Hybrid Time Theory: "Euler's Formula" and the "Phi-Algorithm"

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Abstract: Here a proposed time-equation conforms to a spherical wavefront of propagation in space in deriving the value of π. This will be achieved by first addressing how a time-equation should be most precisely and efficiently used to explain the notion of space and time in detailing a just as efficient and precise use of numbers describing the process of linking a 0 reference in space to an infinite reference. Then, that description will uphold the findings of papers 1-14 [1-14] in this series of papers, most importantly the final premise reached in paper 14 regarding natural radioactive decay. There it shall be explained exists an associated equation for time, not explicitly the proposed phi-algorithm for time, yet an associated algorithm of its own explained in Euler's formula.

Keywords: time; space; golden ratio; pi; phi; Euler's formula; phi-algorithm

1. Introduction

In this series of papers on the φ-algorithm for time [1-14], the concept of time as the φ-algorithm has been the core focus of topic. Through the development of the papers, the idea of the φ-algorithm for time seeking to define π has resulted in the development of a vast field of ideas covering what is perceived and measured of the natural physical world, containing equations that fit all of the thus-far tackled phenomenal data regarding the field forces for light, mass, and energy and associated constants thereof. These results took shape from the initial premise of defining space as a "0" 3-d construct associated to time, "time" as a concept that is tagged to a basic logical construct of consciousness, namely the features

of time-before, time-now, and time-after, and how that process of time from time-before to time-after can fit with the basic feature of 3-d 0-space in time-now.

It was initially proposed that time would propagate from any point in 0-space as a spherical wavefront at a fixed rate. Now, in this paper, that assumption will be fully addressed, namely the assumption of time seeking to conform to a spherical wavefront and thus to the notion of the value of π. This will be done by first addressing how words should be most precisely and efficiently be used to explain the notion of space and time in detailing a just as efficient and precise use of numbers describing the process of linking a zero (0) reference in space to an infinite (∞) reference. Then that description will uphold the findings of papers 1-14 [1-14], most importantly the final premise reached in paper 14 [14] regarding the feature of $e = m c^2$ and associated process of natural radioactive decay as per Euler's formula [15]. There, it shall be explained exists an associated equation for time, not explicitly the φ-algorithm for time, yet an associated algorithm of its own explained in Euler's formula.

This paper will be structured as follows:

1. Introduction.
2. Explaining space and time with mathematics.
3. How time is currently measured.
4. Hybrid time-theory.
5. Conclusion.

The conclusion reached suggests that Euler's formula as an equation for time implies a "naught" future, as a natural process of radioactive decay, whereas the φ-algorithm presents a more worthwhile steady-state process to time and space, yet a compromise can be reached between those two determinations for time.

2. Explaining space and time with mathematics

In this chapter the assumption of 0-scalar space and associated time-algorithm seeking "π", the φ-algorithm, as presented in paper 1 [1] shall be addressed. Here, the basic idea of mathematics shall be explained, why mathematics represents a type of "logic" for our tendency to "adapt" to reality, and what would represent a most basic wording for the concepts of space and time. *It should be noted that* mathematics is a tool that brings measurement as mathematics to gaze upon physical phenomena.

Science has evolved using mathematics in a fashion that standardises certain features of physical phenomena, key features, as equations with associated constants. One need not be concerned about the idea of space and time representing certain measurements as an a-priori. Indeed, space and time are both unfathomable "until defined" with a mathematical tool of measurement, and thus for the "purpose" of science, mathematics is employed to discuss their relationship, the relationship between space and time, ideally as follows.

2.1 Mathematics

Mathematics represents a broad field of interests, interests such as numerical quantity as number theory, mathematical structure as algebra, space as geometry, and change as mathematical analysis, employing with those ingredients certain mathematical models to formulate conjectures, axioms of choice, through abstraction and logic that are proven true or false through mathematical proof.

Successful proofs are considered as good models for real phenomena. Through such a process, the notions of counting, calculation, and measurement, have been applied to the phenomena of physical objects. Mathematics may nonetheless be purely mathematical without any design or purpose in mind, yet Mathematics has primarily held its purpose in explaining the world. In a world that was initially thought of a generally flat, the idea of explaining reality using a flat surface with drawn lines and angles seemed to be intuitive for the ancients.

