

## Physics, Edgar Morin and Complex Thinking

**Abstract.** In this paper a new way to cope reality is proposed, putting the accent on the symbolism used, which must then reflect its well known dual structure and also include its uncertainty, a reason why it must be triadic, which has furthermore an equivalent mathematical representation with complex numbers, based on Euler relation, which has the unique characteristic to remain the same with differentiation and integration, i.e., with change. On the other hand the magnetic field with its three characteristics, similar to those three principles presented by Edgar Morin in his *Introducción al Pensamiento Complejo*, makes it a real candidate for the fundamental field -not a particle anymore- of the universe.

### Introduction: Complex Thinking and the Crisis of Physics

My adventure with Complex Thinking began, I think, in that very moment I decided to study electrical engineering, but more precisely in the year 1968, when I had my first serious encounter with Euler Relation:

$$e^{i(\theta)} = \cos(\theta) + i \sin(\theta)$$

From that moment I was deeply impressed by this relation: just a single mathematical equation that included a radical duality or a minimum of information:

- the “real” and
- the “imaginary”

At the time I had already heard about that well-known famous duality of wave-particle and the big problems it had caused to the physicists at the beginning of XXth century; problems that Karl. R. Popper defined at the end of that same century as the “intrusion of subjectivism in physics”(8,25)

“Today, we have a crisis in physics... but that crisis has another aspect: it is a crisis of comprehension... This crisis of comprehension is so old as Copenhagen interpretation of quantum mechanics (8,25)... <<objective reality does not exist anymore>>, and quantum mechanics does not represent particles, but our knowledge, our observations, our consciousness of particles”(8, 57)

Certainly it is a crisis of comprehension, as it were, a semiotic crisis; of that symbolism used to represent reality (6); a symbolism that does not allow or that had not had the need to include both:

- complementarity,
- as a concept of unit as well, that included duality, without any reductionism.

The dualistic philosophy that has prevailed in Western science since Descartes, and that was born as a defense mechanism against the invasion of Aristotelian philosophy in the domains of science -according to Stillman Drake in his book *Galileo- is really at the base of that crisis.*

In fact that another duality subject-object (mind-body), not being able to close the gap between both concepts, only has had two extreme alternatives as a solution:

- Ontological idealism or subjectivism in physics and
- Realism, called naïve by the others

Both these alternatives, as all those alternatives in dualistic philosophy exclude each other, they are opposed, with no chance of complementarity, or of finding a common or intermediate ground.

The former one, that of Copenhagen School of thought, contains in fact some truth, something worth, a reason why it has prevailed so long, even in those schools of thought that can be named by one term: post-modernists, whose main criticism is that they certainly have defined very well the problem, but on the other hand, they have not given any valid solution to the problem up to now; that element of truth has to do, IMHO, with the symbolism used by “the observing subject” to represent reality; a reality that always has a radical duality; it has to do with the question whether or not reality has a deep structure, and with the need to close that gap between object and subject.

The latter one, that of realism, is right too in the sense that the concept of object, of objective reality, cannot in no way be reduced to subjectivism, to the “unreal”; the thing in itself, the reality “out there”, cannot be denied under any metaphysical proposition. The great mistake of philosophy at all times, has been precisely to postulate the being, or reality as simple and one, but for thinking and perceiving oneness in

multiplicity, must not consciousness have at its disposal a conceptual tool, i.e., a symbolism, so that the “being” be posed or thought, not as simple and unique, but as a kind of synthesis built not just based in the bare equal sign, but in spite of it, so we can have information even at the physiosphere, without any subjectivism?

