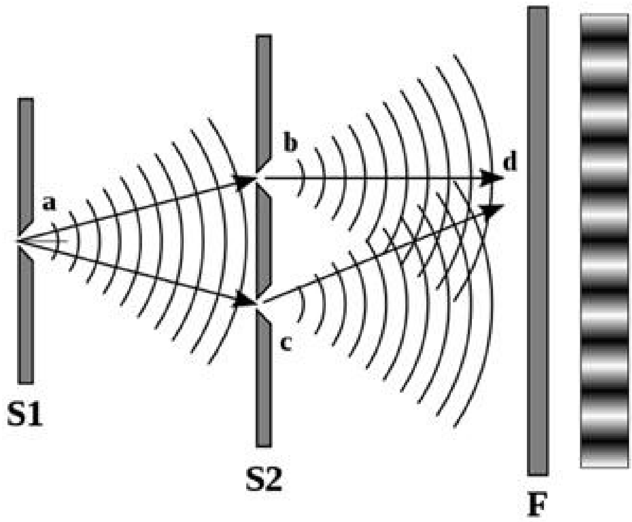
ISSN 1825-7968 2024: 31-45

Dual solution of energy or Collapse of the wave function?

Ulisse Di Corpo[1]

The double-slit experiment was devised by Thomas Young in the 18th century to show that light propagates as a wave. In the presentation of his results to the Royal Society of London on 24 November 1803, Young said: "*The experiment which I am about to give (...) may be repeated with great ease, whenever the sun shines.*" Young's experiment was very simple: a ray of light passes through a slit in a piece of cardboard (S1), then through two slits in a second piece of cardboard (S2), and then lands on a flat white surface. What is observed is an alternation of light and dark lines, which Young explained as the interference between light waves. White lines occur when the interference is constructive and the light waves add together, while dark lines occur when the interference is destructive, and the waves do not add together.



Thomas Young's Double Slit Experiment

Young's experiment was generally accepted as a demonstration that light propagates as waves. If light were made of particles, interference would not have occurred, but only two well-localized points of light would have been observed in association with the slits in the second cardboard. Instead, in the experiment the brightest line is found between the two slits, in what was expected to be a dark area. Young's experiment demonstrated the wave properties of light, until quantum mechanics showed the dual nature of matter: waves and particles at the same time.

[1] Ulisse Di Corpo: www.sintropia.it

- *The wave/particle duality*

In 1905, Einstein solved the paradox of the photoelectric effect by describing light as composed of particles, rather than waves. When light or electromagnetic radiation hits a metal, electrons are emitted, this is called the photoelectric effect. The electrons can be measured, and the measurements show that until a specific threshold is reached, the metal does not emit any electrons; above the threshold, electrons are emitted, and their energy remains constant; the energy of the electrons increases only if the frequency of the light is raised. The wave theory of light was unable to explain:

- Why the intensity of the light does not increase the energy of the electron emitted by the metal.
- Why frequency affects the energy of electrons.
- Why electrons are not emitted below the threshold.

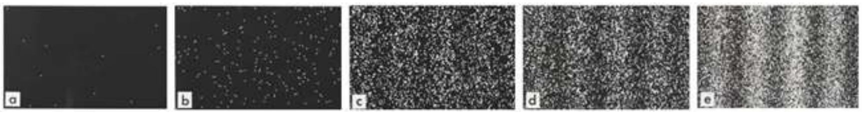
Einstein answered these questions by using Planck's constant and suggesting that light, previously thought of as an electromagnetic wave, was composed of packets of energy, particles now called photons. Einstein's interpretation of the photoelectric effect treated light as particles, rather than waves, paving the way for the wave/particle duality.

Experimental proof of Einstein's interpretation was given in 1915 by Robert Millikan who, ironically, spent 10 years trying to prove that Einstein's interpretation was wrong. In his experiments Millikan found that all alternative theories failed the experimental test, while only Einstein's was correct. Several years later Millikan commented:

> "*I spent ten years of my life testing Einstein's 1905 equation and contrary to all my expectations I was forced in 1915 to affirm its unequivocal experimental verification despite its unreasonableness since it violates everything we knew about the interference of light.*"

Young's experiment can now be performed using single electrons. Electrons used in a double-slit experiment produce an interference pattern and therefore behave like waves, but upon arrival they give rise to a point of light, behaving like particles.

Do electrons travel as waves and arrive as particles?



The double slit experiment with electrons:
a) 10 electrons; b) 100; c) 3,000; d) 20,000; e) 70,000 electrons.

