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Riemann hypothesis supports topological propulsion and faster-than-light travel through space-time

Abstract

Question – How does the Riemann Hypothesis Support Topological Propulsion and Faster-than-light Travel? Answer – a) Using the axiom that there indeed are infinitely many nontrivial zeros on the critical line (calculations have confirmed the hypothesis to be true to over 13 trillion places), the critical line is identified as the y-axis of Wick rotation (see the text accompanying Figure 6). This suggests the y-axis is literally infinite and that infinity equals zero. In this case, it is zero distance in time and space (again, see the text accompanying Figure 6). Travelling zero distance is done instantly and is therefore faster-than-light travel. b) Wick rotation is essential to this article's description of a topological (mathematical) universe and the Riemann hypothesis' identification with Wick means the hypothesis doesn't just apply to the distribution of prime numbers but also applies to the fundamental structure of the mathematical universe's space-time.

As an introduction to this idea, I'll provide background info from "Cosmos" magazine. Then I'll move on to ideas which, today, may seem as fictional as Zefram Cochrane's first warp-drive flight in 2063 (in the movie "Star Trek: First Contact"). But today's science fiction is sometimes a non-technical preview of tomorrow's science and technology. Three things are essential for the movement of both Cosmos' curved-space robot and the propulsion-less (by known means) spaceship – shape changing, friction, and gravity. Future computers will take care of the first condition when they transform parallelograms into topological shapes. Friction is accounted for by deletion of the 3rd dimension (possible because of holographic-universe theory) plus topology's single surfaces and self-intersections plus general relativity's refraction of light by gravity. And the third requirement is satisfied by general relativity's statement that gravity is the curvature of space-time. Topological propulsion also provides insights into travelling at significant fractions of – as well as faster than - light, the Higgs boson and field, electroweak interaction, dark matter, dark energy, other dimensions, space-time (eg the expanding-universe question and time travel), quantum mechanics, quantum computers, the Riemann hypothesis, and Unidentified Flying Objects.

Keywords: cosmos, holographic universe, Zefram cochrane, fuel, propulsion, friction, gravity, parallelogram, ellipse, Mobius strip, Mobius doublet, dimensions, topology, general relativity, curved space-time robot, rubber-sheet geometry, bits, binary digits, Mobius matrix, dark matter, dark energy, ufo, unidentified flying object, exhaust, g-force, unity of time, shapeshifting, wick rotation, quantum gravity and frames of reference, faster-than-light travel, time travel, Riemann hypothesis

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Introduction

As an introduction to this idea, I'll provide background info from "Cosmos" magazine.[1]

A robot engineered at Georgia Institute of Technology (Georgia Tech) has done the unthinkable and flouted a steadfast law of motion, suggesting that new laws need to be defined. Such new principles may have applications in new forms of locomotion without propellants. Newton's third law states that for every action there is an equal and opposite reaction. So, when a human takes a step, we push against the Earth and the Earth pushes back, propelling us forward. But this only works thanks to friction. The same is true of all locomotion. Rockets, for example, eject massive amounts of matter at high speed to push themselves in the opposite direction. But the Georgia Tech robot has bypassed this need for a thrust in order to change momentum. It does this by making use of curved space (Figure 1).

We let our shape-changing object move on the simplest curved space, a sphere, to systematically study the motion in curved space," says lead researcher Zeb Rocklin, assistant professor in the School of Physics at Georgia Tech. "We learned that the predicted effect, which was so counter-intuitive it was dismissed by some physicists, indeed occurred**:** as the robot changed its shape, it inched forward around the sphere in a way that could not be attributed to environmental interactions. The robot felt only slight forces due to friction and gravity, but the two effects were seen to hybridise with the curvature of the space itself to produce a strange dynamic with properties which could not have been produced by either friction or gravity on their own.

Figure 1 Experimental "curved space-time robot" moving on a sphere with actuated motors on a freely rotating boom arm. Credit: Georgia Tech.

While the observed effects due to curved space are small, the researchers believe that increasingly precise robotics will see these curvature-induced effects having practical applications. The principles

of how the curvature of space can be harnessed for locomotion may ultimately be useful in circumnavigating the highly curved space around black holes. Because space time is very slightly curved, a device could actually move forward without any external forces or emitting a propellant – a novel discovery. (End of background info from "Cosmos")

How might we progress to the practical application of circumnavigating the highly curved space around black holes, or of navigating the very slightly curved space in the solar system or between the stars?

