Ideo-semantics and quantum physics: epistemological and linguistic approach

Helios JAIME
Science Epistemologist
International School of Astrophysics Daniel
Chalonge / de Vega
Researcher in Linguistics
PhD in Comparative Literature

One of the fundamental problems posed by quantum physics is that of the transmission of its principles to the language of the so-called classical physics. Another is the questioning of its ability to establish correspondences with languages. Certainly, the conceptions of this physics can be stated by the mathematical language but given the difficulties to express them in proper language, its founding theorists, Niels Bohr, Heisenberg, among others, think that the only possible language for quantum physics is the mathematical language.

Indeed, if we take into account one of the first properties, that is, the one that contributes to establish the semantic properties on which the coherence of a linguistic discourse is based, we come up against the principle of non-contradiction: we cannot affirm that a concept P is at the same time it and its non P opposite: ¬(P∧¬P). But weknow that the quantum particle is, at the same time, matter and wave. An electron canhave a material behavior but also can act like a photon. Moreover, the principle of logical disjunction A or B, A v B, also refuses the fact that a particle can pass at the same time by two places which are distant from each other and even more so if it passes by several in a simultaneous way.

Following this reasoning, it is clear that the only admissible language for quantum physics is mathematics. However, I believe that there are semantic and morphosyntactic structures in European languages, which are also spoken on the American continent, that are capable of expressing quantum complexity. Although some scientists maintain that the appropriate language for quantum mechanics is mathematical language, they admit that to make quantum concepts explicit it is necessary to use the language system. The physicist Roland Omnès, while giving priority to mathematical language: "the first language of this

physics, the closest to itsprinciples, is mathematical", recognizes that most physicists use languages to explainquantum phenomena: "ordinary language is always preferred to formal language when it comes to explain or decipher"[1].

• Roland Omnès, *Les indispensables de la mécanique quantique*, Odile Jacob, Paris, 2006, pp.109-110.

What I propose to do is not to question the quantum theories that are true in many fields of physics and astrophysics, and even less to question the mathematical language. On the other hand, what I want to demonstrate is the correlation of quantum reasoning and linguistic thinking, because it would not only allow the development of interdisciplinary epistemology but also the achievement of a great progress in scientific communication. In this way, there would be no divorce betweenthe two languages, which would facilitate its understanding. To demonstrate this correlation, I will use my ideo-semantic theory.

Ideo-semantics

Research in diachronic linguistics has found that semantic functions follow the evolution of the conceptions of ideas. This correlative function between the structure of meanings and the process of thinking is called ideo-semantics. Briefly, my ideo- semantic theory studies the meaning of words and linguistic structures not as abstractconcepts, which are limited to the definition of the object without taking into accountits context, but as a combination of psycho-physiological processes which will configure significant psychic images expressing the conception of space and time andalso the vision of the man and the cosmos. Therefore, according to my ideo-semantic theory, the morpho-syntactic and semantic systems of the languages, especially thosespoken on the European and American continents, must present relations with the creative mental processes that, leading to scientific notions about space and time, try to interpret the nature of the universe and of life[2].

Following my theory, I propose to demonstrate that the principle of non-contradictionand the principle of disjunction can be overcome not only by the conception of quantum physics but also by semantic composition.

The principle of non-contradiction

Let's start by looking at how this difficulty of linguistic transmission was envisaged by one of the founders of quantum mechanics, Niels Bohr. In his work published in 1931, *Atomtheorie un die Naturbeschreibung*, unlike classical physics which considers that by knowing the causes of a phenomenon

one can predict its behavior ateach moment of its development in the future, Bohr maintains that because of the inseparable character of the observation and the manifestation of the quantum event, there is an impossibility of any univocal prediction because, in order to observe the behavior of the microcosmic world, it is necessary an intervention of the researcher's apparatus which modifies the course of the quantum event. Consequently, there are superpositions of representations of the quantum event that prevent it from being perceived as an object completely independent of the observer. Thus, the particle-

• In addition to the talks I have given at the Chalonge-de Vega School of Astrophysics and published in the website of this School, I develop my ideo-semantic theory in my interdisciplinary books, *Le voyage dans la vie, la littérature la musique et la science, Eds* Baudelaire, 2014, *Le rêve dans la littérature, la musique et la science*, Fauves, 2016, *Le défi de lacréativité*, Fauves, 2019.

wave superposition does not limit itself to indicate a discontinuity but gives rise to akind of reality which is incompatible with the principle of non-contradiction.

