Addison-Wesley. 295 p.]. *However, AST implies that PRFs are linked to centers of gravitational mass, which implies that an AST coordinate system would be non-comoving. In a non-comoving coordinate system, the interpretation of cosmological redshift as kinematic relativistic Doppler shift can be applied to objects separating due to Hubble expansion.*

We may have to ditch the comoving method altogether##. Here is a screenshot from the above paper:

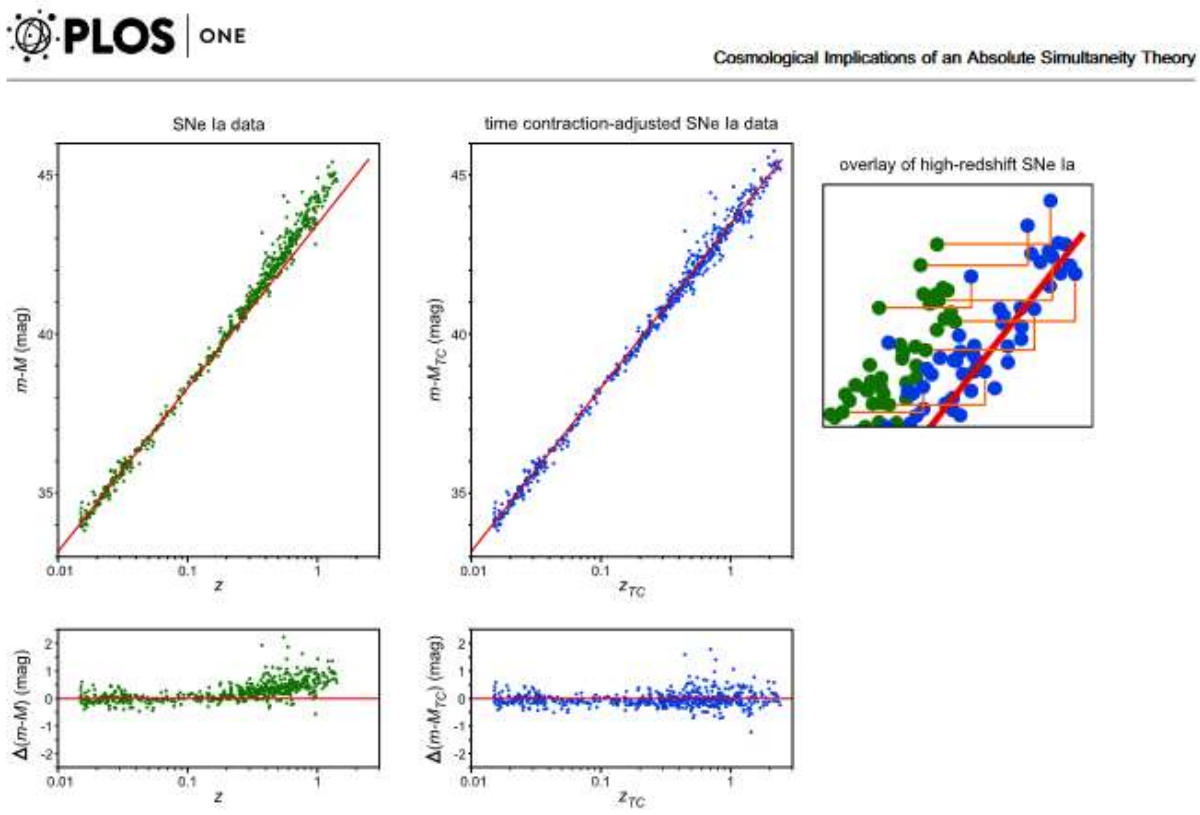

Fig. 1. Top: Diagrams of SNe plotted for z and m-M (green, left) and z_{TC} and m-M_{TC} for which redshifts and distance moduli have been adjusted to compensate for increased blueshifted emissions under TC conditions (blue, center). The straight line in each is a linear regression derived using SNe Ia with $z<0.14$. Bottom: Residuals in distance moduli relative to the linear regression line derived using SNe Ia with $z<0.14$. An overlay of high-redshift SNe Ia at increased magnification is shown on the right. Orange lines mark the shift between positions for selected SNe Ia.

doi:10.1371/journal.pone.0115550.g001

Absolute Time in Quantum Mechanics

[**A Philosopher Looks at Quantum Mechanics (Again)**; Hilary Putnam; Brit. J. Phil. Sci. 56 (2005), 615–634]

But if we are optimists and think that there is somehow a realistic interpretation (about Quantum Mechanics) to be found, then—as argued in Maudlin [1994]—we are left with GRW and Bohm.

…….as Maudlin argues, it is pretty clear that ***no theory*** *in either of the classes that they represent (the 'no collapse and hidden variables class' and the 'spontaneous collapse' class)* ***can do without an 'absolute time' parameter. An absolute time will come back into the picture if either sort of theory is destined to be the future physics****.*

.....in my view, ***present-day quantum cosmology does already involve a 'background' time parameter. It is sometimes concealed, as when cosmologists say that they are not really taking an absolute time as the parameter in the Schrodinger equation but are taking something such as the 'radius' of the universe as the time parameter. But this parameter plays exactly the role of an absolute time in which the cosmos is supposed to evolve.***

So, what relieves my initial distress at the idea of an absolute time coming back into the picture is the following thought: it might not be quite as bad a contradiction of Einstein's vision as it first seems. It might be that, before we 'superimpose', each space-time is perfectly Einsteinian—each space-time is a Minkowski space-time which knows nothing about any 'simultaneity'. And it may be that ***the time parameter that both GRW (The Ghirardi–Rimini–Weber theory (GRW) is a spontaneous collapse theory in quantum mechanics) and Bohm need is just the absolute time parameter that quantum cosmology seems to need.***

Anyone will be surely amazed to see the number of publications and experimental results supporting absolute simultaneity. To see a partial list (which is by no means exhaustive), please see the **appendix: absolute simultaneity and universal time.**

But this concept of absolute time leads to a seeming paradox: time is passing at different rates in different inertial frames (as shown by Einstein's relativity), and yet time can't pass at different rates! Nature is absolutely adamant to keep everything in the universe of the same age (at any particular instant).

Usage of the term 'the same age' needs some clarification. Muons may decay faster in one frame of reference compared to the other. But we must consider the decay products and sum up the ages (Recall the Hindu concept of incarnations. We have to consider all incarnations).

The solution to the paradox lies in the fact that there are two entirely different concepts of time involved here:

1) The universal time (distance from BBC divided by **c**) and

2) Our concept of time, which is based on process process/clock time.

[One of them can be described by a real number, while the other is associated with an imaginary number.]

Actually this paradox is more psychological than conceptual. Let us consider the twin paradox (without the rocket journey).

The twin paradox (without the rocket journey)

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Let us consider two twins, A and B. The nurse, the midwife and the medical attendant who had witnessed their birth had all certified that the twins were born within minutes of each other.

But somehow twin A started ageing very rapidly (Doctor's said it was a rare case of 'Progeria', also known as Hutchinson-Gilford syndrome). His beard had turned white, his skin wrinkled like raisins, his teeth fell off, and he was already on his deathbed while the twin B barely looked in his 20s.

Now should we say that the twins are of same age, or of different ages?

The answer seems so obvious. Yet we seem so utterly confused, while dealing with this same question that pops up unnoticed in physics. Clearly there are two concepts of time involved here. One is sort of global or universal Time (that is the duration from the twins' birth to this moment). The other is related to the ageing process (it is a sort of process time). All clock rely on some process (radioactive decay, pendulum swing period etc.) Special relativity was so obsessed with light speed travel and time dilation, that it didn't bother what happens even without any rocket travel.

We have grown so utterly confident of the ever increasing accuracy of our clocks that we tend to forget that everything in the universe has a common birth moment-the moment of big bang (which has very strong evidences of have actually happened). Nature is utterly determined to maintain the duration from big bang to this present moment equal for every object in the universe, irrespective of whether it is moving at 99% velocity of light or at rest. Every object in the universe has the same age. (We may say that our own age is 55 years. But if we consider the tiniest constituents of our body, we have to agree with a universal Time).

The Hafele-Keating experiment and muon decay experiment has demonstrated beyond doubt that time indeed runs slowly for a fast moving object. But is it the universal Time, or the process time? [There is confusion in physics literature. Tau or 'proper time' is said to be the process time. In fact, the term proper time should be reserved for the universal Time (eg. CMB temperature reading), which every observer in every frame of reference can agree].

We never give a second thought that even the most accurate of our clocks are ultimately based on some **process**, whether it is radioactive decay or atomic transition or whatever. In fact different types of clock would behave differently under varying conditions. For example, an atomic clock would show that time has slowed down in a stronger gravitational field, while the pendulum clock will actually show that time is moving faster. Again consider two exactly identical candles. We can measure time by the rate at which the candles burn. But if we place one candle in an atmosphere with slightly higher oxygen content, it will burn much faster.

This shows that the universal Time is much more fundamental, while the process time can vary. They are often instances, in which our viewpoint of relative simultaneity, and relative time clashes with nature's view of absolute simultaneity and universal time. In every case, nature's view wins. Here is one such instance, which unfortunately could not get published in a reputed journal [**Strong Paradoxes Challenging the Foundation of Relativity Theory**; Xiaoping Hu] *The indisputable paradoxes presented in this paper cannot be explained by any existing, sophistic arguments from relativity theory proponents (RPTs). Because of the simplicity and obviousness of these paradoxes, anyone can see the absurdity of such a theory.*

It must be mentioned here that any clock tick is ultimately related to the universal Time (otherwise it would be worthless as a clock). However the process determining the clock rate can depend on more factors apart from the passage of universal Time.

But then why do we so utterly depend on our clocks for measuring time? Why can't we read the universal Time directly from the temperature of the cosmic microwave background radiation?

Maybe one day when our future civilization will build accurate measurement device for reading time from CMB radiation temperature, then we will.

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Inflation Theory

Inflation theory (pioneered by Alan Guth et al) is required only because we are dependent on general relativity (just like a handicapped person dependent on crutches). Since general relativity is an inside view, inflation theory is also an inside view.

When we inflate a wrinkled balloon, the wrinkles automatically disappear, and we have a very smooth and stretched surface.

My claim is: the universe is expanding at a constant rate (its radius is increasing at the velocity of light c). Today, the universe is so big that expansion at this rate is hardly noticeable at all: we had to wait for Hubble (till the 1920's and 30's) to arrive at the scene.

But right after the big bang, the picture is drastically different. Let us take the moment when our universe had a radius of 1 cm (assuming that the universe was initially so small, or maybe even smaller).

Let's go one dimensional below to understand the phenomena. Here we are assuming a normal balloon (2d surface).

When r = 1 cm = 0.01 m

Then surface area = $4.\pi.r^2 = 4\pi\ (0.01)^2\ \ m^2$

After 1 second, radius= $3 \text{ X } 10^8$ m

Surface area = $4.\pi.R^2 = 4.\pi.(3 \text{ X } 10^8)^2 = 4.\pi.(9 \text{ X } 10^{16})\ m^2$

Ratio = $[4.\pi.(9 \text{ X } 10^{16})]/[4\pi(0.01)^2]$

here we had used the formula, for a normal balloon. For the practical case, the more appropriate formula should have been **$2.\pi^2 R^3$ rather** than $4.\pi.R^2$ [i.e. power 3 of radius, instead of power 2].

Therefore, Ratio = $[2.\pi^2.(27 \text{ X } 10^{24})]/[2.\pi^2.(0.01)^3] = (27 \text{ X } 10^{24})/10^{-6} = 2.7 \text{ X } 10^{31}$

Going back in time even further (when the universe was less than the size of a proton) till it became the size of a grape (according to standard inflation theory), the expansion of space would have been even more dramatic.

Here is what the standard inflation theory says: *The inflationary epoch lasted from **10^{-36}** seconds after the conjectured Big Bang singularity to some time between **10^{-33}** and **10^{-32}** seconds after the singularity*.

Kindly note that, when the universe was so small, the curvature would have been very great (just compare the curvature of a ping-pong ball, and curvature of the earth). Since general relativity is an inside view, it mistakes such strong curvature as singularity.

However, the standard inflation theory suffers from many drawbacks, and is being increasingly challenged. [**Is The Inflationary Universe A Scientific Theory? Not Anymore**; Sabine Hossenfelder, https://www.forbes.com/sites/startswithabang/2017/09/28/is-the-inflationary-universe-a-scientific-theory-not-anymore/?sh=7b2f2fab45e2]

Thus we see, that his present theory simulates the experience of the standard inflation theory, and can claim all its successes, without suffering those drawbacks.

In fact, the concept of inflation is required only if the initial explosion (big bang) had happened in 3d. All explosions produces chaotic pattern (regions of extreme heat jostled with cold regions). But in this balloon model of universe, it will appear as explosion of space rather than an explosion in space (which is exactly what it is observed).

Quaternary (1+3) or Tachyonic view

True meaning of Quaternion

What is the square root of -1 (minus one)?

Let us take a straight line (x-axis) and fix the origin somewhere on it. The right-hand side of the origin is the positive x-axis, while the left-hand side is the negative x-axis.

We have seen that the square root of -1 (minus one) is just an operator, which when performed twice transforms +1 into -1. This operation can be represented (by a higher dimensional being) as just the 90° rotation of the x-axis into y-axis.

But then it is also possible to represent the same operation by a 90° rotation of the x-axis into z-axis.

I have already claimed that nature's true geometry is four dimensional (i.e. the embedding space for the 3d FPHS is 4d). Therefore, the same operation can also be represented as a 90° rotation into the w-axis.

The square root of -1, is therefore either of the three operations. To distinguish between them, we need three symbols (generally represented by **i,j, and k**). Therefore, the square root of -1 is the addition/summation of all three operations.

A quaternion uses one real number, and three imaginary numbers (which are just square root of -1).

This mathematics strongly suggest one real dimension, and three imaginary dimensions.

Our familiar world (Minkowskian spacetime) has three real dimensions, and one imaginary dimension. Therefore, quaternion doesn't seem to belong to our world.

But then the question arises: why is quaternion so ubiquitous in physics? Even Feynman was amazed at how fine-tuned quaternions were in describing quantum mechanics.

So the question is: is it really possible to find the geometry which quaternions describe? The answer, surprisingly is an emphatic **'yes'**.

Planck scale: Quaternion geometry is the viewpoint from the big bang Centre of the universe, of the tiniest objects.

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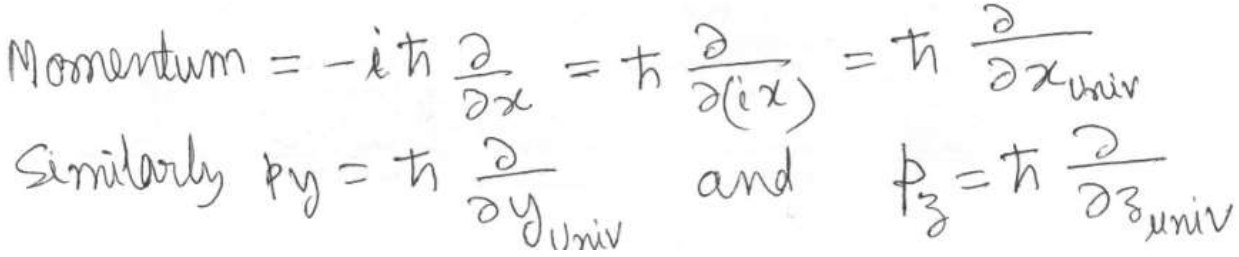
Since the true geometry of the embedding hyperspace of the (hyper) balloon universe is 4 dimensional, therefore at the Big Bang Center (BBC) of the universe, we can 4 mutually perpendicular axes (X, Y, Z, W). Let us consider only one axis out of this for axes (let us say X axis). If we extend this axis, it will touch the wall of the balloon universe at a single point. The other three axes (Y, Z, and W) will touch completely different points (which will be billions of light years apart). Therefore for any point located on the hyper surface, only one real dimension is sufficient (from the BBC). But the hyperspace is four dimensional everywhere. So what happens to the other three dimensions at the point located on the hyper surface? As far as the centre of the universe's view is concerned, those three dimensions will appear as imaginary/temporal directions. But this will be true only as long as the point is extremely tiny (of the order of Planck length). The rule of pure geometry dictates that when a line (1d) meets a surface/hypersurface, the point will have zero dimension. But here we are considering a physical system, and hence point will still have extremely tiny volume. The condition for small (Planckian) scale is very crucial, because if instead of a point, the object is say of human scale, then it will start using a very different coordinate system (i.e. the curved coordinate system of the hypersurface, which is the same x,y and z axis we humans use, and designate as spatial dimensions).

We have already seen that for a trapped creature (like us), confined eternally inside the walls of the balloon universe, the true radius of the universe is an impossible direction (and hence must be represented by imaginary number).

Let us imagine a tiniest particle (located in our familiar 3d space, or 3d FPHS) and free to move in the y and z direction, but trapped in the x direction (within an extremely tiny length of order of Planck length). For this particle, the y and z directions are accessible and real. However, it will be forced to use imaginary quantity to represent any arbitrary length in the x direction [i.e. it will have to use i.x where i=sqrt(-1)]. Kindly note that while the particle remains trapped in a tiniest length (Δx), the trap itself is free to move. The trap need not even be a physical trap. It can be an intangible trap. The intangible trap can be just the meaning of 'remaining extremely small at all times', which creates an invisible and intangible trap. The situation is similar to a passenger sitting inside a fast moving train. If the windows are closed, he can ignore the distance travelled by the train, just as we are ignoring that we are travelling at the speed of light (and using an imaginary quantity instead).

In case it is trapped, in the y and z directions as well, then it will have to use imaginary quantity for all three directions (i.x , i.y and i.z). Notice, how the quantum mechanical operator for momentum actually uses i.x , i.y and i.z (or in other words, the Universe's viewpoint for tiniest scale objects):



Kindly note that this tiniest volume need not be cubical in shape; it can be a tiniest sphere also (and still experience trapping in all three dimensions). Just as we are unable to detect our movement (at velocity c) along the fourth dimension, and must use imaginary number (making it temporal rather than spatial), similarly this tiniest volume cannot detect movement along x, y or z directions (which are spatial for us) and will have to use imaginary numbers (i.e. all three directions will appear temporal/time like for this tiniest volume). But this 1+3 dimension phenomena is true only as long as the point is so small that it doesn't start using 3 spatial dimensions of its own (just like we do).

Now let us look at this tiniest volume from the Centre of the universe (BBC). From the Centre of the universe (BBC), the radius of the universe is a very much real dimension. And since the universe is expanding at velocity c along the radius, and every point located on the walls of the balloon universe will be travelling at $\mathbf{c.t_{abs}}$.

To get a feel of universe viewpoint, let us freeze an instant and mark this tiniest volume as P_0. After time t, the point P_0 will be at P_1 . As I have already explained earlier, one of the key difference between the conclusion drawn by Minkowski and my theory is that every point/particle in the 3d FPHS is travelling with a velocity c along the fourth dimension (along the radius of the universe) regardless of its spatial velocity along the x, y, z axes. Therefore, the distance travelled along the universe radius by this point P_0 will be $\mathbf{c.t_{abs}}$. However the spatial distances travelled (as viewed by this tiniest volume, as well as the universe/BBC view will be **i.x , i.y and i.z**).

The universe's view will also be using imaginary numbers for a very simple reason. We use imaginary numbers for the temporal dimension, since we are able to ignore any distance travelled along the fourth dimension. We are completely unaware that we are travelling at a tremendous velocity c. This happens because our building, our apple orchard, desk and blackboards, planets and galaxies are all travelling with the same velocity as ourselves in the same direction. Think of a passenger, sitting in your next seat, as the train rushes by. As far as you and your co-passenger is concerned, you can easily ignore the train's velocity.

In a very similar way, our universe simply ignore any spatial distance travelled. That's because, regardless of spatial distance travelled, the radial distance (which is the only real direction/dimension from the BBC) will be same. This ignoring phenomena can be illustrated through an example: let us imagine a person X measures the acceleration due to gravity at a particular point on the equator. Then he hops on an aeroplane, and travels half round the globe, along the equator. Then he takes the same measurement once again, and finds to his astonishment that the value of g hasn't changed. Nature has simply ignored his long air travel.

For us moon is nearer than the sun. The Alpha Centauri is farther than the sun, while andromeda galaxy is farther still. From BBC, the sun, the Alpha Centauri & the andromeda galaxy are all at the same distance! If any phenomena depends on the radial distance from the BBC, nature will ignore our spatial distances and use i.x , i.y and i.z instead.

The same phenomena is happening here also. At every single point (lying on the 3d FPHS) along the journey of the particle, the point can be located on the tip of the universe's radius (as long as the point is extremely small i.e. almost 0 dimension).

Thus, from the other viewpoint we are getting one real dimension, and three imaginary dimensions. This is nothing but Quaternary mathematics. That's exactly why, quaternions appears so finely tuned for describing the very small.

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And it also becomes clear, why quaternions are immune to gimbal lock (see diagram below).

Adding a fourth rotational axis can solve the problem of gimbal lock, but it requires the outermost ring to be actively driven so that it stays 90 degrees out of alignment with the innermost axis (the flywheel

shaft). Without active driving of the outermost ring, all four axes can become aligned in a plane as shown above, again leading to gimbal lock and inability to roll.

We face this problem because in the above diagram, there is no guarantee that the outermost ring will remain 90 degrees out of alignment with the innermost axis without active effort. But a quaternion resembles the viewpoint of BBC, and since the universal time axis (universe radius) is always perpendicular to all three x,y and z axes, this condition is automatically satisfied regardless of which axis out of x,y and z axes is taken as innermost axis. A quaternion is of the form: **a** + i.x + j.y + k.x (where i , j and k are square roots of -1, and they satisfy the relation $i^2 = j^2 = k^2 = i.j.k = -1$). As already explained, the presence of i , j and k (which are 90 degree rotation operators) guarantees that x, y and z always remain perpendicular to the real axis (on which **a** lies), as well as perpendicular to each other. Thus immunity to gimbal lock is guaranteed for quaternions.

Now let us apply the space-time distance formula which we had applied earlier in case of Minkowskian space. The original formula was:

$ds^2 = (ic\ dt)^2 + dx^2 + dy^2 + dz^2 = (ic\ dt)^2 + dr^2$.

Now it gets modified to:

$ds^2 = (c\ dt)^2 + (i.dx)^2 + (i.dy)^2 + (i.dz)^2 = (c\ dt)^2 + (i.dr)^2$.

Now suddenly, the equation has transformed from timelike to spacelike. In Minkowskian space, velocity of light was the upper limit. Now it has become the lower limit. Superluminal communication is not only possible, it is the new normal now. It must be stressed that every single point in our 3d FPHS can be both spacelike and time like (depending on the scale). A similar conclusion has been reached, following different argument:

[**Operational constraints on dimension of space imply both spacetime and timespace**; Jakub Czajko, International Letters of Chemistry, Physics and Astronomy, 17(2) (2014) 220-235]

We hardly bother to think that our coordinate axis (x, y and z axes) are invariably curved. Proxima Centauri is four years back in time, while the sun is eight minutes back in time. This situation is very similar to observing a boat sailing away in the ocean. It seems the boat is gradually sinking until only its mast is visible.

