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Different events that led to the Physics of the XX Century to the absurd

by
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Modern Physics has had a great influence on many aspects of human believe. It has become the main argument of natural science and its influence goes beyond technology. It has changed thought and culture and has modified man's conception of the Universe. The exploration of the atomic and subatomic world in the twentieth century has revealed an unsuspected limitation of classical ideas and has necessitated a radical revision of many of our basic concepts. The concept of matter in subatomic physics, for example, is totally different from the traditional idea of a material substance in classical physics. The same is true for concepts like space, time, or cause and effect. These concepts, however, are fundamental to our outlook on the world around us and with their radical transformation our whole world view has begun to change. These changes, brought about by Modern Physics, have been widely discussed by physicists and by philosophers all over the twentieth century.

The primary cause of these changes and transformations resides in a few events, facts and discoveries; all of them pointing in a direction against classical ideas. The events, facts and discoveries which have led Modern Physics to the present situation are the following:

1 - The optical experiment carried out by Michelson and Morley, first performed in 1887. An interferometer was used to attempt to detect a difference in the velocities of light in directions parallel and perpendicular to the earth's motion. The negative result caused such a problem to Physics that nobody was able even to venture a solution until 1905, 18 years later, when Albert Einstein developed the Special Theory of Relativity. The mechanical model was in the end found to be definitely in contradiction with the result of this experiment.

2 - The introduction of Planck's constant "h" in 1901 as a fundamental constant. It is equal to the energy of any quantum of radiation divided by its frequency. The result of introducing into physics Planck's constant "h" has been the recognition that the energy emitted by an orbiting electron can only have a set of discrete values. There are only a few allowed electron orbitals corresponding to certain "stationary states" and the energies of the radiation emitted by these electrons are said to be "quantized".

3 - The statements made by Einstein:

- Mass is a form of energy according to the equation $E = m c^2$. Even an object at rest has energy stored in its mass.

- Mass increases with speed according to the expression

$$m_v = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

This means that the particle can no longer be seen as a static object, but has to be conceived as a dynamic pattern, a process involving the energy which manifests itself as the particle's mass. Mass is a dynamic quantity associated with activity or with processes.

4 - In 1913, the idea of the atom as a system of electrons orbiting around the nucleus, similar to that of the planets moving around the sun, in circular and elliptical orbits, had to be abandoned. The laws of Electromagnetic Theory of James Clerk Maxwell (1831-1879) state that electrons orbiting about the nucleus must radiate energy in the form of electromagnetic radiation, such as light or X rays, as they are subjected to accelerating forces. Consequently, the electron would soon collapse into the nucleus. As atoms are stable, it was time to alter the concept of elementary particles. To think of elementary particles as passive well-defined objects with an electric charge, in the same way as Classical Physics had conceived them, was abandoned. At the same time angular momentum and magnetic moment, when referred to elementary particles, could not be any longer conceived as the result of a gyration. They were just intrinsic properties of the particles.

These were the four obstacles physics had to face at the beginning of the century. Each of them strong enough to make many concepts change. And the four obstacles had appeared in a short time. It was time to modify some of the honored concepts of classical physics and to change dramatically the way of thinking. Physicists, at the beginning of the twentieth century, felt that the foundations of their world view were shaken by the new experience of the atomic reality.

Two new theories, Relativity and Quantum Mechanics, came to fill the vacuum. And they have been very successful in solving many problems. It has been said that "Relativity Theory and Quantum Mechanics have been the two foundations of twentieth-century physics, which have forced us to see the world in a completely different way, in which the whole of science seems to collapse like a house of cards".

According to the Special Theory of Relativity, the velocity of light in empty space, determined by Maxwell's theory, is the same whatever the relative speed of the source and the receiver, regardless of the speed of either of these with respect to the universe as a whole. The Special Theory of Relativity showed that it was no longer admissible to consider space-time properties always as attributes of individual objects. The question "What is the length of this rod? has a unique answer only if it is specified with respect to what system of reference one determines the length. The same is true for the duration of physical processes and the simultaneity of distant events. It is not possible to give an absolute meaning to the notion of simultaneity of distant events.

Classical Physics has always considered material particles as "mass points" and Newton saw them as "small, solid, impenetrable and indestructible objects out of which all matter was made. They are so very hard as never to wear or break in pieces". Matter was therefore always conserved and essentially **passive**. In Classical Physics, the mass of an object had always been associated with an indestructible material substance, with some "stuff" of which all things were thought to be made. In order to put the effect of the force of gravity on a mass point into a precise mathematical form, Newton had to invent completely new concepts and mathematical techniques, those of differential calculus. This was a tremendous intellectual achievement and has been praised by Einstein as "perhaps the greatest advance in thought that a single individual was ever privileged to make".

But when Einstein showed that mass is a form of energy, Newton's concept of mass was shattered. Elementary particles could never be essentially passive. They had to possess some kind of dynamic characteristic.

On the other hand, the existence in the atom of "stationary states" and the fact that the energies of the emitted radiation is "quantized", as well as the fact that the atom could not been considered as a planetary system of electrons orbiting around the nucleus added confusion to the situation.

In the 1920s an international group of physicists, including Niels Bohr from Denmark, Louis De Broglie from France, Erwin Schrödinger and Wolfgang Pauli from Austria, Werner Heisenberg from Germany and Pauli Dirac from England joined their forces across all national borders and found the mathematical formulation of Quantum Mechanics.

If elementary particles were not those "small, solid, impenetrable, indestructible and essentially passive objects" as Newton had conceived them, it was necessary a new concept to define those particles.