If electrons were particles, we might conclude that they would go through one of the two slits. However, interference shows that they behave like waves that go through both slits at the same time. Quantum entities seem to be able to go through both slits at the same time and know how to contribute to the interference pattern. If matter were made only of particles, quantum entities would go through one slit at a time and no interference would be visible. If matter were made only of waves, the dots of electrons would not be visible on the screen, only the interference lines.

Richard Feynman[2], known for his contributions to the development of quantum electrodynamics, considered the dual nature of matter (wave/particle) as the central mystery of quantum mechanics:

> "*The double-slit experiment is a phenomenon that is impossible, absolutely impossible, to explain classically and which contains within itself the heart of quantum mechanics.*"[3]

- *Supercausality*

In 1924, Wolfgang Pauli, one of the pioneers of quantum mechanics, discovered that electrons have a spin, a momentum that can never be zero and that approaches the speed of light. Therefore, when combining quantum mechanics and relativity, it is necessary to use the extended energy-momentum-mass equation.

In 1925, physicists Oskar Klein and Walter Gordon formulated a probabilistic equation that could be used in quantum mechanics and was relativistic. The Klein-Gordon equation uses a square root and has two solutions. The positive-time solution describes waves that propagate from the past to the future (retarded waves), while the negative-time solution describes waves that propagate backward in time, from the future to the past (advanced waves).

Klein and Gordon explained the dual wave/particle nature of matter as a manifestation of the interaction between the positive-time solution (which manifests as particles) and the negative-time solution (which is probabilistic and manifests as waves). This interpretation was supported by the work that physicists did up to the 1930s and paved the way for a "supercausal" view of reality, where the present is the result of causes acting from the past and attractors acting from the future.

The transition to the supercausal view was considered unacceptable and in 1927 Werner Heisenberg and Niels Bohr (both fervent Nazis) were asked to formulate an interpretation that could explain the dual nature wave/particle in a mechanistic way. Heisenberg and Bohr met in Copenhagen and their interpretation is now known as the Copenhagen Interpretation of Quantum Mechanics. The Copenhagen interpretation explains the dual nature wave/particle in the following way: electrons leave the electron gun as particles that dissolve into probability waves in a superposition of states by passing through both slits and interfering to create a new superposition state. The screen, by making a measurement, forces the waves to collapse into particles, at a well-defined point on the screen.

Essential elements of the Copenhagen Interpretation are:

- The *uncertainty principle* formulated by Heisenberg, according to which for a quantum entity both position and velocity cannot be known at the same time.

---

[2] www.feynman.com
[3] Feynman R. (1949) *The Theory of Positrons*, Physical Review 76: 749.

- The *principle of complementarity* which states that a single quantum entity can behave as a particle or as a wave, but never simultaneously as both; that a greater manifestation of the nature as a particle leads to a lesser manifestation of the nature as a wave and vice versa.
- *Schrödinger's wave equation,* reinterpreted as the probability that the electron (or any other quantum entity) will be found in a specific place.
- *Superposition of states*, where all waves are superimposed until a measurement is made.
- The *collapse of the wave function* which is caused by observation and the act of measurement.

According to this interpretation, consciousness, through the exercise of observation, forces the wave to collapse into a particle, creating reality. In this way, Heisenberg and Bohr introduced the notion that consciousness is a prerequisite for reality. In other words, the existence of the electron in one of the two slits, independent of observation, has no meaning. Electrons only seem to exist when they are observed. Reality is therefore created by consciousness, by the act of observing.

- The double solution of the fundamental equations

In 1927 Klein and Gordon re-formulated their equation as a combination of Ψ, the Schrödinger wave equation (quantum mechanics), and the energy-momentum-mass equation of relativity:

$$\Psi E = \Psi \sqrt[2]{p^2 + m^2}$$

This equation uses a square root which always leads to two solutions: retarded waves and advanced waves.

In 1928, Paul Dirac, an English theoretical physicist who made fundamental contributions to the early development of quantum mechanics, attempted to eliminate the anticipated wave solution by applying the energy-momentum-mass equation to the study of relativistic electrons. He again found himself with a double solution: electrons (e^-) and neg-electrons (e^+, the electron's antiparticle). Dirac's equation predicts a universe made of matter propagating forward in time and antimatter propagating backward in time.

Dirac noted that: "*this difficulty was overcome by arbitrarily excluding those solutions that have negative energy. You cannot do this in the quantum world.*"[4]

Dirac named the electron's antiparticle neg-electron, and in 1932 it was observed experimentally by Carl Anderson, who renamed it the positron. Positrons are produced naturally in certain types of radioactive decay, and in 1934 the Swiss mathematician Ernst Stueckelberg, and later Richard Feynman, provided a formalism in which each line in a diagram represents a particle propagating both backwards and forwards in time. This formalism is now the most widely used method for calculating quantum fields, and because it was first developed by Ernst Stueckelberg, and acquired its modern form in the work of Feynman, it is called the Feynman-Stueckelberg interpretation of antiparticles.