From such beginnings, certain "functions" in mathematical congress to explain numbers and their association to one another become apparent, basic functions-operators such as addition and subtraction, and even then the concept of what those numbers represent, such as lines in space or length in time, had to be to be explained "with words", otherwise mathematics was nothing but a collection of symbols with no literary meaning other than numbers alone with expressed functions.

2.2 Explaining the diversity of equations, formulas, and theories.

To explain how such diversity has evolved in mathematical equations, formulas, and theories, it can be considered that such diversity has depended on three key things:

1. Our conscious ability to achieve such, our conscious pixilation of intelligence and drive.
2. The process of applying our intelligence and drive to what appears to be a never-ending vastly and unfathomable reality.
3. Our diversity as beings, having a different point of view to each other, and thus a vast well of unknowns based on the difficulty in sharing a common concept.

Each of such things are primary, and each of such things do not represent a mathematical process in their entirety. Subsequently, the application of mathematics to observed phenomena has focused primarily on physical objects in space and their motions with each other, and how mathematics as numbers with associated structures can be related to space as a type of geometry with an associated feature of change some would interpret as a process of time's flow. How mathematics has been applied to reality has depended primarily on the wording, the actual transcript of context, for the use of mathematics central to the nature of space, the nature of objects in space, and the nature of the motion of those objects in space.

2.3 Wording a mathematical axiom for space

It could be suggested that the concept of space is a fairly routine concept to measure as a mathematical construct requiring only a few words, only a few literary axioms, yet the concept of time not so. Two key mathematical features used for space and time that appear to be fairly routine through scientific definition is that space can be measured with a straight line using three axes as 3 dimensional space, and time can be measured as a single dimension in regard to that 3d space. A few of the basic tenets of this process include:

- Straight lines are generally used to measure 1d space.
- A circle is measured in relation to 2d space as the curved line drawn as an arc equidistant from a nominated central point of any nominated line.

Given a circle is very different to a line, π, the value for the circumference of a circle with diameter “1”, is why we need *words* to *primarily* describe the mathematics of a circle in regard to space, to explain the connection between the arc of a radius drawn as a circle in reference to a line (such as its diameter), and how that is achieved; simply, any ***key*** irrational number such as “π” needs words to explain exactly what is happening there, how that irrational number comes into being.

To define why “π” could be an irrational number, a key one, in words, is a good way to set a standard of use of words to then describe other features of space that could be related to for instance the idea of time; in describing π with words alone, why π "is" an irrational number, one need only ask oneself how and why "π" is ***related*** to a "line". For instance, take a straight line, real and rational, determined, say length of arbitrary unit “1”, and then go to the midpoint of that line and draw an arc around that straight line from the midpoint of that line. The proposal is that length of the circle around that line can never be the concept of a complete number as the distance of that line could be. Why? If one suggested that the concept of the distance of that line the circle arcs around can never be determined, then how can that circle be drawn on such an undetermined length of line? Furthermore, to draw that circle is to use a geometry related to that line (diameter) that has ***no*** actual relationship to the exactness of the number assigned to the distance of that line other than a value that (as a number related to that line) is forever incomplete as a description of a number value, as it can only be, in trying to link the beginning of that line with the end of that line without ***being*** that line. In other words, that line could be at any angle in reference to the circle. That’s intuitive; and so, if the line is known as a determined length, its circle can never be properly defined, and thus must be irrational. Therefore, how indeed can a straight line be in a perfect ratio with a circle if the angle of that line in space can never be determined owing to the nature itself of the circle, no beginning, and no end? The question is how such improbability of exact definition manifests itself in reality.