The new concept envisages the subatomic units of matter as very abstract entities which have a dual aspect. Depending on how we look at them, they appear sometimes as particles, sometimes as waves. This property of matter is very strange. It seems difficult to accept that something can be, at the same time, a particle, an entity confined to a very small volume, and a wave, which is spread out over a large region of space.

The contradiction between the particle and the wave picture was solved in a completely unexpected way: "at the subatomic level, matter does not exist with certainty at definite places, but rather shows tendencies to exist". In the formalism of Quantum Theory, "these tendencies are expressed as probabilities and are associated with mathematical quantities which take the form of waves. This is why particles can be waves at the same time. They are not real three-dimensional waves like sound or water waves. They are **probability waves**, abstract mathematical quantities with all the characteristic properties of waves which are related to the probabilities of finding the particles at particular points in space and at particular times ". Quantum Mechanics defines an elementary particle as "**a localizable system for which the position observables constitute a complete system of compatible observables**". And in the words of Niels Bohr: "**Isolated material particles are abstractions, their properties being definable and observable only through their interaction with other systems**".

A typical quantum effect is that whenever a particle is confined to a small region of space it reacts to this confinement by moving around, and the smaller the region of confinement is, the faster the particle moves around it. The particles confined to dimensions of the size of nuclei must move so fast that their speed should come close to the speed of light. The reasoning of Quantum Mechanics is this: "Being of the same quantum nature as electrons, the nucleons respond to their confinement with high velocities, and since they are squeezed into a much smaller volume their reaction is all the more violent. They race about in the nucleus with velocities close to the speed of light. Nuclear matter is thus a form of matter entirely different from anything we experience "up here" in our macroscopic environment. We can, perhaps, picture it best as tiny drops of an extremely dense liquid which is boiling and bubbling most fiercely".

This is why, after the formulation of Quantum Theory, it became clear that a complete theory of nuclear phenomena must not only be a Quantum Theory, but must also incorporate Relativity Theory as every description of natural phenomena involving velocities close to the speed of light has to take

Relativity Theory into account. And this is what Professor Fritjof Capra of the University of California in Berkeley has said about that: "**What we need for a full understanding of the nuclear world is a theory which incorporates both Quantum and Relativity Theory. Such a Theory has not yet been found**, and therefore we have as yet been unable to formulate a complete theory of the nucleus. Although we know quite a lot about nuclear structure and about the interactions between nuclear particles, we do not yet understand the nature and complicated form of the nuclear force on a fundamental level. The proton has a structure, but Quantum Mechanics has not yet found an economic set of observable properties from which it can be defined, and on the basis of which prognostications can be made. In rather general terms, the basic question facing high energy physics at the moment is to establish the elementary set of observables appropriate to sub-nuclear physics. Quantum Mechanics has to admit that **it is impossible to specify the observables in terms of which all physical properties can be defined**. We do have several "quantum relativistic" models which describe some aspects of the world of particles very well, but **none of them is free from mathematical difficulties, and they all contradict each other in certain ways**, but all of them reflect the basic unity and the intrinsically dynamic character of matter. **The fusion of Quantum and Relativity Theory into a complete theory of the particle world is still the central problem and great challenge of modern fundamental physics".**

Note that there exist certain points of similarity between Quantum Mechanics and the Theory proposed in the Book "A New Physics for a New Millennium". It consists of a 286-page book that has a Certificate of Registration issued under the Seal of the United States Copyright Office – The Library of Congress in accordance with title 17, United States Code. The complete Book can be requested by e-mail at the address jdejuand@telefonica.net and will be sent free to the applicant by the same system. Let us remember the above concept: "A typical quantum effect is that whenever a particle is confined to a small region of space it reacts to this confinement by moving around, and the smaller the region of confinement is, the faster the particle moves around it. The particles confined to dimensions of the size of nuclei must move so fast that their speed should come close to the speed of light". The Theory proposed in this Book says: "More energy means smaller size and more movement (higher frequency). The speed of light is always present inside the particle".

There is another point of similarity: When Quantum Mechanics tried to explain the significance of Schroedinger's equation, the theory seemed to imply the existence of a minimum proper length-and time-interval. The statement was made that, in considering the motion of a fundamental particle, no physical significance could be given to an interval of proper length less than h/mc or of proper time less than h/mc^2, m being the rest mass of the particle. If we analyze these two expressions, bearing in mind the formulas of the Theory put forward in this Book: $mc^2 = h \nu$; $2\pi R \nu = c$; we see that the minimum proper length h/mc is equal to $2\pi R$ and the minimum proper time is equal to $1/\nu$. The minimum length interval in Schroedinger's equation is precisely the particle equator's length proposed by this Theory. And the minimum time interval is the time it takes the particle to complete a turning around its axis. And, as we have seen in a previous article, these are precisely the units of length and time proposed by this Theory, by adopting a system of units in which the speed of light is the unit of speed and Planck's constant is equal to 1. In some way, the ideas of Schroedinger were coincident with the fact that material particles have their own feelings concerning length and time. One of the outstanding exponents of this quantum view, implying the existence of a principle of least time, was Arthur March, who proposed a system of geometry based on the concept of the existence of a minimum length, space having the character of a cell-like structure. He believed that, with the acceptance of this concept, difficulties concerning the existence of infinite magnitudes in quantum electrodynamics and nuclear field theories could be avoided.

There is another point of similarity. In Classical Physics, the constituents of matter had always been considered as being either elementary units which were indestructible and unchangeable, or as composite objects which could be broken up into their constituent parts; and the basic question was whether one could divide matter again and again, or whether one would finally arrive at some smallest indivisible units.

