Chapter 2

Dual energy solution and supercausality

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2.1 Introduction

Changes of paradigm often coincided with counterintuitive discoveries:

- It was intuitive to imagine Earth to be flat, but counterintuitive to imagine it round;
- It was intuitive to imagine the Sun orbiting around the Earth, but counterintuitive to imagine the Earth orbiting around the Sun.

Nowadays it is intuitive to imagine time which flows from the past to the future, but counterintuitive to imagine that past, present and future coexist!

Einstein's relativity started a new description of reality which is symmetrical in respect of time: on one side energy and waves which propagate from the past to the future, on the other side energy and waves which propagate backwards in time from the future to the past, and which we experiment as *attractors*. Einstein used the term *Übercausalität* (supercausality) to refer to this new model of causality.

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2.2 The energy/momentum/mass equation

The equation **E = mc²**, commonly associated with the work of Albert Einstein, was first published in 1890 by Oliver Heaviside and then refined by Henri Poincaré in 1900 and Olinto De Pretto in 1903, and it then become famous with Einstein's special relativity where it was integrated with the momentum (speed) in the energy/momentum/mass equation:

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

which relates energy (**E**), momentum (**p**) and mass (**m**).

In order to calculate the value of energy it is necessary to operate a square root which produces always two solutions, one positive and one negative. This simple property of square roots implies that the solution of energy is always dual: positive (**+E**) and negative (**-E**). According to Einstein's special relativity and quantum physics:

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

The negative energy solution was immediately considered impossible, a mathematical trick, because it implied the existence of causes located in the future which retroacted on the past. This absurd situation was automatically solved in inertial systems in which the speed (**p**) is equal to zero. In these cases the momentum equals to zero **c²p²=0** and the equation is simplified in the famous **E = mc²** which has only positive solutions (+E).

But, in 1924, Wolfgang Pauli (Nobel prize 1945) discovered the spin of the electrons. The spin consists of a speed (**p**) which can never be equal to zero: even an object which is totally still has inner speed derived from the spin of electrons which form it. As a consequence of the energy associated to the spin, the energy/momentum/mass equation could no longer be simplified in the **E = mc²**.

In 1926 Klein e Gordon generalized the Schrödinger wave equation into a relativistic equation by inserting the energy/momentum/mass equation. In this way, Klein and Gordon discovered the existence of a dual wave solution: waves which propagate from the past to the future (+E) and waves which propagate from the future to the past (-E).

In 1928 Paul Dirac tried to solve the unacceptable negative solution by applying the energy/momentum/mass equation to the study of electrons, turning them into relativistic objects. But, also in this case, the unwanted negative solution emerged in the form of electrons (+E) and its antiparticles (-E).

The antiparticle of the electron, initially named neg-electron, was experimentally observed in 1932 by Carl Anderson in cosmic rays and named *positron*. Anderson become the first person who proved empirically the existence of the negative energy solution and of waves which propagate backwards from the future to the past: the negative solution was no longer an impossible mathematical absurdity, but it became empirical evidence. Dirac's equation predicts a universe made of matter which moves forward in time and antimatter which moves backwards in time.

2.3 The EPR experiment

Einstein's special relativity shows that positive energy can tend to the speed of light but it can never be faster. For example, in order to arrive at Earth the light reflected by the Moon (300.000 Km) requires 1 second, while the light emitted by the Sun (150.000.0000 Km) needs 8 minutes. Instead, negative energy always travels faster than the speed of light, enabling instantaneous transmission of signals, independently from spatial and temporal distance.

In 1980 Alain Aspect performed the first EPR (Einstein-Podolski-Rosen) experiment which proved the possibility of transmitting information instantaneously despite the distance (Aspect, 1982). The EPR experiment had been suggested by Einstein in 1935 and consisted in separating two electrons which share the same quantum state (the same orbit around an atom), take them at a distance and measure their spin. Electrons can have clockwise or anticlockwise spins; clockwise spins go upwards, while anticlockwise spins go downwards. The Pauli exclusion principle showed that two electrons which share the same orbit of an

atom need opposite spins. This law remains active also when the two electrons are separated. According to Pauli's exclusion principle, if the first electron inverts its spin the second electron is forced, instantly, to invert its speed, regardless of the space and time which separates them. In other words, an electron receives the information about the change of spin instantly, even if at the opposite side of the Universe (Corbucci, 2005).