How does this look therefore on paper in the form of a mathematical axiom for space, with the notion of time being the variable seeking to perfect π, as though time is a type of endless algorithm forever trying to reach the perfect value of π? Consider a total "1" length of a line "A" that could represent "any" part of an infinite region of 2-d space around a central "0" point, as follows (figure 1):

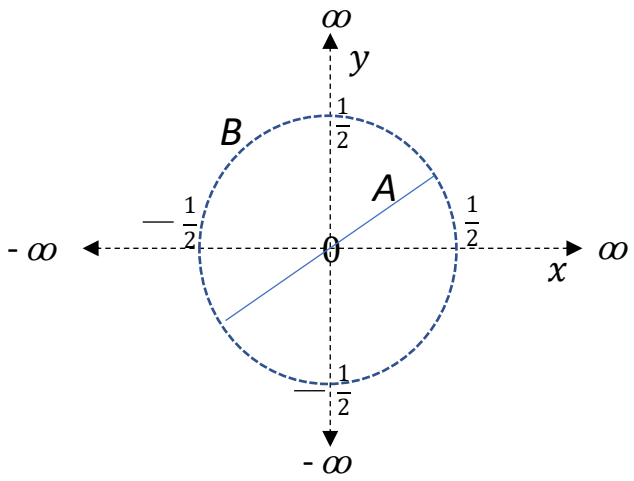

Figure 1: here, A is a straight line of length "1" in any infinite region of 2d space effected by the axes x and y around an arbitrarily reference point "0" such that from that "0" point the line extends a length of +½ and – ½ from that "0" reference. "B" is the value of π as the arc around the central point "0" radius ½.

Here the blue dotted line "B" is the value "π". Yet what indeed is the value "π"? Can it be represented as a whole number, a fraction even? One thing that is certain is that the circle never gets to "0", never breaches the "0" point.

Therefore, as an arbitrary condition of definition here, let it be suggested that in regard to space for the circle, $\frac{1}{\infty}$ represents that "non-0" concept for the circle in that the circle as a type of curved line in not skewing "0" would somehow constantly "approach" zero from a $\frac{1}{2}$ (radius) reference, never meeting it though, as per equation 1.

$$\frac{1}{\infty} \sim 0 \qquad (1.)$$

In other words, the "reference" of the blue line "A" represents a unit vale per anywhere in ∞ "as" what would trace a "circle" ***if*** "0" is not being used as the reference for that line. It is just a statement that dispels the notion of "0" and replaces it with the idea of $\frac{1}{\infty}$ for the idea of the circle. Yet how can ∞ be defined to give substance to this reference for the circle?

Let it now be suggested that to define this circle one must use an increasing denominator value **<u>from the reference of line A</u>** as a fraction central to "0", in approaching "0" from a $+\frac{1}{2}$ and $-\frac{1}{2}$ value in order to define the "0" reference; more correctly, in *approaching* the "0" reference, the length of the circle as an exact number would represent a number not expressed by a perfect ***single*** fraction given ∞ can never be defined, yet a series of fractions that would employ the use

of a denominator of the fraction ***extending*** to ∞ through a process of subtraction and addition ***around*** a "0" reference (as technically "0" is being approached, yet never reached, as what the "circle" wold best represent relevant to this line "A"), as per equation 2:

$$\pi = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} \ldots etc \qquad (2.)$$

The problem there though is that any fraction as a factor of $\frac{1}{2}$ cannot be used, as $\frac{1}{2}$ is integral to the length of each axis for line A (relevant to "0") "***of the line***" being used, **and therefore "unique" numbers NOT integral to $\frac{1}{2}$ thus must be used**. Therefore, the process would become as equation 3:

$$\pi = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} \ldots etc \qquad (3.)$$

Why is subtraction and addition used in this manner? The point here is being central to while approaching the "0" reference, and thus what must be a negative and positive scale around the "0" reference, the first step clearly being a negative step from the basic "1" line reference (diameter of the circle), the step following that a positive step, the step after that a negative step, and so on and so forth. In short, the idea of "0" is best explained central to $\frac{1}{\infty}$ by this definition ***for the circle***.

Thus, we start with 1 as the overall length of the line, and then seek to determine how to define the circle as a concept that would "approach" a "0" reference therewith, to create a process of balancing subtraction and addition central to this "0" reference of an overall "1" line, one $+\frac{1}{2}$ length to the $-\frac{1}{2}$ length meeting at a "0" point, from $-\frac{1}{2}$ to $+\frac{1}{2}$. Once again note that any factor of $\frac{1}{2}$ from 1 to ω cannot be used in this sequence owing to $\frac{1}{2}$ already representing the scale of each axis in use for line A, as a unique scale is needed "***from***" that $\frac{1}{2}$ scale all the way to ∞ ***<u>for the circle</u>***.