This is Dirac's answer to the question of the division of matter: "When two particles collide with high energies, they generally break into pieces, but these pieces are **not smaller than the original particles**. They are again particles **of the same kind** and are created out of the energy of motion (kinetic energy) involved in the collision process. The only way to divide subatomic particles further is to bang them together in collision processes involving high energies. This way, we can divide matter again and again, but we never obtain smaller pieces because we just create particles out of the energy involved in the process. The subatomic particles are thus destructible and indestructible at the same time".

If you read carefully this paragraph from Dirac, you will see that it is in complete agreement with this Theory, except the last sentence, a real paradox: "The subatomic particles are thus destructible and indestructible at the same time". Dirac is explaining what happens in the process of the division of matter. He is right, but he does not see any physical reality behind the process and ends up in a paradox.

The only way of looking at this process is by **knowing exactly the physical reality: Matter is a form of energy which only exists as turning goo. This goo is subjected to its own simple mechanics**:

$$\mathbf{2 \pi R E = h c}$$

$$\mathbf{2 \pi R \nu = c \ (at \ rest)}$$

$$\mathbf{m c^2 = h \nu} \ .$$

Once we know the physical reality, we can even explain Dirac's paradox: Subatomic particles are destructible and the outcome of the hypothetical successive destruction is "again particles of the same kind", formed by turning goo. Each time this process would take place particles would be larger and less energetic (lower frequency), the limit case being when energy and frequency tends to zero and size tends to infinity. Then mass would disappear.

Note that I have said "hypothetical successive destruction". The reason is that Nature has been compelled to admit only a few stable particles. Otherwise the Universe would not exist. I invite future theorists to try to discover the physical explanation of the mass spectrum. I must confess that I do not see any path to go into the problem. It is a question of time and inspiration. I imagine that the solution to this problem will be related with some intrinsic characteristic of "goo" and with the correlation between "goo" and the electric component.

The new concepts of Quantum Theory, considered as "abstruse" by some physicists, created a source of difficulties from the beginning in the late twenties of last century to the present day. They have been the subject of numerous controversies and they continue to worry contemporary physicists. There is no agreement. Mathematics and statistics were much more important than a physical reality which the mind could grasp. As Sir James Jeans stated: "The Great Architect of the Universe now begins to appear as a pure mathematician".

Although Einstein was one of the founders of Quantum Mechanics, he was also one of its strongest critics. He questioned its completeness and here is what he wrote about this: "I reject the basic idea of contemporary statistical Quantum Theory, insofar as I do not believe that this fundamental concept will prove a useful basis for the whole of Physics. I am, in fact, convinced that the essentially statistical character of contemporary Quantum Theory is solely to be ascribed to the fact that this Theory operates with an incomplete description of physical systems".

And he added: "All my attempts to adapt the theoretical foundation of physics to this new type of knowledge failed completely. It was as if the ground had been pulled out from under one, with no firm foundation to be seen anywhere, upon which one could have built".

According to Einstein "**Quantum Mechanics does not furnish a complete description of the physical reality** of individual systems but merely describes the statistical properties of ensembles of systems". Einstein took the position that "**Physics is concerned with the description of physical reality**". He affirmed that "**an objective reality exists which does not depend on our observation**. ***A priori,* we do not know what it is**, **but this precisely is the task of Physics: to establish the properties of the existing physical reality**". Einstein was aware that this position required a "**meaningful definition of physical reality**", and that this was not easy. It was considered by some as impossible "in physical terms alone".

In the late fifteenth century the study of nature was approached in a truly scientific spirit and experiments were undertaken to test speculative ideas. Galileo was the first to combine empirical knowledge with mathematics and is therefore seen as the father of modern science.

Modern science is mainly concerned with rational knowledge. This knowledge is acquired through the process of scientific research which can be seen to proceed in three stages. The first stage consists in gathering experimental evidence about the phenomena to be explained. In the second stage, the experimental facts are correlated with mathematical symbols and a mathematical scheme is worked out which interconnects these symbols in a precise and consistent way. Such a scheme is usually called a mathematical model or, if it is more comprehensive, a theory. This theory is then used to predict the results of further experiments which are undertaken to check all its implications. At this stage, physicists may be satisfied when they have found a mathematical scheme and know how to use it to predict experiments. This way of basing all theories firmly on experiment is known as scientific method and shows the empirical attitude of modern science.

In the twentieth century physicists were able to tackle the question about the ultimate nature of matter experimentally. With the help of a most sophisticated technology they were able to probe deeper and deeper into nature, uncovering one layer of matter after the other in search for its ultimate "building blocks". Thus the existence of atoms was verified, then their constituents were discovered, the nuclei and electrons, and finally the components of the nucleus, the protons and neutrons, and many other subatomic particles.

The delicate and complicated instruments of modern experimental physics penetrate deep into the submicroscopic world, into realms of nature far removed from our macroscopic environment, and make this world accessible to our senses. However, they can do so only through a chain of processes ending, for example, in the audible click of a Geiger counter, or a dark spot on a photographic plate. What we see, or hear, are never the investigated phenomena themselves but always their consequences. The atomic and subatomic world itself lies beyond our sensory perception. It is, then, with the help of modern instrumentation that we are able to "observe" the properties of atoms and their constituents **in an indirect way,** and thus to "experience" the subatomic world to some

extent. **The knowledge about matter at this level is no longer derived from direct sensory experience**.

Then, there is a limit beyond which we cannot observe directly the subatomic world. It seems natural that, beyond that limit, the empirical method, which relies on observation and experiment and not in theory, is no longer valid. Beyond that limit, direct observation and experiment must be forgotten. What is the sense of imagining an observer and an observed system when the observed system can never be directly observed? And if the observer tries to observe the observed system it is modified so that the observation is not reliable. The only way of acquiring knowledge beyond that limit is theory.

