Physical Meaning of Wick Rotation and Advanced Waves

By Rodney Bartlett

Abstract -

"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." ("Physics of the Impossible" by Michio Kaku - Penguin Books, 2009: pp. 276-277)

Advanced waves are usually discarded because they are thought to violate the causality principle: advanced waves could be detected before their emission. On one level, I can appreciate that reasoning. But ultimately, I think it's an error that should be replaced by Isaac Newton's idea of gravity and the modern idea of quantum mechanics' entanglement. After writing a paragraph about entanglement and Newtonian gravity, several paragraphs are devoted to the motion of electromagnetism and gravitation, plus absorption and re-radiation. These are followed by (1) advanced waves and the dating of, among other things, dinosaur fossils, (2) existing technology that, unknown to everyone, detects the presence of advanced waves, (3) advanced waves plus disease and ageing, (4) partially overcoming ageing with technology based on noise-cancelling

headphones, and (5) the role of Wick rotation and advanced waves in entanglement and evolution.

Just as advanced waves are usually discarded, very few physicists or mathematicians will venture to ascribe a physical meaning to imaginary numbers, which seem to have no correspondence with external reality. Here, it will be shown that imaginary time (which is described by such numbers) has two physical meanings - (1) it provides a way to unify space and time into one space-time, (2) it will allow construction of what may be called "imaginary computers".

Keywords

Wheeler-Feynman absorber theory; Transactional Interpretation of Quantum Mechanics; retarded waves; advanced waves; electromagnetism; gravitation; radioactive dating; noise-cancelling headphones; better health; longer life; nature of space and time; increasing Astronomical Unit; Pioneer anomaly; entanglement; evolution; imaginary computers; SUSY; supersymmetry

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ADVANCED WAVES AND DINOSAURS

Consider the Wheeler-Feynman absorber theory (also called the Wheeler–Feynman time-symmetric theory) (1) and the Transactional Interpretation of Quantum mechanics. (2) These speak of "retarded" electromagnetic waves going forward in time and "advanced" waves going backwards in time^ (time, being indissolubly joined to space, may be like the different points displayed during the playing of a DVD ie space is identified with matter and energy while time may be the built-in apparent motion of matter and energy). In 1925, mathematical physicist George Yuri Rainich showed that Albert Einstein's gravitational equations contained enough information about electromagnetism to allow James Clerk Maxwell's electromagnetism equations to be restated in terms of these gravitational fields. (3) So gravitation could also have retarded and advanced components. In a 1919 paper, Einstein proposed that a unified theory of the electromagnetic and gravitational fields could explain the structure of matter, as well as quantum effects. (4) This is supported by modern theories in which the role of the mass-bestowing Higgs field is played by various couplings eg of the graviton and photon. (5)

^ Advanced waves are usually discarded because they are thought to violate the causality principle: advanced waves could be detected before their emission. On one level, I can appreciate that reasoning. But ultimately, I think it's an error that should be replaced by Isaac Newton's idea of gravity and the modern idea of quantum mechanics' entanglement. 17th century scientist Isaac Newton's idea of gravity acting instantly across the universe could be explained by gravity's ability to travel back in time, and thereby reach a point billions of light years away not in billions of years, but in negative billions-of-years. That is; the negative/advanced component of a gravitational wave would already be at its destination as soon as it left its source, and its journey is apparently instant. Instantaneous effect over large

distances is known as quantum mechanics' entanglement and has been repeatedly verified experimentally. If the retarded (forwards) wave component travels in positive space, the advanced (backwards) component corresponds to an equal amount of negative distance. The forwards and backwards movement in time can potentially cancel to produce a quantum (and, since large objects are products of subatomic structure, macroscopic) entanglement that eliminates the need for the Big Bang's and Cosmic Inflation's solution that the universe is roughly the same everywhere on large scales because everything was once in contact in a tiny space.

If a stone is dropped into a pool of calm water, many circular waves soon cover the surface of the water, and the water appears to be moving outwards from where the stone was dropped in. Actually, the particles of water simply rise then fall – it's the wave motion that moves outward. Similarly, the particles (photons) of light and microwaves etc that apparently travel through space-time would have relatively little movement themselves. It's the disturbances from the sources of electromagnetism (shock waves of fluctuating amplitudes and frequencies) that travel. As Paul Camp, Ph.D. in theoretical physics, writes -

"A photon is a quantum of excitation of the electromagnetic field. That field fills all space and so do its quantum modes." (6)

This is consistent with energy being transferred from one place to another (as wave motion) without involving an actual transfer of particles (little or no movement of photons).

