Supercausality and free will

Antonella Vannini[1]

Abstract

Dirac's equation is mathematically consistent, it satisfies all of the known data, explains strange phenomena as non-locality and retrocausality but, in 1934, its negative solution was refused as it implies causes located in the future and the flow of energy and information backwards in time: from the future to the past.

1. Dirac's equation.

In 1928 Paul Dirac united the relativistic equation of energy conservation:

$$E^2 = c^2p^2 + m^2c^4$$

with Schrödinger wave equation in its famous generalization (Dirac 1928), known as Dirac's equation. This equation allows the description of any type of wave, and for this reason, according to Dirac, it is at the basis of all the manifestations of the universe (Perkins 2000). But, square roots $^{1/2}$ always give place to two solutions, one positive and the other negative:

$$\pm E = (c^2p^2 + m^2c^4)^{1/2}$$

[1] antonella.vannini@gmail.com

Where:

1. the positive energy solution (**+E**) describes waves which diverge from causes located in the past and which propagate towards the future (retarded potentials);
2. the negative energy solution (**-E**) describes waves which diverge from causes located in the future and which propagate backwards in time from the future towards the past.

Particles which move backwards in time appear of opposite sign to those which move forwards (Butterfield e Pagonis 1999), Dirac's negative energy corresponds therefore to ordinary electrons which move backward in time. The only possible way to account for anticipated potentials was that of admitting the existence of opposite particles, and in this way Dirac, in 1928, predicted the existence of the neg-electron, similar to the electron, but with reversed time flow: instead of moving from the past to the future it moves from the future to the past (Von Baeyer 2001). The existence of the neg-electrons was proved in 1932 by Carl Anderson, when he observed their existence in cosmic rays: Anderson named this new particle *positron* (Anderson 1932).

Now we know that each subatomic particle has a corresponding antiparticle which flows in the opposite direction of time, from the future to the past: anti-electrons, anti-positrons, anti-neutrons. In 1949 Richard Feynman, thanks to his famous diagrams, reached the conclusion that while all the particles flow from the past to the future, all antiparticles flows from the future to the past (Feynman 1949). The term anti-matter was coined to indicate anti-particles with a opposite flow of time, while matter continued to be used for "traditional" particles which flow in the usual way, from the past to the future.

Dirac's equation consists of two parts:

- The famous relation between matter and energy, $e=mc^2$, which in this equation is expressed as m^2c^4.
- The energy associated to the spin of the particle which is equal to c^2p^2.

Keeping track of the energy associated to the spin, Dirac's equation satisfies the law of energy conservation (Bohm e Hiley 1993) and allows for simple and effective explanations of attractive phenomena such as the electromagnetic fields, the gravitational forces, and the strange properties of quantum physics, as non-locality.

But, nevertheless, a considerable number of physicists finds it difficult to accept the implications of the negative solution of this equation. Classical physics considers the possibility of energy which flows backwards in time as pure nonsense, as it contradicts the assumptions that entropy and cause-effect relations are universal laws (Hotson 2002).

2. How the negative solution of Dirac's equation was cancelled.

The negative solution of Dirac's equation caused emotional reactions among physicists. For example Heisenberg wrote to Pauli:

- "The saddest chapter of modern physics is and remains the Dirac theory" (Heisenberg 1928a);
- "Magnetic electron had made Jordan melancholic" (Heisenberg 1928b);
- "I regard the Dirac theory ... as learned trash which no one can take seriously" (Heisenberg 1934).

Causes located in the future were simply unacceptable and it was also unacceptable the conclusion that science had investigated only the "positive" half of the universe. Even though Dirac's equation is mathematically consistent, is Lorenz-invariant, has electron spin, gives the right magnetic moment, the Thomas factor appears automatically, the Sommerfield fine structure formula is derived with the correct Goudsmit/Uhlenbeck quantum numbers and at low energies it gives the ordinary Schödinger wave equation results, predicts positrons and is the very basis of Quantum Electrodynamics (Hotson 2002), in 1934, Heisenberg suggested to

remove the negative solution using the “zero order subtraction” which Dirac used in order to simplify the calculations. Zero order subtraction consisted of filling the negative states arriving in this way to a negative null result. Heisenberg used this solution to show that the negative part of Dirac’s equation was non-existing and since then physicists have continued to consider only the positive half of this equation, giving birth to what is now known as the Standard Model (SM).