Yet the next question is***, what value, what fraction, of π is being calculated through this process?*** Is "π" being calculated whole or a fraction of "π? The value of π being calculated can only be a factor of the axes being used, and here this is as a progression based on one positive axis of length $\frac{1}{2}$ and one negative axis of length $\frac{1}{2}$, and thus a factor of $\left(\frac{1}{2}\right)^2$. Thus, equation 3 must become as equation 4:

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} \ldots etc \qquad (4.)$$

Note also that ω is a concept that would exist by default as a very large number, and thus for the most accurate value for $\frac{\pi}{4}$ to be reached this series of fractions must extent to include

a denominator approaching ∞, in successfully demonstrating the reference for the circle of $\frac{1}{\infty}$; simply, $\frac{\pi}{4}$ is the value reached that joins the ends of each axis from "0" to a value of $\frac{1}{2}$ as the radius around "0", as it only can be, as this is not a direct calculation of the ends of the axes together, yet the value held in the context of ∞. The next real question is, "what is the implication of this curve?". Is it a feature of space or a feature of time? The thinking is that if space has already been measured as the straight-line axes incorporating line "A", space as the "0" construct anywhere and everywhere, then the value of the curve ($\boldsymbol{\pi}$) in the context of ∞ would be relevant to that other fundamental feature of reality, "time", which shall be discussed shortly.

Nonetheless, this equation is an actual confirmed equation for π, as reached through different axioms of definition as per the work of Gottfried Wilhelm Leibniz [16] and Madhava of Sangamagrama [17]. Here though, π has been reached by this equation in the context of defining the hypothetical concepts of "0" and ∞ using straight lines and a circle for 2d space, which can then be applied to a 3d grid of space. Note that this is not a process of rounding something off using an infinite progression, this is quite the opposite, this is accepting the nature of what is being defined and why it is being defined in such a manner. The question though is, "how can this algorithm as space represent a function of time?". It's fine to define this concept of space as π, yet what about defining π using a function of time? That has been the quest in paper 1-14 [1-14] using the φ-algorithm for time, and to demonstrate its worth by deriving known feature of time and space.

In short, if space is associated to"0", time is associated to the value of a circle, to π, the emphasis of the preceding papers [1-14]. This is why it was considered very intuitive to use this idea for the wave-function of light in this series of papers [1-14], namely time as the wave-function seeking to define "π". The implication here is that if 3d-0 space can be determined with lines exactly, as an ideal scenario, then light cannot and should not be exactly determinable other than seeking to define π.

2.4 WORDING A MATHEMATICAL AXIOM FOR TIME

Here the idea of time is given the quality of not just our conscious ability (time-before, time-now, and time-after) as described per paper 1 ([1]: p1-6) (the φ-algorithm for time), yet a property of an axis associated to space, as an analogue of a sinusoidal wave in space along an axis whose aim is to properly "define" π, as per paper 2 ([2]: p4-12). The quest of that paper and subsequent papers was to determine how that function for time, that wave-function, would represent what would be "perceived" of reality. And so each paper built upon that basic wave-function for time in space, driving the basic features of such an association of time with space, time "as" the consciousness-related algorithm of time in space, as per what would be the most logical thing to perceive of reality using that concept of time, that golden ratio signature of time, based on the basic conscious notions we have for time, namely time-before, time-now, and time-after. That theory then led to where we are now, using those 14 papers [1-14] to then take a

general and complete look at what has been achieved and perhaps why the scientific community has yet to cotton-on with such a theory.

