the general science journal
March 2024

Logic and Biology of Schrödinger's Cat 2/3 (1/3, 3/3)

Antonio Leon
Retired Professor. Independent researcher in the foundations of science.
Links to other related works.

Abstract.-This second article in the series confronts certain interpretations of quantum mechanics with the Principle of Directional Evolution of the Universe, according to which the universe has always evolved in the same direction of increasing its isotropy (entropy) without the presence of organic observers, which emerged after billions of years precisely as a consequence of this directional evolution.

Keywords: Schrödinger Cat, Principle of Directional Evolution, isotropy, entropy, observers, quantum mechanics, cellular automata.

1 Three previous issues

The first issue to be recalled in this section is the Principle of Directional Evolution of the Universe, which states that the observable universe always evolves in the same direction of increasing its entropy (where entropy can be exchanged for isotropy). It is an inductive principle of maximum empirical evidence, already accepted in thermodynamics under the name of the Second Law of Thermodynamics. From this principle is formally derived another result of great interest: the Theorem of the Consistent Universe, which states that the universe evolves under the control of a unique set of formally consistent laws. [4, pdf].

The second issue is the so-called *problem of change*. A problem that was raised more than 2700 years ago and is still a problem to be solved. But the worst thing is that physics, the science of change, has completely forgotten it. To the point that some contemporary physicists ignore its existence. But until the problem of change is solved, we will not have a complete explanation of the physical world, if a complete explanation of the universe were possible. And it is also worth remembering that the problem of change could find its solution in a discrete space and time, while it can also be proved that the problem of change is insoluble in the infinitist spacetime continuum [5, p. 297].

And the third issue is the mathematical infinity. For over 120 years, mathematics has been essentially infinitist: it assumes the Hypothesis of Actual (not potential) Infinity, subsumed in the Axiom of Infinity. Any infinite set, such as the spacetime continuum, exists as a complete totality. For example, the open real interval (0,1) contains ALL numbers greater than 0 and less than 1, even though there is no first real number greater than 0 and no last real number less than 1. Over the last 30 years, I have given more than 40 proofs that such actual infinity is inconsistent [5, pdf], and here [3, pdf] you can see one of the simplest and shortest. Obviously, the inconsistency of the actual infinity would change everything if it were to be accepted: space, time and all physical entities and magnitudes would be discrete, with indivisible minimal units.

2 The measurement problem

For many authors, decoherence explains the relationship between the fuzzy quantum world and the sharp macroscopic world. But decoherence does not solve the so-called measurement problem. In fact, measurement in quantum theory is special because the principle of superposition in quantum systems keeps the possible outcomes (sometimes mutually exclusive[1]) together until the last moment, when suddenly only one of them emerges as an observable reality, and there is no explanation why one and not the other is the one that finally collapses in the macroscopic world. The new problem is that non-directional changes are inconsistent with the observed directional evolution of the universe. And the reason for this inconsistency could be an undue projection of the macroscopic reality onto the microscopic world of quantum mechanics.

As is well known, the wave function of a quantum system contains the possible outcomes with their corresponding probabilities, but it does not provide any information about what the concrete result of a concrete measurement made by an observer will be. In fact, the measurement of a system is an unpredictable value among all possible outcomes. For this and other reasons, it has been written that [1, p. 8-9]:

> ... quantum mechanics banished the objectivity of physical properties, which makes them, along with the system itself on which they are predicated, dependent entities of the cognitive processes in which they are involved; it dislocated physical systems in space; it blurred the sharp boundary between the observed and the means of observation; it eliminated the possibility of accessing the most complete possible knowledge of a system from the exhaustive knowledge of its individual parts; and it abolished the determinism that allowed conceiving

[1] which goes against the Second Law of Logic, see paper [6, pdf].

> the world as an immense, well-coordinated mechanism.

However, and this is the counterpoint offered by the content of this article, the universe has been evolving for billions of years, "as an immense, well-coordinated mechanism", in the same direction perfectly defined by its increasing entropy and under the control of a unique and formally consistent set of physical laws without which the directional evolution of the universe would be impossible.