3. Criteria for a successful scientific theory.

Hotson (2002) underlines that the criteria for a successful scientific theory are:

1. Simplicity: it should embody as few “entities” as possible (this criterion is known as “Ockham’s Razor”).
2. Few or preferably no adjustable parameters.
3. It should be mathematically consistent.
4. It should satisfy all of the known data, including data unexplained, anomalous, or dismissed as “coincidence” according to previous theories.
5. It should obey causality: every effect should have a proximate cause, with no “action at a distance”.
6. It should be falsifiable, making testable predictions.

In the following paragraphs the Standard Model is compared with Dirac’s equation in relation to these criterions.

- First criterion: Ockham’s Razor

The criterion known as “Ockham’s razor” was stated by Guglielmo of Ockham (1295-1349) and states (in Latin) that: “*Entia non sunt multiplicanda praeter necessitatem*” (Elements are not multiplied if it is not necessary to do so). This criterion means that the trend of universal laws is that of “economy” and simplicity: the lowest possible number of “entities” are used.

Science should therefore evolve from more complex models to simpler ones, and in any demonstration it should always be necessary to use the lowest number of entities, for example:

- before modern chemistry it was thought that the chemical elements were infinite;
- in 1890 it was shown that all chemical elements are derived from the combination of 92 atoms;
- in the Twenties the 92 atoms derived from the combination of electrons, protons, neutrons, positrons, photons, gravitational and electromagnetic forces. In this way science moved from 92 atoms to 7 elements;
- Dirac's equation reduced the entities to two: the positive and negative solutions of his famous equation.

But Heisenberg's refusal of the negative solution of Dirac's equation lead to the Standard Model which now requires 36 basic elements (particles), each one with its anti-particle (*gluons, gravitons, iperons, pions, kaons, muons, tuons, neutrins, fermions, quark, pentaquarks, tetraquarks, bosons, …*) from which the 3 basic particles are derived (electron, proton and neutron) and then the 92 atoms and all the chemical combinations of the physical world.

Two sequences exist:

1. Dirac's sequence infinite-92-7-2;
2. Standard Model: infinite-92-7-36.

If the second sequence would be correct the Ockham criterion should be considered wrong; on the contrary, if the first sequence is correct the Standard Model should be considered wrong.

Ockham's criterion is based on the fact that the universe always shows economy of means. For example, DNA, which is at the basis of life, and which is now considered the most complex entity, codes information using 4 elements, the 4 azotize bases. Complexity theory

shows that 3 elements would not have been sufficient, whereas 5 would have been redundant; DNA could have used an unlimited number of elements, but only 4 were necessary and only 4 have been used.

Similarly, in order to produce stable matter, only 3 particles were necessary: electrons, protons and neutrons, and again only 3 particles are used.

Information science shows that it is possible to generate any sort of complexity simply starting from two elements: yes/no, false/true, 0/1, +/-. Only two elements are necessary and because the tendency towards economy is a basic law of the organization of the universe, it is plausible that only the two solutions of Dirac's equation (positive and negative) would suffice in order to produce all the complexity of the university.

Comparing the Standard Model with Dirac's equation it is clear that the Ockham criterion is satisfied only by Dirac's equation and that the Standard Model openly violates the "economy law" of the universe.

- *Second criterion:* few or preferably no adjustable parameters.

The second criterion implies that a valid scientific theory should allow for few or preferably no adjustable parameters. Differently from Dirac's equation, the Standard Model requires at least nineteen parameters, parameters which have to be entered by hand among which the rest mass of the electron which comes out to be infinite (Hotson 2002). Most of the particles of the Standard Model are considered to have properties but no mass, as for example: leptons, quarks, bosons and gluons; when masses are entered the values of the equations tend to infinite. A universe without masses is however very distant from our universe, where all particles pretend stubbornly to have masses! Adding particles "ad hoc" in order to explain what has been left out from the previous particles is also a violation of the second criteria. A well known case is the gluon which has been added in order to justify why the different parts of the atoms are glued together. The need for a specific particle is the consequence of the fact that, because the Standard Model considers only the positive solution of Dirac's equation,

cohesive forces continue to be un-explained.

