Advanced Waves, Retrocausality and Consciousness

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Abstract

In quantum mechanics, advanced waves, which propagates backward in time, have been usually ignored, as they were considered to be unphysical. Nevertheless, in the sciences of life, advanced waves may permit to answer some of the major mysteries and paradoxes. In this paper, a model which relates advanced wave solutions with the properties of living systems will be examined, and a retrocausal model of consciousness will be briefly presented.

Advanced waves and living systems

In the Copenhagen Interpretation of quantum mechanics the collapse of the state vector (the collapse of a wave into a particle) occurs at the same time at all positions in space. This collapse would seem to require faster-than-light propagation of information, violating in this way the limit of the speed of light posed by Special Relativity in the propagation of causality. This was Einstein's original objections to quantum mechanics, which was later formulated in the EPR paradox.

Analyzing the EPR paradox, Schrödinger concluded that the problem lies in the way time is used in quantum mechanics. The Schrödinger wave equation, which was the focus of most of the discussion surrounding EPR, is not relativistically invariant and treats time in an essentially classical way. For example it assumes that there can be a well-defined "before" and "after" in the collapse description.

The relativistically invariant version of the wave equation was produced by Klein and Gordon in 1926. In order to turn the Schrödinger wave equation into a relativistically invariant equation Klein and Gordon had to insert the energy/momentum/mass relation:

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

(where E is the total energy of an object, p the momentum, m the mass and c the speed of light)

arriving to what is now known as the d'Alambert operator.

The d'Alambert operator, depends on a square root, and yields always a dual wave solution: retarded waves (which propagate forward in time) and advanced waves (which propagate backward in time). The Schrödinger wave equation had, instead, only the retarded wave solution.

The advanced wave solution of the d'Alambert operator was usually ignored as it was considered to be unphysical. But, as has been shown by Cramer's Transactional Interpretation (Cramer, 1986), and by Costa de Beauregard's Advanced-Action Interpretation (Costa de Beauregard, 1953), the EPR paradox just disappears when considering the advanced waves to be real physical entities.

The same conclusion was reached, in December 1941, by one of the major Italian mathematicians, Luigi Fantappiè. While working on quantum mechanics and Special Relativity equations, he noted that the retarded waves (retarded potentials) are governed by the law of entropy, while the advanced waves (advanced potentials) are governed by a symmetrical law that he named syntropy.

The following letter, written by Fantappiè to a friend, describes well the implications of the law of syntropy: "*I have no doubts about the date when I discovered the law of syntropy. It was in the days just before Christmas 1941, when, as a consequence of conversations with two colleagues, a physicist and a biologist, I was suddenly projected in a new panorama, which radically changed the vision of science and of the Universe which I had inherited from my teachers, and which I had always considered the strong and certain ground on which to base my scientific investigations. Suddenly I saw the possibility of interpreting a wide range of solutions (the anticipated potentials) of the wave equation which can be considered the fundamental law of the Universe. These solutions had been always rejected as "impossible", but suddenly they appeared "possible", and they explained a new category of phenomena which I later named "syntropic", totally different from the entropic ones, of the mechanical, physical and chemical laws, which obey only the principle of classical causation and the law of entropy. Syntropic phenomena, which are instead represented by those strange solutions of the "anticipated potentials", should obey two opposite principles of finality (moved by a final cause placed in the future, and not by a cause which is placed in the past): differentiation and non-causable in a*

laboratory. This last characteristic explained why this type of phenomena had never been reproduced in a laboratory, and its finalistic properties justified the refusal among scientists, who accepted without any doubt the assumption that finalism is a "metaphysical" principle, outside Science and Nature. This assumption obstructed the way to a calm investigation of the real existence of this second type of phenomena; an investigation which I accepted to carry out, even though I felt as if I were falling in a abyss, with incredible consequences and conclusions. It suddenly seemed as if the sky were falling apart, or at least the certainties on which mechanical science had based its assumptions. It appeared to me clear that these "syntropic", finalistic phenomena which lead to differentiation and could not be reproduced in a laboratory, were real, and existed in nature, as I could recognize them in the living systems. The properties of this new law, opened consequences which were just incredible and which could deeply change the biological, medical, psychological, and social sciences."

It is important to note that it appears to be impossible to test the existence of advanced waves in a laboratory of physics:

- According to Fantappiè, anticipated waves do not obey classical causation, therefore they cannot be studied with experiments which obey the classical experimental method (Fantappiè, 1942).
- According to Wheeler's and Feynman's electrodynamics, emitters coincide with retarded fields, which propagate into the future, while absorbers coincide with advanced fields, which propagate backward in time. This time-symmetric model leads to predictions identical with those of conventional electrodynamics. For this reason it is impossible to distinguish between time-symmetric results and conventional results (Wheeler and Feynman, 1949).
- In his Transactional Interpretations of Quantum Mechanics, Cramer states that "*Nature, in a very subtle way, may be engaging in backwards-in-time handshaking. But the use of this mechanism is not available to experimental investigators even at the microscopic level. The completed transaction erases all advanced effects, so that no advanced wave signalling is possible. The future can effect the past only very indirectly, by offering possibilities for transactions*" (Cramer, 1986).