The first step is vector-tensor-scalar geometry.

Quantum computers seem to use what I call vector-tensor-scalar geometry.[2] A vector is a quantity which possesses both magnitude and direction. Two such quantities acting on a point (represented by the red Scalar Higgs boson) may be represented by two adjoining sides of a parallelogram (e.g. CD and AD), so that the resultant diagonal^ (green line) also represents the vectors. The two sides and diagonal thus illustrate the graviton's spin 2 and the photon's spin 1. The resultant diagonal represents the interaction of the sides/vectors (1÷2 = the spin ½ of every matter particle). Tensor calculus changes the coordinates of the sides and diagonal into the coordinates of a single point (the scalar) on the diagonal. This scalar point is associated with particles of spin 0. If the mass produced previously happens to be 125 GeV/c^2, its union with spin 0 produces the Higgs boson - and relates the Higgs boson/field to the supposedly unrelated graviton/ gravitational field (together with the latter's constant interaction with the photon/electromagnetic field).

The resultant diagonal of those two sides can be pictured as a boat being driven in, say, the vertical direction across a river while simultaneously being pushed horizontally by the river's fast-flowing current. The parallelogram can be converted by computer into the shape of Earth's elliptical orbit, which means the vector/tensor/scalar relationship applies to this planet. One vector can be the magnitude and direction of the orbiting Earth itself. It and a second vector (Earth months later in its orbit – more about this at the paragraph's end) are represented by two sides of the parallelogram as well as by the resultant diagonal. Being represented by the diagonal, Earth is naturally also represented by the diagonal's central scalar point. Successful conversion of the parallelogram to an ellipse, followed by tensor analysis, means our planet is also a scalar object. This is equivalent to reducing the innumerable spins of particles composing the planet to spin 0. Such particles have no restriction on the number of them that occupy the same state. This state means Earth can possess magnitude occupying a literally infinite and eternal amount of space-time, thus having no need of direction and being capable of possessing the same state as any other material or immaterial body.

The idea of gravity reacting with electromagnetism to produce the mass of any particle (fermion or boson) is derived from two sources – a) 1915's General Relativity,[3] which modified Newtonian gravity**:** thus making it conceivable that gravity produces mass, instead of the currently accepted view that mass causes gravity, and b) Albert Einstein's 1919 follow-up paper "Do Gravitational Fields Play an Essential Role in the Structure of the Elementary Particles of Matter?" [4] which, when not directed towards explanation of atomic structure (its original intent), implies matter may be united with General Relativity's revised possibility of gravity producing mass. The works of 1915 and 1919 would then open the door to Einstein's Unified Field Theory and his dream of unifying everything.

Since they'd accommodate Earth's infinity, the material bodies would similarly do the equivalent of reducing the innumerable spins of particles composing them to spin 0 (they'd only possess magnitude and would be scalar, infinite bodies). Occupying all space-time, vector-1 Earth must be united with vector-2 Earth. The condition of everything being infinite, superposed and existing everywhere/every when in space-time completely removes the need for any kind of universal contraction or expansion (and removes any need for the Big Bang, Inflation, or cyclic cosmology's oscillations between Big Bangs and Big Crunches). Such a unified field sounds very strange because every object and event anywhere in space or time would be entangled with and capable of affecting any other object/event. However, it might add some common sense to quantum mechanics which has been repeatedly verified by experiment but makes no sense at all if we cling to the notion of finite, separate objects and events. The bits or binary digits used in traditional computers have one of two values (on/off, or 1 and 0). The qubits of quantum computers possess both values at the same time because any object is infinite and eternal (∞/∞t), merely appearing spatially and temporally finite. Since a quantum computer is ∞/∞t in actuality, it can use 1 and 0 simultaneously (a traditional computer, though ∞/∞t, is built and programmed to function in a more limited manner). How can any object be infinite yet appear finite? The finiteness corresponds to the scalar Higgs boson. This particle is actually an excitation of the Higgs field, which is depicted here as combination of the gravitational and electromagnetic fields. The Higgs field is a field of energy that is thought to exist in every region of the universe,[5] and could therefore be ∞/∞t.