---

[4] Dirac P.A.M. (1928) *The Quantum Theory of the Electron*, Proc. Royal Society, London 117:610-624; 118:351-361.

- *Ether?*

The 1928 Dirac equation is consistent with special relativity, is mathematically flawless, and can explain almost everything, since it is the relativistic generalization of the already widely applied Schrödinger wave equation. But, in addition to negative energy and retrocausality, it requires that every charge occurs in electron-positron pairs (called "epos"). Experiments have always verified the presence of epos and the fact that the vacuum between interacting particles is not empty.

Unfortunately, in 1928, this sea of epos resembled the ether. For decades, the ether war had raged in every physics department. And only in 1905 did Einstein manage to put an end to it, proving that the "luminiferous ether," the supposed carrier of light, was not observed in experiments and was therefore nonexistent. For Heisenberg, any reference to a universal substance that fills space sounded too much like the ether. He was therefore troubled by the Dirac's equation and states of unlimited negative energy.[5] Dirac tried to resolve the conflict with Heisenberg by suggesting that if all the negative states and none of the positive states were filled, the two energies could have no effect on each other. This hypothesis was called "zero-order subtraction," and was later used by Heisenberg to remove from the Dirac equation those parts that refer to negative energy.

Heisenberg was thus able to bypass the "sea" of negative energy states by replacing the operator that requires an unlimited number of epos with an operator that magically creates epos out of nothing. Since epos must be present, Heisenberg's operator creates them on the spot, and when they disappear, they are annihilated. By using zeroth-order subtraction, which forces all results to be positive, an ocean of negative energy no longer exists and there are no more negative-time solutions. In this way Heisenberg made the Dirac equation blind to the negative-energy solution.

The zero-point energy of the quantum vacuum is the lowest possible energy that a quantum system can have; it is the energy of its ground state. But experiments show fluctuations around this baseline, which are now called zero-point fluctuations. The Dirac equation explains these fluctuations as particles emerging from the sea of negative energy.

According to Heisenberg, every physical system has a zero-point energy higher than the minimum of its potential, and this translates into the creation of particles even at absolute zero.

The Heisenberg operator requires the creation of an unlimited number of epos without the contribution of energy. Furthermore, when particles are annihilated, the epos vanishes without a trace. This massive violation of the conservation of energy principle (first law of thermodynamics) did not bother Heisenberg who used the uncertainty principle to claim that epos is virtual rather than real. When epos are created they borrow virtual energy and when they annihilate, they return this virtual energy to the uncertainty principle. For Heisenberg virtual meant having any property we need. In this way the unlimited number of virtual epos could violate the conservation of energy law and relativity and offer an escape from the

[5] Heisenberg W. (1934), Zeitschr. f. Phys., 90, 209.

negative-time solution and thus save the mechanistic paradigm.

In 1934 science took this escape route:

> "*Science makes choices all the time. Once a choice is made, scientists tend to unify behind that choice to the point of denying and eventually forgetting that a choice has been made. Textbooks describe science as a march toward the path of truth. Since it is forgotten and denied that such choices have been made, these choices are rarely revised. Not only is there no provision, nor incentive, for such revision, there is pressure not to have it.*"[6]

Today, physicists ignore the negative-time solutions of the two most widely used and respected equations in modern physics: the energy-momentum-mass equation and the Dirac equation. Experiments confirm the validity of these two equations, but Heisenberg's objection was always the same: "*Negative energy is impossible, without any conceivable physical meaning.*" After nearly a century, this statement is generally accepted by physicists, even though the created electron has sixteen times more energy than the photon that creates it. Current theories say that this excess energy (in the form of angular momentum) is an intrinsic attribute of particles. Calling it an intrinsic attribute ends the discussion and provides a justification for a 1600% violation of the conservation principle.

For Heisenberg, putting physics into the business of creation, violating the law of conservation of energy, was more acceptable than the negative-time solution. It seems that in particle physics, conservation of energy is something to be respected when it agrees with the model, but to be thrown away when it turns out to be inconvenient.

Ignoring these massive violations of energy conservation, the idea that complex entities, such as electrons and positrons, can be created from nothing is now generally accepted. But energy does not provide the information needed to make these small and highly complex entities we call electrons and positrons.

Since 1934, physicists have rejected the negative-time solution of the fundamental equations, even though this puts science in the realm of creation, on a plane that rivals God and religion, and has given rise to interpretations such as New Age that violate the basic laws of causality and conservation of energy. Rejecting negative-time solutions is a denial of science itself. The question now is how far scientists will go to reject negative-time solutions.