### The Third included and the Symbolism

It was perhaps, Teilhard de Chardin, the one who with his deep gaze, saw the problem more clearly when he wrote:

“I am convinced that the two points of view require to be brought into union, and that they soon will unite in a kind of phenomenology or generalised physic in which the internal aspect of things as well as the external aspect of the world will be taken into account. Otherwise, so it seems to me, it is impossible to cover the totality of the cosmic phenomenon by one coherent explanation such as science must try to construct.”(6,53)

The within and the without of things, the qualitative and the quantitative, time and space, the “real” and the “imaginary”, the dynamic and the static, the wave and the particle; all these dualities that are really “annoying thorns in philosophers’ side” claim to be brought into union in a new concept of unit, as it were, a complex unit or just a triadic unit; “Ah, and there’s the rub”: the real needing to integrate the one in multiplicity or vice versa.

The North American philosopher Ken Wilber, has elaborated extensively sort of integral philosophy establishing at the outset the “holon” concept, sort of unit that includes the “whole/part” duality, joined together by some sort of glue or principle. (8, 17-18)

Both Edward Sapir and Ferdinand de Saussure in their intent to take language to a most elementary level, saw the need to introduce sort of unit that contained too a duality, unit that can be qualified then as a triadic unit.

In his classical, **Course in General Linguistics**, published after his death Saussure wrote:

*“...linguistic units are dual in nature, comprising two elements...These two elements are intimately linked and each triggers the other...A linguistic sign is not a link between a thing and a name, but between a concept and a sound pattern...The ambiguity would be removed if the three notions in question were designated by terms which are related but contrast. We propose to keep the term sign to designee the whole, but to replace **concept** and **sound pattern** respectively by **signification** and **signal**.”*

In this way we can write succinctly:

**(Linguistic sign = (Signification/ Signal.)**

where we have:

- that the equal sign is not anymore just a bare symbol to reduce the one to the other, as what we really have are three elements encapsulated, including in this way “the third”.
- The symbol ( ), is that one that encapsulates the whole in a unit
- And the symbol "/" is that one that permits us to relate and contrast the terms at the same time, i.e., the signification and signal.

But if complexity cannot be expressed with a completely mathematical symbolism, it is no useful at all from the point of view of symbolic representation in physics.

### Complex Numbers and Triadic Symbolism

We wrote at the beginning about the importance of Euler relation, because mathematically it contains by definition a duality. Complex numbers based on that relation are both the mathematical basis of electrical engineering, i.e., electromagnetism, as a fundamental tool in quantum mechanics as well, whose starting point is the well-known complex Schrodinger wave equation. Roger Penrose in his classic the New Mind of the Emperor wrote:

“...complex numbers... They are absolutely essential for the structure of quantum mechanics and are therefore, essential for the behavior of the physical world”-

The importance of the complex mathematical representation lays not only in its quantitative precision, but in its qualitative and conceptual richness; with Euler relation it is possible to conceive a triadic unit that by definition gives us a sum greater than the sum of its parts -without the metaphysical drawback- as it is in

fact a vectorial sum. This sum is realized in the complex plane, which is then sort of canvas where we can make “drawings” of the dynamic complexity of the real. We can write then

$$e^{i(\theta)} = (\text{Coseno}(\theta) + i \text{Seno}(\theta))$$

where the symbol “ $i$ ” is the equivalent sign to  $i = \text{square root of minus one}$ , a symbol that makes it possible to represent both a radical separation as complementarity as well, giving us the chance of a sum greater than the sum of its parts, so in the same way we can express the fact that:

$$(\text{Energy} = (\text{Wave} / \text{Particle}))$$

The alternating current we have at home comes to it through one of the more complex networks ever built by man, and it is based precisely in complex numbers, as the communication network around the planet as well. Roger Penrose is completed right in recalling the importance of complex numbers, as Euler relation has the unique mathematical characteristic that it remains with the same form with respect to those processes that represent change mathematically, I mean, integration and derivation: it is an ideal mathematical tool, or the necessary requisite claimed by Einstein for his general relativity, but without the need, in this case, to reduce geometry to algebra, or to eliminate the concept of force from physics.

As a matter of fact, with this relation, differential equations become normal algebraic equations, a reason why that historical conflict between Edison and Steinmetz was solved when Steinmetz presented an article demonstrating this fact, an article based on another one written by an unknown Englishman, Oliver Heaviside, so alternating current prevailed instead of direct current.