Conversion of Figure 2's parallelogram to Figure 3's ellipse demonstrates that computers can also morph the shape-changing parallelogram into the shape of figure-8 Klein bottles (shapes in mathematical topology – aka "rubber-sheet geometry" – that are each a union of two Mobius strips). Immersed in the 3rd dimension, figure-8 Klein bottles possess self-intersections and self-interference (a photograph of a stapler is a 2-dimensional immersion of a 3-dimensional stapler). Perpendicular motion of photons and gravitons (e.g. along adjoining sides in Figure 2) creates a pressure we identify as the solidity of mass and matter. The holographic-universe theory says the 3rd dimension is merely a projection of information from the second dimension (in this case, from the 2D Mobius strip).[6] If the 3rd dimension (the depth or height) of Figure 2's parallelogram is deleted, the photons and gravitons can no longer travel on adjoining sides but must move along parallel sides. Should the photons and gravitons go in opposite directions (along sides that are now in contact and form the Mobius strip's one surface), they'd produce resistance to each other's motion * i.e. they'd produce friction.

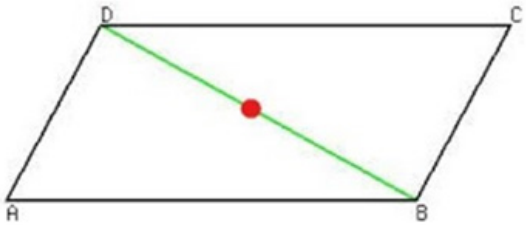

Figure 2 Parallelogram with diagonal and central scalar point. (See text below – the momentum of photons and gravitons produces a pressure we identify as the solidity of mass and matter)

General relativity says a light ray sent from a star and passing by the Sun is deflected 1.75 arc seconds from its original path by the Sun's gravity. Also, Isaac Newton knew of gravitation's effect on light more than 300 years ago. Like the "lock and key" mechanism in biological organisms of molecules engaging with cells' receptors,

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gravity may deflect light because the latter's photons are a key fitting into the former's graviton-locks. This makes sense if trillions of Mobius strips make up a photon, and trillions of figure-8 Klein bottles make a graviton. Photons and gravitons fit together because Mobius strips and figure-8 Klein bottles fit together – as noted above, the second topological shape is called a Mobius Doublet since it's a joining of two strips.

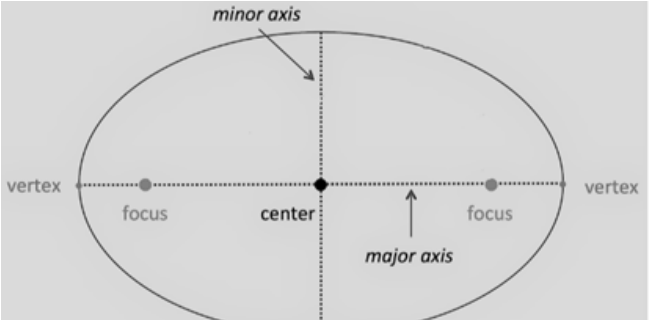

Figure 3 Ellipse: earth's orbit around the sun is elliptical.

Three things are essential for the movement of both the curved-space robot and the propulsion-less spaceship – shape changing, friction, and gravity. Future computers will take care of the first condition when they transform parallelograms into topological shapes. Friction is accounted for by deletion of the 3rd dimension (possible because of holographic-universe theory) plus topology's single surfaces and self-intersections. And the third requirement is satisfied by general relativity's statement that gravity is the curvature of space-time.

Computers can only physically alter reality – eg by constructing a spaceship that doesn't require propulsion - if that reality is composed of electronic BITS (Binary digits). Assuming the Mobius is indeed a fundamental constituent of reality, how does it originate? Anybody can go on the Internet and look at an image of the Mobius strip. The Mobius, in both our hypothetical reality and as an online image, is two dimensional and can obviously be programmed/coded/drawn by computer. This means it's composed of BITS (the binary digits of 1 and 0, which can represent electrical pulses being "on" or "off"). Then two strips combine into a figure-8 Klein bottle which is immersed in the 3rd dimension (Wick rotation^ is built into the strips and bottles to produce the 4th dimension of time). And trillions of strips and bottles respectively form electromagnetism's photons and gravity's gravitons. These interact via vector-tensor-scalar geometry to produce all massive particles - matter, antimatter, the bosons of the Higgs field and of the strong and weak nuclear forces. They might even interact further (via the "Mobius Matrix") to form other large-scale dimensions where Dark Matter and Dark Energy could reside and interact with our familiar dimensions via quantum gravity.