Faced with a choice that involves a paradigm shift, scientists since Galileo have chosen what saves the old paradigm, even going against experimental evidence and proof. Einstein's energy-momentum-mass equation, Dirac's equation, and the Klein-Gordon equations require symmetry between positive and negative-time energy: forces that diverge and forces that converge.

The Dirac equation describes unlimited and symmetric amounts of negative and positive energy. As one approaches zero, negative energy becomes predominant. At very low temperatures, a Bose-Einstein condensate (BEC) forms. BECs act as single units rather than as a collection of molecules, allowing states in which negative energy (convergent and coherent) exceeds positive energy (dissipative and disordered).

---

[6] Hotson D. (2002), *Dirac's Equation and the Sea of Negative Energy – part 1*, Infinite Energy, 2002, 43: 1-20.

BECs arise from the supremacy of negative-time energy over positive-time energy. They are ordered energy systems, governed by a single wave function that is destroyed by positive-time energy.

Zero-point energy is not reached at 0 degrees Kelvin, but slightly above. This value differs for different substances, and some substances exhibit BEC properties at much higher temperatures. At zero point, instead of no energy at all, there is suddenly a flood of energy. This is real energy, with measurable effects. What BEC applications show is that the sea of negative energy required by the Dirac's equation must exist and becomes available at zero point. The Dirac equation suggests that we are surrounded by a huge Bose-Einstein condensate, which allows for non-local effects, effects that propagate instantaneously, regardless of their spatial separation. If an electron is inserted into a BEC it emerges on the other side instantaneously, traveling the distance faster than the speed of light, this is the phenomenon of superconductivity.

The theory of the electromagnetic ether was developed by Hendrik Lorentz (1853-1928) between 1892 and 1906, in collaboration with Poincaré, and was based on the theory of Augustin-Jean Fresnel, Maxwell's equations and the electronic theory of Rudolf Clausius. Lorentz introduced a strict separation between matter (electrons) and ether, where the ether is completely immobile. Lorentz died in 1928, when Dirac formulated his equation. Had he lived longer, he would certainly have recognized the theory of electromagnetic ether in the sea of negative energy. With his influence, he would probably have limited the devastating effects of Heisenberg's positions.

- *Non-locality*

In his second paper on "*The Dirac Equation and the Sea of Negative Energy*," Don Hotson states:

> "*The Dirac equation explains simply, intuitively and clearly the size of the nucleus, the mass of the nucleus, the very peculiar form of the strong nuclear force, the strong nuclear force and the strange fact that the proton and the electron have opposite charges of exactly the same strength. No other model explains these peculiarities.*"[7]

However, the rejection of negative-time energy has made the two theories on which all modern physics rests (relativity and quantum mechanics) incompatible, since when they are united a universe of energy emerges that flows backwards in time.

The Copenhagen interpretation assumes that the collapse of the wave function (the collapse of the wave into a particle) occurs at the same time at all points of the wave. This requires instantaneous propagation of information that violates the limit of the speed of light considered by Einstein to be the maximum limit in the propagation of information and causality. Einstein considered causality to be local and information could only propagate at speeds less than or equal to the speed of light, never faster.

Starting from these assumptions, Einstein rejected the idea that information about the collapse of the wave could travel faster than light and, in 1934, formulated these considerations in the EPR paradox.

[7] Hotson D. (2002), *Dirac's Equation and the Sea of Negative Energy – part 2*, Infinite Energy, 2002, 44: 1-24.

The EPR paradox (named after the initials of Einstein-Podolsky-Rosen) remained unanswered for more than 50 years.

EPR has been presented as a thought experiment, to demonstrate the absurdity of the Copenhagen interpretation, by raising a logical contradiction. According to Pauli's discovery that electrons have a spin, and that in an orbit only two electrons with opposite spins can fit (Pauli exclusion principle), the Copenhagen interpretation concludes that pairs of electrons that shared the same orbit, remain entangled. If in a pair of entangled particles one, regardless of the distance, starts to rotate in the opposite direction the other instantly changes its direction of rotation. This violates the limit of the speed of light in the propagation of information.

No one expected that the EPR experiment could be performed. But in 1952 David Bohm suggested replacing electrons with photons, and in 1964 John Bell showed that Bohm's change opened the way to the possibility of a real experiment.

At the time even Bell did not believe that the experiment could be performed, but 20 years later several groups had developed the required precision of measurements and in 1982 Alain Aspect published the results of an experiment that proved that Einstein was wrong, and that nonlocality was real.[8]

Aspect's experiment measured the polarization of photons. Atoms were forced to produce entangled photons, which went in opposite directions. Each photon in an entangled pair has opposite polarization.