But this theory should be **complete, consistent, simple and logica**l. It is a general rule that **the significance of a theory depends on the economy of its concepts and the generality of its conclusions.** In words of James Clerk Maxwell: "The first process in the effectual study of the sciences must be one of **simplification and reduction of the results of previous investigations to a form in which the mind can grasp them**". And besides that, the theory must be able to establish the properties of **the existing physical reality**, that meaningful definition of physical reality, required by Einstein, and considered by some as impossible "in physical terms alone". This physical reality should be defined through very few and simple laws. This theory must be **in agreement with all existing knowledge** and must be able "**to observe the unobservable**" by giving explanation of phenomena which form part of the physical reality but cannot be observed. In the case of elementary particles, the theory should be able to define what they are, where they are, what they are doing. In a word, the theory must be able to explain in detail what is happening at the subatomic level, although experimenters will never be able to go on with their empirical method based on observation and experiment.

Experimenters will never be able to observe directly an electron orbiting around the nucleus. But, if we know the laws of electric attraction and the laws of elementary particles proposed by this Theory, we shall be able to **deduce** what the electron is doing all the time. Experimenters will never be able to check the fact that the turning axis of the electron is adjusting its position whenever the speed of the electron changes along the orbit. But this adjustment can be deduced by reasoning when we know that there is a law stating that every differential element of the electron's equator must necessarily travel at the speed of light. This phenomenon is out of all observation and consequently cannot be subjected to any empirical method. The empirical method, which requires an observer who sees and feels the phenomenon, must be substituted, beyond certain limit, for the deductive method. **There is a limit for observation and experiment, beyond which it does not make sense to talk of observer and observed system.**

According to Quantum Mechanics "it does not make sense to ask what the real electron is doing during the intervals between the observations on which the state function is based. At this question the physicist can only reply: "I do not know. If you want an answer to that you must ask a philosopher. He won't know either, but he will probably tell you" ". The answer to this question, concerning orbital electrons, is that the electron actually follows a classical orbit with definite position and momentum which, owing to our clumsiness and the limitations imposed by our probes, we are unable to observe.

There is an evident lack of harmony between Relativity and Quantum Mechanics. These are some of the paragraphs I have mentioned before:

- Professor **Fritjof Capra** of the University of California in Berkeley:

- "**What we need for a full understanding of the nuclear world is a theory which incorporates both Quantum and Relativity Theory. Such a Theory has not yet been found**".

- "**None of the** "**quantum relativistic models**" **is free from mathematical difficulties, and they all contradict each other in certain ways**"...

- "**The fusion of Quantum and Relativity Theory into a complete theory of the particle world is still the central problem and great challenge of modern fundamental physics**".

- **Einstein**:

- "**I reject the basic idea of contemporary statistical Quantum Theory, insofar as I do not believe that this fundamental concept will prove a useful basis for the whole of Physics**".

- "**All my attempts to adapt the theoretical foundation of physics to this new type of knowledge failed completely. It was as if the ground had been pulled out from under one, with no firm foundation to be seen anywhere, upon which one could have built**".

- "**Quantum Mechanics does not furnish a complete description of the physical reality of individual systems but merely describes the statistical properties of ensembles of systems**".

- "**Physics is concerned with the description of physical reality**. **An objective reality exists which does not depend on our observation**. ***A priori,*** **we do not know what it is**, **but this precisely is the task of Physics: to establish the properties of the existing physical reality**".

And the next paragraph is from H. T. Flint, formerly Professor of Physics at Bedford College, London, in his book "The Quantum Equation and the Theory of Fields":

"If the electron is regarded as a point charge the energy of the field is infinitely great. To avoid this difficulty it has been necessary to introduce a small but finite dimension to the charged particle. Moreover **it is difficult to introduce the concept of a finite particle into the Quantum Theory and, with it, to satisfy the demands of the Special Theory of Relativity**".

I shall also recall some paragraphs that I have mentioned in the Book "A New Physics for a New Millennium":

- Experimenters with neutrinos: " **A new physics will have to be developed to account for the missing solar neutrinos**, one of the most puzzling and provocative mysteries in the physical sciences."

- Dr. John N. Bahcall, of the Institute for Advanced Study at Princeton, N. J., when dealing with the same problem of solar neutrinos: He found the new evidence "very convincing" and said that the most likely explanation involved "**some new physics, not new solar astronomy**". He said this was the "**overwhelming consensus**" of physicists at a recent workshop on neutrinos.

- Martinus J. G. Veltman, professor of physics at the University of Michigan, who has worked at the Stanford Linear Accelerator Center: "Indeed, modern theoretical physics is constantly filling the vacuum with so many contraptions such as the Higgs boson that **it is amazing a person can even see the stars on a clear night**!"

- Alan D. Krisch, Professor of Physics at the University of Michigan: "The Quark Theory of particle scattering, Quantum Chromo dynamics (QCD) has made few predictions that could be verified. QCD is a flexible theory and has been easily able to adjust to most new scattering data after the act. I am a rather formal scientist, I am impressed less by adaptability than by predictive power. Perhaps I shall eventually change my old-fashioned view that **particles must be well-defined objects**. I believe that a simple concept should not be abandoned in favor of a more complex one until the hard experimental evidence is overwhelming. Perhaps we should also search for **a new and more useful theory** of interactions of spinning protons and of their spinning constituents. Perhaps measurements made in the near future will yield a clue that will help some clever young theorist to finally understand the proton's constituents and their strong forces".