The physicist and science historian Abraham Pais wrote that "In 1924 the scientist Wolfgang Pauli was the first to propose a doubling of electron states due to a two-valued non-classical "hidden rotation".[7] Extending the ideas of "doubling", "two-valued" and "hidden rotation" from the quantum spin Pauli had in mind to the Mobius strip being a basic, fundamental unit of reality**;** it can be seen that Pauli's proposal has an analogy to this article. The doubled Mobius strips (doubled to form a figure-8 Klein bottle) could be produced by the two-valued binary-digit system used in electronics. The bottles possess a hidden rotation, now identified as adaptive Wick rotation, which gives a fourth dimension to space-time.

The Mobius strip is a closed surface with no distinction between inside and outside. Thanks to quantum mechanics' entanglement applying on macroscopic scales,* this doesn't refer only to the surface itself. This results in the space-time of our universe existing everywhere and every when. The inside and outside of the universe's energy and mass are continuous when it's composed of Mobius strips and figure-8 Klein bottles acting macroscopically - there cannot be other universes outside our infinite and eternal universe, and there's no universe with different laws of physics (such a state of supposed multiple universes is called the multiverse) (Figure 4).

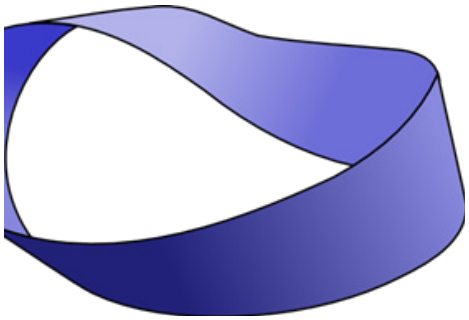

Figure 4 The Mobius strip.

(**Source:**http://www.clker.com/cliparts/3/7/a/9/12205465347817139511ummie_Mobius_Strip.svg.hi.png)

"Physicists now believe that entanglement between particles exists everywhere, all the time, and have recently found shocking evidence that it affects the wider, 'macroscopic' world that we inhabit."[8] Though the effect is measured for distances in space, the inseparability of space and time means that moments of time can become entangled too (Figure 5).[9]

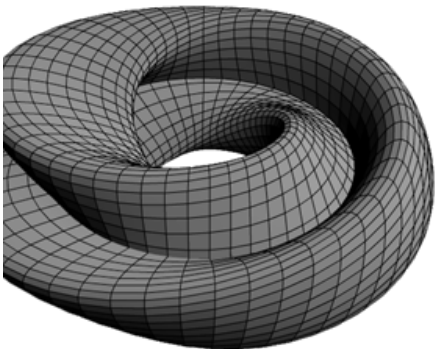

Figure 5 Mobius doublet. (FIGURE-8 KLEIN BOTTLE)

(**Source:**https://upload.wikimedia.org/wikipedia/commons/7/73/KleinBottleFigure8-01.png)

Note that the positive curvature fits together with the negative curvature to produce the outline of a doughnut which is technically flat (see the reference to Vanessa Janek.[10] When many doublets are placed together, binary digits can fill in any gaps or voids in the same way that computers can morph a picture on a screen and extrapolate a small patch of blue sky to make a sky that's blue from horizon to horizon. Morphing by bits can also delete a single doublet's central "hole". But the doublet doesn't become multiply connected like the doughnut. Merely the doughnut's outline is adopted – the doublet retains the property of being simply connected, a property necessary for space-time's infinity. (Informally, if an object in space consists of one piece - the constituent two Mobius strips now have the outline of one doughnut - and no longer has any "holes" that pass all the way through it, it is called simply-connected. A flat universe that is also simply connected implies an infinite universe.[11]