The general criticism of contemporary physics in light of the φ-algorithm for time is contemporary physics' use of inertia as a concept of cause and effect as opposed to the natural cause and effect flow of time of time-before to time-after via time-now, and how such a concept has limited contemporary physics theory, preventing contemporary physics theory from properly understanding the nature of light in "pure space" and why there is such a thing as the redshift of light [13], and how a correct understanding of light in space through a correct understanding of the axiom of time and space can solve the cosmological constant problem [14]. Yet inertia is not the fundamental problem for contemporary physics. There is something more fundamental that seems to be the over-arching problem for contemporary physics theory, and that is how contemporary physics theory measures the concept of time. The only way to highlight this feature of how time is measured using inertia theory, the basis of Newton and Einstein's theories of mass in space with time, and how ineffective it is, is to make the necessary comparison to the φ-algorithm for time theory, that equation, with a few key highlights,

3. How time is currently measured

As indicated by the successful results of papers 1-14 [1-14], as summarized in paper 14 ([14]: p 29-30) by comparison to contemporary science, in not setting a suitable standard for the idea of "0" and ∞ and π as a notion of space, another process was used as per contemporary science, that being the exponential grid equations introduced by Euler. The force behind Euler's formula is equally interesting, for we should ask ourselves how the idea of using ∞ in an algorithm became sought after in physics. For Euler at the time, it was the mathematics of financial wealth, namely compound interest (superannuation), for e is the number linked to exponential growth, a key determinant in financial analysis. In mathematics, Euler's formula, or **Euler's identity**, named after its founder the Swiss mathematician Leonhard Euler, is as (equation 5):

$$e^{i\pi} + 1 = 0 \tag{5.}$$

where e is Euler's number [18], the base of natural logarithms, i is the imaginary unit, which by definition satisfies $i^2 = -1$, and π is the ratio of the circumference of a circle to its diameter.

Euler's formula is considered to be a standard of mathematical beauty in demonstrating the profound connection between the most fundamental numbers in mathematics in the way it does. Nonetheless, Euler's formula uses the idea of e and i as a limiting function with ∞, whereas the concept presented in this paper regarding time as the φ-algorithm uses the idea of 0-1-∞ and π as a primary definition for space which is then annexed with "φ" as a time-algorithm. Nonetheless, for an equation such as Euler's to be presented so simply and fundamentally, it certainly must represent a key concept for reality, for instance, space or time. It does, as a type of analogue for time. And such is indeed the case,

as the idea of time is measured objectively using Euler's formula regarding the concept of the time-constant [19]. Here, Euler's formula is used to explain the radioactive decay of particles, and does this with the radioactive decay of the Caesium atom [20] central to the idea of a "half-life" [21]. Yet, one may ask if time is in fact completely a process of radioactive decay? What are the general applications therefore of Euler's formula?

Half-life ($t_{1/2}$) [21], the key application of Euler's formula, is the time required for a nominated quantity to reduce itself to half of its initial nominated quantity value. It has applications in two key fields of study:

- **Physics**
  - Ernest Rutherford applied the principle of Euler's formula as the radioactive decay of an element, as a half-life, to study the age of rocks through measuring the decay period of radium to lead-206.
  - In nuclear physics half-life describes how quickly unstable atoms undergo radioactive decay (or conversely how long they survive, depending on the choice of view, half full or half empty); nuclear chain reactions as per a uranium nucleus undergoing fission produce multiple neutrons that each can be absorbed by adjacent uranium atoms, causing them also to undergo fission reactions, and thus a runaway exponential explosion.
  - Avalanche breakdown is the term given for a dielectric material whereby a free electron frees up additional electrons as it collides with atoms or molecules of the dielectric media after becoming sufficiently accelerated by an externally applied electrical field; the subsequent secondary electrons behave the same way as the initial free electron. The resulting exponential growth of electrons and ions may rapidly lead to complete dielectric breakdown of the material

- **Biology**:
  - Generally, half-life describes any type of exponential or non-exponential decay; the biological half-life of drugs and other chemicals in the human body is based on Euler's formula.
  - Converse to the idea of half-life is the idea of "doubling time", used to describe biological population growth.
    - Studies show that the population of microorganisms in a culture increases exponentially until an essential nutrient is exhausted, indicating a constant growth rate.
    - So too with the Human population; for instance, the population of the United States of America is exponentially increasing at an average rate of one and a half percent a year (1.5%), and thus the doubling time of the American population is approximately 50 years [22].