Nevertheless, to establish a semantic bridge between the language of quantum physics and the formal expressions of classical physics, Bohr proposes the notion of complementarity. In fact, as we shall see throughout this work, it is the notion of complementarity that also allows us to establish the links between quantum conceptsand linguistic meanings.

The principle of non-contradiction and semantics

Let us begin by seeing if the principle of non-contradiction can be overcome by semantics: to do this, let us examine the title of Bohr's very moving book, *Atomtheorie un die Naturbeschreibung*, in which he poses precisely this problem.

The meaning of the first word, *Atomtheorie*, is quite clear but the second, *Naturbeschreibung*, in German has a complex meaning because it is a compound lexicon: *Nature + Beschreibung*. This last noun, *Beschreibung*, can designate a description but also a painting. Following the ideo-semantics, let us analyze this compound word. We can ask ourselves what Bohr proposes to do: if he wants to make a description of nature, in this case, it is a question of giving the details of its structure, or if he proposes to make a painting of nature, in this case he gives us an idea of the whole, or both things at the same time, i.e. to represent the manifestationsof nature as a painting, a picture that presents us with the images of its intrinsic functioning. I think that this last interpretation is more adequate to the goal that Bohrproposes.

Moreover, let us remember that in French the word *description* can refer to a figure aswe can see in the sentence: *la description d'une orbite elliptique*. This is why in the very title of Bohr's book, we find a semantic use of words that is able to express in a single statement the concordance of different meanings to lead to a new meaning.
This semantic simultaneity of different meanings is also found in many linguistic constructions. I will limit myself to giving an example in French: *ce tableau montrebien le clair-obscur*. Thus, the concordance of these two adjectives of opposite meanings results in a noun, *clair-obscur* (chiaroscuro), which designates a new meaning. We can see that the apparent quantum contradiction can be stated by the structure of languages.

Quantum physics

According to what we have just observed and following our ideo-semantic approach, should we call this science *quantum mechanics* or *quantum physics*, because the word *mechanics* is not synonymous with the name *physics*.

Of course, many physicists call this science *quantum mechanics* but, following the epistemological approaches of its founders, I believe that instead of saying *quantum mechanics* it is more appropriate to call it *quantum physics*.

Indeed, the word *mechanics* refers to the study of motions and forces, kinematics, butalso to the equilibrium of bodies, which is a matter of the mechanisms of macrocospic structures or machines rather than of the research on the principles of energy and matter; while the name *physics*, which proceeds from the Greek φυσικως (physikôs) designating that which conforms to the laws of nature, can take on the meaning of nature of the universe. Therefore, I will refer to quantum physics.

The contribution of the oxymoron

It is interesting to observe that the correspondence between quantum conceptions andsemantic conformations is synthesized by the rhetorical notion of oxymoron.
Oxymoron is a word in linguistic terminology taken from the Greek οξυμορος (oxumoros) that designates a morpho-semantic composition bringing together twowords of contradictory meanings into a new word that states a new meaning, thus allowing for the expression of new ways of thinking.

Now, we can ask ourselves if this property of the oxymoron can contribute to widen the horizon of knowledge, that is, if the oxymoron can express fundamental conceptsthat are the object of research and that can contribute to the scientific interpretation.

It is well known that mathematical language is considered as a system that respects the principle of non-contradiction. But, in the same way that we find in quantum physics and in the semantic conformation of languages the simultaneous enunciation of different meanings expressing a new meaning, we also find it in the enunciation ofcertain mathematical conceptions. We can see it in the statement: *les variantes des constantes*. One can be a little surprised by this statement introduced by Pierre-Simonde Laplace because, in principle, a constant cannot have variants.

Let's take a closer look at what this oxymoron proposed by a great mathematician andastronomer means. Let us remember that Laplace had also had the premonition of black holes. We can understand it by analyzing its semantic content. To solve some linear differential equations, Laplace conceived a method to find the solutions of a differential equation with second member by replacing the constant, which had already been found for a simpler associated equation, by unknown functions.

This idea that constants can have variants was taken up in the twentieth century by another great French scientist Paul Dirac. From Plank's constant h which determinesthe relationship between the energy of a photon E and its frequency ν, thus $E = h\nu$, Dirac came to establish Plank's reduced constant: $h/2\pi$ which facilitates the interpretation of quantum observations.

All that we have just observed allows us to arrive at the conclusion that the oxymoronis a linguistic form that, following the principles of ideo-semantics, can contribute to the notional horizon of the sciences finding its representation in the semantic configuration.

Following our approach, let us see how ideo-semantics can find an answer to theproblem of quantum non-localization.