"The complex plane reveals i's special relationship with cycles via the circle of i, also known as Wick rotation. Whenever a point on the complex plane is multiplied by i, it moves a quarter rotation around the origin or center of the plane." [Figure and quote from[12]] The Riemann hypothesis, proposed in 1859 by the German mathematician Georg Friedrich Bernhard Riemann, is fascinating. It seems to fit these ideas on various subjects in physics very well. The Riemann hypothesis doesn't just apply to the distribution of prime numbers but can also apply to the fundamental structure of the mathematical universe's space-time. In mapping the distribution of prime numbers, the Riemann hypothesis is concerned with the locations of "nontrivial zeros" on the "critical line", and says these zeros must lie on the vertical line of the complex number plane i.e. on the y-axis in Figure 6. Besides having a real part, zeros in the critical line (the y-axis) have an imaginary part. This is reflected in the real +1 and -1 of the x-axis in Figure 6, as well as by the imaginary $+i$ and $-i$ of the y-axis. In the upper half-plane of Fig. 6, a quarter rotation plus a quarter rotation equals a half – both quadrants begin with positive values and ¼ + ¼ = ½. (The Riemann hypothesis states that the real part of every nontrivial zero must be 1/2.) While in the lower half-plane, both quadrants begin with negative numbers and a quarter rotation plus a negative quarter rotation equals zero**:** 1/4 + (-1/4) = 0. In the Riemann zeta function, there are infinitely many zeros on the critical line. This suggests the y-axis is literally infinite. To truly be infinite, the gravitational and electromagnetic waves it represents cannot be restricted to the up-down direction but must include all directions. That means it would include the horizontal direction and interact with the x-axis – with the waves rotating to produce ordinary mass (and wave-particle duality) in the x-axis' space-time,* and dark matter in the y-axis' imaginary space-time.

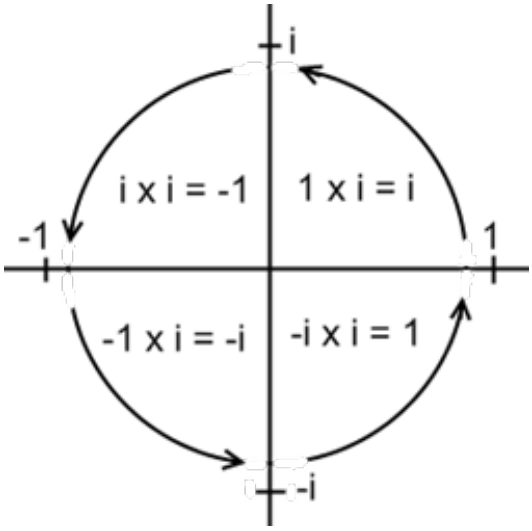

Figure 6 Wick rotation.

The inverse-square law states that the force between two particles becomes infinite if the distance by which they're separated goes to zero. Remembering that gravitation partly depends on the distance between the centres of objects, the separation only goes to zero when those centres occupy identical space-time coordinates (not merely when the objects' sides are touching). That is – infinity equals the total elimination of distance, or zero. The infinite, eternal cosmos could possess this absence of distance in space and time (deletion of the 3rd dimension) via the electronic mechanism of binary digits which would make the universe as malleable and flexible as any image on a computer screen. If infinity is the total deletion of distance in space-time, there is nothing to rule out instant intergalactic travel or time travel to the past and future. Infinity does not equal nothing – nor does zero. Zero would be something if it's paired with one to form the binary digits used in computers and electronics. Could the universe, and life, have begun with all the brains of past and future history acquiring increasingly sophisticated knowledge of time and space? Then an extra-dimensional hyperspace might be used to access the infinite past and purposely switch the digits composing the universe from 1 to 0 or vice versa (this switching would be comparable to the quantum fluctuations associated with Big Bang theory). Renormalization is a mathematical procedure for cancelling infinities. At present, it's regarded as a prerequisite for a useful theory and is part of attempts to unite general relativity with quantum mechanics. But if the Big Bang never happened, we'd be living in an infinite and eternal cosmos. Removing infinities mathematically (or by any other means) would be an error and retaining the infinite values would point the way to deeper understanding of the universe (Figure 7).