The initial utility of Euler's formula was in compound interest, yet as is apparent it has been applied to the idea of a "time-constant" [19] for radio-active decay as the value of the time it takes for decay to reach $\frac{1}{e}$, which technically bases the value of "time" as a type of compound percentage value, when in fact the concept of time can be something else entirely. How did this happen? It was considered that the idea of half-life is a "constant" over the lifetime of an exponentially decaying quantity, that radio-active decay is constant as an accumulative measure of any such quantity.

Such is the contemporary understanding for time as an objective measurement of such processes that can be relied upon as a standard (as per the radioactive decay of the Caesium atom [20]), time that uses that process of "decay", decay of a quantity of an atom no longer being a part of the process of time. Time though when locked in with space according to the φ-algorithm has a different function as highlighted in papers 1-14 [1-14]; the issue with exponential growth and exponential decay is one of an atom that is undergoing a process of exponential growth or decay, radiation, that is no longer a part of the stabilized form of space and time, yet instead a part of the unhinged and unbound process of time and space, as highlighted in paper 14 ([14]: p26). Such processes would occur as a manner of disintegration, even exponential growth, as exponential growth incurs a resource-incursion that takes away from an otherwise time-correct steady state situation; exponential decay or growth are two sides of the one coin, as even in a situation of the growth of cellular material, there would be an accountable exponential loss of resources.

In short, as per paper 14 [14], it seems that in the process of time's flow as the φ-algorithm, there is an allowance for radioactive decay (as radioactive decay), and thus a distinct allowance for the idea of Euler's formula for time and the φ-algorithm for time as one ([14]: p26), held in the one general overall equation for time of the φ-algorithm. How can such be possible? The answer lies in the code itself, the presented function, of Euler's formula according to the φ-algorithm and their relationship to the phi-quantum wave-function spatial template.

Euler's formula on the surface is analogous to $t_B + t_N = t_A$ where $t_N = 1$ and $t_A = 0$ and $t_B = e^{i\pi}$, as per equation 6:

$$e^{i\pi}_{t_B} + 1_{t_N} = 0_{t_A} \tag{6.}$$

The idea of $t_A = 0$ is essential to understanding this is a time-equation for particle decay, or quite simply, a 0-future outcome of particles in regard to energy. The "e" component of time as t_B is simply represented to a power of π on a complex number plane, as π in a complex number plane.

This is the proposed hybrid time feature, namely $t_B + t_N = t_A$, and $e^{i\pi}_{t_B} + 1_{t_N} = 0_{t_A}$, and will be demonstrated to be essential to a basic understanding of the energy processes for time and space as *timespace*, to be proposed in a subsequent paper.

4. Conclusion

The purpose of this paper has been to present a case for why the φ-algorithm for time seeks to define "π", and how this happens, to address the assumption of 0-scalar 3d space in paper 1. Yet in doing so, interesting new conclusions become apparent regarding the current contemporary scientific measurement process of time, namely via an equation, Euler's formula [15], that primarily represents a process of "decay" (or growth, depending on the perspective of interest). In short, if space is associated to"0", time is associated to the value of a circle, to π, and both are proposed to be to the basic human perception ability which when reduced to three features of time as time-before to time-now to time-after brings to bear the φ-algorithm for time, which then brings to bear the phi-quantum wave-function for light seeking π, which then as a process of time in space manifests the theory for time and space and all associated processes such as electromagnetism, gravity, and mass, to make that work, as per papers 1-14 [1-14], as summarised in paper 14 ([14]: p29-30). The task ahead is to add further resolution of understanding to the energy components of these equations for time and space and thence a description for associated phenomena.

Conflicts of Interest

The author declares no conflicts of interest; this has been an entirely self-funded independent project.