Nevertheless, living systems constantly seem to be engaged in anticipation, and show behaviours which cannot be explained by classical causation or studied in classical laboratory settings. When considering that, according to Fantappiè, living systems might

be a direct consequence of anticipated waves and backwards causality (law of syntropy), it becomes plausible that retrocausality could be tested using living systems.

For example, in the field of psychology, various empirical evidences show the existence of retrocausality and anticipatory effects:

- *Pre-stimuli heart rate differences.* In his article "*Heart Rate Differences between Targets and Nontargests in Intuitive Tasks*" Tressoldi and coll. report the results of two experiments, aimed at investigating pre-stimuli heart rate changes. In the first experiment a statistical significance (error risk) of p=0,015 was obtained, while in the second experiment p reached 0,001. These results support the hypothesis that the heart rate reacts before the stimulus takes place (Tressoldi and coll., 2005).
- *Anticipatory reaction of skin conductance.* In 2003 Spottiswoode and May of the Cognitive Science Laboratory replicated Bierman and Radin (1997) experiments which show an increase in skin conductance 2-3 seconds before emotional stimuli are presented. Spottiswoode and May replicated these results with a statistical significance of p=0,0005, and performed controls in order to exclude all possible artifacts and alternative explanations. These results support the hypothesis that the autonomic nervous system reacts in advance to stimuli (Spottiswoode and May, 2003).
- *Retrocausality in REG (Random Event Generator) experiments.* In 1979 the PEAR (Princeton Engineering Anomalies Research) laboratory was established under the direction of Robert Jahn, Dean of the University's School of Engineering and Applied Sciences. The purpose of this laboratory was to replicate and study the results obtained by a student which showed anomalous mind/machine interactions when using REG systems. PEAR and a consortium of other universities have replicated these results. The anomalous mind/machine interaction which is observed is very simple: REG systems produce ultra-precise gaussian distributions, but when a subject tries to distort these distributions only by the expression of his intentionality, statistically significant deviations are observed. Even more fascinating is the fact that those distributions which have been produced before the subjects' expression of intentionality show an amplified effect. The statistical significance of these "retrocausal" amplifications is p<0,000000001 (Jahn, 2005).

These results show that the classical experimental methodology can be used in psychology to test the existence of retrocausality. One of the aims of my Ph.D will be to devise simple and easily replicable experiments which could prove the existence of anticipatory and retrocausal effects.

Retrocausal model of consciousness

In this paragraph a brief description of a retrocausal model of consciousness, which I am developing, will be provided.

Wheeler and Feynman showed that advanced waves behave as absorbers while retarded waves behave as emitters; in 1941 Fantappiè arrived at the conclusion that, according to the law of syntropy, living systems are a consequence of advanced waves and should therefore behave as energy absorbers. According to Fantappiè, the energy balance of living systems should, therefore, always be in favour of absorption, and this would be why biological masses concentrate energy, as it can be easily demonstrated with petrol, gas, and coal.

This distinction between absorbers and emitters provides an interesting insight in one other basic property of life, the “feeling of life”. According to Kant the feeling of life is the essence of life itself. If both Kant and Fantappiè are right, it would be possible to state that the feeling of life is a direct consequence of advanced waves, as life itself is, according to the law of syntropy, a consequence of advanced waves. This statement may result more intuitive when considering the “feeling of life” as a consequence of converging waves / absorbers (advanced waves) rather than a consequence of diverging waves / emitters (retarded waves). The equivalence *feeling of life=advance waves* leads to the conclusion that systems based on the positive energy solution (entropy), as for example machines and computers, would never show a “feeling of life” independently from their complexity, while systems based on the negative energy solution (syntropy), as for example life itself, should always have a “feeling of life”, independently from their complexity.

The distinction between absorbers and emitters was used by Chris King (King, 2003) in order to explain free-will, another basic property of life. Chris King states that living systems are constantly faced with bifurcations between information coming from the past (retarded waves) and information coming from the future (advanced waves), and that they are in a constant state of choice. This constant state of choice would be common to all the levels and structures of life, from molecules to macrostructures, up to organisms and would take the form of free will in the most complex systems. Free choices and free will would cause chaotic dynamics which would explain why life is organized in fractal

structures, another important property of living systems.

Nevertheless, why would living systems be forced to operate choices? This question is answered by the "vital needs model" which was developed as a consequence of the conflict between syntropy and entropy. As it is well known, entropy is the law which dominates the macrocosm and which causes organized forms to gradually disintegrate into lower and lower levels of organization. Syntropy, instead, as Albert Szent-György (Nobel prize 1937 for physiology and discoverer of vitamin C) describes it, is the force which drives living systems from simple molecules to form macromolecules, and from macromolecules to form organelles and eventually put these all together to form the greatest wonder, a cell, with its astounding inner regulations. Then it goes on putting cells together to form "higher organisms" and increasingly more complex individuals… at every step, new, more complex subtle qualities are created, and so in the end we are faced with properties which have no parallel in the inanimate world (Szent-Gyorgyi, 1977). The conflict between life and entropy (death) is well known and it has been discussed continuously by biologists. This conflict justifies the existence of vital needs, at all levels of the organization of living systems; needs which have to be met in order to survive. According to this vital needs model, living systems are constantly forced to operate choices in order to survive, at all the levels of its organization; this constant use of "free will" would gradually lead towards complex neuronal systems, which are able to be conscious of themselves.

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