- *Third criterion:* mathematically consistent.

Closely related to the second criterion, the third criterion requires that no equation should lead to impossible results, as the ratio among two infinite values. In the Standard Model divisions among infinite are common, and this impossible operation can be solved only entering manually the results. When the results of the Standard Model tend to infinite, values need to be normalized, which means that they have to be entered by hand. Equations lose their predictive power and require the a-priori knowledge of the results, violating in this way also the second criterion. This does not happen with Dirac's equation which always produces results which are mathematically consistent and coherent with empirical data produced by the experiments.

- *Fourth criterion: it should agree with empirical data.*

The fourth criterion requires that the results of the model and empirical data should agree. While the equations of the Standard Model lead to indeterminate results, which require the knowledge of the values which have to be entered manually, Dirac's equation produces always exact results which agree with empirical data and which can be therefore verified empirically.

- *Fifth criterion: causality.*

Every effect should obey causality and be explained as the consequence of proximate causes. The Standard Model refused Dirac's negative results and therefore finds it impossible to explain the causal chain which produces the "anomalous" effects which are observed in quantum mechanics such as non-locality, the unified field and the entanglement.

Accepting the negative solution of Dirac's equation, all the mysterious properties of quantum mechanics become clear as consequences of causes located in the future. For example, in

order to move backwards in time negative energy has to travel at a speed which is always greater than the speed of light. The information carried by negative energy can therefore travel infinite spaces instantly. The classical example are the EPR experiments which use the spin of particles (Corrucci, Iacarelli e Cavalieri 2005) in order to instantly transfer information at any distance.

The converging properties of negative energy allow to explain in a logical and causal way (even though the cause is located in the future) all the attractive forces (such as gravity) which in general remain mysterious in the Standard Model.

- Sixth criterion: it should be falsifiable, making testable predictions.

The sixth and last criterion requires that a scientific model should produce hypothesis which can be verified. The Standard Model produces a wide range of indeterminate results which cannot be verified while the Dirac's equation produces results which are always exact and can be verified empirically.

4. Limits of the Standard Model.

Heisenberg's refusal of the negative solution of Dirac's equation has lead to the development of a model which does not meet the basic criterion of a valid scientific theory. The immediate consequence is that this model is not able to correct itself and solves its contradictions adding "ad hoc" particles such as gluons and gravitons which are nothing more than patches applied to save a failing model. As Hotson brilliantly shows in his article "Dirac's Equation and the Sea of Negative Energy", the refusal of the negative solution of Dirac's equation has lead to the hardening of the mechanistic paradigm, and to the systematic violation of the basic laws of physics and the basic requirements of science. For example in Dirac's equation the energy of the spin is a component of the equation, while in the Standard Model it is an intrinsic property of electrons and positrons which is not taken into account in the equations. This becomes clear comparing Einstein's energy equation (1) with Dirac's energy equation (2):

$$1) \qquad E = mc^2$$

$$2) \quad \pm E = (c^2p^2 + m^2c^4)^{½}$$

While in Einstein equation (1) energy is always positive and always moves from the past to the future, in the energy/momentum equation (2), which takes into account also the spin (c^2p^2), energy can be positive or negative and it can therefore flow in both directions: from the past to the future and from the future to the past.

Not taking into account the energy which is associated to the spin, the Standard Model behaves as if this energy can be created from nothing, an implicit property of electrons and protons, to which no explanation has to be provided. This approach leads to the paradox that the electron created by the photon has, according to the Standard Model, 16 times more energy than the photon which has created it; in this way the Standard Model accepts that a huge quantity of energy is continually created from nothing, and this fact violates the law of energy conservation which states that energy is perpetual: it cannot be destroyed or created, but only transformed (Hotson 2002).