The Copenhagen interpretation predicts that when a measurement is performed on one photon it instantly determines the state of the second photon. This is what Einstein called "*phantom action at a distance.*".

Aspect measured the polarization of photons at an angle that he could adjust. According to nonlocality, changing the angle at which the polarization of one photon is measured instantly changes the measurement made on the second correlated photon.

The experiment was performed on sets of pairs of entangled photons. Bell's theorem stated that if locality is true, polarization measurements made on photons moving through the first apparatus, which could be adjusted by changing the angle, should always be higher than measurements made on the second set of entangled photons (Bell's inequality theorem). Aspect obtained the opposite result by violating Bell's theorem and thus showing that non-locality is real. Einstein thus lost the competition with quantum mechanics. Aspect's experiment proved that instantaneous correlations are real and possible in nature.

In 1947 Oliver Costa de Beauregard, a French relativist and quantum physicist and philosopher of science, proposed to Louis de Broglie his interpretation of the EPR paradox that calls into question the notion of time. He suggested that Aspect's experiment can be explained by the theory of retrocausality.[9] According to de Beauregard, when the negative-time solution is considered, quantum mechanics and

[8] Aspect A. (1982) *Experimental Realization of Einstein-Podolsky-Rosen-Bohm Gedanken experiment*, Physical Review Letters, vol. 49, 91, 1982.
[9] De Beauregard O. (1953) Comptes Rendus 236, 1632-1634;

relativity become compatible.

- *Retrocausality*

In 1978, John Archibald Wheeler proposed a variation of the double-slit experiment in which the detectors could be turned on after the photon had passed through the slits. When, in a double-slit experiment, a detector is used to measure which slit the photon passes through, the interference pattern disappears. In the delayed-choice experiment, the detector is placed between the slits and the detector screen.

The Copenhagen interpretation says that when the detectors are turned on, the interference pattern disappears, forcing the waves to collapse and the photons to pass through the slits as particles. This should happen even if the detector is turned on after the photons have passed through the slits. The experiment was made possible by the speed of computers, which can randomly choose when to turn on the detectors between the double slit and the screen. The results show that the choice affects the way the photon passes through the slit (wave/particle), and that this works backwards in time.

The first two experiments to test this hypothesis were performed independently in the 1980s at the University of Maryland and in Munich, Germany, and showed that the decision to activate the detectors influences the nature of the photons.

Wheeler noted that a double-slit experiment could be done using light from quasars and a galaxy as a gravitational lens. This light produces an interference pattern that shows that light travels as waves. But if a measurement were made before the detector screen, the interference pattern would dissolve, and the photons would change from waves to particles. In other words, our choice of how to measure the light from a quasar would affect the nature of the light (particle/wave) emitted ten billion years ago. Wheeler said this experiment shows that retrocausal effects operate at the quantum level.

In 1986 John Cramer[10], physicist at Washington State University, published the transactional interpretation of quantum mechanics. In this interpretation the formalism of quantum mechanics remains the same, but the interpretation changes. Cramer was inspired by the absorber-emitter model developed by Wheeler and Feynman[11] which used the double solution of Maxwell's equation. As is well known, the generalization of Schrödinger's wave equation into a relativistic equation (the Klein-Gordon equation) also has two solutions, a positive one describing retarded waves traveling forward in time, and a negative one describing advanced waves traveling backward in time. This double solution makes it easy to explain the dual nature of matter (wave/particle), nonlocality, and all the other mysteries of quantum mechanics, and allows quantum mechanics to be united with relativity. The transactional interpretation requires that waves can actually travel backward in time. This statement is counterintuitive, since we are used to the fact that causes always precede effects.

---

[10] Cramer J.G. (1986) *The Transactional Interpretation of Quantum Mechanics*, Reviews of Modern Physics, Vol. 58: 647-688.

[11] Wheeler J. e Feynman R. (1945) *Interaction with the Absorber as the Mechanism of Radiation*, Review of Modern Physics (17).

It is important to note that the transactional interpretation considers special relativity, which describes time as a dimension of space, in a totally different way from our intuitive logic. The Copenhagen interpretation, on the other hand, treats time in a classical way and that is why it needs to introduce consciousness, in a mystical way and with creative powers, to resolve the dual nature (wave/particle).

Cramer claims that the probabilistic equation developed by Max Born in 1926 contains an explicit reference to the nature of time and the two possible solutions that describe the advanced and retarded waves. Since 1926, whenever physicists have used the Schrödinger equation to calculate quantum probabilities, they have considered the advanced wave solution without even realizing it.

Cramer's mathematics is the same as the Copenhagen interpretation. The difference is only that the interpretation solves all the mysteries and puzzles of quantum physics, while also making it compatible with the requirements of special relativity. This miracle comes, however, at the price that the quantum wave can travel backwards in time. This is in stark contrast to the mechanistic logic that says that causes must always precede their effects.