Thus we can see, that at very tiny scales, the time-like space-time equations turn space-like and at the Planck scale, the whole of the universe is causally connected (instant communication takes place between farthest distances of the universe). We have experimentally verified instant communication ('spooky' at action at a distance) in entangled particles.

This transition from 3+1 to 1+3 dimension means that plank volume behave quite like a black hole. At the event horizon of a black hole, temporal and spatial dimensions gets exchanged. Similar is the case at the Planck dimension, although the phenomena are quite different (a black hole arises because extremely heavy objects stretch the fabric of 3d FPHS in the fourth dimension, along the universe axis

and away from the BBC. Every mass in the universe has a tendency to move away from the BBC, and the stretching provides an opportunity for every particle (including photons) to do so. In fact the fabric is so stretched, that it becomes almost parallel to universe radius, and any particle moves one-way and has no tendency to return back, thus giving the black hole a monstrous character.

3+1 (Classical regime) ⇔ 2+2 (Compton regime) ⇔ 1+3 (Planck regime)

Scientist had always assumed that the discrepancy between special relativity and quantum mechanics arises because the one-way speed of light can't be measured and the average measurement of the two-way speed of light always comes to be c. The suspicion was light may be travelling at the velocity **c/2** in one direction and instantaneously in the other direction. However, hundreds of observations have put an extremely stringent limit on the anisotropy of the speed of light (effectively ruling it out). But nobody had suspected, that the Devil may be hiding even in one-way speed of light! What if the humble photon travels both at speed c and infinite speed? Have we ever ask the photon if it travels at velocity c or at infinite velocity? If we had asked, it might have replied "I can travel from one corner of the universe to the farthest corner without ever noticing a moment pass".

It is not a question of direction, but about scale i.e. which coordinate system we are using:

a) The 3+1 curved coordinates of a trapped creature in 3d FPHS

b) Coordinates of the Centre of the universe.

Special relativity is based on constancy of speed of light. It straightaway throws away nature's viewpoint, and makes tachyons a mythical beast like a unicorn.

Just as temporal and spatial dimensions changes role at the event horizon of a black hole, similarly, the exchange of temporal and spatial roles at the Planck scale causes it to appear like a Schwarzschild black hole (this view is supported by modern research. Similarly, an electron or other standard model particles can modelled by Kerr type black hole). Therefore, depending just on the scale, the same volume inside a room can be smooth (as GR demands) and punctured everywhere (as Planck objects demands) or appear frothy (as QM demands).

Evidences for minimum Planck length

[**Minimum Length from Quantum Mechanics and Classical General Relativity**; Xavier Calmet, Michael Graesser, and Stephen D. H Hsu; Phys. Rev. Lett. 93, 211101 – Published 15 November 2004]

Modelling standard model particles as black holes

[**Quantum mechanical black holes: towards a unification of quantum mechanics and general relativity**; Sidharth R G; Indian Journal of Pure and Applied Physics; Journal Volume: 35; Journal Issue: 7; p. 456-471]

In this paper, starting from vortices we are finally lead to a ***treatment of Fermions as Kerr-Newman type Black Holes*** *wherein we identify the horizon at the particle's Compton wavelength periphery. A naked singularity is avoided and the singular processes inside the horizon of the Black Hole are identified with*

Quantum Mechanical effects within the Compton wavelength. Inertial mass, gravitation, electromagnetism and even QCD type interactions emerge from such a description including relative strengths and also other features like the anomalous gyromagnetic ratio, the discreteness of the charge, the reason why the electron's field emerges from Newman's complex transformation in General Relativity, a rationale for the left handedness of neutrinos and the matter-antimatter imbalance. ***This model describes the most fundamental stable Fermions viz., the electrons, neutrinos and approximately the quarks****. It also harmoniously unifies the hydrodynamical, monopole and classical relativistic perspectives.*

[**Quantum Mechanics and General Relativity Identify Standard Model Particles as Black Holes**; T. R. Mongan, Journal of Modern Physics, Vol.13 No.6, June 2022]

Plank scale introduces a minimum length scale in nature, and solves several problems at once:

1) Explains Ultra High energy cosmic ray and the TeV-photon paradoxes

2) Partially explains why duality (which is immensely powerful concept in physics) arises. The rest is explained by two (dual) viewpoints.

3) Explains the origin of exotic Quantum phenomena.

Consequences (of Planck length) for

a) Ultra-high energy cosmic rays

Existence of planks length (a minimum length) in nature solves one of our greatest mysteries:

[**Planck-scale deformation of Lorentz symmetry as a solution to the ultrahigh energy cosmic ray and the TeV-photon paradoxes**; Giovanni Amelino-Camelia and Tsvi Piran, Phys. Rev. D 64, 036005]

One of the most puzzling current experimental physics paradoxes is the arrival on Earth of ultrahigh energy cosmic rays (UHECRs) with energies above the Greisen-Zatsepin-Kuzmin threshold. Photopion production by cosmic microwave background radiation photons should reduce the energy of these protons below this level. The recent observation of 20 TeV photons from Mk 501 (a BL Lac object at a distance of 150 Mpc) is another somewhat similar paradox. These high energy photons should have disappeared due to pair production with IR background photons. A common feature of these two paradoxes is that they can both be seen as "threshold anomalies": energies corresponding to an expected threshold (pion production or pair creation) are reached but the threshold is not observed. Several (relatively speculative) models have been proposed for the UHECR paradox. No solution has yet been proposed for the paradox. ***Remarkably, the single drastic assumption of the violation of ordinary Lorentz invariance would resolve both paradoxes. We present here a formalism for the systematic description of the type of Lorentz-invariance deformation (LID) that could be induced by the nontrivial short-distance structure of space-time,*** *and we show that this formalism is well suited for comparison of experimental data with LID predictions. We use the UHECR and TeV-γ data, as well as upper bounds on*

time-of-flight differences between photons of different energies, to constrain the parameter space of the LID. A model with only two free parameters, an energy scale and a dimensionless parameter characterizing the functional dependence on the energy scale, is shown to be sufficient to solve both the UHECR and the TeV-γ threshold anomalies while satisfying the time-of-flight bounds.

b) Duality of SpaceTime

[**Duality and Zero-Point Length of Spacetime**; T. Padmanabhan, Physical review letters; VOLUME 78, NUMBER 10, 10 MARCH 1997]

The principle of duality is connected in some deep manner with the spacetime intervals having a zero-point length. Alternatively, one may conjecture that any approach which introduces a minimum length scale in spacetime (such as in string models) will lead to some kind of principle of duality.

We are changing the infinitesimal action for the relativistic particle from $ds \text{ to } (ds + L^2/ds)$.

It is not easy to interpret this term directly in the continuum limit or even find a modified continuum action.

As already discussed, the universe viewpoint involves quaternary mathematics (1+3), which creates Schwarzschild type black hole at the Planck scale. The transition from 3+1 to 1+3 dimensions has to pass through 2+2 dimensions also (which is the region of relativistic quantum mechanics). At the scale of electron, we have Kerr type black hole (which can accurately model an electron)

c) Quantum Mechanics

This recent paper [**Quantum principle of relativity**; Andrzej Dragan and Artur Ekert, New J. Phys. 22 (2020) 033038, https://doi.org/10.1088/1367-2630/ab76f7] has shown that all that is needed for the strange phenomena of quantum mechanics to take place is the existence of super luminal observers. Every exotic quantum phenomena, like superposition, particle travelling along multiple paths can be easily explained provided superluminal frames of reference are allowed. I have shown that tiniest scale objects view our 3+1 spacetime as 1+3 timespace (and superluminal communication is natural for Quantum scale objects). I'll come to this topic shortly.

There is profound effect of Quaternary (1+3) or Tachyonic view **(please see the reference: Quaternary (1+3) or Tachyonic physics)**

Principle of Least Action (PLA)

The ‘principle of least action’, is arguably the most fundamental concept in whole of physics. It is closest thing we have ever come to a ‘theory of everything’ in physics. All presently known laws of physics can be derived from some variation of ‘principle of least action’.

Let us begin our discussion by starting with the result from this very important paper:

[**Duality of the Principle of Least Action: A New Formulation of Classical Mechanics**; David J. Tannor, arXiv:2109.09094]

Abstract: A dual formalism for Lagrange multipliers is developed. The formalism is used to minimize an action function **S(q2, q1, T)** without any dynamical input other than that S is convex. All the key equations of analytical mechanics – the Hamilton-Jacobi equation, the generating functions for canonical transformations, Hamilton’s equations of motion and **S** as the time integral of the Lagrangian- emerge as simple consequences**. It appears that to a large extent, analytical mechanics is simply a footnote to the most basic problem in the calculus of variations: that the shortest distance between two points is a straight line.**

Conclusions: We hope that the reader will share our amazement that **essentially all the major formulas of analytical mechanics – the Hamilton-Jacobi equation, generating functions for canonical transformations, Hamilton’s equations of motion, and even the Lagrangian and the action itself- emerge from just an assumption on the convexity of the action. Hence the entire analysis is essentially just a footnote to the variational problem of finding the curve that minimizes the distance between two points.**

Since convexity is a property of the shortest distance between two points, it would appear that this paper is simply an extension of that problem to general convex functions S(q1, q2, t), with the physics entering through the choice of S(q1, q2, t). Thus, it seems that much of analytical mechanics is essentially just a footnote to the mathematical problem of finding the shortest distance between two points.

##The first thing to take note is just how many times the sentence “**the shortest distance between two points”** has been repeated. That’s because this profound fact can’t be emphasized enough. It is at the very heart of the principle of least action. However, the shortest distance between the two endpoints is through the four dimensional (4d) hyperspace.

I repeat, “**The shortest distance between any two points has always been, and shall always remain, the straight line**”. However this is only true if there is no restriction which makes us ‘flatlanders’. Take for example the distance between London, and another point on Earth. It doesn’t matter whether that point lies in the northern hemisphere, or the Southern Hemisphere. It does not even matter if that point lies on the other side of the Earth, or on top of a mountain, or lying on a deepest valley. If we are allowed to dig a straight tunnel through the earth, connecting those two points, then it will definitely with the shortest path. However, if we were to take a flight, the shortest distance would be the path along the great circle. But if we were to make the journey travelling on foot, we will have to take into

consideration the land connectivity (map/geography), the contour of the terrain etc. to find the shortest path.

The model of our universe presented in this paper is that of a (hyper) balloon, in which a tiny region of the (hyper) balloon is 3d hypersheet is moving through a 4d hyperspace. Let us assume that this 3d hypersheet is a piece of paper, which is moving upwards. The piece of paper need not be absolutely flat. It is also fine if it is irregular like an egg carton. Let a particle move from point A to point B on the surface of this egg carton, as it is moving upwards. Let the upwards journey start from the top of a table, and end when it hits the ceiling. Let points X, be the position (marked on the table) which coincided with point A. Let point Y be the point on the ceiling where point B on the carton hits the ceiling.

Now regardless of whatever the path the point might have taken in travelling from point A to point B, the shortest distance between points X and point Y is always a straight line (here the distance is taken in the absolute embedding 4d space). This fact will now become clear in the next section which explains why **PLA implies maximization of proper time**.##

Let's tackle the issue '**PLA implies maximization of proper time**'.

$$ds_E^2 = dx^2 + dy^2 + dz^2 + dw^2 = dr^2 + (c\,t_{abs})^2$$

$$ds_M^2 = dx^2 + dy^2 + dz^2 + (i\,dw)^2 = dr^2 - (c\,t)^2$$

Here the metric for both Euclidean space & Minkowskian space are shown (subscripts E and M are used to denote Euclidean & Minkowskian respectively).

Euclidean space has the property that if ds=0, then each of the components must be individually zero. Also, it has the property that if ds is minimum (which is straight line between 2 points), then each of the components must be individually minimum.

PLA is actually a statement for shortest distance in Euclidean space. Hence, dw (which is $\mathbf{c.t_{abs}}$) must be minimum.

This will look to a trapped creature (in Minkowskian space) as **i.c.t**

Since **ict** is minimum, therefore $\mathbf{(ds^2)_{Minkowskian}}$ must be maximum, or $\mathbf{(ds)_{Minkowskain}}$ is maximum.

But $ds_M = c.d\tau = c.$ (Proper time)

Since c is a constant, therefore **proper time is maximum**.

Let's now try to understand the fundamental meaning of principle of least action

[**On the fundamental meaning of the principle of least action and consequences for a "dynamic" quantum physics**; Helmut Tributsch; Journal of Modern Physics 7:365-374 (2016)]

Abstract: *The principle of least action, which has so successfully been applied to diverse fields of physics looks back at three centuries of philosophical and mathematical discussions and controversies. They could not explain why nature is applying the principle and why scalar energy quantities succeed in describing dynamic motion.* ***When the least action integral is subdivided into infinitesimal small sections each one has to maintain the ability to minimize. This however has the mathematical consequence that the Lagrange function at a given point of the trajectory, the dynamic, available energy generating motion, must itself have a fundamental property to minimize. Since a scalar quantity, a pure number, cannot do that, energy must fundamentally be dynamic and time oriented*** *for a consistent understanding.* ***It must have vectorial properties in aiming at a decrease of free energy per state (which would also allow derivation of the second law of thermodynamics).*** *Present physics is ignoring that and applying variation calculus as a formal mathematical tool to impose a minimization of scalar assumed energy quantities for obtaining dynamic motion.*

The Principle of Least Action Is a Dynamic Statement on Energy

The principle of least action selects (at least for conservative systems, where all forces can be derived from a potential), the path, which is also satisfying Newton's laws, as for example, demonstrated by Feynman via the calculus of variations.

How can the principle of least action be understood in more detail? ***The path, described by the least action integral, can be split up in many infinitesimally small sections, which equally have to follow the principle of least action****. We replace the Lagrange function L (which expresses the dynamically available energy), which generates motion, by a more general energy quantity E, which is dependent on time, position and velocity, since L in physics is treated as a scalar quantity only. Then one obtains for an infinitesimal section of the action integral (variables: position, time)*

$$S = \lim_{\Delta t, \Delta q \to 0} \int_{t}^{t+\Delta t} \int_{q}^{q+\Delta q} E(t,q,\dot{q})\,\mathrm{d}t\mathrm{d}q \approx E(t,q,\dot{q})\,\Delta t \Delta q$$

Its ability to minimize as an infinitesimally small section is a mathematical necessity, if the principle of least action should be generally valid (Feynman). Mathematically this is entirely clear, since a deviation from such a condition for only one infinitesimal section would violate the principle of least action in general. *The derivative with respect to time and location has consequently to become a minimum, approaching zero*

$$\mathrm{d}S' = \frac{\mathrm{d}S}{\mathrm{d}t\mathrm{d}q} \approx \frac{E(q,q',t)\,\Delta t \Delta q}{\mathrm{d}t\mathrm{d}q} \approx E(q,q',t) \to \min$$

The behavior of the infinitesimal action remains merely determined by the energy quantity

$E(t,q,\dot{q})$

This energy has to have the property to decrease and minimize. *What does it now mean, when the energy, which produces movement, has to approach a minimum? What are the possible interpretations for this minimization process?*

The interpretation given here is different and definitively simpler. Relation (4) clearly shows that the dynamic energy quantity

$$E\left(t,q,\dot{q}\right)$$

has to have itself the ability to minimize. It is important now to recall first what this energy means. It is definitively not the total energy of the system, which would be the sum of kinetic and potential energy (K + U). It would anyway stay constant during the dynamic process, which is subject to the minimization of least action, while energy is being converted and entropy generated. The Lagrange function is the difference of kinetic and potential energy (L = K - U). It describes the energy, which becomes available for generating dynamic motion. It is the free energy, which can be converted into other energy forms and into not anymore available (entropic) energy. This free energy can of course and also must decrease during an energy conversion process.

In fact, variational calculus is imposing and simulating a variation, which a scalar quantity itself cannot perform. This enables the consequence that the properties of the principle of least action can at least partially and superficially be simulated and exploited. Why is physics doing that?
All fundamental physical laws are formulated in such a way as to function in both positive and negative time direction. ***There is now no fundamental law in physics claiming a preferred time direction, as the here discussed. The entropic time arrow of present physics*** *can only be derived from a time invertible statistical ensemble by drastically simplifying the mathematical procedure (Boltzmann's H-Theorem, coarse graining procedures), which means by throwing away information. The statistical time direction is thus just manipulated mathematically and would anyway not work where self-organization and local reduction of entropy takes place.*

The energy

$$E\left(t,q,\dot{q}\right)$$

must be able to decrease its presence in this state. The process is time oriented. When every point on the track of a stone rolling down a hill minimizes the presence of energy per state, a minimum action route will automatically result.
It is consequently claimed here, that available energy is fundamentally time oriented and aims at decreasing its presence per state. This means a paradigm change, since a time orientation is fundamentally imposed. This explains why action is indeed minimized. It is minimized because energy has the drive to minimize its presence per state. Thereby waste energy in not usable form is generated and entropy increases. The second law of thermodynamics follows immediately, which is an important result, because it cannot be deduced from the present day time-invertible physical formalism*.*

In other words, the energy available for motion

$$E\left(t,q,\dot{q}\right)$$

cannot be a scalar, it must have time oriented properties. If the principle of least action is considered to be fundamentally relevant for physics, the definition for free energy must consequently change:
"free energy has the tendency to decrease and minimize its presence per state,
within the restraints of the system"
It is here suggested that the principle of least action is nothing else than the statement that our world is fundamentally time oriented and irreversible. Rate controlling entropy production is critically and fundamentally shaping the change in our environment and determining the progress of time.
How did the energy concept in present-day physics loose its relation to change, from where it was actually born? The Italian-French mathematician Lagrange, around 1788, when studying his famous energy equations for dynamic systems, still considered and investigated conditions, which reflected irreversibility and time orientation. This means, he paid attention to change. Also the Irish mathematician W.R. Hamilton, when, during the first half of the 19th century, deriving the now famous Hamilton functions, still argued that external irreversibility should be considered. He also felt that there had to be a relation to change. Other scientists also had the impression that the principle of least action is related to change. Ernst Mach [9], for example, concluded, that "the principle of 'vis viva' (energy of movement) is the real foundation of the theorem of least action". With Jacobi together they recognized the meaning of the principle of least action in the least expenditure of work.
Energy in present day physics, in fact, got the capacity to do work, but has no interest to do it and no preference to minimize, to decrease the presence of energy per state. The principle of least action ended up in that scalar energy is treated with variational calculus to predict motion. This gives the superficial illusion that the principle of least action is compatible with time-reversibility. But it is not. It is a statement on time-orientation and was for that reason linked to teleology, which is always time oriented. Historically, the question was asked how a system can know in advance via what path it can minimize action. Minimization of an infinitesimally small interval of action, give a precise answer: it is sufficient to assume that free energy is time oriented, that it minimizes its presence per state. It will do that for any point of its path, subject to the constraints given, and thus find that path which is subject to a minimum of action. A fundamentally directed and irreversible nature of energetic behavior in dynamic processes is the answer to the strange philosophical mystery around the principle of least action. Energy must have a relation to change.

##As already mentioned, each particle (in a massive body) is a resonance with its field, which is spread in the entire universe. The most ontological version of quantum mechanics is the de Broglie-Bohm version. The particle can be viewed as a water droplet caught in its own wave. Since a particle and a wave have completely contradictory properties (particle is localized, while the wave is spread over vast regions) they cannot be present simultaneously, although experiments have firmly confirmed the particle wave duality of matter. What actually happens is that the particle disappears and spreads in the entire universe. Then the return wave once again form the particle (a resonance phenomenon is a sort of standing wave. That's why a particular frequency appears in a particular length of (say) a flute). The entire process of particle spreading in the entire universe and then forming back a particle does take some time (although it is extremely fast of the order of Compton frequency in quantum domain, and Planck frequency in the Planck domain). The particle spreads in the universe, and then reassemble back just a tiny spatial distance away at a point where action is minimized.##

Now let's tackle the issue of equivalence of principle of least action (in Lagrangian Dynamics) and the principle of least energy (statics). Let's see the derivation first:

[The Mysterious Connection between Cyclic Imaginary Time and Temperature; Marco Tavora Ph.D., https://towardsdatascience.com/the-mysterious-connection-between-cyclic-imaginary-time-and-temperature-c8fb241628d9 **]**

It turns out that, limiting ourselves to classical mechanics only, stranger things already happen after a Wick rotation. As we show below (following this analysis) Lagrangian dynamics turns into statics!

Consider this example. The energy of a string in ***n*** dimensions (Let's choose n=3)) in equilibrium with fixed endpoints subject some external field *V* is:

$$E_{\text{string}} = \int_{s_1}^{s_2} ds \left[\frac{k}{2} \left(\frac{dq}{ds} \right)^2 + V(q(s)) \right]$$

The first term is the elastic potential energy (since the spring is stretched) *k* is Hooke's constant. The variable *s* merely parameterizes the string. If the string is in equilibrium its total energy will be at a minimum, which means that

$$\delta E_{\text{string}} = 0 \Rightarrow k \frac{d^2 q(s)}{ds^2} - \nabla V(q(s)) = 0$$

Note that this differential equation describes the *static* configuration of the string only, and there is no time involved. If we perform a Wick rotation, substituting *s* by *it,* the energy becomes (proportional to) the action of a *moving* particle of mass *k*:

$$E_{\text{string}} = -i \int_{it_1}^{it_2} dt \left[\frac{k}{2} \left(\frac{dq(it)}{dt} \right)^2 - V(q(it)) \right] \propto S_{\text{particle}}$$

Hence, the problem of finding the equilibrium string configuration via energy minimization, which is a static problem, becomes the problem of finding the equations of motion of a mass by via the principle of least action, which is a dynamical problem. Summing up, we see that:

- The principle of least energy becomes the principle of least action
- The system described changes from a fixed string to a moving particle
- The elastic energy becomes kinetic energy
- The external potential energy becomes the potential energy which influences the motion of the particle
- The Hooke's spring constant becomes the particle mass

Forget the **–i** sign appearing in the equation connecting the energy of the stretched string and the action of the moving particle. **i** denotes the inaccessible perpendicular axes (fourth dimension or universal time axis) while the negative sign denotes the direction.

The 3d FPHS always remain stretched (just like the rubber wall of a balloon), and particles are mere resonances appearing in this. This stretching of the 3d FPHS alone is sufficient to explain the above equivalences.

Even in the deepest space (far away from massive bodies) the 3d FPHS is stretched and perfectly 3d flat. Particles don't feel any net force because it is pulled equally from all sides (and hence net force is zero).