The disjunction principle and quantum non localization

Since Thomas Young's experiment in 1801, we have known that light manifests a wave action. This experiment applied by means of a technique much more developedin the twentieth and twenty-first centuries to atomic particles such as the electron or the proton allows us to observe that matter can also behave as a wave.

According to the interpretation of the physicist Richard Feyman, this means that the particle can pass at the same time through two holes A, B placed at a certain distance from each other[3]. Therefore, this quantum peculiarity calls into question the principle of disjunction A v B, because this principle maintains that one cannot be or pass at thesame time through two places that are far from each other: either one passes through A or one passes through B. At first sight, this observation could not be expressed by the language itself.

Let us now see if this feature can occur in languages. In all European languages thereis a semantic form called figurative language. The same word can have two differentmeanings at the same time. That's why in all dictionaries you can find the proper meaning of the word together with another meaning called *figurative*.

Let's look at an example: in French the verb *enchasser* can mean to fix something in asupport, *enchasser une pierre précieuse*, but also to indicate the intercalation of a sentence: *enchasser une citation dans un texte*.

However, one could say that these different meanings of the same verb are not used atthe same time. But if I say: *cela a été bien enchassé*, I can use the same verb for the stone and for the quote. What we have just observed allows us to deduce that there is a psycho-semantic complexity in the structure of the meanings of the words allowing to express different meanings. Moreover, the fact of saying *figurative language*, refers to the combination of the psychic images that configure the meaning without the word changing its form.

These confluences between quantum physics and ideo-semantics lead us to consideranother principle of quantum physics: the uncertainty principle.

[3] Richard Feyman and Steven Winberg, *Elementary particles & the laws of physics*, Cambridge University Press, 1987.
R. Feyman, *Leçons sur la physique*, Odile Jacob, Paris, 2007.

The uncertainty principle

There would be another difficulty to express another of the quantum conceptions in the languages which would be posed by the fact of the indeterminism of the quantumsituation. One cannot locate the particle and at the same time specify its activity as a wave and vice versa, if one knows this one, one does not know where the particle is. This is the uncertainty principle proposed by Heisenberg.

It is interesting to observe that the name of *uncertainty principle* is due to a semanticapproach. The article in which Heisenberg explains this principle was written in German. The first term he uses to designate it is *Unsicherheit*, which means uncertainty. But later he looks for a word that might be more appropriate. He found *Ungenauigkeit*, that is, imprecision, and finally he decided to use the name *Unbestimmtheit*, which has the meaning of indeterminacy. But, as the first version ofthe article had already been translated into English, it was the word *Unsichercheit*, *uncertainty*, that came to designate this principle whose formula is:

$$\Delta x \times \Delta p \geq h/2\pi$$

where $h/2\pi$ is a constant value

Now, we find this principle in semantic indeterminacy. If I say: "I like..." we don't know if I am talking about a person or a dish. In short, if I express a feeling or a sensation. Moreover, we can also find it in the constructions of our languages. Indeed, we can say that we know a situation but we cannot determine its evolution intime and if we know the time in which it takes place, on the other hand we ignore itssituation in space.

I give some examples: for the first case, "The present situation supposes an uncertainfuture"; for the second, we know the time but we cannot determine the situation: "Today my journey begins but I do not know where it will end".

The uncertainty principle and the semantic indeterminacy lead us to two other notionsshowing the correspondences between quantum conceptions and the ideo-semantic conformation of some fundamental linguistic structures.

Determined dimension and contextual dimension

We have seen above that another disadvantage for the linguistic transmission is posedby the indeterminacy of the quantum unfolding. In classical physics the dimension ofa phenomenon can be determined in space and time, while in quantum mechanics thedimension takes on an indeterminate value, that is to say, a probable one. In this respect, the physicist Carlo Rovelli says: "a particle can no longer be described by itsposition but by a "cloud" of probabilities of each position in which the particle could

be - and he adds - we no longer describe the movement of a particle but "the evolution in time of the probability of presence of the particle"[4].

The idea of probability is the one that allows to correlate the quantum indetermination with the linguistic structure. In fact, in languages the way the actioncan be carried out is expressed by specific verbal forms. If the action is accomplished, the indicative mode is used but if the realization of the action is possible, the subjunctive is used. Moreover, in French, when the indicative refers to the action in the future tense, it no longer indicates the accomplishment but the eventuality, as we can see in the example: *peut-être fera-t-il beau*. These different ways of considering the action are due to the fact that we can determine or not its accomplishment. This is why the realization of the action can be considered as determined or undetermined.