When Dirac presented his equation in 1928 he stated that, because matter and energy evolve as waves, his equation should be the basic equation for a unitary theory of all the aspects of the universe. The direct application of Dirac's equation provides simple, logical, and natural models of the electromagnetic field, the photon, the strong nuclear force, the gamma wave, inertia, gravitation, non-locality, entanglement. It provides direct-contact causal models that agree with experiments, as opposed to purely mathematical and unworkable models. The models which derive from Dirac's equation do not require ad-hoc particles or adjustable parameters as happens with the Standard Model which Bohr and Feynman describe as follows: "no one understands quantum mechanics … the strangeness of quantum mechanics has to be taken on faith." Taking into account the properties of negative energy these strangeness disappear and causal chains becomes clear.

5. Retrocausality

A wide number of research works has shown the existence of causes which propagate backwards in time, for example:

- Robert Jahn and Brenda Dunne (2005) of the Princeton Engineering Anomalies Research laboratory have proved anomalous mind/machine interactions, studying the variations of random generated distributions. They also proved the existence of non-local interactions in which the cause is located in the future (statistical significance $p<0,000002$). These results show the need for a model which can take into account causes located in the future.
- James, Spottiswoode e May (2003) of the Laboratories for Fundamental Research, have discovered prestimulus responses of the autonomic nervous system, using emotional and non emotional images and measuring skin conductivity 3 seconds in advance. Results show a difference with a statistical significance of $p<0,0005$. .

Other experiments have shown the existence of retrocausality:

- Radin D.I., (1997) Unconscious perception of future emotions: An experiment in presentiment. Journal of Scientific Exploration, 11, 163-180.
- Bierman D.J. and Radin D.I. (1997) Anomalous anticipatory response on randomized future conditions. Perceptual and Motor Skills, 82, 689-690.
- Bierman D.J. and Radin D.I. (1998). Conscious and anomalous non-consciuos emotional processes: A reversal of the arrow of time? in Toward a Science of Consciousness, Tucson III (pp. 367-386) Cambridge, MA: MIT Press.

6. Supercausality

In *Dual-time supercausality* Chris King (King 1989) starts from the energy/momentum equation:

$$E^2 = c^2p^2 + m^2c^4$$

and shows that the dual solution of this equation implies a new causal model which King named supercausality. This model has been refined in *Chaos, Quantum-transactions and Consciousness* becoming the starting point for the description of the subjective experience and consciousness (King 2003).

The dual energy solution:

1. positive solution, **+E**, implies causes which flow from the past to the future;
2. negative solution, **-E**, implies causes which flow backwards, from the future to the past.

In this way the universe becomes symmetrical in respect to the flow of causes. This model had been formalized in Feynman and Stueckelberg diagrams, in which it is shown that the present state is the result of the encounter of waves coming from the past and from the future.

King uses this model of supercausality in order to describe the way in which brain structures function. According to King brain structures are constantly faced in front of bifurcations which are generated by the encounter of information (causes) which come from the past and from the future. In each moment brain structures have to decide which bifurcation to choose. King believes that from this constant state of choice free will and consciousness start, and a constant learning process is activated (Atmanspacher e Bishop 2002).

This constant interaction between past and future creates a paradox which is incompatible with the deterministic model (Penrose 1989). For example, supercausality implies that the future is not determined and that it can be influenced and shaped by subjective choices. If only past causes existed, the universe would resemble a big mechanism, totally determined

by past states. The encounter of past causes and of future causes (attractors) leads to the necessity of subjective processes of choice and to a future which is undetermined.

King underlines that the subjective consciousness is a necessary consequence of supercausality. The interaction between causes placed in the past and causes placed in the future leads to a new understanding of the differences among subjective consciousness and computational skills, which are instead based only on “mechanical” processes of data analysis, determined by the past. According to King, the reason which lead to the selection of subjective consciousness instead of mere computational skills, is based on the fact that “anticipated information” is vital to the survival of the living system. King states that in order to understand the meaning of anticipated information, it is necessary that the fundamental equation of physics allows for an anticipatory space-time principle, which is not present in mechanical computational systems, which have therefore been refused by the natural selection process. If subjective consciousness were not vital for the survival of life, it would have been refused by the natural selection process.