### **Beyond Systemism: The Basic Unit System**

From Euler relation it is the possible to conceive a sort of complex dynamic geometry by posing at the outset a minimum unit of complexity we have named a *basic unit system*, thinking in Bertalanffy and his General System Theory, besides the need to eliminate the drawback of systemism, so a BUS is represented as:

$$DS = \text{Abs}(DS)e^{i(\theta)}$$

Where Abs means absolute value of DS.

From this simple and complex equation, and perhaps inspired by that concern of Einstein expressed in his general relativity, we have found it is possible to deduce the fundamental equations of physics, i.e.:

- the Lorentz transformation group of equations that make Maxwell equations invariant as was pointed out by Einstein in his special relativity. It is note worthy to point out that this new deduction is done in a context that is more ontological than relativistic, so in this sense we go far away from Einstein relativism, but his great contributions remain valid in another framework.
- The Schrodinger wave equation; it is important to note that Euler relation is by definition a wave equation(see sine and cosine terms included in it), as was the wave nature of the electron a physical fact.
- Those equations of gravitational fields, so these conservative fields are put in the same framework as those other electromagnetic fields.
- The equation of the simple pendulum with its approximation factor that can even be validated with what has been observed; the importance of this case lies though in that it is a truly physical example of an open dynamic equilibrium system, whose equilibrium is obtained when a resonant or synergetic frequency is obtained, in the same way as those resonant processes that are used in the tuning process of radio waves, when capacitive and inductive processes are equalled to obtain the corresponding tuning. Before the acquisition of that frequency the system behaves itself as a chaotic one, but this does not mean at all that chaos is the cause of the synergetic state. Once this state has been reached what we have is a state of maximum power, or else a synergetic o resonant state, the well-known steady state, where there is a minimum of entropy.

### **Questions not solve in a class room**

With the works of some physicists such as Vesselin Petkov, and specially Puthoff regarding his theory of Zero-Point-Energy, it is not a novelty to say that the electromagnetic field is the fundamental field

of the universe; in fact it is a field that contains both kinds of fields: the conservative, in the electric field, and the nonconservative, in the magnetic field, and its unity being well expressed in Maxwell equations.

During my studies of physics I used to ask myself some of those questions that surely would not receive a good answer:

- Why the magnetic field -that seems so fundamental in nature- is not consider the fundamental field of the universe?
- Is not solved, with this starting point of view, those all unanswered questions regarding the spin and its magnetic nature?

If fact the spin is one of those annoying thorns in physicists' side, that is even classified as non-classic to mean that it remains a whole mystery in spite of quantum mechanics. It is there in electrons at "rest", in the proton, but even more dramatically in the neutron that does not contain an electric charge. It is this concept though the one that has suggested that electrons do not behave as a classic sphere as its observed intrinsic magnetic moment is double as that one calculated under a classical point of view, i.e., as it were a little sphere(4, 569). Does not each intrinsic polarity contribute proportionally to give a double value?

It is the answer to these questions the one that I want to share with all those interested in the evolution of scientific and philosophical thinking. For the normal prevailing dualistic approach to physics it was more natural to start with the part, with the concept of a negative electric charge, i.e., with the electric field concept; with a conceptual entity that was part of another so it had externally an equivalent positive charge, than start with a unit in itself such as the magnetic field whose poles cannot be isolated. In that way the Aristotelian logic, the binary logic, remained a fundamental one, and we did not have the need to think in a logic or more appropriately in a symbolism of complexity that included the "third". It is in this way that the texts of physics that I know, the study of electromagnetism is begun with the electric field and its Coulomb law, by making even a clear analogy to the gravitational field and its inverse square law that is not so universal after all.