References

1. Jarvis S. H. (2017), Gravity's Emergence from Electrodynamics, https://www.researchgate.net/publication/328738261_Gravity's_Emergence_from_Electrodynamics, https://vixra.org/abs/1704.0169
2. Jarvis S. H. (2017), Golden Ratio Axioms of Time and Space, https://www.researchgate.net/publication/328738109_Golden_Ratio_Axioms_of_Time_and_Space, https://vixra.org/abs/1706.0488
3. Jarvis S. H. (2017), The Emergence of Consciousness from Chaos, https://www.researchgate.net/publication/328738518_The_Emergence_of_Consciousness_from_Chaos, https://vixra.org/abs/1707.0044
4. Jarvis S. H. (2017), Phi-Quantum Wave function Crystal Dynamics, https://www.researchgate.net/publication/328738422_Phi-Quantum_Wave-Function_Crystal_Dynamics, https://vixra.org/abs/1707.0352
5. Jarvis S. H. (2017), Time as Energy, https://www.researchgate.net/publication/328738526_Time_as_Energy https://vixra.org/abs/1711.0419
6. Jarvis S. H. (2018), The Relativity of Time, https://www.researchgate.net/publication/328738389_The_Relativity_of_Time https://vixra.org/abs/1801.0083
7. Jarvis S. H. (2019), Golden Ratio Entropic Gravity: Gravitational Singularity Field Testing, https://www.researchgate.net/publication/332672475_Golden_Ratio_Entropic_Gravity_Gravitational_Singularity_Field_Testing, https://vixra.org/abs/1904.0485

8. Jarvis S. H. (2019), The Golden Ratio Time Algorithm, https://www.researchgate.net/publication/332879052_The_Golden_Ratio_Time_Algorithm, https://vixra.org/abs/1905.0081
9. Jarvis S. H. (2019), The Physics Chimera, https://www.researchgate.net/publication/333668324_The_Physics_Chimera, https://vixra.org/abs/1906.0127
10. Jarvis S. H. (2019), The Conception of Time, https://www.researchgate.net/publication/333972239_The_Conception_of_Time, https://vixra.org/abs/1906.0441
11. Jarvis S. H. (2019), Space, and the propagation of Light, https://www.researchgate.net/publication/335232726_Space_and_the_Propagation_of_Light https://vixra.org/abs/1908.0388
12. Jarvis S. H. (2019), Space, and the Nature of Gravity, https://www.researchgate.net/publication/336130560_Space_and_the_Nature_of_Gravity, https://vixra.org/abs/1909.0656
13. Jarvis S. H. (2019), Space, and the Redshift Effect, https://www.researchgate.net/publication/337019159_Space_and_the_Redshift_Effect, https://vixra.org/abs/1911.0064
14. Jarvis S. H. (2019), Solving The Cosmological Constant Problem, https://www.researchgate.net/publication/338159068_Solving_the_Cosmological_Constant_Problem, https://vixra.org/abs/1912.0451
15. Moskowitz, Martin A. (2002). A Course in Complex Analysis in One Variable. World Scientific Publishing Co. p. 7. ISBN 981-02-4780-X. Retrieved 13 January 2020.
16. Davis, Martin (28 February 2018). *The Universal Computer : The Road from Leibniz to Turing, Third Edition*. CRC Press. p. 7. ISBN 978-1-138-50208-6. Retrieved 13 January 2020.
17. T. Hayashi, T. Kusuba and M. Yano. 'The correction of the Madhava series for the circumference of a circle', *Centaurus* **33** (pages 149–174). 1990. Retrieved 13 January 2020.
18. Oxford English Dictionary, 2nd ed.: natural logarithm Retrieved 13 January 2020.
19. Bong Wie (1998). *Space vehicle dynamics and control*. American Institute of Aeronautics and Astronautics. p. 100. ISBN 978-1-56347-261-9. Retrieved 13 January 2020.
20. L. Essen, J.V.L. Parry (1955). "An Atomic Standard of Frequency and Time Interval: A Caesium Resonator". *Nature*. **176** (4476): 280. Bibcode:1955Natur.176..280E. doi:10.1038/176280a0 Retrieved 13 January 2020.
21. *Muller, Richard A. (April 12, 2010). Physics and Technology for Future Presidents. Princeton University Press. pp. 128–129. ISBN 9780691135045.* Retrieved 13 January 2020.
22. 2010 Census Data, "U.S. Census Bureau", 20 Dec 2012, Internet Archive: https://web.archive.org/web/20121220035511/http://2010.census.gov/2010census/data/index.php Retrieved 13 January 2020.