Now, the eventuality is conditioned by a set of circumstances that can be foreseeable, this is the case of the future tense of the indicative, but the subjunctive mode, starting from what is determined, can express what is unforeseeable: *bien qu'il suive ce chemin connu il peut arriver quelque chose qui l'empêche de continuer, ce n'est pas sûr qu'il puisse arriver*.

The semantic probability that emerges from the determined/indeterminate alternationis not exclusive to Western European languages, it is even more accentuated in Russian. Indeed, in this language the determined/indeterminate alternation is specificto its verbal structure. In Russian all verbs in all modes, including the infinitive, havethis double aspect. Except for the present tense which is imperfective, it is found in all other tenses which take a determinate and an indeterminate form.

In short, it is for this reason that linguistic and quantum eventualities are linked by probability. Thus, the contextual dimension is found in both linguistic functions andquantum experiments.

It seems important to me to point out that this way of considering probability is not based on a quantitative model but on a qualitative vision of the complexity of terrestrial, biological or cosmic phenomena. This qualitative dimension of the epistemological approach had already been expressed by Henri Poincaré. In his book, *La science et l'hypothèse*, the French scientist had noted that a quantitative model, even if it was formulated in a very precise way, cannot predict the future. This qualitative dimension of quantum processes leads us to the notion of « entanglement ».

4 Carlo Rovelli, *Et si le temps n'existait pas?* Dunod, Paris, 2012, p. 27. The quotation marks are from the original.

Ideo-semantics of quantum entanglement

Moreover, the experiments carried out on the particles show that they are identical, there is nothing that distinguishes, for example, an electron from another. The observations on the activity of the particles have allowed us to see that two particlesor groups of particles constitute a linked system and present quantum states independently of the distance that separates them. This particularity of quantum systems is called *entanglement*.

Furthermore, if we take into account the fact that the dynamism of the universe ishomogeneous, it is logical that the particles or groups of particles act in concert whatever the distance that separates them.

However, these observations on the behavior of particles at n-distance lead us to wonder whether the terms *intrication* or *enchevêtrement* are the most appropriate to designate it. In fact, these words are the translation of the English word entanglement which means *enchevêtrement* or *intrication*. This name comes from the verb entangle, *empêtrer*. Thus, the words *intrication* and *enchevêtrement* designate what is entangled. But, the fact that particles communicate their quantum state to each other at any distance is not a muddle or a confusion, but an entanglement.

Indeed, the name *imbrication* designates a close connection between elements or circumstances. This is why it seems to me much more appropriate to use the Frenchword *imbrication* to designate this quantum action.

Continuing our approach, we can ask ourselves if in the word *universe* we find thedynamism of the meanings we have just observed.

Ideo-semantics of the universe

Nowadays, we perceive the word *universe* as a simple lexicon, i.e. it is not composed like, for example, *clair-obscur (chiaroscuro)*. However, the word *universe* is the result of the morphosemantic combination of two Latin words. Thus, to understand itsdeep meaning, we have to recompose the words that contributed to build the semanticcomplexity of the noun *universe*.

In most European languages, we find the word *universe*. This name comes from a Latin lexical combination, *unus* + *uersus*. The first, *unus*, designates what is unique, the second, *uersus*, indicates the action of turning, because it is a derivative of the verb *uertere*, to turn and also to transform. But its form *uers*, which is the origin of the French preposition *vers*, indicates the tendency

towards a direction. In fact, *uersus*can also designate the force that directs towards a goal.

Now, according to the observations, the universe is a holistic complex that functionsas a unit, which joins the first meaning *unus*. However, the universe being the result

of a constant interaction between energy and matter, its constitution is not stable, it takes place through an activity that constantly transforms energy into matter and, in its turn, from this one emerges a multiplicity of energetic functions, like the force thatacts on hadrons, nuclear particles, or the weak force that causes radioactivity, among the four fundamental forces found in the structure of the universe. Following this conception that energy can turn into matter, we find again, the meaning of *uersus*.
Moreover, these intrinsic transformations that we could call quantum spread in all possible directions, shaping a universe that is oriented in a homogeneous way, whichevokes the third meaning of *uersus*, that is to say *vers (towards)*.

Therefore, our ideo-semantic analysis allows us to observe that in the word universewe find the meanings that denote the specificity of the dynamism of its structure.

Now, in the universe exists life and, even if it is not found, for the moment, in the exoplanets listed, it animates our planet. This is why we can ask ourselves if there is aword that, while designating the universe, also contains the meaning of life linked to the cosmos.