- Abner Shimony in "The Reality of the Quantum World": "We live in a remarkable era in which experimental results are beginning to elucidate philosophical questions. The bizarre and counterintuitive character of Quantum Mechanics has led some investigators, **including Einstein, to believe that quantum - mechanical descriptions of physical systems are incomplete and in need of supplementation.** The experimental results reveal more clearly than ever that we live in a strange "quantum world" that defies comfortable, commonsense interpretation".

Can anyone say that the present situation of physics is satisfactory? But, on the other hand, can anyone say plainly that most theoretical physicists of last century are or have been wrong? Nobody can say that, unless he is out of his mind or he comes up with a new theory and "a New Physics". But this theory must be capable of giving solution to the four obstacles physics has encountered in the last century and at the same time capable of giving answer to all the additional problems physics is facing today: nuclear forces, neutrinos, black holes, unseen matter, matter and antimatter, finite speed of mater equal to the speed of light, angular momentum and magnetic moment of particles, Heisenberg's Uncertainty Principle, etc. In a word, this theory should be able to reach the "physical reality" which might fit in with most events of the physical world at the subatomic level.

Let us now see schematically the actual path followed by physics in its attempt to solve the problems created by the four obstacles in comparison with this Theory's way. Classical ideas about elementary particles were abandoned when Einstein stated that mass is a form of energy. This is something that nobody could discuss. Particles should be considered as something **dynamic** against the **passive** nature supposed by Classical physics. The introduction of Planck's constant into physics and the fact that electrons orbiting around the nucleus should give off energy, according to Maxwell's laws, made physics revise the concept of particles. Physics was facing a dilemma. There were two courses of action. One of the paths led to abandon the logical idea of the atom as a very small solar system. Particles were something more difficult to understand than well-defined objects with electric charge. Otherwise orbiting electrons should emit energy. The other path, which certainly was not the one chosen by physics, consisted in maintaining the idea of the atom as a planetary system, in the hope of reaching in the future the right definition of particles capable of explaining the fact that orbiting electrons do not emit energy. This second option should imply that electrons were something more complex than simple charge points.

The first option, the one which made physics abandon the logical idea of atoms as planetary systems, suggested that particles could no longer be considered as well-defined objects. Particles could be anything but well-defined objects and we had not the right to try to know what they really are. The obstacle was the impossibility of observing directly the particle following the orthodox empirical method. The result of this situation was the idea that particles are probability waves, abstract mathematical quantities, or, in the words of Niels Bohr, abstractions. That new concept of matter had nothing to do with Einstein's statement that mass is a form of energy. I do not say that the new

concept was against Einstein's ideas about matter, but it seems as if Quantum Mechanics and Einstein were talking about completely different things. I have mentioned before some Einstein's comments rejecting the basic idea of statistical Quantum Theory.

On the other hand this situation helped physics to give an explanation of some phenomena by admitting that the nature of physics was such that mankind was unable to comprehend. Paradoxes were accepted by some as normal events, without even considering that the cause of the paradox could be an inconsistent theory. There was an immense sack which accepted all that was difficult or impossible to understand. This was the result of choosing the first option. And this option had appeared because the behavior of orbital electrons could not be explained. The main protagonist of this drama, the electron, which made physics turn 180º on its path, was completely unknown. Nobody had defined what the electron could be. A charge point with a certain mass, a certain spin and a certain magnetic moment, impossible to observe. Even its size was completely unknown. Nobody could say anything about what the real cause of its mass, its spin and its magnetic moment was. But nobody thought of the possibility of looking for the right definition of the electron which could help physics to solve the problem of orbiting electrons. **The electron, something which has not yet been defined, has marked the path of physics along the twentieth century until now.**

The second option was abandoned without paying any attention to it. The logical idea of atoms as planetary systems could not even be considered as orbiting electrons would emit energy. But let us see what the line of reasoning could have been in case of paying some attention to this second option. We need a definition of elementary particles with some **dynamic** features so that they can be a form of energy. On the other hand, particles, at least electrons, cannot be charge points. It is quite clear that, if electrons were charge points, they would give off energy when orbiting around the nucleus. So, to work inside this second option, we must admit that **electrons are not charge points**, they must have their charge distributed in some way. So far, we have two firm conclusions: **dynamic features and certain complexity in charge distribution.**

Note that the fact of assigning certain complexity in charge distribution to the electron does not solve the problem of orbiting electrons not emitting energy. It will be necessary to reach a definition of the electron capable of explaining this phenomenon. It is not an easy job. I should say that it is an impossible job, unless we are in the right path. The task is much more difficult to perform, if we consider that the definition of elementary particles, besides solving the problem of orbiting electrons, should fit in with a great number of well known facts. Among them, size of nucleons in the range of 10^{-13} cm., time on the nuclear scale in the range of 10^{-23}, the known experimental values of spin and magnetic moment, speed of light as limit speed of matter, etc.

The reader must accept that giving a definition of material particles without ending up in a complete mess is impossible unless the definition is correct. And, if the definition is correct, the problem of orbiting electrons would be solved sooner or later. We have seen in the Post entitled "The Standard Model is wrong", page 17, that there is an irrefutable proof that the Bohr Atom is the correct model for the atom and that it works as a planetary system since the emissions of the hydrogen atom obtained experimentally, the Lyman, Balmer and Paschen series, coincide with the emissions which result from a situation in which the atom consist in a planetary system. This proof seems to have gone unnoticed by modern physicists who have condemned from the beginning the idea that the atom behaves just like a planetary system in which negatively charged electrons are rotating around a positively charged nucleus. The problem is that orbital electrons, supposed to be point negative charges, should radiate energy and therefore end up rushing to the core. If the electrons were simple point charges the Bohr atom would collapse since they would be constantly emitting energy.