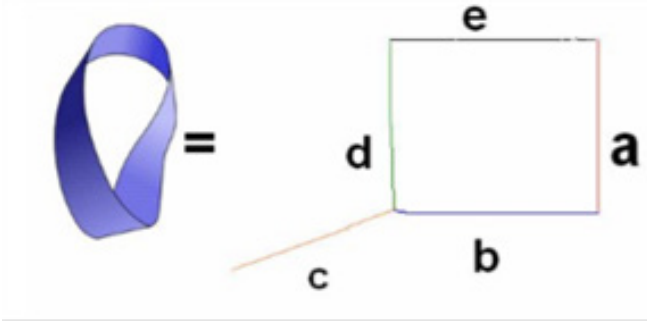

Figure 7 Mobius matrix. (Mobius equals a, b, c, d, e array).

"Mobius Matrix and Extra Dimensions" paragraph

Width a is perpendicular to the length (b or e) which is perpendicular to height c. How can a line be drawn perpendicular to c without retracing b's path? By positioning it at d, which is then parallel to (or, it could be said, at 180 degrees to) a. d is already at 90 degrees to length b and height c. d has to be at right angles to length, width and height simultaneously if it's going to include the Complex Plane's vertical "imaginary" axis in space-time (the "imaginary" realm is at a right angle to the 4 known dimensions of space-time, which all reside on the horizontal real plane). In other words, d has to also be perpendicular to (not parallel to) a. This is accomplished by a twist, like on the right side of the Mobius strip, existing in the particles of matter composing side a. In other words, a fundamental composition of matter is mathematics' topological Mobius, which can be depicted in space by binary digits creating a computer image. The twist needs to be exaggerated, with the upper right of the Mobius descending parallel to side "a" then turning perpendicular to it at approximately the level of the = sign, then resuming being parallel. Thus, 90+90 (the degrees between b & c added to the degrees between c & d) can equal 180, making a & d parallel. But 90+90 can also equal 90, making a & d perpendicular. (Saying 90+90=90 sounds ridiculous, but it has similarities to the Matrix [of mathematics, not the action-science fiction movie] in which X multiplied by Y does not always equal Y times X. The first 90 plus the second 90 does not always equal the second 90 plus the first 90 because 90+90 can equal either 180 or 90).

"Mobius Matrix and Dark Matter/Dark Energy" paragraph

Quaternions were first described by Irish mathematician William Rowan Hamilton in 1843. Hamilton defined a quaternion as the quotient of two vectors.[13] In this case: the quotient of two vectors is 1/2, the division of the electromagnetic vector (photonic quantum

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spin of 1) by the gravitational vector (gravitonic quantum spin of 2). In other words, the term "diagonal" (like 1/2, the result of these 2 vectors interacting) in VTS Geometry can be replaced with the term "quaternion". And the counter clockwise rotation of the x- and y-axes in Wick Rotation - which represents rotation of gravitational and electromagnetic waves - can be viewed as either rotation into diagonal form or as a quaternion function. It can also be responsible for the gravitational/electromagnetic energies forming all mass in space-time or, as dark energy acting via Wick rotation, forming all mass in imaginary time - which, since time and space can never be separated, is linked to an imaginary space and can be illustrated by the imaginary number *i* and its Wick rotation (this imaginary mass is known as dark matter). And this concept of dark energy invalidates its role as the cause of an expanding universe … which could be static.

Doublet mode / Mobius mode / UFO

The 3rd dimension of astronauts and their equipment is naturally accommodated when the propulsion-less spaceship is in doublet mode (the mode of a figure-8 Klein bottle, which combines two Mobius strips into a structure mathematically immersed within the 3rd dimension). However, this mode means the ship needs propulsion and fuel since there's no friction. In Mobius mode, the 3rd dimension is eliminated and the photons/gravitons comprising both organic and inorganic matter move in opposite directions ^ on the Mobius strip's single surface. Thus, friction exists and the ship doesn't need any propulsive mechanism. And the passengers/materials inside the ship must undergo "dimensional engineering" that allows them to function in two dimensions.