General Relativity says gravitation IS space-time ie the gravitational field also fills all space, so the seeming motion of gravitational waves could also be due to fluctuations of shock waves' amplitudes and wavelengths causing excitations called gravitons in the field. Since the excitations called gravitons and photons occupy all space-time, the shock waves and those excitations are "absorbed" at certain spots to form matter then "re-radiated". After absorption (whether in oceans, in space, or anywhere else), most of the gravitation - and, to a far lesser extent, electromagnetism - may be used in building and refreshing particles of matter and, plausibly, also the particles of the atoms' associated strong and weak nuclear forces. (This building and

refreshing by gravitons could explain why gravity is easily the weakest force in the universe – being 10^{36} times more powerful, a much smaller quantity of electromagnetism's photons are required to build up particles and that force wouldn't be substantially weakened.)

Thus, the atomic and subatomic particles would possess quantum mechanics' wave-particle duality: and the gravity that's re-radiated from stars, planets, interstellar and intergalactic gas and dust, etc would form a Gravity Wave Background, challenging the idea that Cosmic Inflation is necessary to generate gravitational waves. Though the graviton is very different from the photon in certain ways eg quantum spin, their constant interaction effectively produces a unified GEM (Gravitational-ElectroMagnetic) force. Then the waves emitted after absorption could also include all types of electromagnetic waves – including an infrared background whose heat output exceeds that of the stars alone, in addition to a microwave background. The latter challenges the idea that existence of the cosmic microwave background proves the universe began with the Big Bang.

If a star only received the input of gravitational waves from deep space entering it, there would be no limit to its potential growth. Since it also radiates mass-forming gravitational waves, there is a limit to the growth. More than 99% of the solar system’s mass / gravitational waves / gravity are associated with our star, so the gravitational push on Earth from its sphere may be slightly greater than the push from the waves originating in deep space. In the end, our planet’s orbit would be growing slowly larger. The distance between Sun and Earth is growing by approx. 15 centimetres per century according to (7). The two authors attribute this increase of the Astronomical Unit (AU – the average distance between Earth and the Sun) to dark energy. The increase may actually be gravitational. The waves from deep space are a possible unrecognized contributing factor to the Pioneer anomaly, where the Pioneer spacecraft near the solar system's edge are a few thousand kilometres closer to the Sun than predicted.

Putting everything in the ***first*** paragraph together - if a dinosaur died mere thousands of years ago, the advanced gravitational and electromagnetic

waves composing its particles would continue travelling back in time. By the time its surroundings, bones or fossilized remains were subjected to modern science's dating methods, those advanced waves might have gone so far back in time that the dating method says the dinosaur died 80 million years ago or more. Radioactive dating is thus a form of (advanced) gravitational-wave detection, just as LIGO - the Laser Interferometer Gravitational-wave Observatory (8) - picks up (retarded) gravitational waves. Technology based on the way noise-cancelling headphones work might provide a more accurate reading of when the dinosaur lived. The headphones increase the signal-to-noise ratio by incorporating a microphone that measures ambient sound (noise), generating a waveform that is the exact negative of the ambient sound, and mixing it with any audio signal the listener desires. (9)

Generating a waveform that's the exact opposite of the advanced waves emitted by the deceased dinosaur should, at least partially, neutralize the advanced waves. This would restrict measurement of the age of the dinosaur fossil to the retarded gravitational and electromagnetic waves which go forward in time and are associated with the amount of radioactive decay occurring between the animal's death in the past and measurement in the present. Advanced waves also cause living creatures to age faster than they would without those waves - by extending the creatures' reach into the past (this is the equivalent of having been alive for more years). Neutralizing the advanced waves should dramatically increase the health and lifespan of dinosaurs, humans and all other species if it doesn't adversely affect anatomy and physiology ie if the retarded waves alone are sufficient for normal structure and function.