The 3d FPHS is moving and dragging everything with it at the same velocity c, in the fourth dimension. Imagine/visualize a sheet of paper, and mark some dots on it.

[NB This section is incomplete, and further materials will be added soon].

Gauge Theory

[**The symmetry and simplicity of the laws of physics and the Higgs boson**; Juan Maldacena, European Journal of Physics, Volume 37, Number 1, 015802]

Electromagnetism is based on a gauge symmetry. In fact, at each point in spacetime the symmetry corresponds to the symmetry of rotations of a circle. One way to picture it is to imagine that at each point in spacetime we have an extra circle, an extra dimension. See figure 9(a).

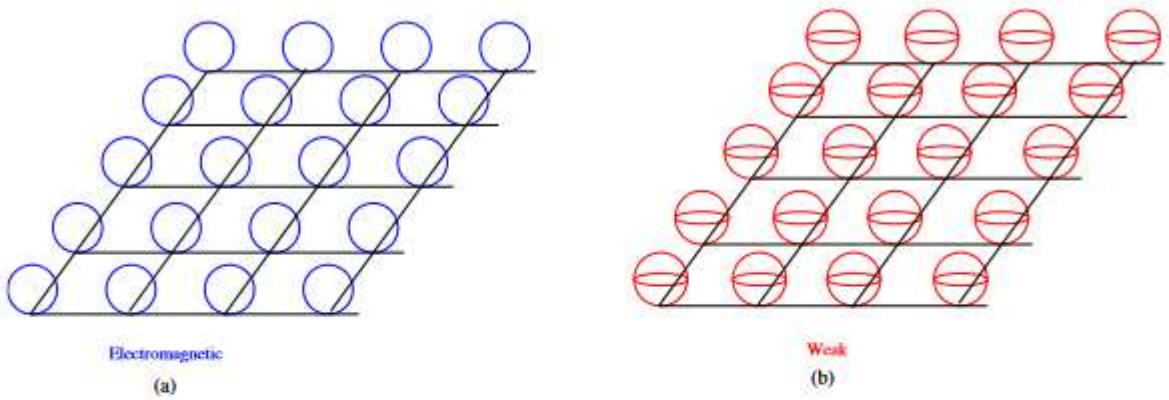

Figure 9: (a) The electromagnetic interaction has the same symmetries as a configuration where we have a circle at each point of spacetime. Here each spacetime point is where the black lines intersect. We can think of the circle as an extra dimension. (b) The weak force has the same symmetries as a configuration where we have a sphere at each point in spacetime. We do not know whether the circles or spheres really exist as extra dimensions. What we do know is that the gauge symmetry is the same as if they existed. The circles of spheres are useful for visualization but we only think about their symmetry and focus only on the associated "exchange rates".

We do not know if indeed there is an extra dimension. All we know is that the symmetry is similar to the symmetry we would have if there was an extra dimension. In physics we like to make as few assumptions as possible. An extra dimension is not a necessary assumption, only the symmetry is. Also the only relevant quantities are the magnetic potentials which tell us how the position of a particle in the extra circle changes as we go from one point in spacetime to its neighbor.

The weak force*: The weak force can also be understood using a gauge theory. In this case, at each point in space we have the symmetries of a sphere.*

[Please keep scrolling to the next page]

Origin of Gauge Theory

For EMT

$$e^{it} = \cos t + i \sin t = \cos t + (\sin t)_{\perp} = \cos t + (\sin t)_{w\text{-axis}}$$

$$\Rightarrow it = \ln\left[\cos t + (\sin t)_{w\text{-axis}}\right] = \ln\left[\text{eq}^{n} \text{ of circle}\right]$$

$$\Rightarrow t_{\text{axis/axis}} = \ln\left[\text{circle}\right]$$

For strong Force

when the size is of Planck scale, then x, y, z will be seen by the trapped particle as $i.x$, $i.y$ and $i.z$

In a similar ~~manner~~ manner (to what was explained earlier)

$$e^{i.x} = \cos x + i.\sin x = \cos x + (\sin x)_{\text{our axis}}$$

$$\Rightarrow i.x = \ln\left[\cos x + (\sin x)_{\text{our axis}}\right] = \ln\left[\text{eq}^{n} \text{ of circle}\right]$$

$$\Rightarrow i.x = (x)_{\text{our x-axis}} = \ln\left[\text{eq}^{n} \text{ of circle}\right]$$

In the same manner we get another 2 eq^{n}s of circles for $i.y$ and $i.z$.

But each of them must be conserved separately, since movement along x-axis is NOT the same as movement along y-axis or z-axis.

Weak Force

$$(\text{EMT})^{3+1} \rightleftharpoons \underset{(\text{Weak})}{2+2} \rightleftharpoons \underset{(\text{Strong})}{1+3}$$

Duality

Physicists have intensely debated in the past whether light is a particle or a wave. When evidences on both sides grew so strong that neither could be ignored, they reluctantly accepted the perplexing wave-particle duality of nature. They didn't realize that the duality arises because our concept of space-time differs from nature's.

A direct consequence of the tug of war between these two viewpoints is that of field-particle duality. A particle is just a resonance in its finitely extended field. The field is the (Quaternary or 1+3) viewpoint, which occurs at very high energy. Particle is our viewpoint (3+1). It is very important to note that resonance has an intrinsic frequency (for example resonance in a flute depends on the length of the flute). In this case, resonance frequency depends on the surface area of our 3d balloon universe (since it is three dimensional, the surface area of these higher dimensional sphere is actually in units of volume i.e. in cubic metres). The formula for the surface area of the hypersurface is $\mathbf{2.\pi^2.R^3}$

Recently, the topic of 'large numbers hypothesis' has received strong attention. Irrefutable evidences are emerging that the tiniest and the largest scales of the universe are tightly interlinked. This is also responsible for UV/IR mixing. This present model is a (closed) one universe model, and the two viewpoints theory (3+1 vs 1+3) guarantees tightest interlinking.

[**Duality and Zero-Point Length of Spacetime**; T. Padmanabhan, Physical review letters; VOLUME 78, NUMBER 10, 10 MARCH 1997]

The principle of duality is connected in some deep manner with the spacetime intervals having a zero-point length. Alternatively, one may conjecture that any approach which introduces a minimum length scale in spacetime (such as in string models) will lead to some kind of principle of duality.

Magnetic Monopoles

Dirac had proved that magnetic monopole is compatible with quantum mechanics, and will automatically lead to charge quantization. Almost every unification theory in physics requires magnetic monopole. However magnetic monopole has never been observed in nature.

The perfect symmetry between electric and magnetic fields require imaginary (i) to be associated with the magnetic field. This shows that the field must be perpendicular to the 3d FPHS (i.e. perpendicular to all three spatial axis X,Y and Z). This is the first clue.

The second clue comes from the fact that the magnitude of the magnetic monopole must be extremely large (almost astronomical). Dirac had used this argument for nonexistence (nil observation) of magnetic monopoles.

However both these clues strongly suggest that there is indeed a magnetic monopole at the Centre of our universe (BBC). This does not necessarily mean a magnetic monopole is physically present at the

BBC. Consider a uniformly (electrically) charged spherical shell. All the lines of electric field a march perpendicular to the thin surface, giving us the impression that an electric charge (monopole) is present at the Centre. In a similar way, the 3d FPHS itself might be magnetically charged.

[This section is incomplete, and I'll soon add further materials]

Massive particles vs massless particles (photon)

"All the fifty years of conscious brooding have brought me no closer to answer the question, "What are light quanta?" Of course today every rascal thinks he knows the answer, but he is deluding himself."

— Albert Einstein

The debate over the nature of photon is far from over.

[1) **What is a photon?** OPN Trends, supplement to Optics & Photonics News,Vol. 14, No. 10, 2003, Optical Society of America.

2) **What are photons?** Paul Sutter, March 10, 2022, LiveScience, https://www.livescience.com/what-are-photons

3) **What is a photon?** Amanda Solliday and Kathryn Jepsen; Symmetry Magazine, A joint Fermilab/SLAC publication, https://www.symmetrymagazine.org/article/what-is-a-photon]

Unlike particles (e.g. fermions) quanta of light are constantly moving at velocity c (which actually means infinite velocity, as explained earlier). No frame of reference can ever be attached to a photon, in which it will appear to be at rest.

Theoretical physicist John Wheeler once used the phrase "great smoky dragon" to describe a particle of light going from a source to a photon counter. "The mouth of the dragon is sharp, where it bites the counter. The tail of the dragon is sharp, where the photon starts," Wheeler wrote. The photon, in other words, has definite reality at the beginning and end. But its state in the middle — the dragon's body — is nebulous. "What the dragon does or looks like in between we have no right to speak."

When a particle and an anti-particle (e.g. electron and positron) interacts it gets converted into pure energy (photons). Similarly, photons can create particle antiparticle pairs. This clearly shows that the equivalence between massless and massive particles. But we know that particles are resonances. The equivalence suggest that a photon must also be a sort of photon.

[**How the Physics of Resonance Shapes Reality;** Ben Brubaker, QuantaMagazine, https://www.quantamagazine.org/how-the-physics-of-resonance-shapes-reality-20220126/]

A system's natural frequencies depend on its intrinsic properties: For a flute, for instance, they are the frequencies of sound waves that exactly fit inside its cylindrical geometry.

Particles are mere resonance in the fields. But the field extend through the whole universe. For the frequency to be intrinsic property of that particular particle (which determines its mass etc.) the

frequency has two exactly fit the volume of the universe (i.e. surface of the 4 dimensional hyperball) which in this case is $\mathbf{2.\pi^2.R^3}$ [where R is the radius of the universe]. Experiments demonstrating non-locality and entanglement over vast distances simply prove that resonance between a tiny particle and the entire universe is not a mad idea. But for the resonance to occur (and that too at an intrinsic frequency) the universe must be closed and finite in size. Resonance simply can't happen in an infinitely extended universe. As already clarified, universe only refers to the 3d FPHS which forms the wall of the (hyper) balloon universe.

The balloon universe model offers a better explanation of photon and particles:

A particle (e.g. fermions) is a resonance such that the Centre of the resonance is located on the surface of the (hyper) balloon universe.

A photon is also a resonance such that its center coincides with the Centre of the universe (BBC). Think of the standing electron wave in hydrogen atom. The situation is very similar, but instead of the atom, think of this resonance as a standing pulsation spanning the entire hyper surface of the balloon universe. Since there is no resonance Centre on the hypersurface (that is in our 3d world), we cannot fix any frame of reference in which it is at rest, and hence it always appears to be travelling at velocity c (which actually is infinite velocity). From the universe/nature's point of view, emission and absorption of photon takes place at the same time (simultaneously).

Quantum Mechanics

Quantum physics needs imaginary numbers

The Schrödinger equation

$$i\hbar\frac{\partial}{\partial t}\Psi(x,t) = \left[-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2} + V(x,t)\right]\Psi(x,t)$$

The left hand side (LHS) of the above equation can be written as:

$$i\hbar\frac{\partial}{\partial t}\psi = -\hbar\frac{\partial}{\partial(it)}\psi = -\hbar\frac{\partial\psi}{\partial t_{abs}}$$

where t_{abs} = absolute universal time

it was our lack of understanding of imaginary numbers, which had turned quantum mechanics into something very mysterious. The presence of imaginary **i** in Schrödinger equation is just a demand for absolute time. Above equation clearly shows that quantum mechanics needs absolute time. There is a very good reason: relativistic time would cause causality problems for the wave function which is spread over vast regions, and special relativity forbids any instant communication (thus turning long distances into space-like regions).

Let us imagine a tiniest particle (located in our familiar 3d space, or 3d FPHS) and free to move in the y and z direction, but trapped in the x direction (within an extremely tiny length of order of Planck length). For this particle, the y and z directions are accessible and real. However, it will be forced to use imaginary quantity to represent any arbitrary length in the x direction [i.e. it will have to use i.x where i=sqrt(-1)].

In case it is trapped, in the y and z directions as well (which is the very definition/meaning of tiniest), then it will have to use imaginary quantity for all three directions (i.x , i.y and i.z). Notice, how the quantum mechanical operator for momentum actually uses i.x , i.y and i.z (or in other words, the Universe's viewpoint for tiniest scale objects):

$$\text{Momentum} = -i\hbar\frac{\partial}{\partial x} = \hbar\frac{\partial}{\partial(ix)} = \hbar\frac{\partial}{\partial x_{univ}}$$

$$\text{Similarly } p_y = \hbar\frac{\partial}{\partial y_{univ}} \quad \text{and} \quad p_z = \hbar\frac{\partial}{\partial z_{univ}}$$

It must be noted that imaginary number is absolutely essential in quantum mechanics:

Quantum physics requires imaginary numbers to explain reality. Theories based only on real numbers fail to explain the results of two new experiments (https://www.sciencenews.org/article/quantum-physics-imaginary-numbers-math-reality)

[Testing real quantum theory in an optical quantum network; Zheng-Da Li, Ya-Li Mao et al; Phys. Rev. Lett. 128, 040402 – Published 24 January 2022**]**

We experimentally demonstrate quantum correlations in a network of three parties and two independent EPR sources that violate the constraints of real quantum theory by over 4.5 standard deviations, hence disproving real quantum theory as a universal physical theory.

[Quantum physics needs complex numbers; Marc-Olivier Renou, David Trillo et al; arXiv:2101.10873**]**

Thus, are complex numbers really needed for a quantum description of nature? Here, we show this to be case by proving that real and complex quantum physics make different predictions in network scenarios comprising independent quantum state sources. This allows us to devise a Bell-type quantum experiment whose input-output correlations cannot be approximated by any real quantum model.

[Ruling out real-valued standard formalism of quantum theory; Ming-Cheng Chen, Can Wang et al, Phys. Rev. Lett. 128, 040403 – Published 24 January 2022]

Our experimental results violate the real-number bound of 7.66 by 43 standard deviations. Our results disprove the real-number formulation and establish the indispensable role of complex numbers in the standard quantum theory.

Quantum theory based on real numbers can be experimentally falsified [Marc-Olivier Renou, David Trillo et al; Nature (2021)]

Here we investigate whether complex numbers are actually needed in the quantum formalism. We show this to be case by proving that real and complex Hilbert-space formulations of quantum theory make different predictions in network scenarios comprising independent states and measurements.

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The Schrödinger equation is basically a diffusion equation. There is a strong correlation between the two equations. It is the imaginary **(i)** which distinguishes between the two.

[**1) Correlation between diffusion equation and Schrödinger equation**; Takahisa Okino, Journal of modern physics, 2013, 4, 612-615 **2) A diffusion model for the Schrödinger equation**; L. Bess, progress of theoretical physics, volume 49, No. 6, June 1973 **3) Schrödinger equation as a diffusion equation**; Katsunori Mita, American Journal of physics, 89 (5), May 2021 **4) Schrödinger equation as an energy diffusion equation;** Jean Louis Van Belle, 26 September 2017]

Wavefunction is real

[**Quantum Theory's 'Wavefunction' Found to Be Real Physical Entity;** Eugenie Samuel Reich (Nature magazine), Scientific American (SPACE & PHYSICS), November 17, 2011]

The wavefunction is a real physical object after all, say researchers. This can rock quantum theory to its core. At the heart of the weirdness for which the field of quantum mechanics is famous is the wavefunction, a powerful but mysterious entity.

Whereas many physicists have generally interpreted the wavefunction as a statistical tool that reflects our ignorance of the particles being measured, the authors of the latest paper argue that, instead, it is physically real.

"I don't like to sound hyperbolic, but I think the word 'seismic' is likely to apply to this paper," says Antony Valentini. He believes that this result may be the most important general theorem relating to the foundations of quantum mechanics since Bell's theorem, the 1964 result in which Northern Irish physicist John Stewart Bell proved that if quantum mechanics describes real entities, it has to include mysterious "action at a distance".

We have wrongly assumed that since the wave function of a multi-particle system depends on the coordinates of all the **n** particles, the wave function itself is **3n**-dimensional (and imaginary) i.e. Hilbert space.

The Hohenberg–Kohn theorem (which states that the energy of the ground electronic state is a unique functional of the electron density and provides the foundation for density functional theory) clearly demonstrate that the electron density is only three dimensional. Just because we can't calculate the electron density accurately (till now) does not entitle us to claim that the electron density (and hence

the wave function itself) is **3n**-dimensional, and simply a mathematical abstraction. We can easily say that a glass of water is three-dimensional. We don't need to consider the billions or trillions of atoms and say this glass of water is trillion dimensional. The wavefunction represents a physical system, and has to be physically real. And as already mentioned, the need for the imaginary (**i**) in the Schrödinger equation is just a demand for absolute universal time. Imaginary (**i**) signify the inaccessible fourth dimension, and arises due to dynamic 3d FPHS.

The wave function itself is very much real. This strongly suggest that quantum mechanics does have an ontological explanation. The de Broglie-Bohm version of quantum mechanics is the true picture of quantum mechanics. Contrary to popular belief, the de Broglie-Bohm version (which implies a nonlocal quantum potential, as well as the presence of a particle at all times) can be directly derived from the Schrödinger equation. The particle is in resonance with its field, which is spread in the entire universe (The large numbers hypothesis (LNH) suggested by Paul Dirac, Arthur Eddington, Hermann Weyl et al is very true indeed. Existence of super luminal communication, and presence of absolute simultaneity in our universe removes all doubts and obstacles introduced by special relativity). Quantum mechanics can be visualised as a droplet caught in its own wave (see YouTube video "**is this what quantum mechanics looks like?**").

[**Decoherence and the Transition from Quantum to Classical-Revisited**; Wojciech H. Zurek, Los Alamos Science Number 27 (2002)].

In the absence of a crisp criterion to distinguish between quantum and classical, an identification of the classical with the macroscopic has often been tentatively accepted. The inadequacy of this approach has become apparent as a result of relatively recent developments: A cryogenic version of the Weber bar—a gravity-wave detector— ***must be treated as a quantum harmonic oscillator even though it may weigh a ton*** *(Braginsky et al. 1980, Caves et al. 1980)*

Q) Why even a several ton equipment has to be treated quantum mechanically at extremely small timescales?

Ans) Minkowskian space-time (our viewpoint) links distance with time (due to space-time mixing). We don't realize, that we are using curved coordinate systems (just like straight lines drawn on a balloon surface). For example, a galaxy line 10 light years away needs 10 years to be causally connected.

As timescales get smaller and smaller, lesser and lesser distances will be causally connected (according to our viewpoint). But every tiniest particle of the several ton equipment is using a different space-time structure rather than our Minkowskian space-time (i.e. 2+2 for atoms, and 1 +3 for quarks. These quarks are free to do spooky things), hence they are causally connected even at the tiniest timescale. In these extremely small timescales, the universe view (simultaneity is absolute, and superluminal communication is the rule) dominates. Hence the entire equipment will so quantum behavior.

Quantum Mechanics & Relativity have a common origin.

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[**Quantum principle of relativity**; Andrzej Dragan and Artur Ekert, New J. Phys. 22 (2020) 033038, https://doi.org/10.1088/1367-2630/ab76f7]

Abstract

Quantum mechanics is an incredibly successful theory and yet the statistical nature of its predictions is hard to accept and has been the subject of numerous debates. The notion of inherent randomness, something that happens without any cause, goes against our rational understanding of reality. To add to the puzzle, ***randomness that appears in non-relativistic quantum theory tacitly respects relativity****, for example, it makes instantaneous signaling impossible. Here, we argue that this is because the special theory of relativity can itself account for such a random behavior. We show that the full mathematical structure of the Lorentz transformation, the one which includes the* ***superluminal*** *part,* ***implies the emergence of non-deterministic dynamics, together with complex probability amplitudes and multiple trajectories. This indicates that the connections between the two seemingly different theories are deeper*** *and more subtle than previously thought.*

This recent paper has shown that all that is needed for the strange phenomena of quantum mechanics to take place is the existence of superluminal observers.

Let's see how the above-mentioned paper relates Quantum Mechanics exoticism to superluminal phenomena:

Non-deterministic events occur naturally. If in one system at point A there is generation of a superluminal particle, even completely predictable, emitted towards point B, where there is simply no information about the reasons for the emission, then from the point of view of the observer in the second system events run from point B to point A, so they start from a completely unpredictable event.

Taking into account superluminal solutions, the motion of a particle on multiple trajectories simultaneously appears naturally, and a description of the course of events requires the introduction of a sum of combined amplitudes of probability that indicate the existence of superposition of states, a phenomenon thus far associated only with quantum mechanics.

Space-time dimensions seem to change their physical roles. Only one dimension of superluminal light has a spatial character—the one along which the particle moves. The other three dimensions appear to be time dimensions.

A characteristic feature of spatial dimensions is that a particle can move in any direction or remain at rest, while in a time dimension it always propagates in one direction (what we call aging in everyday language). The ageing process of a particle in a superluminal system (1+3), observed from a subluminal system (3+1), would look as if the particle was moving like a spherical wave, leading to the famous Huygens principle (every point on a wavefront can be treated itself as a source of a new spherical wave) and corpuscular-wave dualism. All the strangeness that appears when considering solutions relating to a system that looks superluminal turns out to be no stranger than what commonly accepted and experimentally verified quantum theory has long been saying.

I have already shown that this is not possible for any observer (references system) following the 3+1 coordinate system. However, I have also shown that at extremely small scales (Planck scales) it is very

much possible to have superluminal communications, since, it uses the 1+3 coordinate system. For almost a hundred years quantum mechanics has been awaiting a deeper theory to explain the nature of its mysterious phenomena. Similar is the case for relativity. Both have a common origin: **expanding balloon universe.**

It is amazing to think, that a missing dimension (fourth dimension) coupled with expansion of our balloon universe effectively splits our 3d FPHS into time-like and space-like regions depending on the scale (scale relativity), when in fact this 3d FPHS is continuous like a balloon's surface.

Quantum Mechanics indeed arises from superluminal consideration. However, superluminal phenomena is not about speed, but about scale. The Minkowskian coordinate system (3+1) we use simply won't allow velocity greater than **c**. Secondly, the method proposed above works very well for 1+1 dimensions, but run into problem for 3+1 spacetime.

However, as I have shown in the attached paper, the same spacetime becomes Quaternion/superluminal (1+3) for tiniest scale objects, when viewed from the center of our (hyper) balloon universe.

1+3 is the Planck scale. However, for the transition from 3+1 to 1+3 to take place, it has to pass through 2+2 regions (that is, two Time dimensions, and to spatial dimensions). Relativistic Quantum Mechanics uses the Compton scale lying between (3+1) and (1+3), and has a spacetime dimension of 2+2 as proved by G.N. Ord in this paper [**Fractal space-time: a geometric analogue of relativistic quantum mechanics**; G.N. Ord 1983 J. Phys. A: Math. Gen. 16 1869; http://iopscience.iop.org/0305-4470/16/9/012). Nonrelativistic QM uses dimension between 2+2 and 1+3 (lying outside the light cone).##

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Shortcomings & successes of General Relativity

Despite its spectacular successes, General Relativity **GR** in its present form (i.e. over-emphasis on 'everything is relative') suffers from severe drawbacks. If everything is relative, then how can we measure inertia? Besides, why inertia arise at all? General relativity fails to incorporate Mach's principle (since it would require instantaneous communication with most distant stars. This possibility is ruled out by special relativity, and hence by general relativity as well, which uses the same space-time structure. However, I showed that at very small scales the space-time structure gets inverted, and universe is causally connected even over enormous distances. Hence this model can easily justify the dependence of inertia on the furthest stars in our universe).