If the theory of quantum gravity indeed unifies everything in the universe – everything in space and time – it's obvious that humans have a different frame of reference … for we see and understand things and events as separate and distinct. For a person seeking to comprehend the universe, two frames of reference need to be used – the human one of classical mechanics (it permits motion in opposite directions), plus the universe's unified or quantum-mechanical view. Perhaps some readers think this duality of references should have been mentioned at some earlier point. But this article seeks to approach the cosmic unity which means the concepts of earlier and later are less important than people think (less anthropocentric, too).

There have been reports of UFOs having no exhaust and experiencing g-forces (accelerations and decelerations) that are so high they could never be handled by the human body or present technology. If a ship flew without using fuel, it'd produce no exhaust. If it flew without using mechanical, electrical, or chemical – but only topological – propulsion, it wouldn't produce g-forces on its crew because gravity acting alone does not produce g-forces**:** they're a result of resistance to gravity by physical, tangible forces. This invites the question "Are Unidentified Flying Objects a result of future human technology dimly recognized by the ideas in this article?" Of course, a positive answer makes time travel necessary.

All mass is composed of gravitational and electromagnetic waves, according to vector-tensor-scalar (VTS) geometry inspired by the title of Einstein's 1919 paper "Do gravitational fields play an essential role in the structure of elementary particles?" Both types of waves possess retarded and advanced ** components which travel forwards and backwards in time, cancelling one another and entangling all masses. Wick rotation (time) is built into the Mobius strips and figure-8 Klein bottles composing electromagnetism's photons and gravitation's gravitons. Therefore, all time (the entire past and present and future) is united into one thing just as all space and all mass are united into one thing. (If time only passed rectilinearly - from past to present to future - the idea of waves travelling back in time would make no sense at all. But if time is curvilinear - with past, present, and future interconnected - time must be able to move from future to present to past.)

When we solve (19th-century Scottish physicist James Clerk) Maxwell's equations for light, we find not one but two solutions: a 'retarded' wave, which represents the standard motion of light from one point to another; but also an 'advanced' wave, where the light beam goes backward in time. Engineers have simply dismissed the advanced wave as a mathematical curiosity since the retarded waves so accurately predicted the behavior of radio, microwaves, TV, radar, and X-rays. But for physicists, the advanced wave has been a nagging problem for the past century."[14]

Stars and galaxies etc. send us retarded light which, through spectroscopy, gives an approximate measurement of how long that light has been travelling (the distance to the astronomical body). The light includes an advanced component that reaches back into the past, producing a measurement that significantly exceeds the real distance. The farther away a star or galaxy is, the more the advanced part of waves from it will reach into the past, giving us a greater inaccuracy regarding its true distance. This increase is analogous to redshift increasing with distance. We might call it readshift - retarded advanced shift. Readshift would explain the astronomical results which were interpreted as accelerating expansion of the universe. Surveyed supernovas would appear fainter, therefore apparently farther away than they truly are. Unless advanced waves are considered a possibility, the only rational way to move a supernova from its apparent, distant position to its true nearer location is to conclude the universe has expanded.

Conclusion

This article proposes that spaceships of the future will not need mechanical, electric, chemical, or other known forms of propulsion in all circumstances. They can be propelled topologically (using Mobius strips, figure-8 Klein bottles, and deletion of the 3rd dimension by means of the holographic-universe theory). This motion could progress to the practical application of circumnavigating the highly curved space around black holes, or of navigating the very slightly curved space in the solar system or between the stars. It could indeed lead to interstellar travel if it eliminates the 3rd dimension to the ship, making it and an astronaut's body limitlessly flatter than a sheet of graphene (which is a single layer of carbon atoms). They would then truly be 2 dimensional. That enormous deletion of mass would speed up the ship fantastically – this article suggests faster-than-light, and even instant, travel in space and time are possible. And the ship's basic operations depend on Mobius strips and Doublets. Particles of matter play a secondary role. When the strips and doublets are fashioned into photons and gravitons, the ship's capable of reaching significant fractions of the speed of electromagnetic and gravitational waves. Topological propulsion also provides insights into the Higgs boson and field, electroweak interaction, dark matter, dark energy, other dimensions, space-time, quantum mechanics, quantum computers, the Riemann hypothesis, and UFOs.

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None.

Conflict of interest

The Authors declares that there is no Conflict of interest.

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