In 1980, the EPR experiment was performed between Rome and Geneva: 2 electrons which shared the same quantum state were separated at the I.N.F.N. (National Institute of Nuclear Physics) in Rome and one was carried (confined in a special magnetic container) to the C.E.R.N. (European Center for Nuclear Research) of Geneva. At Geneva the spin of the electron was changed and instantly the spin of the second electron in Rome changed, as foreseen by Pauli's exclusion principle.

Einstein had not predicted that the information between the two electrons could travel at a speed greater than light, but he had suggested this experiment in order to show that it was possible to know all the information about particles (position and speed), contradicting in this way Heisenberg's uncertainty principle.

The EPR experiment has been replicated in laboratories all over the World, and shows that when two coupled electrons are separated the measure performed on one of them coincides instantly with the measure performed on the other. It is as if the second electron knows what is happening to the first one, regardless of the distance which separates them. In this way it is possible to transmit information at any distance and instantaneously. In the first EPR experiment it was estimated that the transmission of the information had been at least 20 times faster than the speed of light. In a more recent experiment performed in Geneva by Nicolas Gisin (Baggott, 2003), a speed between 20,000 to 30 million times the speed of light was observed.

These data show that the transmission of the information did not use positive energy (+E), which is limited to the speed of light, but negative energy (-E), providing in this way evidence in support of the empirical existence of this type of energy.

2.4 Microcosm and macrocosm: time symmetry and asymmetry

In 1951 John Stewart Bell showed the existence of the CPT symmetry (Charge Parity and Time reversal symmetry), also known as time symmetry, according to which in the microcosm a perfect time symmetry is observed among all the physical laws (Nambu, 1985). CPT symmetry provides empirical evidence of the fact that the laws in the microcosm are governed by the dual solution of the energy equation, which implies the dual direction of time and causality (Taylor, 2001).

But in 1982 Frautschi proved that in the macrocosm entropy prevails, because our universe is expanding, and for this reason all physical laws are governed by entropy and time flows from the past to the future. This is the reason why our experience of time is that of events which flow constantly from the past to the future, with causes located in the past. The division microcosm/macrocosm suggests two different levels of description of reality:

- that of classical physics (macrocosm), in which time flows from the past to the future and classical causality reigns;

- that of quantum physics (microcosm), in which time is symmetrical and unitary and causality can flow in both directions: from past to future and from future to past.

2.5 Hotson and the criteria for a successful scientific theory: the Standard Model and the Non Standard Model.

The negative energy solution 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).

The negative energy solution and waves which propagate backward in time from the future to the past were considered to be unacceptable, even though experimental evidence was providing empirical proof of their existence. For this reason, 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 at a negative null result. In this way the energy associated with the spin was removed (p), and it was no longer considered in the calculations. Heisenberg used this artifact to show that the negative energy solution was non-existing, and that only the positive half of the equation was real. As a consequence physics split into 2 great movements:

- The Standard Model (SM), which accepts only the positive energy solution and declares that causality can only be mechanical (past-future).
- The Non Standard Model (NSM) which accepts both energy solutions (+E and -E) and asserts the existence of causality and retrocausality.

In this paragraph Hotson's considerations comparing SM and NSM will be shortly described. Hotson uses 6 criteria in order to compare scientific models:

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 unexplained or anomalous data, or data dismissed as a "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.

- First criterion: Ockham's Razor

The criterion known as "Ockham's razor" was stated by Guglielmo of Ockham (1295-1349) and affirms (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 1920s the 92 atoms derived from the combination of the 3 basic particles (electrons, protons, neutrons) and 4 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.

While the NSM reduces all the elements to the dual solution of the energy/momentum/mass equation the SM model, which refuses the negative energy solution, is forced to use 36 basic particles, from which the 3 basic particles and 4 basic forces are derived, and then the atoms and all the chemical combinations of the physical world.

Hoston shows the existence of two sequences:

- That of the NSM which from the two solutions of energy moves to the 7 elements (3 particles and 4 forces), to the 92 atoms and to all the combinations of matter (sequence: infinite → 92 → 7 → 2).
- That of the SM which from 36 particles moves to the 7 elements, to the 92 atoms and to all the combinations of matter (sequence: infinite → 92 → 7 → 36).