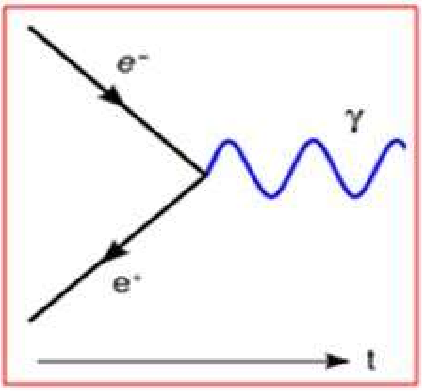
In his book "*The Road to Reality*" Roger Penrose points out that physicists usually tend to reject as "unphysical" any solution that contradicts classical causality, according to which causes always precede effects. Usually, any solution that makes it possible to send a signal backwards in time is rejected. Penrose has chosen to reject the negative-time solution and claims that this rejection is the consequence of a subjective choice, towards which other physicists have different opinions. Penrose devotes almost 200 pages of his book to the paradox of the negative-time solution of energy. According to Penrose, it is important that the value of energy is always positive because negative values of energy lead to catastrophic instabilities in the standard model of subatomic physics.

> "*Unfortunately, in relativistic particles both solutions of the equation must be considered as a possibility, even an unphysical negative energy must be considered as a possibility. This does not happen in non-relativistic particles. In the latter case, the quantity is always defined as positive, and the awkward negative solution is not displayed.*"

Penrose adds that the relativistic version of the Schrödinger equation does not provide a procedure to rule out the negative solution. In the case of a single particle this does not lead to any real problem, however when particles interact, the wave function cannot produce only the positive solution. This conflicts with classical causality.

To remove the awkward negative solution, Dirac suggested using the Pauli principle, according to which no two electrons can share the same state, to suggest that all negative energy states are occupied, thus preventing any interaction between positive and negative states of matter. This ocean of negative energy occupying all positive states is called the Dirac Sea. The standard model is based on this assumption, which Penrose describes as simply insane.

Although classical physics rejects the negative-time solution and the possibility of retrocausality, many scientists have and are working on this hypothesis. An example is provided by Feynman's diagrams of electron-positron annihilation, according to which electrons are not destroyed by contact with positrons, but release energy by reversing the direction in time and becoming positrons.



In the diagram, the arrows on the right represent electrons,
the arrows on the left represent positrons, the wavy lines represent photons.

When Feynman diagrams are interpreted, they necessarily imply the existence of retrocausality.[12] Feynman used the concept of retrocausality to produce a model of positrons that reinterprets Dirac's hypothesis of a sea of negative energy occupying all possible states. In this model, electrons moving backward in time take on positive charges.[13]

Yoichiro Nambu[14] applied the Feynman model to the processes of annihilation of particle-antiparticle pairs, reaching the conclusion that it is not a process of annihilation or creation of particle-antiparticle pairs, but simply a change in the temporal direction of the particles, from the past to the future or from the future to the past.

Until the 19th century, time was considered irreversible, a sequence of absolute moments. In 1954, the philosopher Michael Dummett showed that there is no philosophical contradiction in the idea that effects can precede causes.[15]

In 2006, the AIP (American Institute of Physics) organized a conference in San Diego, California, titled "*Frontiers of Time: Retrocausation - Experiment and Theory.*" The proceedings contain over 20 papers on retrocausality.[16]

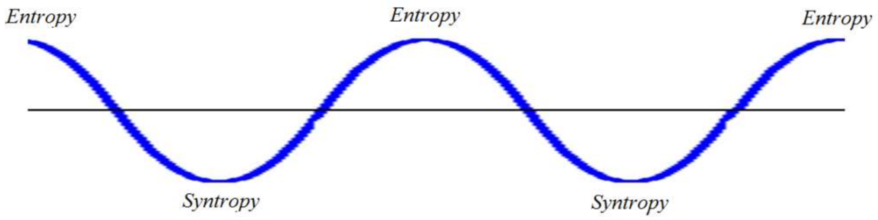
---

[12]Feynman R. (1949) *The Theory of Positrons*, Physical Review 76: 749.
[13] Wheeler J. e Feynman R. (1945*) Interaction with the Absorber as the Mechanism of Radiation*, Review of Modern Physics (17).
[14] Nambu Y. (1950) *The Use of the Proper Time in Quantum Electrodynamics*, Progress in Theoretical Physics (5).
[15] Dummett M. (1954) *Can an Effect Precede its Cause*, Proceedings of the Aristotelian Society (Supp. 28);
[16] *AIP, American Institute of Physics, FRONTIERS OF TIME: Retrocausation - Experiment and Theory*, Proceedings: http://scitation.aip.org/content/aip/proceeding/aipcp/863/