3 Interpretations of quantum mechanics

Quantum mechanics rightly boasts that it is a very successful science. What is rarely made clear is that these successes are only operational and functional; they explain the observed and measured facts. But quantum mechanics does not explain the physical world, which is why there are different interpretations of it. Some of these interpretations involve the actual infinity, so their formal consistency is linked to the formal consistency of this actual infinity (see above). Others, which are the ones we are interested in here, are linked to the presence of conscious observers. It would take the intervention of one of these observers to make one of the quantum states that coexist in the absence of such active and conscious observations collapse and become present (problem of measurement).

But for most of the history of the observable universe there were no conscious observers intervening in the directional evolution of the universe that eventually produced observers, some of them conscious. At most there were mineral observers, but not organic or conscious observers. These observationalist interpretations of quantum mechanics are, to say the least, incomplete: they do not explain the directional evolution of the universe, which has followed its course over billions of years without anyone observing it. A history in which an enormous amount of successive changes, quantum and non-quantum, have not ceased to occur in due form and in the right direction until culminating in the production of conscious and rational observers who set out to explain the physical world, although so far they have only explained certain measurements.

We would have to consider the possibility that the physical laws governing the directional evolution of the universe are actually emergent properties of the universe that cannot be applied to the microscopic world (of quantum potentialities? [7]) that produces its emergence because this world is governed by other more basic level of laws. In R. Laughlin words [2, p. 111]:

> From the perspective of emergentism, physical laws are rules of collective behaviour that follow from more primitive behaviour rules.

It is also important to highlight the fact that the different interpretations of quantum mechanics propose to explain the reality arising from that enormous quantity of successive changes without having even understood and explained how a simple canonical change is produced. Moreover, they propose to explain the world WHILE IGNORING THE EXISTENCE OF THE PROBLEM OF CHANGE. Perhaps this ignorance is the reason for so many interpretations so far removed from the evident directional evolution of the observable universe.

Surely, the great operational success of quantum mechanics has to do with the discreteness of most of the physical entities and magnitudes: matter, mass, energy, electric charge, magnetic charge (dipole), color. The only missing quantities are space and time, which are still assumed to be infinite and continuous and which, moreover, underlie other physical theories such as the theories of relativity. But if the Actual Infinity Hypothesis is inconsistent and the universe is consistent, then even space and time must be discrete in nature.

The discrete nature of space and time is a necessary requirement in models based on cellular automata, in which, in effect, there are two sets of laws: the more basic one, corresponding to the automaton's own laws, and that of the emergent properties resulting from the evolution of the objects in turn emerging from the evolution of the automaton. In these models a solution to the problem of change could be found and the double legislation governing the microscopic (quantum) and macroscopic worlds could be explained. The third and final article in this series of articles discusses this issue.

4 The Principle of Directional Evolution

The universe has been producing the same kinds of objects for billions of years. Or to put it another way, in the observable universe, under the same circumstances the same events have always occurred, the same objects have always been formed, which is only possible if that universe is not only observable but also consistent: it is subject to a unique set of consistent laws. The indisputable directionality of the evolution of the universe, which has even left an analyzable record in the rocks of the planets, is a matter that requires an explanation. And quantum mechanics does not give it either. So, at least from this perspective, quantum mechanics is not a complete science.

One wonders whether this incompleteness has any relation to the infinitist language of the continuum with which quantum mechanics, the science of the discrete, has so far expressed itself. It is worth asking whether there are mathematical alternatives (or computational languages) with which to design new models of the world compatible with quantum mechanics, with the directional evolution of the universe and with common sense. As will be seen in the third and last article of this mini-series, cellular automata could be used to design a new discrete model. A new meeting point between physics, the observable universe and common sense.

Bibliography and References

[1] M.C. Boscá Díaz-Pintado. *El equilibrio cuántico.* RBA Editores México, 2017.

[2] Robert Laughlin. *Un universo diferente. La reinvención de la física en la edad de la emergencia.* Katz, Buenos Aires, 2007.

[3] Antonio León. The shortest proof of the inconsistent infinity. *The General Science Journal pdf*, 2023.

[4] Antonio León. *Towards a discrete cosmology.* Independently published in KDP. Free pdf, 2023.

[5] Antonio León. *Infinity put to the test.* Self edition in KDP. Printed at amazon.com. Free pdf, 2023 (2021).

[6] Antonio León. Logic and biology of schrodinger's cat 1/3. *The General Science Journal pdf*, 2024.

[7] Wolfgang Smith. *El enigma cuántico.* Editorial Sekotia S.L., 2021.