CIRCLES, SPHERES, EVOLUTION AND DINOSAURS

If the animal died 10,000 years ago, why might advanced waves from it indicate 80 million years had passed while retarded waves say only 10,000 years have passed? The retarded and advanced waves journey along different paths in space-time (one goes forward, the other back). If retarded waves only go forward, they could be said to follow a circle's diameter directly

to the radio-dating on the opposite side while the backward path of advanced waves could be said to spread out in the circle's area, and to almost always be headed away from the dating. Since General Relativity says gravitation IS space-time ie the gravitational field fills all space-time, the advanced parts of the gravitational and electromagnetic fields responsible for a particular result of radioactive dating (in the example used here, the eighty million years of the dead dinosaur) is not limited to a particular animal but spans the whole of this positively curved (spherical) local region of space-time: on a global (cosmic) scale, space-time appears to be flat. (10) (more info in 11) The entities called advanced gravitational and electromagnetic waves naturally spread over the surface area and throughout the volume of any positively curved space-time. However, the three dimensions of that spherical space aren't suitable for the following calculations since we're only concerned with the path of the waves between the dinosaur and the dating method. The two dimensions of a circle are adequate. The single dimension of a circle's circumference would point in the right direction for results but would not convey enough information to produce even approximately accurate results. So we'll end up using the formula for the area of a circle, πr^2 (the gravitational and electromagnetic advanced waves spread over the circular area lying between the dinosaur's position and the radio-dater's location, which will be situated 180 degrees away for convenience).

πr^2, where r = 5,000 years (half the path of retarded waves to radio-dating, along the diameter of 10,000 years)

This equals 78,539,750 which is close enough to 80 million. If the dino died 14,000 years ago, today's dating methods would give an age for it in the vicinity of 153,937,910 years (πr^2, where r = 7 000 years and pi is valued at 3.14159). Applying this reasoning to Earth reduces its age from the current scientific estimate of 4.5 billion years (ref. 12) - which is based on the pathway of advanced waves - to 76,000 years (38,000 x 38,000 x 3.14159 = 4,536,455,960), which is based on the diameter and radii followed by retarded waves. But in the case of determining the age of the Earth, we cannot limit our concern to the path of the waves between it and the dating method because the dating takes place on, and is part of, the planet. It seems much more plausible that the 3 dimensions of that roughly spherical

body's volume must be used. Using the volume of a sphere (***4/3 π r^3***), the real age of Earth would be approx. two thousand years if today's measurements make it approx 4.2 billion years old (4/3 x 3.14159 x 1,000 x 1,000 x 1,000). Believing that Earth is only 2,000 years old is obviously puzzling! Instead of simply assuming this article is on the wrong track, let's try assuming something else needs to be taken into account.

What can it possibly mean to say the world is 2,000 years old and much younger than recorded history? Since the calculation resulting in this doesn't seem to be in error, anyone's first instinct is to say it reveals a flaw in basic reasoning and this article should be abandoned. That would be a dead-end, however. It seems better to conclude that the idea of a 2,000-year-old world hints at an unknown truth, and should be pursued in hopes of uncovering that truth. The hint can be related to the later section on Imaginary (in the sense of $i = \sqrt{-1}$) Computers. Then the apparently weird result appears to confirm a concept mentioned in the second paragraph - "The forwards and backwards movement in time - of retarded and advanced waves - can potentially cancel to produce a quantum (and, since large objects are products of subatomic structure, macroscopic) ***entanglement*** that eliminates the need for the Big Bang's and Cosmic Inflation's solution that the universe is roughly the same everywhere on large scales because everything was once in contact in a tiny space." As will be seen in "Wick Rotation and Imaginary Computers", this entanglement unites infinite age with zero age - including 4.5 billion years with 2,000 years - and means all times in the past and future coexist with the present, to form an eternal present.