 ISSN 1825-7968 2024: 31-45

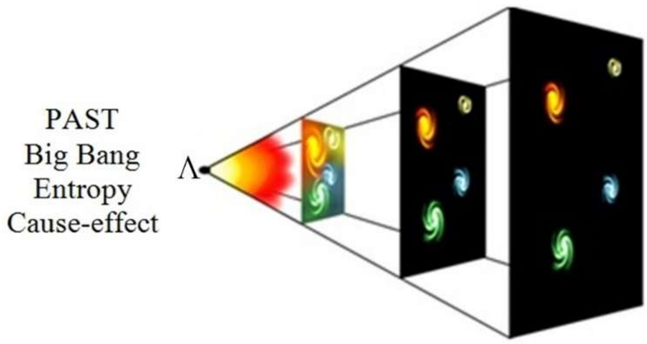
- Divergent and convergent cycles

The entropy/syntropy hypothesis implies that any system, organic or inorganic, vibrates between peaks of entropy and syntropy, acquiring specific resonances over time.



These vibrations can be observed in any system and at any level, from the quantum level to the macro level and to the cosmological level.

The entropy/syntropy hypothesis supports Einstein's cosmological model of infinite Big Bang and Big Crunch cycles. The Big Bang theory was first formulated by Lemaître in 1927, but it was not widely accepted until 1964, when many scientists became convinced that experimental data confirmed that an event like the Big Bang had occurred.



Georges Lemaître, a Belgian Catholic priest and physicist, developed the equations of the Big Bang and suggested that the receding nebulae is due to the expansion of the cosmos.

In 1929, Edwin Hubble and Milton Humason noted that the distance of galaxies is proportional to the shift of the light spectrum toward the red, toward the lowest frequencies of light. This usually happens when the light source moves away from the observer or when the observer moves away from the source. Since the red color is the lowest frequency of visible light, the phenomenon has been called red shift, although it is used in connection with any frequency, including radio frequencies.

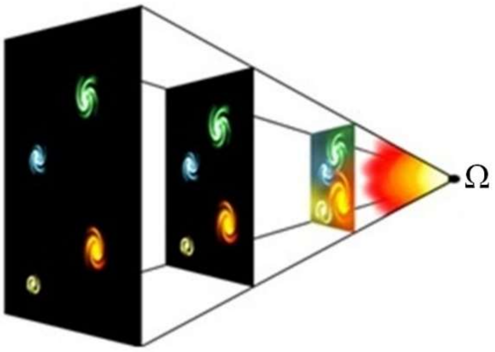
The phenomenon of redshift indicates that galaxies are moving away from each other and, more generally, that the universe is in a phase of expansion. Furthermore, the redshift shows that galaxies and star clusters are moving away from a common point in space: the further they are from this point, the greater their speed.

As the distance between galaxy clusters increases, it is possible to infer, by going back in time, increasingly

ISSN 1825-7968

higher densities and temperatures until we reach a point where the maximum values of density and temperature tend towards infinite values and the positive-time physical laws of the equations are no longer valid.

In cosmology, the Big Crunch is a hypothesis about the fate of the universe. This hypothesis is exactly symmetrical to the Big Bang and states that the universe will stop expanding and begin to collapse on itself.



Gravitational forces will prevent the universe from continuing to expand, and the universe will collapse in on itself. Contraction will look very different from expansion. While the early universe was highly uniform, a contracting universe will be increasingly diverse and complex. Eventually, all matter will collapse into black holes, which will then merge to create a unified black hole or Big Crunch singularity.

The Big Crunch theory suggests that the universe could collapse back to the state it started in and then start another Big Bang. In this way, the universe would last forever, going through cycles of expansion (Big Bang) and contraction (Big Crunch).

Observations of distant supernovae led to the idea that the expansion of the universe is not being slowed down by gravity, but rather its expansion is accelerating. In 1998, measurements of the light from distant supernovae led to the conclusion that the universe is expanding at an increasing rate. Observations of the red shift of supernovae suggest that they are moving away faster as the universe ages. According to these observations, the universe appears to be expanding at an increasing rate, thus contradicting the Big Crunch hypothesis.

In an attempt to explain these observations, physicists have introduced the idea of dark energy, a dark fluid or ghost energy. The most important property of dark energy is that it exerts a negative pressure distributed relatively homogeneously in space, a kind of anti-gravitational force that is pushing galaxies apart. This mysterious anti-gravitational force is considered a cosmological constant, which will cause the universe to expand exponentially. However, to this day, no one really knows what dark energy is or where it comes from.