This present model also explains Newton's rotating bucket experiment. That experiment was designed to demonstrate that true rotational motion cannot be defined as the relative rotation of the body with respect to the immediately surrounding bodies.[Physicists have been observing quantum entanglement and non-locality phenomena for a long time now, to start believing that our universe is indeed finite, closed and an island. It is 'one universe'. By the term 'universe' I mean this (hyper) balloon made of 3d FPHS. It is the substance (fields and particles) which creates the wall of the balloon which should really interest us (because that's what we've unfortunate trapped creatures will ever encounter). I have deliberately excluded the 4d hyperspace from the definition of universe. Somel critics might strongly object "isn't the universe supposed to contain everything that has been, that is existing, and that which

will ever be? Shouldn't we include the 4d embedding hyperspace as well?" I would answer "let's be practical. Why not name your definition of the universe as 'hyper universe'? After all, the 4d hyperspace might be a true vacuum (absolute emptiness, and just pure 4d geometry, but nevertheless the spatial distances are very real) and extending infinitely in all four dimensions". [Excuse me if I am becoming a little philosophical. Our curiosity has always been "who created all this stuff?" and not "who created all this nothingness?"]

I have shown that relative effects like relative simultaneity, time dilation, length contraction etc. arise due to the dynamic motion of the entire 3d FPHS. Such relativistic effects are the viewpoint of a trapped creature. It is only an inside view. General relativity adds the concept of space-time curvature (warping of space-time) to the special relativity picture. Since it is only an inside view, it mistakes the stretching of the 3d FPHS in the 4^{th} dimension as warping of space-time. This present model will also show the same time dilation in a gravitational field, but due to different reason. As I have already explained, the 3d FPHS is moving in the fourth dimension with a velocity c. Hence the fourth spatial component is **c.t** (which appears to us as a temporal component **i.c.t**). But the spatial component appears entirely as temporal component to us only when the fourth axis is absolutely perpendicular to the 3d FPHS (i.e. the fourth axis is perpendicular to all three x,y, and z axes). This certainly is true in deep space, far away from massive bodies (where the 3d FPHS fabric is really 3d flat). But the presence of massive bodies stretches the 3d FPHS in the fourth dimension. Now the fourth axis is no longer absolutely perpendicular to this 3d FPHS. Now we need to resolve c.t into cos (theta) and sin (theta) components. GR fails on a smaller scale (more precisely, in N-body cases like galaxies & galaxy clusters)

GR treats space-time as 4-d entity, and therefore projects a block universe. Which means past, present and future must co-exist! Everything is pre-determined.

General Relativity (**GR**) assumes that just like x, y and z-axis of space, we have access to entire time-axis (block universe view). In **GR**, massive objects cause the warping of all the dimensions of 3+1=4d space-time (**ST**) within 4d itself, which we call gravity.

GR is not compatible with extremely well-tested Quantum Mechanics (**QM**),

It is bound to fail at certain points (e.g. singularities inside Black holes, where it creates infinite curvature) and leads to Information Loss Paradox. GR breaks down inside black holes. GR claims that black holes warp ST so strongly that it curves back on itself, and forms a closed system (i.e. it is completely isolated from the universe). If it is completely isolated, how does it manage to strongly influence objects around it, and make stars/pulsars revolve around it?

GR ignores Tidal effects (where stretching happens in one plane, which compression happens in perpendicular direction). But these can be easily explained if we imagine an additional dimension (e.g. a 2d rubber membrane in 3d space. First, we mark a dot on the RM, and draw radial lines outwards from it. Now, we draw lines perpendicular to the radial lines, like latitudes viewed from North Pole. If we place a marble on the dot, the radial lines stretch, while the latitudinal lines get compressed.

Transverse waves happen only in strings, or rubber membrane, or the surface of water (where the disturbance is NOT allowed access to all dimension, while the medium itself is partially free to move/vibrate in a higher dimension). If we have a 4d in 4d situation (like general relativity, which doesn't have a concept of embedding space) , then Gravity Waves must be longitudinal (e.g. sound

waves in air is longitudinal because sound has access to all 3 dimensions in which air is spread. Only exception is EM waves, where two perpendicular vectors of different fields i.e. electric and magnetic are oscillating, both perpendicular to direction of propagation).

The 'tidal effects' and transverse (rather than longitudinal) nature of 'Gravity Waves (**GW**)' offers strong clues that a boundary/surface is involved (e.g. sound waves are longitudinal since we are completely immersed in air and there is no boundary. Transverse waves occur when some boundary conditions arise like the surface of water or a string)

Astronomical observation of External Field Effect (**EFE**) with extreme accuracy within various galaxies, galaxy clusters, triplet systems etc.

[**Testing the Strong Equivalence Principle: Detection of the External Field Effect in Rotationally Supported Galaxies**; Kyu-Hyun Chae, Federico Lelli et al, The Astrophysical Journal, Volume 904, Number 1, Nov. 20, 2020]

Abstract: *The strong equivalence principle (SEP) distinguishes general relativity (GR) from other viable theories of gravity. The SEP demands that the internal dynamics of a self-gravitating system under freefall in an external gravitational field should not depend on the external field strength. We test the SEP by investigating the external field effect (EFE) in Milgromian dynamics (MOND), proposed as an alternative to dark matter in interpreting galactic kinematics.* ***We report a detection of this EFE*** *using galaxies from the Spitzer Photometry and Accurate Rotation Curves (SPARC) sample together with estimates of the large-scale external gravitational field from an all-sky galaxy catalog.* ***EFE is individually detected at 8σ to 11σ in "golden" galaxies subjected to exceptionally strong external fields. Our results point to a breakdown of the SEP, supporting modified gravity theories beyond GR.***

If we believe GR's version of 4d **ST,** then **EFE** and **SEP** are mutually incompatible [**The strong equivalence principle**; B Bertotti and L P Grishchuk, Classical and Quantum Gravity, Volume 7, Number 10 (1733)] and Dark Matter mystery will never be solved**.** What sets GR apart from all other theories of Gravity is that only GR satisfies Strong Equivalence Principle.[1) **Nonequivalence of equivalence principles**; Eolo Di Casola, Stefano Liberati, and Sebastiano Sonego American Journal of Physics 83, 39 (2015); doi: 10.1119/1.4895342 2) **The strong equivalence principle**; Bruno Bertottits and Leonid P Grishchukf; Class. Quantum Grav. 7 (1990) 1733-1745].

GR has led to Cold Dark Matter (**CDM**) theory, which claims to be best theory of cosmology, and at the same time confess that 95% of its ingredients is missing or unknown! Dark Matter (**DM**) is just an apparent phenomena, which is fully explained by the presence of Normal Baryonic Matter only (explained later).

[**The Three base tests of General Relativity or "The Poverty of Physics"**; AHMET YALCIN]

Abstract: *My aim was to calculate total deflection of light by passing the Sun and compare it with known observations. I had no doubt that I would find the results predicted by General Relativity and confirmed by observations. Unexpectedly, the study led me to striking conclusions not only on the "deflection of*

light", but on the "Shapiro delay" and "gravitational redshift". Observations on these issues are the most basic tests that lead to the acceptance of GR in the scientific world. I'm afraid the article has turned into the story of a "price of passion". The story of the "price" that science pays, due to the "passion for relativity" in traditional physics. Although this study had no intention of doing so, it unintentionally had to exhibit rough examples of the carelessness and maneuvers offered by GR in these three basic tests.

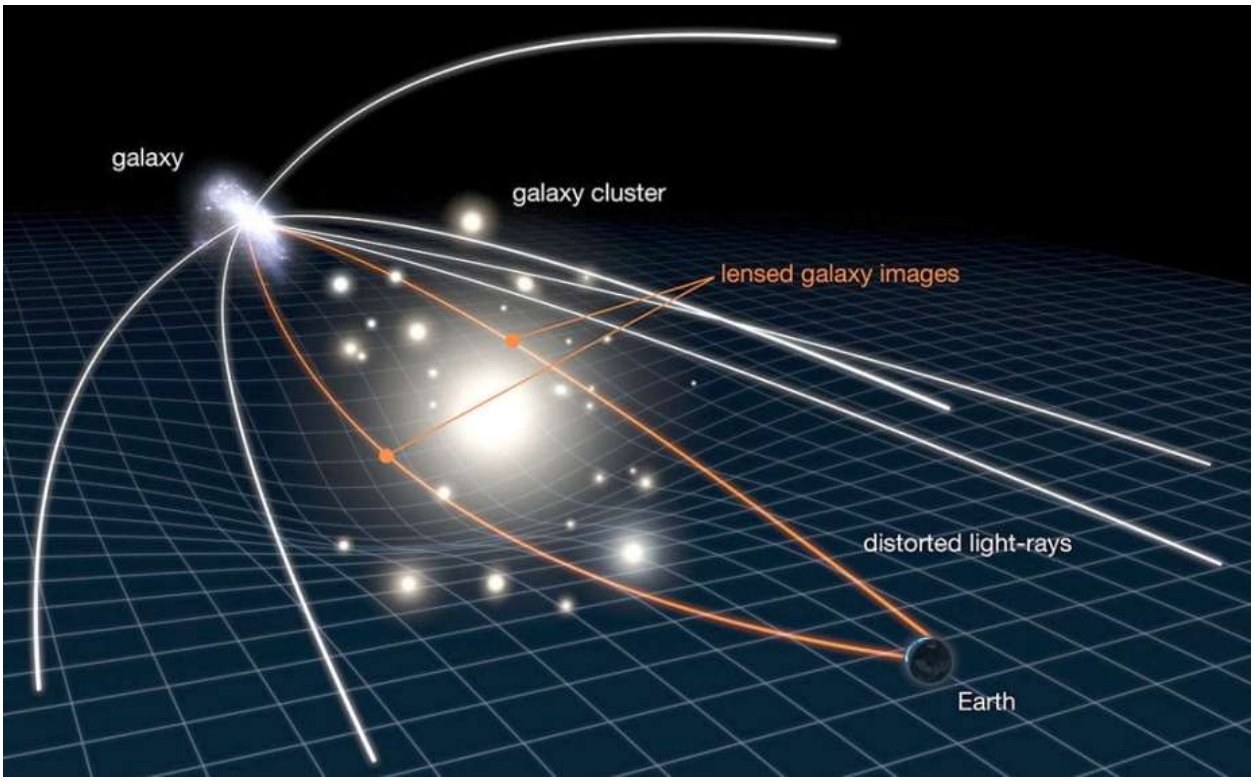
Concluding remarks: *The revolutionary theory of the twentieth century has become the greatest obstacle to the development of physics in the 21st century. As such, problems and impasses are constantly growing. For the solution, string theory, supersymmetry, etc. thousands of competent physicists in pursuit of a host of new theories, are making great efforts towards this end goal. Unfortunately, they all have one common approach: the new theory must be synthesized on the basis of "theories of relativity" and "quantum mechanics" [Zee, 2018].*

This indescribable love of mainstream physics to the GR also demolished the revolutionary nature of science. In general, theoretical physics is supposed to make predictions and experimental physics is supposed to confirm them, and it has often been the case. Nowadays, things have turned around. Experimental physics (technology) offers such new data that traditional physics cannot explain them and creates hypothetical new formations to match observations. Fortunately, many famous physicists devoted to mainstream physics can no longer deny the "crisis" physics is in. [Smolin, 2006].

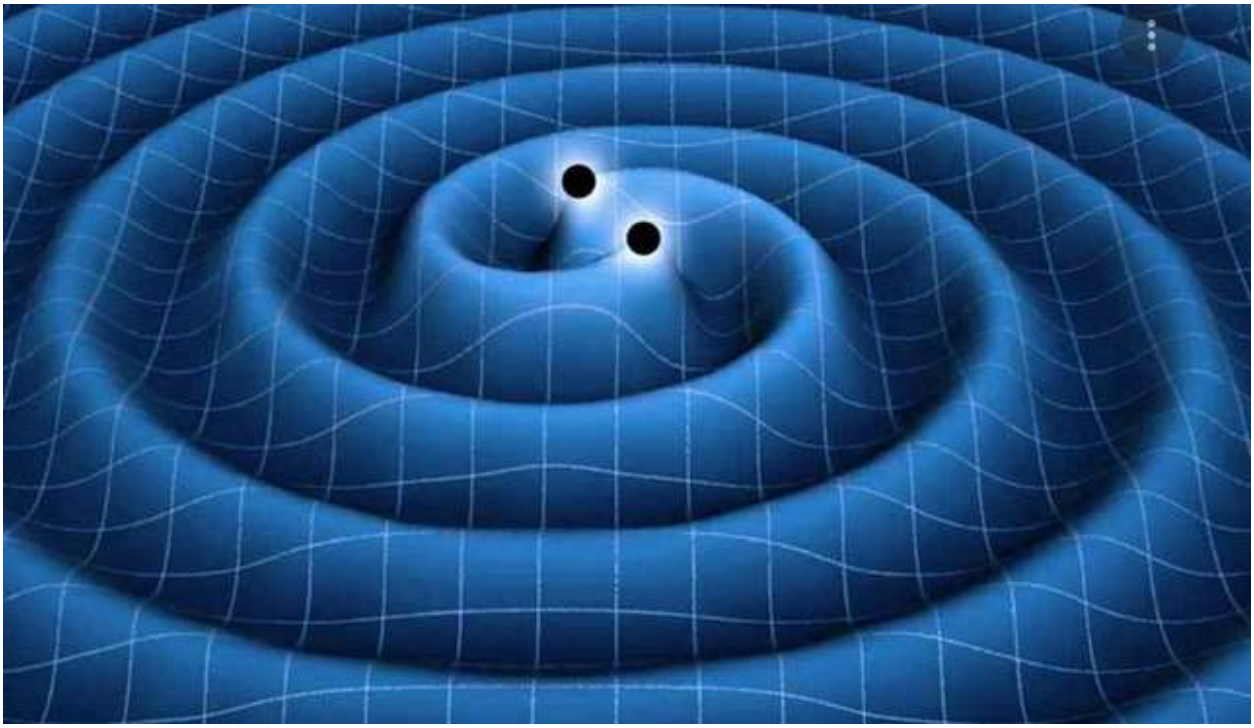
Successes of General Relativity

Presented theory must be able to reproduce the following successes of GR, and do even better.

1) Bending of light (Sun) 2) Gravitational Lensing 3) Universe should expand 4) Time runs more slowly in Gravity 5) Black hole & Black Hole shadow 6) Gravity waves



GRAVITATIONAL LENSING



GRAVITATIONAL WAVES

Gravity

Gravity is not quite what Einstein had thought.

1) Time dilation in gravity field resembles time dilation in a fast moving (but with constant velocity) elevator, rather than an accelerating elevator.
2) However for a person to feel the gravitational force the elevator must be accelerating upwards (a constant velocity won't do the job).
3) At any point, there has to be equivalence between kinetic energy and gravitational potential energy. Einstein had assumed equivalence between gravitational mass and inertial mass.
   [**A new theory of gravity: overcoming problems with general relativity**; Ronald R. Hatch - Physics Essays, Volume 20, Number 1, 2007]
   A fallacy in the equivalence between acceleration and gravity effects is revealed. This fallacy undermines the general relativity theory (GRT), which is based upon that equivalence. It is shown that the real equivalence in local physical phenomena is between the effects of gravitational potential energy and those of kinetic energy.
   In fact both conditions have to be satisfied. [What seems impossible, can be quite easy if we go to a higher dimension. Luckily we have got access to a higher dimension, without crossing the dimensional limit of four].
4) Gravity must accommodate external field effect, so that it can be a viable alternative to dark matter.

Gravity & Quantum Mechanics (substance of 3d FPHS)

There is a deep connection between gravity and quantum mechanics.

In our model of the balloon universe, the wall of the balloon is the 3d FPHS. As the name itself suggests, FPHS is made up of fields and particles (which is the subject matter of both gravity and quantum mechanics studies)

In imaginary time (a misnomer, since it is nothing but Euclidean time, and very real along the universe radius), a stretched string becomes equivalent to removing particle. This is only possible if the particle is a resonance in the stretched 3d FPHS, such that the particle experiences pull from all directions. This is true even in the deepest space, far removed from massive bodies. When we integrate out over the path of the particle, all other tensions except along the path gets cancelled, and we are left with a stretched string.

General relativity is based on the exact equivalence between gravitational mass and inertial mass. This has been tested in strongest gravitational fields. But what happens when we take a mass to deep space, far away from all massive objects? It still has inertial mass, but zero gravitational mass. What happens to the relation: Inertial mass = Gravitational mass?

General relativity hadn't actually solved the problem of inertia. According to Mach's principle, inertia should not have been an inherent property of a body, but it should have been arising due to the collective action from even the farthest of galaxies.

Black Hole

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Schwarzschild solution to Einstein equations written in Schwarzschild coordinates has a peculiar property that time and radial coordinates change their metric signs at the event horizon. This is normally dismissed by arbitrarily stating that the Schwarzschild solutions only make sense above the event horizon, although written in (freely falling) Kruskal coordinates, they are smooth at the horizon. In order to resolve this puzzle we point out that Schwarzschild coordinates correspond to stationary observers placed at fixed distances from the horizon. Such observers can be subluminal only above the horizon, and under the horizon they would require superluminal motions. The sign flip in the metric therefore signifies the transition from a subluminal to a superluminal family of stationary observers residing under the event horizon in a fixed distance from the singularity.

##Space and Time exchanging roles at the event horizon because due to extreme stretching of the Rubber Membrane (RM), the regions of the RM becomes parallel to the Universe's Radius.##

The naked singularity problem at the center of the Black Hole gets resolved because instead of a puncture in the fabric of SpaceTime (ST), it is as if the 3d FPHS is sharply stretched & looks like pointed tip of a pin. It is similar to the situation where the pressure at the breaking point of a droplet falling from a tap don't rise to infinity even though our equations suggests so.

And, the 'Information Loss Paradox' via Hawkin's radiation (HR) gets resolved too. Information is not lost; it's just kept beyond our reach (in a further future than we earthlings experience in our weaker gravity), until enough mass of Black Hole is lost via HR, and stretching of 3d FPHS reduces enough so that the core of Black Hole (now crushed in whatever unknown state of matter/energy) becomes larger than the event horizon and pops back into view.

[Black Holes May Not Be Black. Or Even Holes; Tim Childers, Mar 18, 2021
https://www.popularmechanics.com/space/deep-space/a35875454/what-are-black-holes-new-theory/
]

Instead, a new theory suggests black holes may be dark stars with hearts of extremely dense, exotic matter. "First of all, the event horizon, typical for real black holes, is erased. Instead, a deep gravitational well is formed, where the values of the redshift become enormously large. As a result, for an external observer the star looks black, like a real black hole."

Nikitin also says his theory might **explain another unsolved mystery of the cosmos: the origin of fast radio bursts (FRB).** Astronomers first discovered these powerful, short-lived bursts of radio waves

in 2007, but their origin and nature remains hidden to scientists. If an object such as an asteroid fell into a Planck core, Nitkin says, a flash of high-energy light waves could be released. The dark star's powerful gravity would redshift the light, creating an apparent FRB detectable on Earth.

[**Unification of Space-Time-Matter-Energy;** GARRET SOBCZYK, TOLGA YARMAN, Appl. Comput. Math. 7 (2008), no.2, pp.255-268]

Abstract*: We derive explicit equations of motion for two falling bodies, based upon the principle that each body must subtract the mass-equivalent for any change in its kinetic energy that is incurred during the fall.* ***We find that there are no singularities*** *and consequently no blackholes.*

Introduction: *Einstein's Principle of Equivalence identifying "gravitational mass" with "inertial mass", upon which he based his general theory of relativity, asserts that the effects of gravity and acceleration are indistinguishable [7]. The principle of equivalence between acceleration and gravitation leads to inconsistencies in the breaking of the laws of conservation of energy and momentum [25], [26], and the breaking of the mass-energy equivalence expressed in the famous formula* $E = mc^2$*, which is one of the pillars of the special theory of relativity.*

There are other objections that can be raised to the general theory of relativity, particularly in regards to the existence of singularities [31]. Both Yilmaz and Logunov have proposed exponential metrics (yielding no black holes) [24], [46], instead of the Schwarzschild metric [32], [33]. Indeed, it is shown in [46], [47], [48], that Einstein's field equations are not satisfied in an accelerated elevator.

Discussion*: Taking into account how unit lengths quantum mechanically stretch in a gravitational field, the second author obtained the precession of the perihelion of Mercury as well as the deflection of light passing near a celestial body [43]. Typically, these have been considered to be the best proofs of the validity of Einstein's general theory of relativity.*

A consequence of our theory is that black holes of macroscopic objects solely due to the force of gravity do not exist. Rather, when a sufficient amount of mass coalesces in space, the object becomes either invisible or nearly invisible due to the extreme red-shift near such a body. We thus predict that very dark objects, but no black holes*, should be found in the center of many galaxies.*

(## What the authors have assumed as '*unit lengths quantum mechanically stretch*' is actually due to the stretching of 3d FPHS in a very similar manner to the stretching of a flat trampoline/rubber sheet when we place a small metal ball on it. ##)

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Dark Matter

Cosmologists, Physicists & Astrophysicists are presently divided into two camps:

1) Mainstream 'Cold Dark Matter' group (basically Einstein's General Relativity supporters who find that 95% of the stuff of our Universe is missing or unknown, and have added dark matter & dark energy to cover up their lack of knowledge)

2) Rebel MOND group (basically followers of Mordehein Milgrom) who have started challenging the existence of Dark Matter and questioning whether our Standard Model (SM) of Cosmology is correct. MOND stands for Modified Newtonian Dynamics, and this group believes that the need for dark matter arises because of our lack of proper understanding of gravity. They believe that the missing (dark) matter is simply a question of missing acceleration due to gravity.

General Relativity (GR) is very well tested, and is claimed to be the best theory of gravity yet. MOND has also got something right: the external field effect (EFE), which is not possible in GR due to Strong Equivalence Principle. EFE has been detected at 8 to 11 sigma (compared to the accepted threshold of just 5) and can't be ignored!

External Field Effect (EFE) must for non-linear. But clashes with strong equivalence. The irony is that EFE is incompatible with (linear) Newtonian dynamics, and hence MOND is a forced marriage.