The role of bifurcations is now the topic of a growing number of experimental and theorical researches in neurodynamics, where the transition from chaos to order can be regarded as the process at the base of cognition and perception. These studies are increasingly using quantum mechanics principles which trace back to Dirac’s equation. King believes that the properties of the sub-quantum physics, united with the properties of fractals, chaos and non-locality are the key elements for the understanding of consciousness and free will.

The symmetry of time and the existence of supercausality is underlined also by Sklar (1997) and by Giuseppe and Salvatore Arcidiacono (1991). They state that besides mechanical causation, another type of causation exists which Giuseppe and Salvatore Arcidiacono named final causation. This consideration leads to a description of life which is no longer linear but circular, in which both mechanical and final causation are required. Life becomes the result of the constant interactions between past and future causes: the question as to whether tissues are determined by cells, or cells are determined by tissues, can be solved by accepting both alternatives. Life is no longer a machine, but a creative system which tends

towards causes located in the future. According to Davies, science has been dominated for centuries by Newton's vision which describes the universe as a machine, but now we know that the laws of the universe are creative, and that they support evolution and innovative processes (Davies, 1974).

Notes

Anderson C.D., *The apparent existence of easily deflectable* positives, Science, 76:238 (1932);

Arcidiacono G. e S. (1991), *Entropia, Sintropia e Informazione,* Di Renzo Editore, Roma 1991.

Atmanspacher H., Bishop R. (2002), *Between Chance and Choice*, Imprint Academic, UK, p. 92.

Bohm D. e Hiley B.J. (1993), *The Undivided Universe*, Routledge, London, p. 275-276.

Butterfield J., Pagonis C. (1999), *From Physics to Philosophy*, Cambridge Press.

Corrucci M., Iacarelli G. e Cavalieri G. (2005), *Il trasmettitore a SPIN*, Scienza e Conoscenza, novembre 2005, p. 16-21.

Davies P. The Physics of Time Asymmetry. Surrey Press, 1974.

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

Feynman R.P. (1949), *Theory of positron*, Phys. Rev. 76, p. 749.

Heisenberg W. (1928a) *Letter to W. Pauli*, PC, May 3, Vol. 1, p. 443.

Heisenberg W. (1928b) *Letter to W. Pauli*, PC, July 31, Vol. 1, p. 466.

Heisenberg W. (1934) *Letter to W. Pauli*, PC, February 8, Vol. 2, p. 279.

Hotson D.L. (2002), *Dirac's Equation and the Sea of Negative Energy*, Infinite Energy, 43: 2002: http://openseti.org/Docs/HotsonPart1.pdf .

Jahn R. e Dunne B. (2005) *The PEAR Proposition*, Journal of Scientific Exploration, Vol. 19, No. 2, pp. 195–245, 2005 http://www.princeton.edu/~pear/Allen_Press/PEAR%20Proposition.pdf .

James S., Spottiswoode P. e May E.C. (2003), *Skin Conductance Prestimulus Response: Analyses, Artifacts and a Pilot Study,* Journal of Scientific Exploration, Vol. 17, n. 4, pp. 617-641, 2003. http://www.lfr.org/LFR/csl/library/SCpsr.pdf .

King C. (1989), *Dual-Time Supercausality* Physics Essays 2/2 128-151. http://www.math.auckland.ac.nz/~king/Preprints/pdf/Transup.pdf .

King, C. (2003), *Chaos, Quantum-transactions and Consciousness,* NeuroQuantology 2003; 1: 129-162. http://www.neuroquantology.com/2003/01/129.162.pdf

Mac Cormac E.R., Stamenov M.I., *Fractals of Brain, fractals of mind,* in *Advances in counsciousness research,* Vol.7, John Benjamins Publishing Company, Amsterdam 1996. http://www.math.auckland.ac.nz/~king/Preprints/paps/consc/brcons2.htm

Penrose R. (1989), Isham C., *Quantum Concepts in Space & Time* , Oxford University Press.1989.

Perkins C.H. (2000), *Introduction to High Energy Physics*, Cambridge Press, 2000 p. 13-14

Sklar L., (1997) Space,Time and Spacetime, University of California Press, p. 378.

Von Baeyer C. H. (2001) *The Fermi Solution* Dover Publications, NY, p. 35.