In contrast, the interpretation of the dual solution of the fundamental equations suggests that the observed increase in the expansion rate of the universe is not due to the effect of dark energy or other mysterious anti-gravitational forces, but to the fact that time is slowing down.

In June 2012, professors José Senovilla, Marc Mars and Raül Vera of the University of Bilbao and the University of Salamanca published a paper in the journal Physical Review D in which they dismissed dark energy as non-existent, showing that the acceleration is an illusion that is caused by time slowing down.

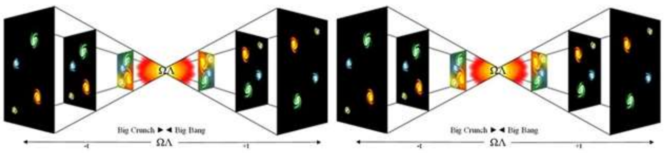
> "*We do not say that the expansion of the universe is an illusion, what we say is that the acceleration of this expansion is an illusion. [...] we have naively kept time constant in our equations to derive the changes in the expansion of the universe, thus showing an acceleration of the expansion.*"

The corollary of Senovilla's team is that dark energy does not exist and that we have been led to think that the expansion of the universe is accelerating, when in fact it is time that is slowing down. On an everyday level, the change is not perceptible, but it is visible in cosmic-scale measurements that follow the course of the universe over billions of years. The change is infinitely slow from a human perspective, but in cosmological terms it can be easily measured and affects the light from stars that exploded billions of years ago. Currently, astronomers measure the rate of expansion of the universe using a so-called red-shift technique. But this technique relies on the assumption that the flow of time in the universe is constant.

If time slows down, it becomes a spatial dimension. So, the most distant and ancient stars would appear to be speeding up. "*Our calculations show that we would be led to think that the expansion of the universe is accelerating,*" says Professor Senovilla. Although radical and unprecedented, these ideas are not without support. Gary Gibbons, a cosmologist at the University of Cambridge, says that: "*We believe that time emerged with the Big Bang, and if time can emerge, it can also disappear – this is just the opposite effect.*"

When the double solution of the energy-momentum-mass equation is interpreted, we get a cosmological representation of the universe vibrating between peaks of expansion and contraction. During the expansion phase, time flows forward, while during the contraction phase, time flows backward. Causality and retrocausality constantly interact and the universe is characterized by infinite cycles of expansion (Big Bang) and contraction (Big Crunch).

The Big Bang is governed by the positive and divergent solution of entropy, that is, energy and matter diverging from an initial point, while the Big Crunch is governed by the convergent and negative solution of syntropy, that is, energy and matter converging towards an end point of infinite density and temperature.

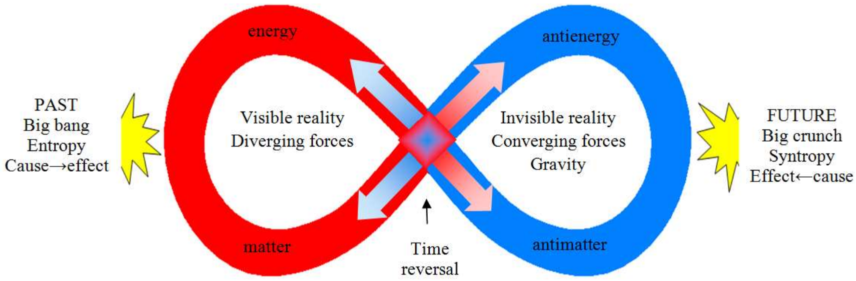


Big Bang and Big Crunch Cycles

The Big Bang is indicated by the first letter of the Greek alphabet, Λ=Alpha (the beginning), while the letter Ω=Omega (the end) indicates the Big Crunch.

 ISSN 1825-7968 2024: 31-45

The question often asked by cosmologists is "*Why do we live in a world mostly made of matter? What happened to antimatter?*" This question is easily answered if we consider the negative-time solution. At the moment of the Big Bang, the amount of matter and antimatter was the same, but matter diverges forward in time, while antimatter diverges backward in time, instantly moving away and preventing annihilation.



According to this interpretation, the universe is composed of equal amounts of matter and antimatter diverging in opposite temporal directions. These two symmetrical planes constantly interact in the form of a continuous influence between divergent and convergent forces, causality and retrocausality, entropy and syntropy.

All that is divergent is governed by the forward in time solution, while all that is convergent is governed by the backward in time solution. Thus, the physical and material plane is continually interacting with the non-physical and immaterial plane of antimatter that is moving backward in time. The intrinsic complexity of the physical universe is a consequence of the interaction of matter and energy with the cohesive forces of antimatter and anti-energy.