MOND's other prediction that in the low acceleration regime ($\mathbf{a_0 < 1.2 X 10^{-10} ms^{-2}}$) gravity falls off as $\mathbf{r^{-1}}$ rather than $\mathbf{r^{-2}}$ is based on observations.

This deviation from the r^{-2} fall off happens because unlike, say the electric field originating from a point source which has to fall off as r^{-2} to preserve the total number of lines of force crossing a spherical

surface (of ever increasing radius centered on the source, whose surface area is $4\pi r^2$) gravity is not a true force: it emerges from the stretching of 3d FPHS in the fourth dimension due to massive objects. The 3d FPHS behave very much like a rubber sheet/membrane. It is the same rubber membrane (RM) model which is used to teach general relativity in schools. But instead of taking the rubber membrane as an analogy, it should be taken very literally. Thus, in the RM model, we get to keep all the good stuffs GR offers (like gravity lensing, gravity waves travelling through vacuum etc.) while getting the good feature from MOND as well (i.e. external field effect)

Problems with MOND It is worth mentioning that MOND is based on outdated Newtonian gravity force. Worse still, MOND has introduced two different regimes ($a<a_0$ and $a>a_0$) without any fundamental principle as its foundation bedrock. It's purely phenomenological, and introduced just to explain certain some observations. And even worse: EFE is incompatible with linear Newtonian dynamics, and hence MOND is a forced marriage.

Points against Dark Matter:

1) Galactic cores: DM predicts density peaks in cores of galaxies

2) Dwarf galaxies: DM also predicts a lot of dwarf galaxies.

3) DM and ordinary matter are strongly correlated (You tell me how much ordinary matter, and I'll tell you how much DM). This is Ridiculous! DM is just a function of baryonic matter.

4) Why DM should always form halo? Why shouldn't it collapse under its own gravity (we are assuming a mass which is 5-6 times baryonic mass) to form dense structures?

5) No dark matter particles detected yet: despite intense global efforts using huge and sophisticated detectors like XENON, IceCube etc. we haven't detected any particle which suits the requirements for

dark matter. Nor have our huge particle accelerators like LHC been able to produce any particles beyond our standard model. Although some of the assumed particles are based on fundamental physics principles (like symmetry between bosons & fermions) I feel amazed that while particle physicists are struggling to produce a single new particle beyond Higgs Boson (which was actually predicted by Standard Model of particle physics), the literature is overflowing with new particle names. Reminds us of the 'particle zoo' days, when dozens of particles arrived on the plate without being ordered. It's the 'reverse particle zoo' now: particles are being ordered in dozens without ever getting delivered by our particle accelerators!

Accurate Fine structure constant measurement has closed the door on additional forces (and hence particles) of nature.

When we take those effects into account, it is clear that we need major modifications to Friedmann,s method of estimating the total mass (critical mass) of the universe. Dark Matter is unnecessary.

The Rubber Sheet/Membrane Model of 3d Field-Particle Hypersheet (3d Space)

[Return Back to **Abstract**]

I present the Stretched Rubber Sheet (**SRS**) Model for our 3d space, which is a result of continuity of 3d Filed-Particle Hypersheet, which we commonly call 3d space (i.e. space doesn't exist in separate patches with abruptly changing values at the boundaries). **SRS** naturally integrates the External Field Effect (**EFE**) as predicted by **MOND** (Modified Newtonian Dynamics) and also without violating the real spirit of the Strong Equivalence Principle (SEP). **SRS** is a small patch of the bubble/balloon model for our universe (with origin at the point of Big Bang).

Once we accept the fact that the fabric of Space-Time has a tendency to remain continuous & stretched across the entire universe, we can't escape the conclusion that our entire accessible universe is nothing but a continuous fabric of 3d FPHS.

The **SRS** model removes the need for Dark Matter, while explaining the rotation curves of galaxies, the large velocities of galaxies within galaxy clusters and anomalies of the Bullet Cluster. It also explains the Big Bang Nucleo-synthesis (BBN) results (while we had such high density of matter. Conventional reasoning of big bang happening everywhere in an initially infinite universe cannot explain such high density of hydrogen for nucleosynthesis), Cosmic Microwave Background (CMB) results (i.e. extraordinary isotropy of CMB temperature), large-scale structure formation in the universe etc. without needing any dark matter (which is nothing but a modern day 'aether').

This model comes at a critical time when EFE (which GR specifically forbids) has been confirmed with 8 to 11 sigma, while at the same time GR's SEP has been confirmed to unprecedented accuracy, which meant only one thing: Lambda-CDM and MOND fanatics would have gone for each other's throats.

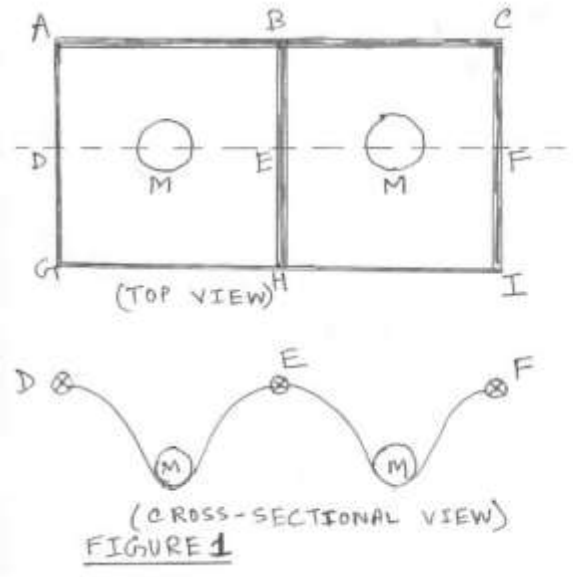
Our 3d space behaves like an infinitely extended rubber sheet (very similar to the RM used to teach **GR** to students), where instead of the lead ball placed on it and being pulled down by gravity to demonstrate the stretching, the ball (which represents massive objects like stars) lies completely inside

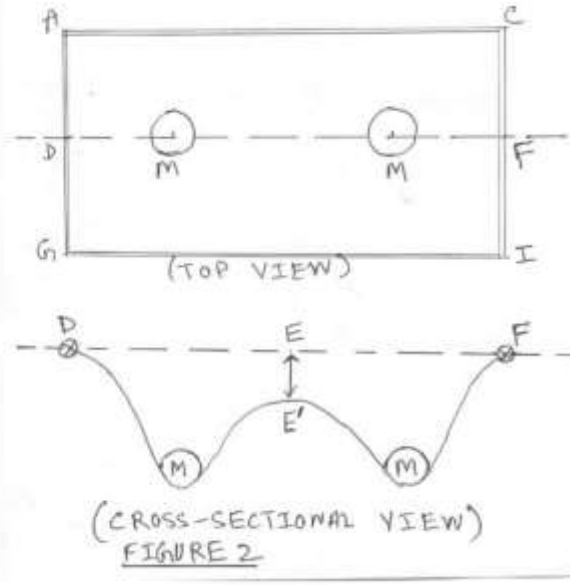
the **RM** (like a coin) and stretches the 3d space in the future direction (away from BBC). All objects into the universe gets inevitably pulled into the future. Everything and everybody in our universe is flowing into the future. Actually, it is the other way round. We'll soon see the big role played by matter & energy in creating the flow of time itself. The crucial point to be noted is that if we place 10 balls nearby, each will stretch the ***RM in a single direction***.

SRS Model demonstrates how stretching effect by massive objects can magnify and compound (cumulate). We have utterly underestimated the power of Normal Baryonic matter (**NBM**) in providing required gravity for observed galaxy rotation velocities, for movement of galaxies within galaxy clusters and so on. We have made an error in estimating the share of **NBM** in the critical mass of the Universe (as derived from Friedmann's equations using **GR** as base).

Theory The rubber membrane model of General Relativity taught to undergraduates is a pretty accurate although very simplified model (e.g. it represents a 4 dimensional space-time with a 2 dimensional membrane. But here it represents 3d hypersheet in 4d hyperspace).

We can diagrammatically see how the gravity sources can reinforce each other, and compound the effect of gravity.





In Figure 1, we have a rectangular metallic frame ACIG (created from 4 rods: AC, CI, IG and GA). Another rod is welded along BH to partition the rectangular frame into 2 square frames. Now imagine that the squares ABHG and BCIH both supports stretched Rubber Membranes (RM). Both membranes have equal thickness & made of the same material i.e. fully identical. Now we place two identical masses M at the center of both squares. [Kindly note that the masses need not be equal. It is only to simplify things while explaining a concept]. The top view is shown in upper diagram of Fig1, while the cross sectional view (cut by a vertical plane DEF) is shown in lower diagram of Fig1. In the simplified cross-sectional diagrams, the small circles with inside cross shows the positions of supporting rods AG, BH and CI where the plane cuts it.

Now, we repeat the same experiment, keeping everything identical, except that we have removed the rod BH (which partitioned the rectangular frame into two square frames, and joining the two rubber membranes). Now, as expected, the shape of the membrane changes. Earlier (in Fig. 1), the rod BH was providing support (point E). Now, since the rod has been removed, the RM dips from point E to E'.

The cross sectional view of the rubber membrane makes it look like a 1d rubber string. But the picture would have been very different if a really 1-dimensional rubber string was used. Then E' would have fallen to the level of both the masses on either sides. E' still lies above the level of either masses because we are considering a 2d sheet. The point E' on the sheet still finds support from transverse directions at points B and H (located on rods AC and GI). We must remember that we are trying to model a 3d space (3d FPHS) rather than a 2d rubber sheet. In this case there will be support from 3 perpendicular directions, and the stretching will happen in the 4th direction (along the radius of the universe, and away from BBC).

(And of course, the position of every other point on the RM has also changed slightly, but that is not what I am highlighting). This is what happens when we join two patches of 3d FPHS (3d space) containing massive objects (like stars, or galaxy or galaxy clusters). To fully understand its significance, let' repeat the experiment with another rectangular frame with higher length to width ratio.

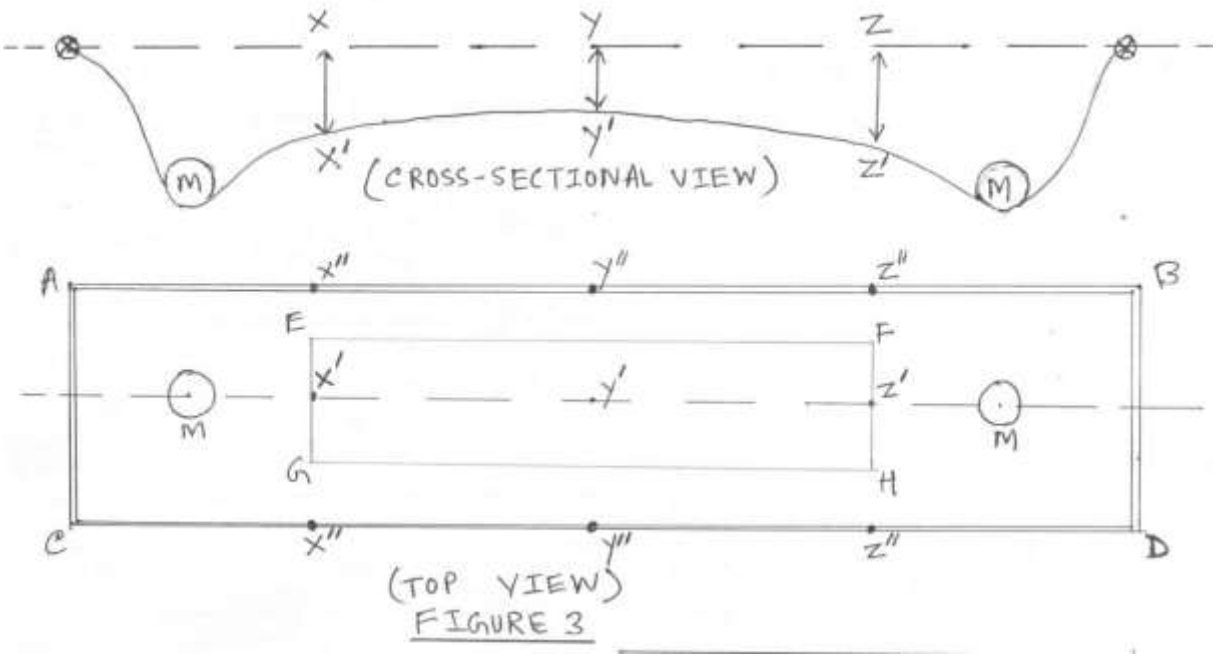


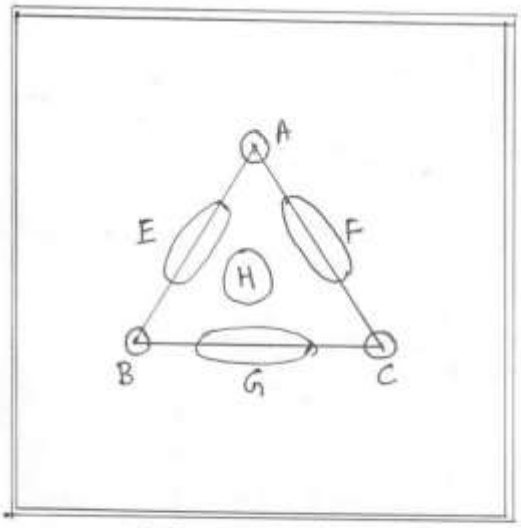
FIGURE 3

As expected, there is a dip YY' in the middle. From the cross-sectional view, it appears that Y' sits on top of a hill X'Y'Z'. But from the top view we see a valley lying within the rectangular section EFHG. This is because although points X', Y' and Z' have dipped from the original positions X, Y, Z the points when the masses M had not been placed, and the RM was flat . X", Y" and Z" lying on the frame rods on both sides have not dipped. Since the points X", Y" and Z" on both sides are still relatively placed higher than X', Y' and Z', therefore from our helicopter view (top view), X'Y'Z' now looks like a river flowing through a valley with two hills on both banks. Thus from a hill X'Y'Z' in cross-sectional 2d view, we suddenly get a

valley X'Y'Z' as we go to 3d view. This dip will be even more prominent in 4d view (i.e. If we could step outside the 3d FPHS and get a divine view). Any creature trapped inside the 3d FPHS will be unaware of the stretching in the fourth dimension. To a 3d creature trapped in this 3d FPHS (RM), this long valley (line X'Y'Z') will look like a tube/filament, joining to galaxies (or Galaxy clusters).

[Quoted from Scientific American "World's Largest Map of Space shows that galaxies are not distributed randomly. Instead they **cluster** in patterns: **long filaments** and two-dimensional sheets of galaxies in some areas; dark voids containing few galaxies in others". This model explains the filament structure].

What is the significance of such dips in cosmology? Well, this dip mimics mass (and hence acts like source of gravity). Any stray interstellar gases (or stray galaxies) will accumulate along X'Y'Z' like a magnet. Just as we infer from the dips where M's are placed that there must be something massive there (through gravitational lensing), we will get a false impression that there is additional masses along X'Y'Z'. Any light ray passing through this valley region will get bent, and we will infer from gravitational lensing: OMG! I found some invisible mass. Eureka. But one thing to be noted here : just by increasing the length of the RM (compare Fig.2 and Fig.3) we have succeeding in creating a much longer & prominent valley, and hence a much larger false impression of additional mass.



TOP VIEW

FIGURE 4

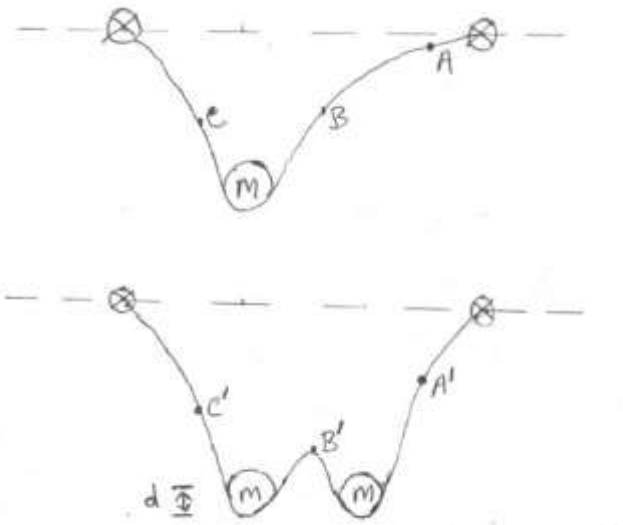


FIGURE 5 (External Field Effect?)

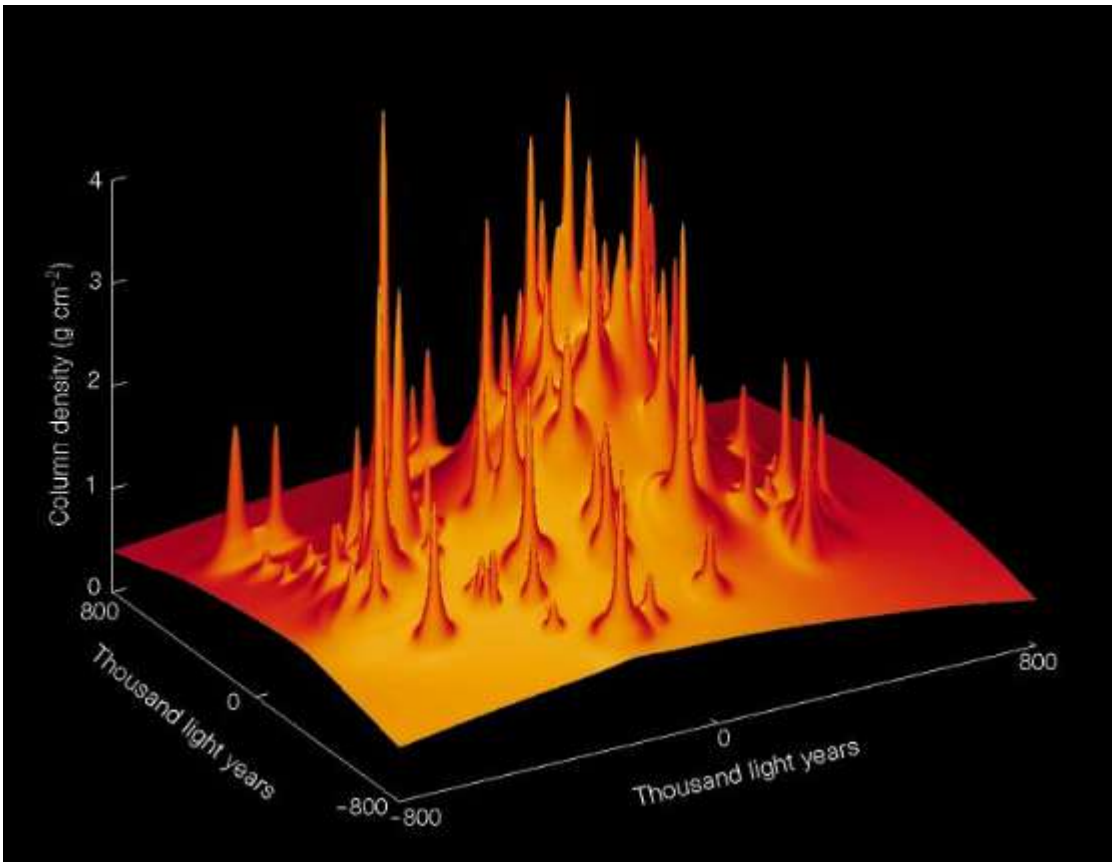
To fully appreciate how the reinforcing effect of multiple sources of gravity rapidly compounds, let's place three masses at points A, B, C of the triangle. Obviously, there will be dips at points A, B and C. In addition, there will be valley like(elongated) depressions at mid-points E, F and G (as discussed earlier). In addition, there will be another significant dip at region H. This is because it is not directly supported by the rectangular frame, and is now surrounded by depressions A, B, C as well as E, F and G.

Let's look at Fig. 5 to see how the External Field Effect (predicted by MOND, and verified by observation) actually works.

We can see from Fig.5 what happens when we place another mass near the original mass. Test particle A has shifted to A'. Also B' and C' are the shifted positions from their original positions (B &C respectively).

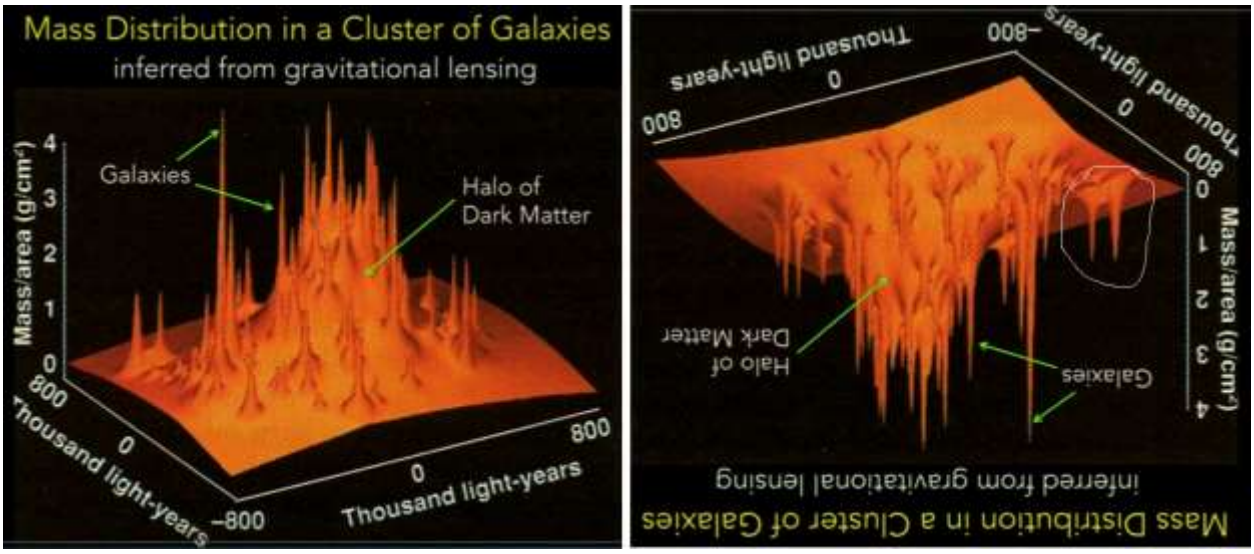
Even though the shift of C is not clearly visible in the figure, the shift is a must because the (original) mass has also slightly shifted downwards by a distance d.