This Theory shows that the explanation of why orbiting electrons do not emit energy has been possible by combining the turning movement of the electron around its own axis and the translation movement along the orbit. And this has been possible simply by applying the definition of material particles proposed by this Theory. The explanation is quite amazing: the electron adjusts itself through a very slight displacement of its turning axis (see Article "Bohr Atom. Orbital electrons do not emit energy"). But remember that, when I chose the second option, I had not yet reached the definition of material particles. I went into the second option without knowing in advance where it might lead and knowing that, if this option were the correct one, the solution to the problem of orbiting electrons would be made clear one way or another. And I also was aware that, if the first option were the right one, my conclusions would be a complete mess. Orbiting electrons would not need any explanation, they would behave like ghosts.

In any case, I felt very uncomfortable having to admit that my body was a huge amount of abstract entities, abstract mathematical quantities. The idea of my body being made out of well-defined objects, subjected to simple and understandable rules, was much more pleasant.

Coming back to the line of reasoning inside the second option, we need a definition of particles which implies a **dynamic** pattern. And, at the same time, there must be some kind of charge distribution. At least, **electrons cannot be charge points.** The next step seems to me quite clear: If particles are not abstractions and have a dynamic pattern, there must be some kind of movement inside the particle. But there are two experimental facts, both of them translated into numerical data: spin and magnetic moment. These two facts are well related with the idea of gyration. And besides that, the two numerical data involved the Greek letter π, which is the symbol of the ratio of the circumference of a circle to its diameter, equal to 3,14159. It was a clear sign of circular movement which showed that the definition of particles would be related with something turning, some kind of whirl.

The problem was that all elementary particles had the same spin, a strange expression $h/4\pi$, the constant "h" being more in agreement with Quantum Theory than it was with einsteinian ideas and that each particle had its own magnetic moment. The reader can have the opportunity to check all the figures and demonstrations which show that the adjustment of the values of spin and magnetic moment of all particles leads to the simple laws of this Theory.

This Theory contemplates elementary particles as "well defined objects", with a dynamic pattern, which completely justifies the fact that mass is equivalent to a certain amount of energy. Note that nobody says that mass is energy. This Theory goes even further; it says that **mass is just movement, it simply is moving goo.** A particle at rest is turning goo. More mass means more frequency and smaller size. A moving particle, whatever the movement may be, has, besides the internal mass corresponding to the turning movement at rest, the mass caused by this additional movement. And when all movement ceases, including turning movement, mass disappears. When Einstein said that mass increases with speed he was right, but it is only part of the truth. **The whole truth is that mass is just movement.**

And all this is explained through two very simple laws, which can be stated by understandable words, while Quantum Mechanics has to resort to "abstract entities which have a dual aspect", impossible to define. As a matter of fact Quantum Mechanics has not even tried to define what particles are, unless one can consider this a definition: "Particles are probability waves, abstract mathematical quantities with all the characteristic properties of waves which are related to the probabilities of finding the particles at particular points in space and at particular times. Matter does

not exist with certainty at definite places, but rather shows tendencies to exist. A particle is a localizable system for which the position observables constitute a complete system of compatible observables". For Quantum Mechanics the only cause of concern is "where" and "when". "The concept of a distinct physical entity, like a particle, is an **idealization which has no fundamental significance**". There is no possibility of knowing what particles really are. Which is more important: to know what they are or where they are? Robert Oppenheimer said this: "If we ask, for instance, whether the position of an electron remains the same, we must say 'no'; if we ask whether the electron's position changes with time, we must say 'no'; if we ask whether the electron is at rest, we must say 'no'; if we ask whether it is in motion, we must say 'no' ".

This theory begins its reasoning with the electron. Once it has been concluded that the electron is formed by something rotating and that its electric charge is somehow distributed it becomes necessary to consider that its gyro-magnetic ratio is e/m instead of the value e/2m that would have if mass and electric charge were distributed in a similar way. This reasoning can be seen in the Article titled "Starting point of this Theory" where it is seen that, in order to fulfill this requirement, two indispensable conditions are necessary: 1- that the electric charge of the electron is located at the equator of the particle, as an electric ring, so that the electric ring and the equator coincide; 2- that each point of the coincident electric ring and equator move at the speed of light.

This reasoning is valid only for the electron, but it indicates the existence of electric rings in other particles with electric charge, rings that determine with their rotation the magnetic moments and at the end the nuclear forces. On the other hand, it indicates that every point on the particle's equator, regardless of the electric ring, always circulates at the speed of light, which is expressed by this formula: $2 \pi R \nu = c$ (at rest)

The reasoning continues by considering that all single particles have a mechanical moment or spin equal to $h/4\pi$. By means of a certain immersion in the differential and integral calculus we arrive at the conclusion valid for all the simple material particles that the Energy at rest is equal to the product of the frequency by the constant of Plank h. Thus $E = h \nu$, the same expression that we know for electromagnetic energy, considering the different concept of frequency in each case.

From the two equations above we can deduce $2 \pi R E = h c$, where for the first time the two universal constants can be seen together, which we could call the Quantum constant with a value of the order of 10^{-27} and an Einstein constant with a value order of 10^{10}. In a previous article I have commented that if a supposed inhabitant in any of the simple material particles had chosen his own system of units, just as we chose the CGS system, the value in that new system of h and c would be unity: $h = c = 1$

I consider this formula the fundamental equation of the Theory and its consequences are: Mass at rest varies proportionally with turning frequency. When the particle turns faster, that is to say, when the frequency is higher, mass and energy will be greater and the size will be smaller. We can in this way comprehend how an infinitely small particle turning with an almost infinite frequency could one day be the primordial particle which contained the whole energy of the Universe. When frequency decreases, mass also decreases and when frequency is zero, size is infinite and mass disappears. This is what happens when the process of annihilation of matter and antimatter takes place. The "goo" of particle and antiparticle is expanded in the Universe and energy is transformed into radiation (see Article "Neutrino and Antineutrino. Matter and Antimatter").