### Three Principles of Complex Thinking and Magnetic Fields

The magnetic fields has in fact three properties that I have found similar to those three principles described by Edgar Morin in his **Introducción del Pensamiento Complejo**(5,105):

- the dialogic principle is that one that always considers a radical duality, so *the dialogic principle permits us to maintain duality in oneness*. We do not have to be a physicist to verify that intrinsic duality in a permanent magnet: just put two magnets near by and you will notice two different forces of attraction and repulsion as we cannot have isolated poles.
- *The recursivity principle that breaks down the cause/effect lineal idea, of product/producer, of structure/superstructure, as all that is been produced comes back to its source*, just as the "lines of force" of a non-conservative field such as the magnetic field, whose lines of force go in and out from its magnetic, as it were, ontological center.
- *The hologramatic principle in which the whole is contained in that same center, containing almost all the information of the represented object*, as in a permanent magnet that when fractioned always becomes another magnet, so and so on until it becomes an electron, as it were, a fundamental "magnet" with its mysterious spin property, that represents then a minimum of information, even at the physical level, that gives reason of all those laws and principles associated with quantum numbers and with Pauli exclusion principle?

This kind of convergence of two different approaches starting from different points of view:

- The one from Complex Thinking and
- the other from the basic unit system concept based on Euler relation

cannot be taken just as a mere coincidence, but as a hint that both approaches have definitively transcended the dualistic framework, but including in this case the best of the old paradigm, as *the principles of complex thinking... will be necessarily those principles of distinction, conjunction and implication*, which means that reality is not simple but complex.

### Conclusions and Reflections

The paradigm of simplification, whose main advantage had been to work just with close systems, with static objects of study, with a mathematics based on the bare equal sign with no chance to include

uncertainty, diversity in oneness or a whole greater than the sum of its parts, is certainly the main cause of the great crisis of physics and in general the crisis of science, as the natural tendency toward reductionism had taken us to:

- physicalism, or that tendency to reduce everything to the physical domain,
- biologicism or that tendency to reduce everything to the living
- psychologism or that tendency to reduce everything to mind, or spiritual

But none of these tendencies alone can give us the whole picture though, and the fundamental problem was answering that question whether or not reality has a deep structure that could be represented by an adequate symbolism; more concretely by means of a mathematical symbolism that allowed us to close the gap between the observer and what is observed.

If physics is not represented by means of a complex mathematical symbolism we have then:

- the tendency to pure speculation, i.e., to systemism(holism?), sort of reduction up-bottom, from the pure abstraction of a concept
- the tendency to reduce bottom-up, by denying the chance of emergence or to obtain a sum greater than the sum of its parts, sort of pure materialism.

The within and the without of things, or the radical duality of the universe must be included in our symbolic representations so not to fall in any of these extremes, a falling that takes us to the great crisis of physics or science in general, crisis that can be overcome with a Complex Thinking as we can then conceive a generalized physics as, *when we come across by via empirical-rational contradictions, it is not an error, but it means we have found ourselves with a deeper level of reality that because of it, cannot be expressed by means of our logic(5,100)*, so we need then a symbolism with a minimum of complexity by including the third what means not only a natural openness, as in that minimum complexity uncertainty is included, but the chance to represent a whole greater than the sum of its parts, that in this case, will not have anything to do with the mystical, as a resonant state is quite documented in the physiosphere but also in the biosphere in those *auto catalytic systems... in which the molecules speed up the very reactions by which they themselves are formed: A makes B; B makes C; C makes A again.*(9, 49), as if the “ontological centers” had recognized their own resonant frequency. The real problem is then finding that resonant frequency and a way to induce it, which implies an external observer to the system, being plausible that hypothesis called “directed panspermia” suggested by Francis Crick, the Nobel Prize winner, co-discoverer of the structure of DNA, according to which life was implanted on earth as soon as matter had reached an adequate degree in complexity in its evolution.

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Note: This is a translation of the original paper published in Spanish in this same KJF, so my apologies if you find that translation a little choppy, but English is my second tongue, and I hope I have done my best.

## References

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