Another consequence of the world being 2,000 (or 76,000) years old is that evolution wouldn't have time to produce the life on Earth today. That would take billions of years. Thinking about this brought to mind evolution's pluses (eg adaptations) and minuses (regarding origins). It brought me to the conclusion that – if evolution just can't do everything expected of it – we need a human, scientific, entirely natural explanation for God. I think everyone sincerely searching for truth owes a debt to astronomer Bob Berman's words in Astronomy magazine (http://www.astronomy.com/magazine/bob-berman/2017/12/intelligent-design) -

'I first want to acknowledge that many religious Astronomy letter-writers merely want to get to the bottom of the deep questions, just as we scientists do.' And in regard to attributing life's origin to either awesome intelligence or random chemical reactions, he says '(we) offer a single, unassailable, factually accurate conclusion: “We do not know.” '

In this spirit, I offer this article as a possible reconciliation between science and religion. My thoughts propose the human condition after death and before conception* is as a member of the Elohim - a name used for God in the Old Testament which, according to World Book Encyclopedia, means the PLURAL MAJESTY OF THE ONE GOD. This led to why some people call a natural process 'supernatural'. Maybe it's because of the applications in thousands of years of finding a theory of quantum gravity (union of quantum mechanics and Einstein's theory of gravity - general relativity). Like quantum mechanics and gravitation, those apps would include all space and all time, and would be as mysterious to us as our technology would be to the builders of Egypt's pyramids. Proposing the human condition after death and before conception is as a member of the Elohim means humans of the distant future must be capable of the creation attributed to God by many people through the centuries. In a science TV program ('Custom Universe – Finetuned For Us?', *Australian Broadcasting Corporation’s 'Catalyst'*, August 29 2013), Dr. Graham Phillips reported that "the physicist and writer Paul Davies thinks the universe is indeed fine-tuned for minds like ours. And who fine-tuned it? Not God but minds from the future, perhaps even our distant descendants, that have reached back through time ... and selected the very laws of physics that allow for the existence of minds in the first place. Sounds bizarre, but quantum physics actually allows that kind of thing."

*The development of the human brain would gradually erase all memory of "super-human" existence as a member of the Elohim. That superhuman life is like quantum mechanics and gravitation, and includes all space and all time **(it would definitely NOT be a "soul" or "spirit", which suggests it's limited to an individual body**). Therefore, memory of the life must persist to some extent during early childhood. However, we become immersed in being human and the brain we now possess becomes our sole source of

memories. All those Elohim recollections fade and usually completely disappear after a few years.

WICK ROTATION, BITS AND COSMIC TOPOLOGY

Mathematics has three types of numbers - real, imaginary and complex. Real numbers are exemplified by 0, the positive numbers used in counting and negative numbers. On a two dimensional "Complex Plane", 'Real Numbers' are on the horizontal plane and 'Imaginary Numbers such as $i=\sqrt{(-1)}$ are on the vertical plane. 'Complex Numbers' can be easily identified as a combination of 'Real Numbers' and 'Imaginary Numbers'.

From <https://www.differencebetween.com/difference-between-complex-numbers-and-vs-real-numbers/>

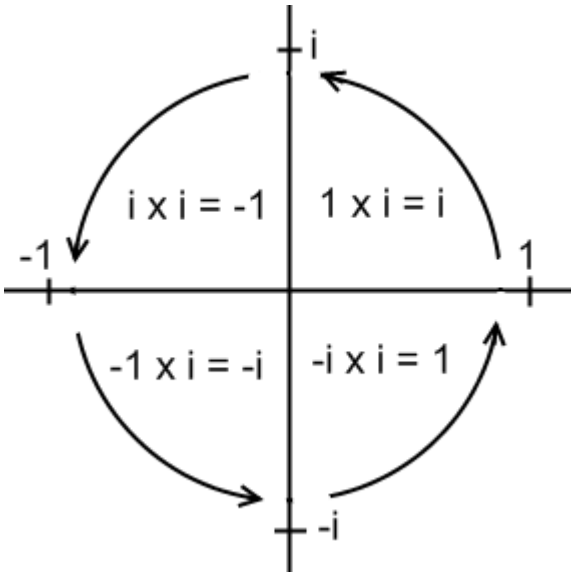
Retarded gravitational and electromagnetic waves that go forwards in the horizontal plane of space-time can be termed real. Advanced waves that go backwards in space-time may be considered complex. The imaginary numbers of the vertical direction could describe waves in an "imaginary" space-time.

Professor Itzhak Bars of the University of Southern California in Los Angeles says, 'one whole dimension of time and another of space have until now gone entirely unnoticed by us'. (Tom Siegfried, 'A Two-Time Universe? Physicist Explores How Second Dimension of Time Could Unify Physics Laws', May 15 2007 https://m.phys.org/news/2007-05-two-time-universe-physicist-explores-dimension.html) Could Prof. Bars' second dimension of space be imaginary (in the sense of $i = \sqrt{-1}$) space which is united with imaginary time the same way ordinary space and time are joined? And in the unification of a quantum gravity universe, the real and imaginary would be connected.