We see that the New Theory put forward reaches a complete definition of the "physical reality" through a few simple sentences with very few words. And these sentences can easily be converted

into simple formulas. And all the conclusions of these formulas are in complete agreement with the "experimental reality". That meaningful definition of "physical reality" required by Einstein, which was not easy to reach and was considered by some as impossible "in physical terms alone", can be understood in this way:

1 - Elementary particles are just turning goo in the form of whirls. The absolute energy of the particle multiplied by the length of the whirl's equator is equal to Planck's constant h multiplied by the speed of light c.

2 - The speed of every differential element of the equator-ring is always equal to the speed of light c. This equator-ring acts as a rigid girdle.

3 - Electric rings turn with the particles to which they belong, following their own frequencies.

And there are no more words, no more explanations. Here is the translation of these words into formulas:

$\mathbf{E\ 2\ \pi\ R = h\ c}$ (for any referential system)

$\mathbf{2\ \pi\ R\ \nu = c}$ (at rest)

And as a consequence of this: $\mathbf{m\ c^2 = h\ \nu}$ (at rest)

The great obstacles Physics has had to face during the first quarter of the twentieth century, which have made Physics be stranded for the rest of the century, are now removed:

Concerning the first obstacle, the experiment of Michelson and Morley, I have dealt with this subject in Part Two of the Book entitled "Light and Relativity" and in the previous Article "New Interpretation of the Michelson-Morley Experiment" in General Science Journal, which I consider complementary to the main Theory put forward in Part One, "Matter and Energy".

The introduction of Planck's constant "h" in 1901, which brought the well known fact that the energy emitted by an orbiting electron in the atom can only have a set of discrete values, as well as the existence of "stationary states" and "quantized energy", has been sufficiently discussed in previous articles.

It is an experimental fact that a photon has a spin equal to the spin unit $h/2\pi$, twice as much as the internal spin of the stable elementary particles, which is $h/4\pi$. Or, in other words, the emission or absorption of a photon by an electron, when an orbital jump occurs, creates an alteration in the electron's spin equal to the spin unit. This is an experimental fact and cannot be considered as patrimony of any theory. As a result of that, **the electron has to follow a definite orbit.** It cannot follow an infinite number of trajectories. If the atom emits or absorbs energy in the form of a photon, as a result of an orbital jump, the total angular momentum will be modified in an amount $h/2\pi$. **The atom must necessarily, in some way, offset that alteration in angular momentum** and this can only be done by changing the electron's orbit path, so that the angular momentum of the orbital electron changes in the same amount. Otherwise, one of the principal laws of Physics, which is that of spin invariability, would be violated.

We see that the electron can only follow orbits so that the corresponding angular momentum should be a multiple of the spin unit $h/2\pi$. The electron cannot follow any of the infinite possible orbits, as Classical Physics seems to permit. There exist well-defined orbits along which the electron's energy does not change and the jumps between these orbits give rise to the so called "quantized energy". **The only cause of this "quantized energy" is the experimental fact that the emission or absorption of a photon by an electron, when an orbital jump occurs, creates an alteration in the electron's spin equal to the spin unit.**

Planck's constant "h" is just one of the two fundamental constants. It is the ratio between energy and frequency. This frequency may correspond either to electromagnetic radiation or to elementary particles. In the same manner as c^2 is the ratio between energy and mass. These two fundamental constants "h" and "c" form part of the universal formula proposed by this Theory: $\mathbf{2\pi R\ E = h\ c}$, which comes to demonstrate that the two constants are deeply connected with each other. They do not belong to different worlds as it is the present belief, as a result of the lack of harmony between Relativity and Quantum Mechanics.

There are many conclusions derived from the laws proposed by this Theory. And all of them are in agreement with the experimental reality. There are no contradictions. In some cases, there seem to appear paradoxes. But "**there is nothing paradoxical about the physical world. Thus if paradoxes seem to appear, they must originate either from an inconsistent physical theory, or they must indicate the limitation of concepts in physics which have acquired their meaning outside the domain of physics**". This sentence is not mine, it belongs to Professor Josef M. Jauch, Director of the Institute of Theoretical Physics at the University of Geneva, Switzerland. He has been a visiting scientist at CERN and has taught at Princeton University. He is the author of a book entitled "Foundations of Quantum Mechanics".

We must compare Professor Jauch's way of dealing with paradoxes with that defended by those (a great part of contemporary physicists) who are willing to blindly accept new ideas, impossible to understand, but that have been supported by cleverer people: "Every time the physicists asked nature a question in an atomic experiment, nature answered with a paradox, and the more they tried to clarify the situation, the sharper the paradox became. It took then a long time to accept the fact that **these paradoxes belong to the intrinsic structure of atomic physics and to realize that they arise whenever one attempts to describe atomic events in the traditional terms of physics**".

Has the author of the above sentence ever thought that he has been working with an inconsistent physical theory and that this is precisely the cause of the paradox? Can we accept, when a physical phenomenon seems to be paradoxical, that such a phenomenon may be considered as one more of the great number of "quantum paradoxes", which cannot be explained simply because Quantum Reality has nothing to do with Physical Reality? In my opinion this is completely unacceptable.