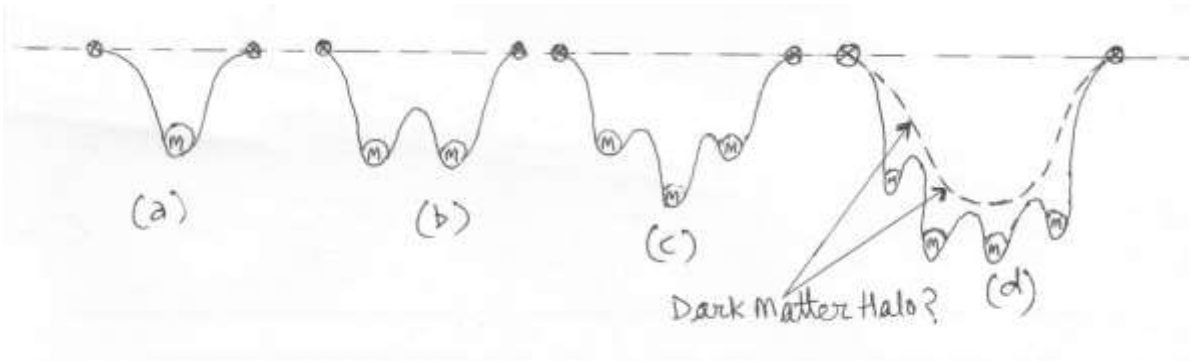
This is the image of a galaxy cluster (left picture) as inferred from gravitational lensing. On the right of the twin images below, the image has just been inverted to stimulate your imagination.



[Galaxy Clusters: Well of darkness; August E. Evrard, NATURE, VOL 394, 9 JULY 1998]

Figure 1 **Profile of a lens**. This is a projected density plot of the galaxy cluster CL0024+1654, inferred from the cluster's gravitational effect on the images of more distant objects. (The sharp peaks are added to mark single galaxies in the cluster.)





Doesn't the dashed line look remarkable similar to the 'halo of dark matter' marked in the colored diagram? Although the huge depression (dashed line) is created by the collective efforts by the galaxies themselves, doesn't the individual depressions due to (individual) galaxies look insignificant like the "Sprinkles on ice-cream"? (The dashed line is the 'ice-cream' as Zwicky called it. Well, it looks more like a cow's udder).

Now pay close attention to the galaxy pair circled in white (on the RHS diagram). Doesn't it resemble the cross-sectional view of Figure2? Isn't the dip EE' (shown in Fig.2) too obvious in this image?

Now let's imagine a very strong, but single rubber membrane (which won't get punctured). Fix it on a rectangular metallic frame. Now looking at the inverted picture of mass distribution in galaxy clusters, press long pins (with the head of pins & not he prickly ends, and preferably the pin head coated with some rubbery material to make the ends blunt like ear buds). Now at every points where the galaxies lies, press vertically with different pins with required pressures to mimic the diagram. How closely the net (central) depression will resemble diagram. What we are assuming as Dark Matter halo, is the collective stretching (compounded enormously by the mechanism explained in Fig. 4). The key here is: ***We have used a single RM.***

Bullet cluster: Before proceeding further, let's visit this paper [**The Bullet Cluster 1E0657-558 evidence shows modified gravity in the absence of dark matter**; J. R. Brownstein and J. W. Moffat ; Mon. Not. R. Astron. Soc. 382, 29–47 (2007)]

Image is not telling a lie. The mass (as shown by gravity lens contour map) lies precisely on the luminously galaxy cores. Intergalactic gas mass is negligible (since gas is so thin & diluted in the vastness of space). We always vastly overestimate the mass of intergalactic gases due to the effects as explained earlier. The gases happen to lie on the ice cream regions, rather than concentrated on the sprinkles on the ice cream. Hence it gives us a false impression of excessive mass. Maybe X-Ray production is similar to heating of highly rarified Solar corona (far above the solar surface) by magnetic fields. In fact, recently huge magnetic fields have been discovered all across the cosmos. There is even a paper which claims that magnetic fields have played a big role in early structure formation of the universe. #counter argument: If mass of galaxies were concentrated at the X-Ray producing gas/dust region, then it would have produced a significant peak in G-lensing map (due to the baryonic mass) regardless of the locations of the supposed DMs. [Also see Wikipedia: Ultraluminous X-ray sources (ULXs): What powers X-ray sources that are not associated with active galactic nuclei but exceed the Eddington limit of a neutron star or stellar black hole? Are they due to intermediate mass black holes? Some ULXs are periodic, suggesting non-isotropic emission from a neutron star. Does this apply to all ULXs?]

One of the reasons for our confidence in dark matter comes from the fact that the estimated mass of the universe is much more than the estimated mass of normal baryonic matter. Let us take a look at some of these issues:

Nucleosynthesis (Big Bang): Estimates of Hydrogen to Deuterium ratio showing baryonic contribution is okay. But is it okay to estimate, the universe using traditional methods, which are based on general relativity? (We have already seen, that general relativity is not wrong, but is only an inside view, and suffer from many shortcomings).

CMB anisotropy study (acoustic baryonic oscillations) also suffer from same weakness. How can we correctly predict the total mass of the universe? Critical density of the universe is obtained from the Friedman equation, which itself is dependent on GR. As discussed general relativity is inside view and can't see the external stretching of the 3d FPHS in the fourth dimension. As we have seen, the appearance of external field effect (which general relativity rules out) causes the appearance a lot of fictious dark matter. In addition general relativity wrongly rules out universal absolute simultaneity, which creates a wrong impression of accelerated expanding universe, and appearance of dark energy (which is another form of mass). Friedman's equation hasn't taken those effects into account.

Structure formation in the universe: Dark matter is as you want to have acted as the seeds for galaxy in smooth baryon-photon soup left after the big bang. GR is fully capable of explaining structure formation. Only it needs additional matter (Dark Matter). **More precisely it needs additional gravitational acceleration. We have just added that extra ingredient** without hampering GR's functioning on the large scale in any way.

With the additional gravitational acceleration, isn't 13.8 billion years (minus 380,000 years) enough for structure formation? As the gases lumped, the gravity field they experienced was much stronger gravity than general relativity predicts (already explained) and seeding process immensely accelerated. We have seen that a ridge in 2d looks like a valley in 3d (i.e as a valley in 2d membrane when viewed in 3d). In 4d view, this should look more like a tube connecting the two masses. This easily explains the filament like structures during formation.

[Return Back to **Abstract**]

Dark Energy

"Dark energy is not only terribly important for astronomy, it's the central problem for physics. It's been the bone in our throat for a long time." --Steven Weinberg, Nobel Laureate, University of Texas at Austin.

Universe expansion is not accelerating. It is expanding at a constant rate (see **Appendix**: **constant rate expansion of universe**). The bone in the throat is now gone

Why is our universe expanding?

We haven't understood the true role Normal Baryonic Matter (**NBM)** plays.

Mass have a natural tendency to move away from the center of the Universe, or in other words, towards the future. The gravity fields which form the wall/membrane of our balloon universe has a natural tendency to shrink if it is released from a stretching mechanism. Hence, there is a competition between gravity fields and NBM. Here, the NBM lying within the wall/membrane of our balloon universe plays the same role as compressed air inside a balloon.

In a recent PRL paper the authors claimed that any theory abandoning **DM** must imply an acceleration law that changes sign on the ~150 Mpc scale. Just like the **EPR** paper trying to disprove 'Quantum Entanglement' ended up in describing a jaw-dropping, but real phenomena, similar is the case now. **NBM** can provides the pull of gravity at smaller length scales, while causing the (constant and non-accelerating) expansion of our universe at a cosmological scale.

Entanglement

We can get to the heart of entanglement phenomena.

[**Stereographic geometry of coherence and which-path information**; Yusef Maleki, Optics Letters, Vol. 44, No. 22 / 15 November 2019, P 5513-5516]

despite dedicated efforts, the quantitative description of the wave-particle duality was not found until 1979, when Wootters and Zurek quantified the wave-particle duality nature of a single quantum [21]. Later, the duality nature of a quantum system was explicitly formulated as an inequality, where the visibility of the interference pattern **V** and the which–path distinguishability **D** of a single quantum in a two-dimensional Hilbert space was shown to satisfy $V^2 + D^2 \leq 1$ [21,22].

Recently, it was shown that analysis of the vector mode coherence in a Young double-slit experiment uncovers the significant role of the entanglement on the duality nature of the light modes [23,24]. Accordingly, for the double-slit experiment, the duality relation can be expressed through $V^2 + \bar{D}^2 + C^2 = 1$ [23,24]. The concurrence, **C**, quantifies the entanglement of the two vector modes involved in the double-slit experiment.

The wave nature of the photon is determined by the fringe visibility [31]:

$$V = \frac{p_D^{\max} - p_D^{\min}}{p_D^{\max} + p_D^{\min}}.$$

The particle nature of the photon is related to our priori knowledge on the predictability of the photon being in the state $|0\rangle$ or $|1\rangle$.

Therefore, the particle nature of the photon can be quantified as [23,24]

$$D = \frac{|p_0 - p_1|}{p_0 + p_1},$$

Where p_0 and p_1 are the probabilities of the photons being detected in the states

$|0\rangle$ and $|1\rangle$.

Surprisingly, the coordinates of the stereographic conformal mapping provide

$$D^2 = x_0^2,$$
$$V^2 = x_1^2 + x_2^2,$$
$$C^2 = x_3^2 + x_4^2.$$

Since the coordinates of the S4 hypersphere satisfy

$\sum_{i=0}^{4} x_i^2 = 1,$ the relation $D^2 + V^2 + C^2 = 1$ emerges naturally.

##First of all, the above equation $\sum_{i=0}^{4} x_i^2 = 1,$ is the equation for a spherical hypersurface, and not a hypersphere itself. Secondly, I am very confident, that the summation runs from 0 to 3 (and not from 0 to 4). They have somehow made a mistake of counting an additional dimension [just like we had mistaken a dynamic 3d hypersurface (3d FPHS) for a continuous four dimension (4d spacetime)]. In that case, the above equation, is just the equation of our balloon universe (whose radius=1. It makes sense, because meter is only our unit. As we are dealing with a 'total probability of being found' problem for a particle, the radius of universe can always be taken as one, whatever its actual value in meters may be). As stressed earlier, every particle is also spread in the entire universe. The relation $D^2 + V^2 + C^2 = 1$ is just the total probability of the particle to be found in the entire universe. ##

Conclusions

We can look back at our ancestors and laugh "how could they assume that our earth rather than the sun is at the center of our solar system?" We can grin and boast "those poor guys did not know that our Earth is not flat but spherical".

Strangely, we humans are in the exact same situation today. We don't realize that our universe is not flat (I mean 3d flat), but rather is curved and **has a center**. Similarly, we don't realize that our ackward position, distorts our concept of space and time. Though by Copernican principle, we know we are not in a special position (that is, we are not at the centre of the universe), we have not got rid of the Geocentric problem, because we assume that our concept of time (as shown by our clock in the laboratory), and nature's concept of time is same. In other words, we are once again fixing the origin at the wrong place.

What happens when fixing origin at the wrong place? (eg. Fixing origin on earth, instead of center of sun, to explain solar system model). Retrograde motion of planets is what is observed from earth and hence is true for us (in fact 'planet' means wanderers. The name 'planet' itself is derived from this unexplainable behavior) Astronomer on earth observatories weren't lying. But the planets orbiting the sun is the deeper truth which someone had to figure out.

The situation is very similar today. We are assuming an origin in our laboratory (wherever our clock is placed) to understand SpaceTime, and to explain various natural phenomena. This makes observations very perplexing, just as planetary motion around sun.

We humans have failed to recognize that quantum mechanics and special relativity have exactly the same origin. Special relativity is just a theory from our viewpoint. We straightaway reject superluminal velocities because we can't ever observe them. But nature uses super-luminal communication all the time

Final remarks: Two burglars looted a bank and escaped safely. Once inside the safety of their den, the apprentice burglar puts down the huge bag on the floor and says gleefully "Lord! We made a kill today. I love the fresh smell from these bundles of notes. Now let's count our loot".

The senior partner calmly smiles back and says "Why bother to do all the counting? We'll get the figure on tomorrow's newspaper".

Well, it's always wise to listen to a good piece of advice, especially if it comes from a wise person like a successful bank robber. I may go on demonstrating the successes of **SRS** model. But, I'd rather someone else doing the job, and list in some article how many birds were hit. (Who says Physicist can't have a sense of humor?)

APPENDIX

Minkowski SpaceTime

Is Minkowski SpaceTime 4 dimensional or 3 dimensional?

[Return back]

Special relativity can be formulated both in 3d and in 4d. Even today greatest physicists (like Petkov and Selleri) are fighting about the dimensionality implied by special relativity. The debate is far from settled even today.

[**What Einstein did not consider about Gravity**; D. Rowland, OSP Journal of Physics and Astronomy, Volume 1, Issue 1, July 05, 2020]

Time measures the changing positions of objects and sequences of events that occur within space. Time is an abstract (nonphysical) measurement within the 3-D. Time cannot be extracted from space and projected onto a fourth supposedly physical axis with its own independent set of reference points. Whatever model you create that includes mathematical measurements of an intangible dimension cannot possibly be real. To believe in spacetime is to believe in at least one direction to which one cannot point.

[Relativity and the Dimensionality of the World; Vesselin Petkov**]**

One of the most difficult problems that science has posed not only to philosophers but to any representatives of humankind, who want to have their world view in accordance with modern science, came from special relativity. The main question is whether the world is three-dimensional (3D) or four-dimensional (4D). It arises from the issue of the ontological status of Minkowski spacetime which leads to a clear dilemma: Minkowski spacetime should be regarded either as nothing more than a mathematical space which represents an evolving in time 3D world (the present) or as a mathematical model of a timelessly existing 4D world with time entirely given as the fourth dimension.

The implications of a 4D world for a number of fundamental issues such as temporal becoming, flow of time, determinism, and free will are profound - in such a world (often called block universe) the whole histories in time of all physical objects are given as completed 4D entities since all moments of time are not "getting actualized" one by one to become the moment "now", but form the fourth dimension of the world and therefore all are given at once. And if temporal becoming and flow of time are understood in the traditional way - as involving 3D objects and a 3D world that endure through time - there is no becoming, no flow of time, and no free will in a 4D world. It is these implications of relativity that have posed perhaps the greatest intellectual challenge humankind has ever faced.

With the stakes at the highest level the reaction of physicists and philosophers to that challenge is quite different. The most frequent answer to the question "What is the dimensionality of the world according to relativity?" given by physicists and especially relativists is "Of course, the world is 4D".

But when asked about the implications of such a 4D world (not a 4D mathematical space), they start to realize that relativity poses serious interpretive problems.

Some philosophers of science regard the block universe view as undoubtedly wrong and believe that somekind of objective becoming and time flow must exist. The assumption that the world cannot be 4D is sometimes considered so self-evident that any attempts to question it are virtually reprimanded. In 1991 H. Stein (1991) criticized the Rietdijk-Putnam-Maxwell argument (Rietdijk 1966; Putnam 1967;

Maxwell 1985) designed to demonstrate that special relativity implies that reality is a 4D world. Stein argued that their use of the concept "distant present events" is a fallacy.

Conclusions: the only view that is consistent with relativity is four dimensionalism. An independent argument for four-dimensionalism comes from the conventionality of simultaneity. Indeed, due to the conventionality of simultaneity all events outside of the light cone of an event exist which leads to the view that all events of spacetime are real (Weingard 1972). In fact, the profound meaning of the conventionality of simultaneity (and of the vicious circle reached when one tries to determine the one-way velocity of light) is that reality is a four-dimensional world whose mathematical model is Minkowski spacetime (Petkov 1989, 2005)

[Relativity Theory May not have the Last Word on the Nature of Time: Quantum Theory and Probabilism; Nicholas Maxwell; Space, Time and the Limits of Human Understanding, ed. G. Ghirardi and S. Wuppuluri, Springer, 2017 (pp 109–124); https://doi.org/10.1007/978-3-319-44418-5_9 **]**

Abstract: *Two radically different views about time are possible. According to the first, the universe is three dimensional. It has a past and a future, but that does not mean it is spread out in time as it is spread out in the three dimensions of space. This view requires that there is an unambiguous, absolute, cosmic-wide "now" at each instant. According to the second view about time, the universe is four dimensional. It is spread out in both space and time - in space-time in short. Special and general relativity rule out the first view. There is, according to relativity theory, no such thing as an unambiguous, absolute cosmic-wide "now" at each instant. However, we have every reason to hold that both special and general relativity are false.*

[On the Reality of Minkowski Space; Vesselin Petkov, Foundation Physics (2007) 37: 1499-1502**]**

Special relativity can be equally formulated in a three-dimensional and a four-dimensional language. However, while the two representations of relativity are equivalent in a sense that they correctly describe the relativistic effects, they are diametrically different in terms of the dimensionality of the world. As the world is either three-dimensional or four-dimensional only one of the representations of relativity is correct.

……

[Time and Reality of Worldtubes; Vesselin Petkov; arXiv:0812.0355 **]**

Abstract

Physicists should face the issue of the reality of spacetime and worldtubes of physical objects for two reasons. First, this issue is not a philosophical question, as some appear to think, since the kinematical

special relativistic effects would be impossible, as will be demonstrated, if the physical objects involved in these effects did not exist as four-dimensional worldtubes. Second, taking into account that worldtubes are real four-dimensional objects provides an unexpected insight into the origin of inertia, the nature of the force acting on a body supported in a gravitational field, and possibly even the nature of quantum objects.

……

[Is There an Alternative to the Block Universe View? Vesselin Petkov; Philosophy and Foundations of Physics; Volume 1, 2006, Pages 207-228; https://doi.org/10.1016/S1871-1774(06)01011-4 **]**

Abstract

This paper pursues two aims. First, to show that the block universe view, regarding the universe as a timelessly existing four-dimensional world, is the only one that is consistent with special relativity. Second, to argue that special relativity alone can resolve the debate on whether the world is three-dimensional or four-dimensional. The argument advanced in the paper is that if the world were three-dimensional the kinematic consequences of special relativity and more importantly the experiments confirming them would be impossible.

…….

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Objections to Minkowski spacetime

[Return Back]

[Minkowski Space-Time: A Glorious Non-Entity; Harvey R.Brown, OliverPooley; Chapter 4, Philosophy and Foundations of Physics, Volume 1, 2006, Pages 67-89**]**

It is argued that Minkowski space-time cannot serve as the deep structure within a “constructive” version of the special theory of relativity, contrary to widespread opinion in the philosophical community.

[The only pure mathematical error in the special theory of relativity; Berisha, Valbona; Klinaku, Shukri, Physics Essays, Volume 30, Number 4, December 2017, pp. 442-443(2); https://doi.org/10.4006/0836-1398-30.4.442]

Two linear equations are independent if none of them can be derived algebraically from the other. This condition does not meet the transformation equation of the x coordinate and the transformation equation of time t into the Lorentz transformation. Despite this, these two equations in the special theory of relativity are treated as linearly independent. This is the only pure mathematical error in this theory.

[Systematical Scrutiny into Special Relativity; Xu Shaozhi and Xu Xiangqun, Chinese J. of Systems Engineering & Electronics, Vol.4, No.2, 1993,pp.75—85**]**

Page 9/13 (PP81)

The mathematical and physical dimensions represented by ct and by (x, y, and z) are

NOT QUALIFIED to be orthogonal.

Alternatively, looking from another viewpoint, the 4-D quadratic

$$x^2 + y^2 + z^2 - c^2 t^2 = F$$

can be expressed in general function form:

$$f\ (x,y,z,t,F) = 0$$

which contains only THREE independent variables. In fact, represents merely a three, not four, dimensional space.

[Minkowski-Einstein spacetime: Insight from the Pythagorean theorem; Crothers, Stephen J., Physics Essays, Volume 31, Number 3, September 2018, pp. 274-278(5), https://doi.org/10.4006/0836-1398-31.3.274 **]**

*ABSTRACT: The Pythagorean Theorem, combined with the analytic geometry of a right circular cone, has been used by H. Minkowski and subsequent investigators to establish the 4-dimensional spacetime continuum associated with A. Einstein's Special Theory of Relativity. Although the mathematics appears sound, the incorporation of a hyper-cone into the analytic geometry of a right triangle in Euclidean 3-space is in conflict with the rules of pure mathematics. A metric space of n dimensions is necessarily defined in terms of **n** independent coordinates, one for each dimension. Any coordinate that is a combination of the others for a given space is not independent so cannot be an independent dimension. Minkowski-Einstein spacetime contains a dimensional coordinate, via the speed of light that is not independent. Consequently, Minkowski-Einstein spacetime does not exist.*

***Conclusion:** Minkowski-Einstein 4-dimensional spacetime has only three independent dimensional coordinates because the hypotenuse of its triangle is neither independent of nor orthogonal to the Cartesian coordinates x, y, z. The quantity ct, is no more an independent dimensional coordinate perpendicular to x, y and z axes*.

[**The four basic errors of special theory of relativity and the solution offered by extended Galilean relativity**; Shukri Klinaku, PHYSICS ESSAYS 33, 2 (2020)]

The passage from the principle of relativity and the constancy of the speed of light to the basic equations of the STR is affected by four fundamental errors—three physical and one mathematical. Continuous attempts to reconcile these latent mistakes have made STR increasingly tricky. As a result, it is in a similar situation to Ptolemy's geocentric model after "improvements" thereto by Tycho Brahe.

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……..

Is 'Euclidean relativity' the key?

What if we rearrange above equation as:

$$c^2dt^2 = -ds^2 + dx^2 + dy^2 + dz^2 = c^2d\tau^2 + dx^2 + dy^2 + dz^2 = c^2d\tau^2 + dr^2$$

This Euclidean form creates a right angled triangle geometry (through Pythagoras Theorem), and hence an additional dimension-the proper time (**τ**), in addition to the 3 dimensions of **r** (**x, y and z**)".

Beware! This is a distorted view of what is really happening. This leads to a dead end. In fact this technique has been used in countless printed scientific papers, and have confused many authors to assume the proper time (**τ**) as the absolute universal time. Most of them have advocated the use of proper time (**τ**) as the independent axis rather than **t** as independent axis. [## The time axis **(t)** used by Minkowski and Einstein is not a truly independent axis (due to space-time mixing), and causes the **t** axes to tilt with increasing velocity (which it shouldn't have done if it were truly independent). Therefore, while it is certainly true that time axis **(t)** cannot be used as an independent coordinate, the proper time can't be used as coordinate either. As Newburgh & Phipps have noted **[A space-Proper Time Formulation of Relativistic Geometry; R.G. Newburgh, T.E. Phipps; Physical Sciences Research Papers, No. 401; November 1969]** that by using the proper time as independent axis, each space-proper time (SPT) must be thought of as a 'private space' belonging to one and only one particle, namely, the one with respect to which the coordinate **cτ** is defined ##]

This website (https://www.euclideanrelativity.com/) lists several papers following the above approach in an attempt to unlock the secrets of spacetime. These papers have wasted a lot of my own time, and I would strongly suggest to stay away from the above approach. In fact, the real key lies right inside the denouncement statement on the website page: *The approach differs from "Wick rotation" or complex Euclidean relativity. Wick rotation replaces time t by it, which also yields a positive definite metric but it maintains proper time as the invariant value whereas in Euclidean relativity, proper time becomes a coordinate.* **[## But let me repeat the caveat: Wick rotation gives us a divine view, but unfortunately doesn't give us access to the higher dimension].**

The above mathematical trick of rearranging the terms doesn't reveal the deeper secret. We must realize that whichever way we may arrange the terms of the Minkowskian equation, it creates an

impossible situation: the straight line between two points is not the shortest, but actually the longest! There is a reversal of the triangle inequality now. **[On the reversal of the triangle inequality in Minkowski spacetime in relativity; Edward B Manoukian, European Journal of Physics, Volume 14, Number 1].** This situation is impossible in Euclidean space (in which we have full access to the dimensions).