The ultraviolet catastrophe, also called the Rayleigh–Jeans catastrophe, is a failure of classical physics to predict observed phenomena: it can be shown that a blackbody - a hypothetical perfect absorber and radiator of energy - would release an infinite amount of energy, contradicting the principles of

conservation of energy and indicating that a new model for the behaviour of blackbodies was needed. At the start of the 20th century, physicist Max Planck derived the correct solution by making some strange (for the time) assumptions. In particular, Planck assumed that electromagnetic radiation can only be emitted or absorbed in discrete packets, called quanta. Albert Einstein postulated that Planck's quanta were real physical particles (what we now call photons), not just a mathematical fiction. From there, Einstein developed his explanation of the photoelectric effect (when quanta or photons of light shine on certain metals, electrons are released and can form an electric current). So it appears entirely possible that another supposed mathematical trickery (imaginary time) will find practical application in the future.

Real, retarded waves date Earth to 2,000 years old while complex, advanced waves date it to 4.5 billion years. Arriving at the true figure (for dinosaurs, too) also requires waves in so-called imaginary time to be considered. This consideration uses Wick rotation (named after Gian Carlo Wick [1909 – 1992], an Italian theoretical physicist).



"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."

(When the point i is multiplied by i, it moves to -1. When the point -1 is multiplied by i, it moves to -i. Then to the 1 position, and finally back to i.)

"Applying Wick rotation to make time imaginary introduces the element of cycling, as i multiplies by itself and moves around the complex plane. This suggests a cyclic, oscillating nature of time, as it moves between the real and imaginary realms."

Figure and quotes from

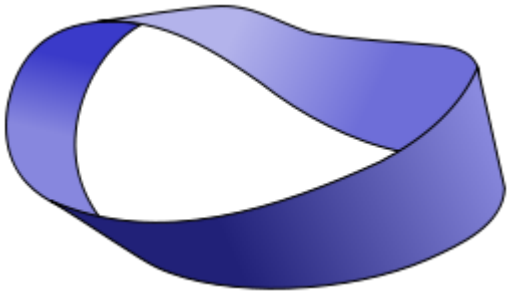
"The Meaning of Imaginary Time: Creativity's Dialog with Timelessness"

Posted on July 15, 2015 by Kerri Welch

<https://textureoftime.wordpress.com/2015/07/15/the-meaning-of-imaginary-time/>

Following Einstein's example of turning Planck's mathematical quanta into the physical photoelectric effect, mathematical Wick rotation appears to confirm physical dating revised by a circle's nature. The single dimension of a circumference used in Wick rotation doesn't give enough information – and 3 dimensions aren't suitable in radio-dating since many irrelevant pathways are included between the dating and the object being studied. Wick's transformation into physical radio-dating needs two dimensions and πr^2

Mobius Strip (source: http://www.clker.com/cliparts/3/7/a/9/12205465347817139 51lummie_Mobius_Strip.svg.hi.png)



There are four scientists I know of that support the idea of the universe being composed of information/mathematics:

a) In 1990, John Wheeler (1911-2008) suggested that information is fundamental to the physics of the universe. According to this "it from bit" doctrine, all things physical are information-theoretic in origin. (27)

b) Erik Verlinde says gravity is not a fundamental force of nature, but an emergent phenomenon. In the same way that temperature arises from the movement of microscopic particles, gravity emerges from the changes of fundamental bits of information, stored in the very structure of spacetime. (28)

c) Cosmologist Max Tegmark hypothesizes that mathematical formulas create reality. (29)

d) “Pioneered (in the late 1980's) by Rafael Sorkin, a physicist at the Perimeter Institute in Waterloo, Canada, the theory (causal sets) postulates that the building blocks of space-time are simple mathematical points that are connected by links, with each link pointing from past to future."(30)

"The quantum spin of a particle cannot be explained in terms of classical rotation since it can only have certain values that are equal to either a whole number or half a whole number multiplied by *Planck's constant* h divided by 2(pi) (a quantity called h-bar).(31) **It seems plausible that the particular values of spin could be determined by another set of particular values viz those in electronics' BInary digiTS, which always take the form of either 1 or 0.* If a subatomic particle of matter really does look like a Mobius strip, this - when combined with the previous sentence - is a clue as to how to make particles (of light and gravity, as well as matter).** First, the 1's and 0's are programmed to form the shape of a Mobius strip, which is merely two-dimensional (2-D).