To end this article I would like to present what I call a "Final Verification" included in the last chapter of the Book "A New Physics for a New Millennium". It is based on the supposition that the Theory was born at the beginning of last century. This is the "Final Verification" as shown in the last chapter of the Book:

There is a final objection to this Theory, which I am going to comment on and answer. It is the following: A physical theory can only be accepted when its predictions are confirmed through experiment. That is to say, if the conclusions of the Theory are not confirmed through experiment, this Theory must be discarded.

In order to clear up this problem, I shall resort to a stratagem, which I think is valid and correct and, of course, more accessible than the Higgs boson. Let us imagine that in 1900, before Einstein pronounced his principle $E = m c^2$, a certain Professor X put forward a theory on matter, which consisted of 4 sole principles. Those principles, referred to elementary particles at rest, are based on the fact that there is something turning:

1 - $E = m c^2$
2 - $E = h \nu$
3 - $2 \pi R \nu = c$
4 - Existence of electric rings with frequency ν

Where ν is the turning frequency and R the equatorial radius of that which turns.

The theory of Professor X, with its 4 fundamental principles, determines a very particular behaviour of matter and defines a special mechanics, which rules that behaviour.

Let us see the predictions of this theory, which must be submitted to the implacable confirmation of experimental results. These are the predictions, supposed to have been listed around 1900, and which are the immediate consequences of the theory put forward by Professor X:

1- Mass increases with speed according to the expression

$$m_v = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

I must point out that this, here, is a consequence of the 4 fundamental principles put forward by Professor X. Einstein has not yet stated this expression and of course the formula has nothing to do with relativity.

2- The spin of all stable fundamental particles is equal to $h/4\pi$.

3- The limit speed of matter is the speed of light.

4- Sizes at nuclear scale in the range of 10^{-13} cm.

5- Times at nuclear scale in the range of 10^{-23} sec.

6- The behaviour of matter is similar to that of light in certain phenomena, such as diffraction, interference and polarization.

7- The size and energy of fundamental particles are inversely proportional.

8- Energy multiplied by time, on the scale of fundamental particles, is always in the range of Planck constant h.

9- Orbital electrons turning around atomic nuclei do not give off energy.

Let us now suppose that, when Professor X has made the above 9 predictions, Science has reached the point of measuring the magnetic moment of the proton, the neutron and the electron. Based on this new knowledge, Professor X can go on listing the predictions of his theory:

10- There exist certain forces between the nucleons which overcome by far the repulsion electric forces between protons.

11- The neutrons are necessary for the above forces to act efficiently. The proportion between neutrons and protons is at least 1 to 1.

12- The deuteron is the sole stable nucleus of two nucleons.

13- There exist energy levels of atomic nuclei, which in the case of $_3Li^6$ are 9 levels and in the case of $_3Li^7$ are 10 levels.

14- The spin of all atomic nuclei is a multiple of $h/4\pi$.

15- The forces acting between nucleons are very strong at short distances, fall deeply as distance increases and practically disappear at the distance of 1 fermi.

16- The binding energy of the deuteron is 2,21 MeV.

These are the 16 predictions which, under the rigour of the most absolute logic, the theory of Professor X, with its 4 fundamental principles, leads to.

What should have happened afterwards? What should have happened is that experiments carried out throughout the World should have confirmed beyond doubt every prediction and with a degree of precision that cannot be understood, even by Professor X. No theory had ever been proved in such a thorough way.

The result of this should have been the complete success of the theory. After this, no more confirmations are needed, and nobody thinks of smashing matter, which would require enormous particle accelerators, and nobody feels the need for the Higgs boson, or for resonant structures of unstable particles, or for exotic states, or for dual models, or for Reggeons field theories, etc, etc.

But why have I resorted to Professor X's stratagem? Because only one of his fundamental principles may be proved through experiment, $E = m c^2$. The other three principles cannot and will not be proved directly. How could the particle frequency be verified? and how could we verify that the equatorial speed of particles is always equal to the speed of light? and how can we prove the existence of the electric rings and measure their sizes and speeds? Completely impossible, now and forever. But we have the predictions of Professor X's theory, the confirmation of which is beyond doubt.

One might ask: is Professor X's abstraction correct? The readers might say: you have played a trick on us, since you knew all the results of the experiments carried out till now. You have taken advantage of us. I would answer: so, **if the trick is accepted**, have I demonstrated that the Theory is

correct? Nobody can deny that the answer to this question is **YES**. If Professor X had really existed before Einstein had pronounced the principle $E = m c^2$ and Professor X had put forward his theory with its 4 fundamental principles and the predictions I have outlined above, Professor X's theory would now be the physical theory most proved through experiment.

And, concerning the correction of the abstraction, I can only say that Reality, Truth and the Universal Laws know nothing about either chronology or the particular claims of one researcher or another. What is is, no matter when the discovery has been made and who has made it. The fact is that if my abstract Professor X had only pronounced the first of his principles, $E = m c^2$, which, by the way, is the present reality, many things without explanation and many doubts would remain to be solved. Only when Professor X states all of his 4 principles do we see the light and come to understand what matter and nuclear forces are and not too many things remain to be solved:

- mass spectrum
- relation between matter and the electric rings and the creation of these electric rings
- some experimental results which may seem not clear enough, subject to interpretations, which require further studies.
- and, of course, **many others**.

I consider it necessary to check whether what I say is correct or not. It is clear to me that those who want to understand will understand and those who do not will not understand. Scientists of today, or maybe of tomorrow, must decide once more who is the winner in the permanent fight between the force of orthodoxy and the force of reason.

And the conclusion is that no other theory would have ever been proved in such a thorough way. My question is this: Which theory would have been more accepted? I am inclined to believe that very few physicists would have even considered Quantum Mechanics. And I would like to make another comment on this subject: I do not think Einstein would have been as critical on this Theory as he was when referring to Quantum Mechanics.

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