As we have understood the true meaning of imaginary numbers, and of Wick rotation, we already have the key. Instead of relying on mathematics alone, we'll use reason & logic to uncover the deceptively simple reason behind relativity, quantum mechanics, fractal geometry & scale relativity, the non-necessity of the 5th dimension for Kaluza miracle, the reason behind 'imaginary time magic' and also the size, shape & structure of the universe itself. I'll show why both dark matter & dark energy are not needed. But, let's not rush ahead, and follow the steps logically. Let's take a deeper look as Minkowskian spacetime.

Absolute space, universal time and absolute simultaneity

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Before proceeding further (and rectifying the second mistake) let's see what Paul Dirac said about absolute universal time.

[A new basis for cosmology; Paul A.M. Dirac, Proceedings of the Royal Society A, 05 April 1938, Volume 165 Issue 921, https://doi.org/10.1098/rspa.1938.0053]

The modern study of cosmology is dominated by Hubble's observations of a shift to the red in the spectra of the spiral nebulae—the farthest parts of the universe—indicating that they are receding from us with velocities proportional to their distances from us. These observations show us, in the first place, that all the matter in a particular part of space has the same velocity (to a certain degree of accuracy) and suggest a model of the universe in which there is a natural velocity for the matter at any point, varying continuously from one point to a neighbouring point. Referred to a four-dimensional space-time picture, ***this natural velocity provides us with a preferred time-axis at each point****, namely, the time-axis with respect to which the matter in the neighbourhood of the point is at rest.* ***By measuring along this preferred time-axis we get an absolute measure of time,*** *called the epoch.* ***Such ideas of a preferred time-axis and absolute time depart very much from the principles of both special and general relativity and lead one to expect that relativity will play only a subsidiary role in the subject of cosmology****. This first point of view, which differs markedly from that of the early workers in this field, has been much emphasized recently by Milne.*

…….

This is what T. Padmanabhan says **[Do we really understand the cosmos? Comptes Rendus Physique; Volume 18, Issues 3–4, March–April 2017, Pages 275-291]**

Our universe selects a preferred Lorentz frame with respect to which you can measure the absolute velocity of your motion. In a few decades your car will be equipped with a gadget which will couple to the

CMB, detect its dipole anisotropy and will tell you your velocity vector with respect to the absolute rest frame of the universe in which the CMB is homogeneous and isotropic. Operationally, to a limited extent, this is no different from the good old 'aether' which was providing an absolute reference frame for defining the state of rest.

In fact, the universe also provides you with an absolute time coordinate in terms of the CMB temperature. *If you specify that you are using a coordinate system in which the CMB is homogeneous and isotropic and the CMB temperature is, say 30 K, you have uniquely specified your Lorentz frame (with the only residual symmetry allowed being that of spatial rotations and spatial translations)". He also adds "The real peculiarity is not the fact that our universe has a preferred Lorentz frame; it is the fact that we see no trace of this preference at sub-cosmic scale physics. To the extent we can determine experimentally, there is no trace of an absolute rest frame or even a preferred class of frames in sub-cosmic level physics.* ***The laboratory scale experiments looking for an absolute frame of rest (without using the CMB) have repeatedly drawn a blank, but WMAP or PLANCK has no difficulty in determining it using the CMB, even locally.*** *Roughly speaking, physics at cosmic scales breaks the general covariance (and even Lorentz invariance) operationally by providing us with an absolute standard of rest; but as we move to smaller and smaller scales, we are left with no trace of the cosmic frame of rest in any other phenomena.*

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We don't need the 5th dimension

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We can actually reap all the benefits proposed by several authors (who have strongly advocated the 5th dimension) without ever needing the 5th dimension.

[Grounding the Fifth Dimension from Kaluza-Klein Theory in Observed Physical Reality, Using Dirac's Quantum Theory of the Electron to Ensure Five-Dimensional General Covariance; Jay Yablon; June 2018, DOI: 10.13140/RG.2.2.21943.01448, https://www.researchgate.net/publication/325604146 **]**

…to summarize, on the one hand, Kaluza-Klein theory has a fifth physical dimension (**# Read this as 4th physical dimension throughout the passage**) *on a par with space and time, but it has been impossible to connect that dimension with actual observations in the material, physical universe. On the other hand, Dirac theory has an eminently-physical* γ_5 *with pervasive observational manifestations on an equal footing with* γ_μ*, but it has been impossible to connect this* γ_5 *with a true physical fifth dimension.* ***Kaluza-Klein has a fifth-dimension unable to connect to physical reality, while Dirac theory has a physically-real*** γ_5 ***unable to connect to a fifth dimension.***

…as a consequence, the fifth dimension of Kaluza-Klein theory which has heretofore been disconnected from physical reality, can now be identified with a true physical dimension. And again, γ_5 ***has a wealth of empirical evidence to support its reality.***

Further, with (14.22) we now have two timelike and three spacelike dimensions, with matching tangent-space signatures between Dirac theory and the Dirac-Kaluza-Klein theory. With the fifth-dimension now being timelike not spacelike, the notion of "curling up" the fifth dimension into a tiny "cylinder" comes off the table completely, while the Feynman-Wheeler concept of "many-fingered time" returns to the table, providing a possible avenue to study future probabilities which congeal into past certainties as the ***arrow of time progresses forward with entropic increases****. And because* γ_5 *is connected to a multitude of confirmed observed phenomena in the physical universe,* ***the physical reality of the fifth dimension*** *in the metric tensor (4.22****) is now supported by every single observation ever made of the reality of*** γ_5 ***in particle physics****, regardless of any other epistemological interpretations one may also arrive at for this fifth dimension.*

...there is no reason to suspect that the many good benefits of Kaluza-Klein theory will be sacrificed because of these changes which eliminate the foregoing problems. But the Kaluza-Klein benefits having of Maxwell's equations, the Lorentz Force motion and the Maxwell-stress energy embedded in the field equations should remain fully intact.

… there is every reason to believe that using the five-dimensional Einstein equation with (4.22) will fully ***enable us to understand this fifth dimension****, at bottom, as a matter dimension,* ***along the lines long-advocated by the 5D Space-Time-Matter Consortium*** *[https://wp.towson.edu/5dstm/introduction/].* ***This may thereby bring us ever-closer to uncovering the truly-geometrodynamic theoretical foundation at the heart of all of nature.***

[EQUIVALENCE BETWEEN SPACE–TIME–MATTER AND BRANE-WORLD THEORIES; J. PONCE DE LEON, Modern Physics Letters A, Vol. 16, No. 35, pp. 2291-2303 (2001)**]**

We study the relationship between space–time–matter (STM) and brane theories. These two theories look very different at first sight, and have different motivation for the introduction of a large extra dimension. However, we show that they are equivalent to each other.

We point out that in brane models the usual matter in 4D is a consequence of the dependence of five-dimensional metrics on the extra coordinate. If the 5D bulk metric is independent of the extra dimension, then the brane is void of matter. Thus, in brane theory matter and geometry are unified, which exactly the paradigm is proposed in STM. Consequently, these two 5D theories share the same concepts and predict the same physics.

[HIERARCHY PROBLEM IN THE SHELL-UNIVERSE MODEL; MERAB GOGBERASHVILI, International Journal of Modern Physics DVol. 11, No. 10, pp. 1635-1638 (2002)**]**

In the model where the Universe is considered as a thin shell expanding in five-dimensional hyper-space there is a possibility to obtain one scale for particle theory corresponding to the five-dimensional cosmological constant and Universe thickness.

Problem is there is no evidence for a 5th dimension (Solution is: we don't need a 5th dimension)

[Limits on the number of spacetime dimensions from GW170817; Kris Pardo, Maya Fishbach, Daniel E. Holz and David N. Sperge, Journal of Cosmology and Astro-particle Physics, Volume 2018, July 2018 **]**

The observation of GW170817 in both gravitational and electromagnetic waves provides a number of unique tests of general relativity. One question we can answer with this event is: do large-wavelength gravitational waves and short-frequency photons experience the same number of spacetime dimensions? In models that include additional non-compact spacetime dimensions, as the gravitational waves propagate, they "leak" into the extra dimensions, leading to a reduction in the amplitude of the observed gravitational waves…….

These constraints imply that gravitational waves propagate in D=3+1 spacetime dimensions, as expected in general relativity. In particular, we find that $D = 4.02^{+0.07}_{-0.10}$ *(SHoES) and* $D = 3.98^{+0.07}_{-0.09}$ *(Planck). Furthermore, we place limits on the screening scale for theories with D>4 spacetime dimensions, finding that the screening scale must be greater than* $\sim$*20 Mpc.*

We seriously need to restrict ourselves within 4 dimensions.

[The status of modern five-dimensional gravity (A short review: Why physics needs the fifth dimension); Paul S. Wesson, International Journal of Modern Physics DVol. 24, No. 01, 1530001 (2015)**]**

…….the resulting 5D theory naturally explains the origin of classical matter and vacuum energy. Also, constraints on the equations of motion near a high-energy surface or membrane in the 5D manifold lead to quantization and quantum uncertainty. These are major returns on the modest investment of one extra dimension. Instead of fruitless bickering about whether it is possible to "see" the fifth dimension, it is suggested that it be treated on par with other concepts of physics, such as time. The main criterion for the acceptance of a fifth dimension (or not) should be its usefulness.

We don't have to go that far. We can have our cake and eat it too!

[Where has the fifth dimension gone? Alan Chodos and Steven Detweiler; Phys. Rev. D 21, 2167 – Published 15 April 1980**]**

We show that a simple solution to the vacuum field equations of general relativity in 4+ I space-time dimensions leads to a cosmology which at the present epoch has 3+ 1 observable dimensions in which the Einstein-Maxwell equations are obeyed. The large ratio of the electromagnetic to gravitational forces is a consequence of the age of the Universe, in agreement with Dirac's large-number hypothesis.

It is remarkable that, under the assumption that a suitable Killing vector exists, Einstein's field equations in five dimensions look exactly like the Einstein-Maxwell system in four dimensions, with or without an extra scalar field. The great difficulty with this approach is to understand why such a Killing vector should exist, or, more loosely, why the observed Universe is four and not five dimensional. Indeed, the assumption of a Killing vector serves at least partially to dismantle the five-dimensional framework and the hoped-for unification of gravity and electromagnetism is severely compromised, if not entirely lost. In this paper we discuss a model of a five-dimensionaI universe which naturally evolves into an effective four-dimensional one, even though all spatial dimensions are treated symmetrically in the field equations and the boundary conditions. As the reader will see, we achieve this at the cost of making some special choices in the solution to the field equations.

[OUR WORLD AS AN EXPANDING SHELL; M. GOGBERASHVILI, COSMO-99, pp. 465-471 (2000)**]**

In the model where the Universe is considered as a thin shell expanding in 5-dimensional hyperspace there is a possibility to have just one scale for a particle theory corresponding to the Universe thickness. From a realistic model the relation of this parameter to the Universe size was found.

It seems that the model where Universe considered as an expanding bubble in five dimensions [5] do not contradict to present time experiments [6] and is supported by at least two observed facts. First is the isotropic runaway of galaxies, which for close Universe model is usually explained as an expansion of a bubble in five dimensions. Second is the existence of a preferred frame in the Universe where the relict background radiation is isotropic. In the framework of the close-Universe model without boundaries this can also be explained if the Universe is 3-dimensional sphere and the mean velocity of the background radiation is zero with respect to its center in the fifth dimension. Usually the confining of matter inside the 4-dimensional manifold is explained as a result of the existence of special solution of 5-dimensional Einstein equations. This trapping has to be gravitationally repulsive in nature and can be produced, for example, by a large 5-dimensional cosmological constant Λ, while in four dimensional space cosmological constant can be hidden [1–3]. In previous paper [5] it was shown that in 5-dimensional shell-Universe model there is a possibility to solve the hierarchy problem, since particles in four dimensions have effective masses.

[General relativity and quantum mechanics in five dimensions; Paul S. Wesson, Physics Letters B 701 (2011) 379–383**]**

In 5D, I take the metric in canonical form and define causality by null-paths. Then spacetime is modulated by a factor equivalent to the wave function, and the 5D geodesic equation gives the 4D Klein–Gordon equation. These results effectively show how general relativity and quantum mechanics may be unified in 5D.

[**Five-dimensional relativity and two times**; Paul S. Wesson, Physics Letters B 538 (2002) 159–163]

[Grand unified theories without the desert; A. Pomarol, Phys. Rev. Lett. 85 (2000)4004–4007, arXiv:hep-ph/0005293 **]**

We present a Grand Unified Theory (GUT) that has GUT fields with masses of the order of a TeV, but at the same time preserves (at the one-loop level) the success of gauge-coupling unification of the MSSM and the smallness of proton decay operators. This scenario is based on a five-dimensional theory with the extra dimension compactified as in the Randall-Sundrum model. The MSSM gauge sector and its GUT extension live in the 5D bulk, while the matter sector is localized on a 4D boundary.

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Quaternary (1+3) or Tachyonic physics

[**Quaternion quantum mechanics as a true 3 + 1-dimensional theory of tachyons; J. Soucek, J. Phys. A: Math. Gen. 14 (1981) 1629-1640.** Printed in Great Britain]

The new approach to quaternion quantum mechanics is given. It is shown that such a theory describes tachyons and that the quantum theory of tachyons should be a quaternionic one. This theory needs fundamental changes in basic physical assumptions and in a sense it is complementary to known physics. An important analogy between the basic notions of quaternionic and complex quantum mechanics emerges from the new scheme. The consequences for the theory of quantum and classical tachyons seem to be very important.

There is a deep analogy between quaternion and complex QM based on the formal similarity between the operator $i\partial_0$ *of the infinitesimal time translation and the quaternion operator* $i\partial = i\partial_1 + i\partial_2 + i\partial_3$

The interrelation between tachyons and quaternion QM seems to be fundamental.

There are other reasons suggesting that our theory of tachyons should be a true one (problems of Cauchy data, of localisation etc). In the 1 + 1-dimensional space-time the problem is rather simple because of the possibility of making the (superluminal) transformation x' = t, t' = x (Parker 1969, Recami and Mignani 1974, VySin 1977a, b). In the 3 + I-dimensional case the problem is difficult because of different dimensionality of time and space and the use of quaternions is essential.

The quaternion analogue of electrodynamics is studied in 5 6. It is suggested in the last section that there is a deep relation among complex numbers, quaternions, dimensions of time and space and topology of the inside and the outside of the light cone. All this is perfectly reflected in the structure of complex and quaternion QM. ***Perhaps the true name of this paper should be 'the trip into the world lying outside the light cone'.***

…the previous investigations did not discover the deep meaning of the quaternion QM.

The discovered analogy between $i\partial_0\psi = H\psi$ *, in complex Quantum Mechanics and*

$(i\partial_1 + i\partial_2 + i\partial_3)\psi = H\psi$ in quaternion QM can be generalized to the more complete analogy called the time-space duality (TSD). ***Its meaning is the exchange of the roles of time and space if we go from complex numbers to quaternions.*** *Thus in the quaternion QM we are going to consider the space variable as an evolutionary one (the state of a system being given in the time variable). Such an interpretation is natural and necessary in the theory of tachyons.*

Now we shall show that the quaternion Dirac equation is in fact the usual Dirac equation written for tachyons.

...the quaternion QM can describe tachyons; we want to show now that this is, in fact, the only correct 3 + l-dimensional theory of tachyons. It was noticed (on the basis of the analogy argument) that the role of an evolution variable is played by the space one in the quaternion QM. To be more precise, the evolution variable cannot be chosen arbitrarily; the correct choice of it depends on the 'dynamics' of the considered system. To choose it correctly means to recognize well in which variable the initial data can be prescribed and in which variable we can localize the system. It is well known (Feinberg 1978, Schroer 1971) that arbitrary initial values for tachyons cannot be prescribed on the hyperplane {t = 0) and that it is impossible to construct wave packets localized in space (see 8 4). Hence time cannot be the evolution variable for tachyons. On the other hand it is possible and quite natural to prescribe arbitrary initial data on the time axis {x = 0) (see this section) and to construct wave packets localized in time. The reason for all this is the fact that the domain influenced by a tachyon lies outside the light cone, hence the initial data on {t = 0) interfere with each other. The best illustration is the case of the 'tachyon at rest' (the one with the velocity v =∞).

……in the complex QM solutions of the Schrodinger equation have 'negative' time dependence (which is clearly related to the 1-dimensionalityof time). But in quaternion QM we have 'negative space' dependence of the solution.

The other meaning is that the solution 3.2 (the plane-wave solutions to the Quaternion Dirac equation) is left-handed. *(Let us note that the helicity has the invariant meaning only for massless particles; this could be explained by the fact that such particles can be considered as a limit case of tachyons.)*

$ su ## Nature indeed is weakly left-handed! ##

The classical theory of tachyons should be the classical limit of the corresponding quantum theory. But the impossibility of localizing a tachyon (in quantum theory) leads us inevitably to the fact that the classical trajectory of a tachyon should be a hyperplane in space-time lying outside the light cone.

The time-space duality (TSD) can be set up as the postulate: fundamental laws of Nature are to be symmetric with respect to time and space in the sense of the analogy between the quaternion and complex QM described above. This implies either the existence of tachyons dual to the known bradyons or that particles should be massless. The second possibility is, of course, more realistic, especially in the context of the Salam-Weinberg model. The observed bradyonic character of our world is the consequence of the spontaneous symmetry breaking.

Remark: Analogy between the quaternion and complex QM is being proposed as a postulate. But this present paper explains why a switching of roles between temporal & spatial dimensions happens.

….our theory may help in understanding the space-parity breaking. The problem lies in the fact that there is nothing in the principles of quantum theory which distinguishes a priori the right-handed and left-handed coordinate system.

[**QUATERNION QUANTUM MECHANICSAS THE DESCRIPTION OF TACHYONS AND QUARKS, J. Soucek, Czech. J. Phys. B29 (1979)**]

Physics is not symmetric with respect to time and space. To obtain symmetry between space and time, it is necessary to consider the new part of physics -- the space-like physics in which the evolution takes place in space and the state of system is defined on the rime axis. It is shown that the corresponding Quantum Mechanics must be based on the field of quaternions instead of the field of complex numbers. Equations analogical to the usual electrodynamics are found. In these equations the Yang-Mills field plays the role of the photon field. Then the corresponding hypothetical particles are interpreted as quarks. In this interpretation the symmetry between space and time is connected with the quark-lepton symmetry.

The main part of physics can be regarded as the time-like physics in the following sense: the state of the system is defined at t = t o and we are interested in the evolution of the system in t. The conservation laws, quantum numbers, interpretation of experiments etc. are understood also in the time-like way. In the Special Relativity, the space and the rime are connected by the Lorentz transformation, but, in fact, the symmetry was not reached, because the rime variable always plays the special role of evolution variable. The real symmetry between t and x can be obtained only in the way that we shall study as the complementary part of physics the space-like physics in which x is the evolution variable and tis the variable in which the state of the system is described. In such a way, a new type of the duality between time and space arises. This duality s mathematically described as the correspondence between lines and hyperplanes.

The main difficulty is to understand what may be the 3-dimensional evolution. For this, it is necessary to introduce the quaternionic wave function, because using it we can construct the 'elegant' 3-dimensional infinitesimal evolution operator (plays the role of time): $i\partial = i\partial_1 + i\partial_2 + i\partial_3$

Now, let us consider the possible interpretation of our theory. Let us suppose the quark-gluon model of hadrons, the Weinberg-Salam model of leptons and let us neglect the gravitation. Then there is a small number elementary particles: leptons, quarks and gauge particles. Duality between space and time implies the duality in the spectrum of elementary particles. One possibility is: to each known particle, there is the corresponding x-like particle (unknown).There is another interesting possibility - the duality works among known particles by: leptons $\leftrightarrow$ *quarks and so quarks would be tachyons. There are the following arguments:*

(i) The hadron would be the t-like bounded system of quarks and from the confinement it follows that the causality would hold outside but not inside of the hadron

(ii) From the scattering experiments (if quarks exist), it does not follow that quarks are bradyons - this is only the usual assumption.

(iii) The quark-lepton symmetry would be based on the fundamental relativistic symmetry between space and time.

(iv) The space-like analog of electrodynamics described above would be the dynamical theory of quarks. The idea is that confinement may be something like the space-like conservation law of our theory.

(v) The fundamental laws of Nature would be symmetric with respect to time and space and the observed asymmetry would be of dynamical origin.

$ su ## Indeed the asymmetry is due to dynamical movement (at velocity c) 3d spatial hypersurface (analogous to an expanding rubber balloon), and our complete lack of access to the fourth dimension (thus making it imaginary) ##

[**Doing Physics with Quaternions; Douglas B. Sweetser (2005)**]

The four Maxwell equations become one nonhomogeneous quaternion wave equation, and the Klein–Gordon equation is part of a quaternion simple harmonic oscillator. Even gravity may be part of a simple quaternion wave equation.

Quaternion operators were employed to express central laws of physics: Newton's second law, the Maxwell equations, and the Klein–Gordon equation for relativistic quantum mechanics. Applications of quaternions to special relativity were done in detail. Quaternions do not make problem solving easy. Rather, they help unite the laws themselves.

When quaternion operators are employed, the Klein–Gordon equation is part ofa larger set, including a scalar and vector identity analogous to the Maxwell equations.

*Every event, every function, every operator used was a member of the field of quaternions**. I prefer to think of it as a great democratic principle. Physics is impressively democratic, with each photon or electron obeying the same collection of laws interchangeably.** The mathematics underlying the laws of physics should reflect this interchangeability.*

Redshifts (Doppler, Cosmological etc.)

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[The kinematic origin of the cosmological redshift; Emory F. Bunn; American Journal of Physics 77, 688 (2009); https://doi.org/10.1119/1.3129103]

Abstract

A common belief about big-bang cosmology is that the cosmological redshift cannot be properly viewed as a Doppler shift (that is, as evidence for a recession velocity) but must be viewed in terms of the stretching of space. We argue that, contrary to this view, the most natural interpretation of the redshift

is as a Doppler shift, or rather as the accumulation of many infinitesimal Doppler shifts. The stretching-of-space interpretation obscures a central idea of relativity, namely that it is always valid to choose a coordinate system that is locally Minkowskian. We show that an observed frequency shift in any spacetime can be interpreted either as a kinematic (Doppler) shift or a gravitational shift by imagining a suitable family of observers along the photon's path. In the context of the expanding universe, the kinematic interpretation corresponds to a family of comoving observers and hence is more natural.