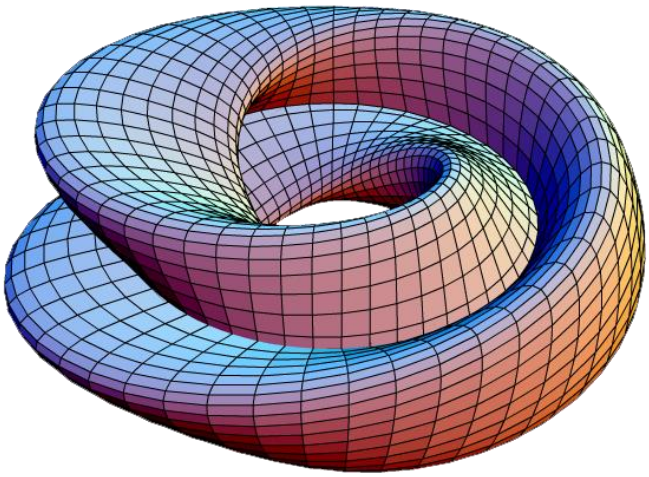
"In a holographic universe, all of the information in the universe is contained in 2D packages trillions of times smaller than an atom."(32)

("Holographic" could refer to the interference between gravitational and electromagnetic waves, while "2D packages trillions of times smaller than an atom" could refer to Mobius strips.)

***Technology of the far future will surely discover a way to, like the infinite digits of pi, cause electronic BITS to be infinite and fill the universe. Remembering that we live in space-time, not space alone, past times existing prior to that technology's development could be accessed via advanced gravitational and electromagnetic waves that the Transactional Interpretation of Quantum Mechanics delivers to the past. These waves could, if they constitute mass as well as spacetime (5) - and if the digital technology for producing and programming gravitons and photons is sufficiently advanced - give the cosmos Artificial Intelligence (AI) on chemical, subatomic, biological and astronomical levels. However, the true origin of life cannot be evolution and chemicals alone – it must be the brains producing AI.**

Then two strips must be joined to make a 4-D Klein bottle which has length, width, depth and the 4th dimension of movement in time. (33) The type of Klein bottle formed would appear to be the figure-8 Klein. A diagram of many figure-8 Klein bottles would show that their positive curvature (on the spherical parts) fits together with their negative curvature (on saddle-shaped parts) to cancel and produce the flat curvature of space-time ["The WMAP science team has nailed down the curvature of space to within 0.4% of 'flat' Euclidean."] (34) Like the pommel protruding from the front of a saddle, negative curvature can cause an "imaginary" space – and thanks to the indissoluble union of spatial plus temporal phenomena, "imaginary" time - to extend 90 degrees from the "surface" of real, flat space-time. When you have trillions of Mobius and figure-8 Klein elements assembled, an appropriate number of photons and gravitons must be included to give the mixture what we call mass.

Figure-8 Klein Bottle (source: https://upload.wikimedia.org/wikipedia/commons/7/73/KleinBottle-Figure8-01.png) Note that, when considering many bottles, the reddish positive curvature fits together with the bluish negative curvature to produce the flatness implying space-time's infinity/eternity.