Universe and life

This word exists in Russian: ВСЕЛЕННАЯ (vsielénnaia) which designates the universe in relation to life. Moreover, it is interesting to observe that, unlike Roman languages, English or German, the Russian word for universe does not derive from Latin but, through Old Slavic, ВьСЕЛЕНАЯ (vsielénnaia) from the passive present participle of the verb οκεω, (okeô) to live, to remain, οικουμενη (oïkoumenê) which means an inhabited world. In fact, its ideo-semantic meaning can be the result of an imbrication of meanings proceeding from other words. To better understand myapproach, I give an example in French. The word *demeure* comes from the Latin *demorari*, 'to delay', 'to linger', cf. the Spanish *demorar*, this meaning evolves tomean 'to remain' and from there 'to stay'. Moreover, its etymological meaning *tarde, retard* is found in current French sentences: *mettre en demeure*, i.e. one makessomeone responsible for the delay. Another case is the adverb *toujours* which comes from the phrase *tous les jours*, that is to say that we go from the meaning of what is daily and

repetitive to that of perennial. This semantic convergence that gives a new meaning to the word is found in all Indo-European languages.

Now, ideo-semantics allows us to establish the semantic field of *visielénnaia* inrelation to the vital conception of a universe that tends towards infinity. Indeed, its meaning is related to that of ПРОСТОР (prostor), which denotes the space that extends without limits but also full freedom. From the morphosemantic analysis ofthe first syllable of *visielénnaia* , *vsie*, a relation to the Russian adverb ВСЁ (vcio), 'always', 'constantly', might emerge. The second, *lénna*, may evoke the idea of infinity in the sense of a constant and unlimited restart in space and time, as *lénna*, could be derived, following a morphophonetic evolution of the word ЛЁНТА (lénta) which denotes the ribbon.

Recall that in my talk on the subject of infinity, given in July 2018 at this same venue and published on the website of this School of Astrophysics, I had demonstrated that the word for ribbon in Greek, *lemniscate*, accurately describes the curve that symbolizes infinity, ∞.

This ideo-semantic meaning relating the word for universe in Russian *vsielénnaia* with the infinite expansion of space and its correspondence with the cosmological progression of life, at the very beginning of the 20th century, had been envisaged by the father of extraterrestrial space travel, who is unfortunately forgotten nowadays by the media hype of the first manned flight to the Moon. I am referring to the great Russian scientist Constantin Tsiolkousski (1857-1935) who in 1903, in his book, *The Exploration of Cosmic Space by Jet Engines*, outlined the scientific theory and even its technological application to achieve the conquest of space. He said: "Since time is infinite (...) the number of moments of life is unlimited in the past and the future and the number of intervals that connect them is also infinite. The moments of life are all subjectively linked together and their sum is as infinite as the whole time of the universe »[5].

In fact, this vision of the universe linked to the sense of a vital expansion presents a semantic relationship with the Russian word ВОЛЯ (volia) which designates at the same time will and freedom, because, in order to consider the exploration of cosmic space it is necessary for man to be able to freely exercise his creative will[6]. Besides, let's not forget that the first to place a satellite in space were the Russians and that in 1959, they had already been able to approach to 6500 km of the Moon. In the same way, the first flight in space was realized, in 1961, by the Russian cosmonaut Yuri Gagarin. Today, it is thanks to the scientists of Pushkin's nation in collaboration with those of other countries

that the International Space Station ISS was built and that Russian Soyuz are exclusively responsible for the relief and supply of the station. In fact, the name of this launcher and space vehicle СЮЗ (soyuz) shows this cooperation as it means 'agreement, alliance'.

Open conclusion

As you have seen, the ideo-semantic connection between quantum physics and the conception of the universe opens a vast horizon of new research that questions whatis reality and the conceptions of space and time. I will develop these themes in the following session.

[5] See *L'univers vivant*, Questions de philopsophie, N° 6, 1992, among others.

[6] In my book, *Le voyage dans la vie, la littérature, la musique et la science*, Baudelaire, 2014, I analyzed thecorrelations between will and freedom.

However, I would like to give an answer to the question asking how is it possible thatgreat geniuses of science could have thought, at the beginning of quantum physics, that the languages could not express the concepts of the new science called quantum.

I think that this is due to the fact that they considered language exclusively from the logical point of view, that is, as a structure reduced to the formal coherence of propositions without taking into account the fact that languages are determined by psychophysiological processes expressing the visions that man has of himself, of space, time and the universe. However, the evolution of scientific thought and the development of the complementarity between mathematical and linguistic languages open new horizons for interdisciplinary epistemology. This is why my conclusion remains open to ideas and initiatives.

Helios Jaime