[Cosmological redshifts vs. gravitational redshifts; Eric Baird]

Under current theory, Einstein's 1916 general theory of relativity applies the Doppler equations of special relativity to motion shifts and gravitational shifts, while cosmological shifts are thought to obey a different shift law. However, geometrical considerations require these arguments and equations to be interchangeable. If this geometrical argument is correct, either the cosmological shift law and/or the core relationships of general relativity will need to be modified.

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Dark Matter

[Green Bank and Effelsberg Radio Telescope Searches for Axion Dark Matter Conversion in Neutron Star Magnetospheres; JoshuaW. Foster, Yonatan Kahn et al; PHYSICAL REVIEW LETTERS 125, 171301 (2020)]

We find no evidence for axion DM and are able to set constraints on the existence of axion DM in the highly motivated mass range between ∼5 and 11 μeV with the strongest constraints to dateon axions in the ∼10–11 μeV range.

Another nail in the coffin for a leading Dark Matter (DM) candidate. DM is not required.

[**An excess of small-scale gravitational lenses observed in galaxy clusters**; Massimo Meneghetti, Guido Davoli et al ; Science 11 Sep 2020; Vol. 369, Issue 6509, pp. 1347-1351]

They found an order of magnitude more small-scale lenses than would be expected from cosmological simulations. As explained, the magnitude of gravitational lensing depends on the net depression in the rubber membrane (3d FPHS). And through the mechanisms already explained, the net depression due to the galaxies in the cluster, as well as the individual depression in each galaxy (due to the net/resultant depressions from each star) far exceeds what we would have expected from general relativity.

[A new formulation of the external field effect in MOND and numerical simulations of ultra-diffuse dwarf galaxies – application to NGC 1052-DF2 and NGC 1052-DF4; Hosein Haghi, Pavel Kroupa, Indranil Banik et al; Monthly Notices of the Royal Astronomical Society, Volume 487, Issue 2, August 2019, Pages 2441–2454, https://doi.org/10.1093/mnras/stz1465]

This external field effect is investigated using a new analytic formulation and fully self-consistent live N-body models in MOND.

Success of MOND in simulating UDG (ultra-diffuse galaxies) will also be repeated in this (3d FPHS) RM model as it incorporates the EFE of MOND (although in a different fashion).

[**No need for dark matter: resolved kinematics of the ultra-diffuse galaxy AGC 114905**; Pavel E Mancera Piña, Filippo Fraternali et al, Monthly Notices of the Royal Astronomical Society, Volume 512, Issue 3, May 2022, Pages 3230–3242, https://doi.org/10.1093/mnras/stab3491]

ABSTRACT *We present new H i interferometric observations of the gas-rich ultra-diffuse galaxy AGC 114905, which previous work, based on low-resolution data, identified as an outlier of the baryonic Tully–Fisher relation. The new observations, at a spatial resolution ∼2.5 times higher than before, reveal a regular H i disc rotating at about 23 km s−1. Our kinematic parameters, recovered with a robust 3D kinematic modelling fitting technique, show that the flat part of the rotation curve is reached.* ***Intriguingly, the rotation curve can be explained almost entirely by the baryonic mass distribution alone.*** *We show that a* ***standard cold dark matter halo that follows the concentration–halo mass relation fails to reproduce the amplitude of the rotation curve by a large margin.*** ***Only a halo with an extremely (and arguably unfeasible) low concentration reaches agreement with the data.*** *We also find that the rotation curve of AGC 114905* ***deviates strongly from the predictions of modified Newtonian dynamics.*** *The inclination of the galaxy, which is measured independently from our modelling, remains the largest uncertainty in our analysis, but the associated errors are not large enough to reconcile the galaxy with the expectations of cold dark matter or modified Newtonian dynamics.*

An ultra diffuse galaxy (UDG) is an extremely low luminosity galaxy. Their lack of luminosity is due to the lack of star-forming gas (i.e. interstellar gas content is extremely low). Considering the 3d FPHS as rubber membrane, and applying the mechanism explained earlier, the mystery is easily resolved.

[Testing the Strong Equivalence Principle: Detection of the External Field Effect in Rotationally Supported Galaxies; Kyu-Hyun Chae, Federico Lelli et al; The Astrophysical Journal, 904:51 (20pp), 2020 November 20]

The strong equivalence principle (SEP) distinguishes general relativity (GR) from other viable theories of gravity. ***The SEP demands*** *that the internal dynamics of a self-gravitating system under freefall in an external gravitational field should not depend on the external field strength.*

…the EFE is individually detected at 8σ to 11σ in "golden" galaxies subjected to exceptionally strong external fields

Our results point to a breakdown of the SEP, supporting modified gravity theories beyond GR.

##The statement "The SEP demands that the internal dynamics of a self-gravitating system under freefall in an external gravitational field should not depend on the external field strength" does not hold if external field effect arises due to stretching of the 3d FPHS in the fourth dimension (which any creature trapped in this 3d FPHS cannot detect). Equivalence principle is simply the equivalence between gravitational mass and inertial mass, which is also respected by this rubber membrane RM model of 3d FPHS.##

[The Real Problem with MOND; Scott Dodelson; International Journal of Modern Physics DVol. 20, No. 14, pp. 2749-2753 (2011)]

Here I point out the most severe challenge facing MOND.

[**Modified Newtonian Dynamics (MOND): Observational Phenomenology and Relativistic Extensions**; Benoît Famaey & Stacy S. McGaugh ; Living Reviews in Relativity volume 15, Article number: 10 (2012)]

Observational Test	Successful	Promising	Unclear	Problematic
Rotating Systems				
solar system			X	
galaxy rotation curve shapes	X			
surface brightness $\propto \Sigma \propto a^2$	X			
galaxy rotation curve fits	X			
fitted M^*/L	X			
Tully-Fisher Relation				
baryon based	X			
slope	X			
normalization	X			

no size nor Σ dependence	X			
no intrinsic scatter	X			
Galaxy Disk Stability				
maximum surface density	X			
spiral structure in LSBGs	X			
thin & bulgeless disks		X		
Interacting Galaxies				
tidal tail morphology dynamical friction		X	X	
tidal dwarfs	X			
Spheroidal Systems				
star clusters			X	
ultrafaint dwarfs			X	
dwarf Spheroidals	X			
ellipticals	X			
Faber-Jackson relation	X			
Clusters of Galaxies				
dynamical mass				X
mass-temperature slope	X			
velocity (bulk & collisional)		X		

Gravitational Lensing				
strong lensing	X			
weak lensing (clusters & LSS)			X	
Cosmology				
expansion history			X	
geometry			X	
Big-Bang nucleosynthesis	X			
Structure Formation				
galaxy power spectrum			X	
empty voids		X		
early structure		X		
Background Radiation				
first:second acoustic peak	X			
second:third acoustic peak				X
detailed fit				X
early re-ionization	X			

 # Clearly MOND is not the final solution.

[Bending instabilities at the origin of persistent warps: A new constraint on dark matter halos; Y. Revaz and D. Pfenniger; Astronomy & AstroPhysics, Volume 425, Number 1, October 2004]

[THE EINSTEIN CROSS**: CONSTRAINT ON DARK MATTER FROM STELLAR DYNAMICS AND GRAVITATIONAL LENSING; Glenn van de Ven, Jesús Falcón-Barroso et al; The Astrophysical Journal, Volume 719, Number 2]**

[Constraints on dark matter from colliders; Jessica Goodman, Masahiro Ibe et al.; Phys. Rev. D 82, 116010 – Published 27 December 2010]

We show that colliders can impose strong constraints on models of dark matter, in particular, when the dark matter is light.

[Dark matter constraints from observations of 25 Milky Way satellite galaxies with the Fermi Large Area Telescope; M. Ackermann et al. (Fermi-LAT Collaboration); Phys. Rev. D 89, 042001 – Published 11 February 2014]

We set some of the tightest constraints to date on the annihilation of dark matter particles with masses between 2 GeV and 10 TeV into prototypical standard model channels. We find these results to be robust against systematic uncertainties in the LAT instrument performance, diffuse γ-ray background modeling, and assumed dark matter density profile.

[An excess of small-scale gravitational lenses observed in galaxy clusters; Massimo Meneghetti, Guido Davoli et al; Science 369, 1347–1351 (2020) 11 September 2020]

The observed cluster substructures are more efficient lenses than predicted by CDM simulations, by more than an order of magnitude.

Easily explained by Rubber Membrane model.

[What Is the Price of Abandoning Dark Matter? Cosmological Constraints on Alternative Gravity Theories; Kris Pardo and David N. Spergel; PHYSICAL REVIEW LETTERS 125, 211101 (2020)]

Conclusions—Cosmological observations place strong constraints on the form of any modification to general relativity. *In the absence of dark matter, the modified theory must explain how density fluctuations grow from the electron velocity field traced by the CMB polarization at z =1100 to the galaxy density field seen in the local universe. In this Letter, we show that any theory that depends linearly on the density field must have the peculiar Green's function. Given the extreme form of the function, it is not clear that it is possible to find such a theory—in particular, the sign changes would induce quite extreme dynamics within the local volume (for a recentwork that performs this sort of analysis for Horndeski models, see Ref. [45).* ***While there are candidate modified gravity theories that fit the CMB temperature spectrum [46], none have shown they can correctly predict the CMB polarization***

spectrum and the large-scale structure. *CDM remains the simplest explanation for our cosmological observations.*

*We show that the Green's function G (x, t, t′**)** must have dramatic features that erase the initial baryon oscillations.* ***This implies an acceleration law that changes sign on the ~150 Mpc scale.*** *On the other hand, if the alternative gravity theory has a large nonlinear term that couples modes on different scales, then the theory would predict large-scale non-Gaussian features in large-scale structure. These are not seen in the distribution of galaxies nor in the distribution of quasars. No proposed alternative gravity theory for dark matter seems to satisfy these constraints. Any alternative gravity theory that obviates the need for dark matter needs to provide an explanation for the growth and evolution of structure.*

##Who is asking to abandon General Relativity altogether? GR is just the inside view (there is no concept of **'outside'** in general relativity, and a block universe view is assumed. This of course is a wrong view because the dynamic 3d FPHS has an embedding 4d hyperspace), and thus can't accommodate the external field effect (EFE) which actually arises from cumulative effects of stretching in the (universal) time direction i.e. along the universe radius and away from the universe Centre (BBC).

When every massive object trapped inside the surface (rubber membrane) of the balloon universe is moving away from the Centre, it is bound to cause expansion of the universe. The expansion is actually happening at a constant rate, but is only assumed to be accelerating. ##

[A DIRECT EMPIRICAL PROOF OF THE EXISTENCE OF DARK MATTER; Douglas Clowe, Marus˘a Bradac et al; The Astrophysical Journal, 648:L109–L113, 2006 September 10]

Due to the collision of two clusters, the dissipationless stellar component and the fluid-like X-ray–emitting plasma are spatially segregated. By using both wide-field ground-based images and HST/ACS images of the cluster cores, we create gravitational lensing maps showing that the gravitational potential does not trace the plasma distribution, the dominant baryonic mass component, but rather approximately traces the distribution of galaxies. An 8 sigma significance spatial offset of the center of the total mass from the center of the baryonic mass peaks cannot be explained with an alteration of the gravitational force law and thus proves that the majority of the matter in the system is unseen.

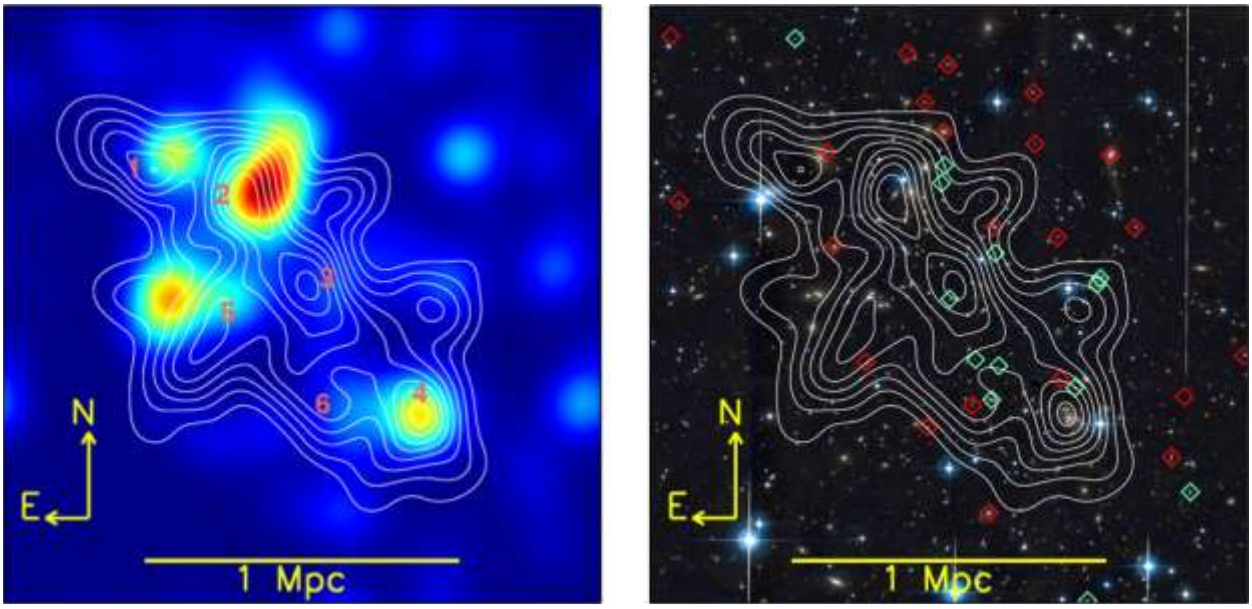
We have been making a wrong assumption all along. The dominant baryonic mass component actually comes from the distribution of galaxies, and not from X-ray–emitting plasma (or the halos surrounding the galaxies). It's a deception caused by the stretching of the RM far beyond the actual location of baryonic matter. The extreme temperature in the plasma (causing the emission of X-ray) is caused by some unknown cause (maybe magnetic heating like solar corona, which gets heated to millions of degree Celsius, although the solar atmosphere is only some 6000 degrees Celsius hot)

[A STUDY OF THE DARK CORE IN A520 WITH THE HUBBLE SPACE TELESCOPE: THE MYSTERY DEEPENS; M. J. Jee, A. Mahdavi et al, The Astrophysical Journal, 747:96 (8pp), 2012 March 10]

The “dark core” that is coincident with the X-ray gas peak, but not with any stellar luminosity peak, is now detected with more than 10σ significance.

(The finding) is at odds with what has been observed in other merging clusters with a similar geometric configuration. To date, the most remarkable counterexample might be the Bullet

Cluster, which shows a distinct bow-shock feature as in A520, but no significant weak-lensing mass concentration around the X-ray gas.



When we place 3 balls (at points A, B and C of a triangle ABC) on a rubber membrane, a depression also appears at the center. Now if even a small amount of mass (X-ray emitting plasma) is placed at the center, it will produce a large depression, and create an illusion of huge amount of dark matter lying there.

[A new relativistic theory for Modified Newtonian Dynamics; Constantinos Skordis, and Tom Zło´snik, Phys. Rev. Lett. 127, 161302 – Published 15 October 2021]

We propose a relativistic gravitational theory leading to modified Newtonian dynamics…..and demonstrate its agreement with the observed cosmic microwave background and matter power spectra on linear cosmological scales. We show that its action expanded to second order is free of ghost instabilities and discuss its possible embedding in a more fundamental theory.

Even if such theories can explain all observations relating to Dark Matter, even then there will be a fundamental problem in the heart of that theory. Non-linear GR and linear Newton’s gravitation (leading to MOND) are fundamentally incompatible!

[Large Scale Structure in Bekenstein’s Theory of Relativistic Modified Newtonian Dynamics; C. Skordis, D. F. Mota, P. G. Ferreira, and C. Boehm; PHYSICAL REVIEW LETTERS, PRL 96, 011301 (2006)]

We show that it may be possible to reproduce observations of the cosmic microwave background and galaxy distributions with Bekenstein's theory of MOND.

Same argument as above.

[The Bullet Cluster 1E0657-558 evidence shows modified gravity in theabsence of dark matter

J. R. Brownstein and J. W. Moffat; Mon. Not. R. Astron. Soc. 382, 29–47 (2007)]

A detailed analysis of the 2006 November 15 data release X-ray surface density Σ-map and the strong and weak gravitational lensing convergence κ-map for the Bullet Cluster 1E0657-558 is performed and the results are compared with the predictions of a modified gravity (MOG) and dark matter.

The MOG prediction of the isothermal temperature of the main cluster is T = 15.5 ± 3.9 keV, in good agreement with the experimental value. Excellent fits to the 2D convergence κ-map data are obtained without non-baryonic dark matter, accounting for the 8σ spatial offset between the Σ map and the κ-map reported in Clowe et al.

Certainly Bullet Cluster phenomena can be explained with a modified gravity, and DM won't be required. However the modified gravity is enhanced GR (which is currently our best theory of gravity). Anyway, it certainly proves that Bullet Cluster isn't really a smoking gun for DM.

[Radial Acceleration Relation in Rotationally Supported Galaxies; Stacy S. McGaugh and Federico Lelli, PHYSICAL REVIEW LETTERS, PRL 117, 201101 (2016)]

We report a correlation between the radial acceleration traced by rotation curves and that predicted by the observed distribution of baryons. The same relation is followed by 2693 points in 153 galaxies with very different morphologies, masses, sizes, and gas fractions. The correlation persists even when dark matter dominates. Consequently, the dark matter contribution is fully specified by that of the baryons. The observed scatter is small and largely dominated by observational uncertainties.

That certainly is a bullet in the chest of Dark Matter.

[A galaxy lacking dark matter; Pieter van Dokkum, Shany Danieli et al, Nature volume 555, pages629–632 (2018)]

NGC1052–DF2 enables us to make the complementary point that dark matter does not always coincide with galaxies either: it is a distinct 'substance' that may or may not be present in a galaxy. Furthermore, and paradoxically, the existence of NGC1052–DF2 may falsify alternatives to dark matter. In theories such as modified Newtonian dynamics (MOND)25 and the recently proposed emergent gravity paradigm26, a 'dark matter' signature should always be detected, as it is an unavoidable consequence of the presence of ordinary matter.

This is answered by this paper making a counter-claim:

[A distance of 13 Mpc resolves the claimed anomalies of the galaxy lacking dark matter ; Ignacio Trujillo, Michael A Beasley et al, Monthly Notices of the Royal Astronomical Society, Volume 486, Issue 1, June 2019, Pages 1192–1219]

Here we carry out a careful analysis of all extant data and show that they consistently indicate a much shorter distance (13 Mpc) than previously indicated (20 Mpc). With this revised distance, the galaxy appears to be a rather ordinary low surface brightness galaxy (Re = 1.4 ± 0.1 kpc; M⋆ = 6.0 ± 3.6 × 107 M⊙) with plenty of room for dark matter (the fraction of dark matter inside the half-mass radius is >75 per cent and Mhalo/M⋆>20) corresponding to a minimum halo mass >109 M⊙. At 13 Mpc, the luminosity and structural properties of the globular clusters around the object are the same as those found in other galaxies.

[THE MASS DISCREPANCY–ACCELERATION RELATION: DISK MASS AND THE DARK MATTER DISTRIBUTION; Stacy S. McGaugh, The Astrophysical Journal, 609:652–666, 2004 July 10]

The mass discrepancy in disk galaxies is shown to be well correlated with acceleration, increasing systematically with decreasing acceleration below a critical scale $a_0 = 1.2 \times 10^{-10}$ ms^{-2}.

Once the disk mass is determined in this fashion, the dark matter distribution is specified. The circular velocity attributable to the dark matter can be expressed as a simple equation that depends only on the observed distribution of baryonic mass. It is a challenge to understand how this very fine-tuned coupling between mass and light comes about.

Big blow to Dark Mateer hypothesis.

[MODIFIED NEWTONIAN DYNAMICS AND THE "DEARTH OF DARK MATTER IN ORDINARY ELLIPTICAL GALAXIES"; Mordehai Milgrom and Robert H. Sanders, The Astrophysical Journal, 599:L25–L28, 2003 December 10]

The recent findings of Romanowsky et al., of an "unexpectedly" small mass discrepancy within 5 effective radii in several elliptical galaxies, are not surprising in the context of modified Newtonian dynamics (MOND). As we show here, they are, in fact, in full concordance with its predictions. One is dealing with high surface density galaxies with mean accelerations rather larger than the acceleration constant of MOND. These findings continue, and are now the extreme examples of, the trend predicted by MOND: the mass discrepancy sets in at larger and larger scaled radii in galaxies with larger and larger mean surface densities or, equivalently, mean accelerations.

Good news that MOND can explain and predict such discrepancy. If MOND can this present theory certainly can, because it draws its strength from the best theory of gravity yet (GR) as well as from the key concept of MOND (External Field Effect & almost 1/r fall off of gravity at longer ranges).

Kindly see the following 4 review articles on Dark Matter to see that the presented model solves so many problems/paradoxes:

1) History of dark matter; Gianfranco Bertone, REVIEWS OF MODERN PHYSICS, VOLUME 90, OCTOBER–DECEMBER 2018
2) Status of dark matter in the universe; Katherine Freese, The Fourteenth Marcel Grossmann Meeting, pp. 325-355 (2017).
3) A tale of two paradigms: the mutual incommensurability of CDM and MOND; Stacy S. McGaugh, Can. J. Phys. 93: 250–259 (2015).
4) Dark matter: A primer; Gintaras Duda, Katherine Garrett, Advances in Astronomy, 2011, [968283]

A new paper [**Dark Matter from Exponential Growth**, Torsten Bringmann, Paul Frederik Depta, Marco Hufnagel, Joshua T. Ruderman, and Kai Schmidt-Hoberg; Phys. Rev. Lett. 127, 191802] outlines a rather unusual hypothesis about the creation of Dark Matter.

In short: dark matter creates dark matter. The idea is that at some point in the early stages of the Universe, dark matter particles were able to create more dark matter particles out of particles of regular matter.

The new research builds on earlier proposals ("Cosmological Lower Bound on Heavy-Neutrino Masses",Benjamin W. Lee and Steven Weinberg; Phys. Rev. Lett. 39, 165) of a 'thermal bath', where regular matter in the form of plasma produced the first bits of dark matter – initial particles which could then have had the power to transform heat bath particles into more dark matter.

 # This is exactly what is expected from the cumulative re-inforcing power of Baryonic (Regular) Matter in simulating Dark Matter.

……

An appeal to all readers:

In case, you liked the idea of 'One Universe', you might also like the idea of 'One World'. It's a mere speck in the vastness of our cosmos, but still it is our only home.

Please view and share the concept of 'One World, One Anthem'.

https://www.youtube.com/watch?v=YgUchABJ0EQ