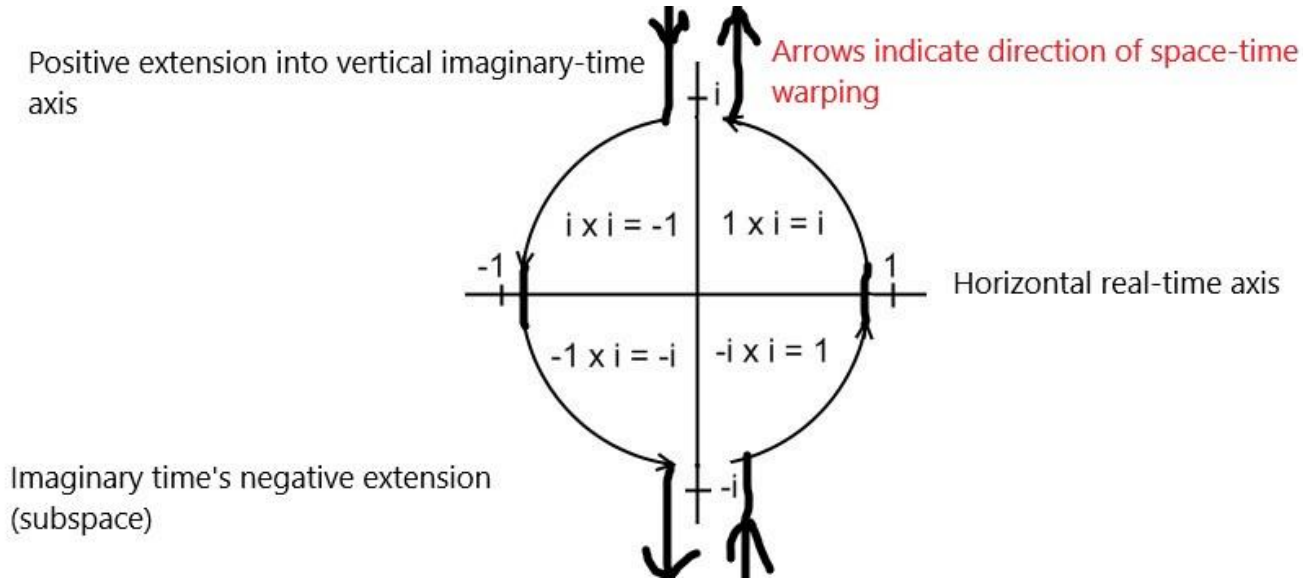
If an object in space consists of one piece and does not have any "holes" that pass all the way through it, it is called simply-connected. A doughnut (and the figure-8 Klein bottle it resembles) is “holey” and not simply connected (it’s multiply connected). "Some scientists believe that large warm and cool spots in the Cosmic Microwave Background could actually be evidence for this kind of ... (doughnut/figure-8 Klein bottle) ... topology". (36) A flat universe that is also simply connected implies an infinite universe. (37) So it seems the infinite universe cannot be composed of multiply-connected subunits called figure-8 Klein bottles. But figure-8 Klein bottles can be made into plausible subunits of a flat and infinite universe. Positive and negative curvatures on this type of Klein bottle can complement each other's shape, and digitized images can morph to perfect the complementarity if necessary (by binary digits filling in gaps and irregularities in the same way that computer drawings can extrapolate a small patch of blue sky to make a sky that's blue from horizon to horizon). This makes space-time relatively smooth and continuous - and gets rid of holes, making these types of Klein subunits feasible.

WICK ROTATION AND SPACE-TIME

(see the first paragraph where it says, "space is identified with matter and energy while time may be the built-in apparent motion of matter and energy").

Supersymmetry (SUSY) proposes a relationship between bosons and fermions. Some scientists believe supersymmetry is a failed theory. A new approach would be proposing that the Mobius strip is a fundamental constituent of both fermions and bosons - and therefore unites all particles (of matter and of energy) into one **space**. The inner and outer surfaces of a Mobius form one continual strip. Constant movement of these surfaces – as well as of the four-dimensional figure-8 Klein bottle, which is a union of two Mobius strips - is carried out by mathematical Wick rotation's continuous cycling between real and imaginary **time**. Therefore, the Mobius strip combined with Wick rotation and imaginary time provides a modern way to unite space and time (and imaginary time) into one **space-time**.

WICK ROTATION AND IMAGINARY COMPUTERS



The imaginary computer (IC) is, naturally, in horizontal real-time. However, its processing is warped into vertical imaginary-time (IT). The IT extensions could potentially go on for great distances. So the IC could perform voluminous processing without any ordinary, real time passing at all (the possibility of no time elapsing in the normal sense is hinted at by Special Relativity's time dilation or slowing of time). Periodically, the output of the processing is looped back to the computer on the horizontal plane. Using this technique, even one of today's digital machines could produce fantastic, unbelievable results in virtually no time. These warps and loops are viable because they're inspired by Einstein's Special Relativity – and they propose the use of space-time warping which, though in its infancy, is a technology being worked on today by places like NASA.

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