If the first sequence is correct the SM would be wrong; if the second sequence is correct the Ockham criterion 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 the energy/momentum/mass equation would suffice in order to produce all the complexity of the university.

Comparing SM with NSM it is clear that the Ockham criterion is satisfied only by the dual solution of Einstein's energy/momentum/mass equation and that SM 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 NSM, SM requires at least nineteen parameters which have to be entered by hand, among which the rest mass of the electron which results infinite. 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 SM considers only the positive energy solution, cohesive forces continue to be un-explained and gravity remains a mystery.

- Third criterion: mathematically consistent*.*

Closely related to the second criterion, the third criterion requires that no equation should lead to impossible results, such as the ratio between two infinite values. In the Standard Model divisions among infinites are common, and this impossible operation can be solved only entering the results manually. 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. For example the SM calculation of many ordinary values, such as the rest mass of the electron, results infinite. However, from experiment we know the electron's rest mass to be 0.511 MeV. To get rid of this "impossible" result, "renormalization" is invoked: the desired value of 0.511 MeV is then simply entered by hand. This admitted fudge would not work if we did not already know the answer. 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 NSM which always produces results which are mathematically consistent and coherent with empirical data produced by 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 SM lead to indeterminate results, which require the knowledge of the values which have to be entered manually, NSM always produces 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. SM refuses retrocausality 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 energy, 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 is the EPR experiments which use the spin of particles in order to instantly transfer information at any distance.

The converging properties of negative energy permit 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 SM.

- 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. SM produces a wide range of indeterminate results which cannot be verified whereas NSM produces results which are always exact and can be verified empirically.

Some considerations

Hotson concludes his article saying that Heisenberg's refusal of the negative solution 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 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 NSM equations the energy of the spin is a component of the equation, while in SM it is an intrinsic property of electrons and positrons which is not taken into account in the equations. Not taking into account the energy which is associated to the spin, SM behaves as if this energy can be created from nothing, an implicit property of electrons and protons, for which no explanation has to be provided. This approach leads to the paradox that the electron created by the photon has, according to SM, 16 times more energy than the photon which has created it; in this way SM 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.

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 SM 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 this strangeness disappears and causal chains becomes clear.

2.6 Why the negative energy solution is still at the boundaries of physics?

Many different reasons keep the negative energy solution at the boundaries of physics:

1. NSM requires the shift from the paradigm of mechanical causation to the paradigm of supercausality (causality + retrocausality). Even if the new paradigm is supported by

empirical evidence it conflicts with the general intuitive way we perceive time and causality. Similar to the difficulties which Galileo encountered when he suggested the shift from the geocentric to the heliocentric paradigm, nowadays the empirical evidences do not seem sufficient to justify the shift from the old to the new paradigm. Galileo brought incontrovertible evidence that Earth circled around the Sun, but this evidence was considered simply unacceptable; similarly today, the incontrovertible experimental evidences which support NSM and supercausality, collide with our intuitive perception of time and are therefore difficult to accept.

2. NSM has lead to the discovery of ZPE (Zero Point Energy). This discovery can be related to the fact that **(+E) + (-E) = 0,** which means that positive and negative energy together produce a null result. Therefore the existence of a practically unlimited source of energy at the point 0 has been predicted. Scientific institutes such as the *Calphysics Institute* and the *Infinite Energy Institute* study Zero Point Energy (ZPE) and Vacuum Energy. The "Union of Concerned Scientists" (founded in 1969 at MIT, which now unites more than 100,000 scientists and researchers) has repeatedly declared that information relative to this infinite source of energy is systematically distorted and opposed in order to protect the corporative interests of the petrol industries. According to various sources, this might explain why Eugene Mallove, Director of the Infinite Energy Institute was brutally murdered.

3. It is important to remember that in 1979 Ilya Prigogine (Nobel 1977) showned that the rejection of the negative solution of energy has blocked the understanding of the mechanisms which are behind the qualities of the living systems, dividing in this way culture in two: on one side mechanical science, on the other side life and finalities (religion). In this way a balance between mechanistic science (causes located in the past) and religion (causes/finalities located in the future) was established. Prigogine names this balance the "old alliance". According to Prigogine, the widening of science to include the negative energy solution will pave the way to a new alliance between science and religion, leading towards a new culture in which science and religion will unite in a new vision of reality. Prigogine names this vision "the new alliance" (Prigogine, 1979).