Brief Report
The superfluid vacuum and the neural nature of the Universe

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Abstract

Recent experiments seem to confirm the Bohmian interpretation of quantum mechanics by supporting the hypothesis of the existence of what Bohm called "pilot waves", but numerous clues coming from the world of scientific research, suggest the existence of what Prigogine identified as the "world behind the scenes" that seems to underlie quantum phenomena; in particular, life related phenomena have anti-entropic behaviors opposite to those typical of classical thermodynamics, showing increases in the degree of order coexisting with the absorption of energy from the environment. If we limited ourselves to the physics of the macroscopic world, except not wanting to admit the existence of "delayed potentials" or "feedbacks" that travel in the opposite direction to that of propagation of the phenomenon, or even through an inversion of the "cause- effect" and of time, as proposed by the "syntropic" mechanism theorized by Luigi Fantappié, it is necessary to look elsewhere for the origin of these behaviors. In this article, starting from recent studies on the superfluid nature of vacuum , taking into account the possibility of a description of polar superfluids through an Ising model, or through a Spin Glass model, and the relative connection of these mathematical models with Hopfield's neural networks, the possibility is suggested that quantum phenomena are connected to an emergent behavior of the void that can be explained through its intrinsic dynamic behavior that can be described with neural mathematical models. In other words, a neural nature of the superfluid vacuum is proposed, and the consequences of this hypothesis are examined.

Keywords: *S*uperfluid vacuum, quantum vacuum, neural network, neural Universe, Spin Glass, theory of everything

1. Introduction

Italian physicists, Stefano Liberati, professor of the International School of Advanced Studies (SISSA) of Trieste, and Luca Maccione, researcher of the Ludwig Maximilian University of Munich have shown, through some experimental observations, superfluidic behaviors associated with the vacuum (Liberati & Maccione, 2014), hence the possibility that the vacuum is itself a superfluid.

One wonders if the postulate on which the relativistic model is based directly, but also indirectly the quantum one, in other words the elimination of this "substrate", is not the reason that still makes the two models incompatible and that does not allow the explanation of a series of phenomena and behaviors particularly relevant in astrophysical observations.

Do we have to continue to "repair" and integrate the concepts of "Relativity" and "Quantum", to adapt them to the observations, or is it not time to question the two models? Below we will try, briefly, to show the shortcomings of this conservative approach.

2. Paradoxes in physics

The absence of the phenomenon of entrainment of the Aether, proved by the Michelson and Morley experiment in 1881, was the basis for postulating the non-existence of the Aether and for laying the foundations of Special Relativity and later of General Relativity.

However, in the light of recent theses on the superfluid nature of the vacuum, it is necessary to ask whether its very existence does not make that postulate fall and invalidate the relativistic model.

In other words, the absence of the entrainment phenomenon demonstrated in the experiment of 1881, can be, by itself, proof of the non-existence of the Aether, if this Aether has the characteristics of a superfluid and therefore a fluid that offers almost zero resistance?

If we renounce the postulate of the non-existence of the Aether, does the relativistic framework still hold up?

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Current models of physics, and in particular relativity and the Big Bang theory, do not explain 94% of the phenomena that are observed in our universe. To overcome this lack, science has "repaired" and integrated these models by devising a series of "dark" physical objects: dark matter, dark energy and dark flow to explain a series of anomalous behaviors such as the non-homogeneous distribution of matter in the universe, the existence of a matter that is not "visible" but whose effects are indirectly detectable, the speed of expansion that not only does not slow down as the distance from the center of the universe increases, but accelerates unevenly.

Despite this, not even these "obscure" integrations to the analysis models have proved sufficient, and to the hypotheses of the existence of dark Energy, Matter and Flow, the hypothesis of the existence of a new particle, the axion, has recently been added (Irastorza, 2022).

Although contemporary science proposes continuous confirmations of Einstein's Relativity, the audience of those who begin to question the Big Bang is expanding and, while all support the intangibility of the concept of "space-time", astrophysics continues to operate as if space and time were distinct entities.

In fact, if Einstein's Relativity were applied, one would have to assume that the variations in the gravitational fabric of the Universe also involve time. The hypothesis of the existence of negative gravity associated with dark matter, introduced to explain the acceleration in the moving away of galaxies, for example, would involve phenomena of acceleration and inversion of time and therefore, galaxies and fragments of the universe should live in a time future compared to ours, a time that, given the non-uniform distribution of dark energy, would vary in a non-uniform way everywhere, producing a schizophrenic distribution of past and future in the Universe.

The paradox of Relativity applied to astronomy and to the expanding Universe with non-uniform accelerations leads to the deduction of a kind of Uncertainty Principle applied to astrophysics, in this sense astrophysics itself would have no reason to exist, if it took into account of Relativity, not being able to carry out measurements on a precise reference time basis.

In a nutshell, astrophysics looks at the Universe using Newton and formulating hypotheses that deny Einstein, and with this it denies relativity, but it also denies the central pillar on which it is based: the non-existence of the Aether.

It is therefore necessary to ask whether the astrophysical phenomena explained using the concepts of matter, flux and dark energy can be explained, calling into question the postulate on which the relativistic model is based, in other words the non-existence of the Aether as it seems to be indirectly happening thanks to a series of new theoretical studies and experimental data.

3. Solved the paradox of surreal photon trajectories

Experimental work has confirmed the correctness of the interpretation of quantum formulated by physicist David Bohm see Mahler et al. (2016). In Bohm's interpretation, quantum phenomena are anything but random, in fact there is a real function, therefore not simply probabilistic, which "guides" the motion of the particles albeit through "surreal" trajectories. In other words, Bohm brings to life a deterministic view of physical reality, albeit partially different from that known in classical physics.

With Bohm, the motion of the particles takes on well-defined trajectories and a "pilot wave" is introduced that traces a kind of invisible highway, along which photons and energy determines the changes of each particle state travel.

Therefore, the probabilistic essence of the functions of quantum mechanics is not denied, but it is connected only to the impossibility of knowing the initial conditions in which the particle is found without violating its state (Heisenberg uncertainty principle). There is, therefore, a sort of underlying tissue that defines the way in which the particle will act once "observed" through the measuring instrument.

4. The "Backstage World" of Prigogine and Bohm

The results of the experimental works that follow each other from year to year seem to confirm the existence of what we could define the "Backstage World" theorized by Karl Prigogine and David Bohm, and this in turn seems to suggest the need to reintroduce a means of "Transmission" of information through a nonlocal mechanism (such as that predicted by Bohm's pilot wave), which disappeared at the beginning of the last century, with the renunciation of the Aether.

The form in which this "uncomfortable intruder" has returned is linked to studies on the "superfluid" nature of vacuum (Liberati & Maccione, 2014), but also to new theoretical approaches that tend to replace the quantum relativistic model with other models inspired by classical mechanics; such as, for example, a work by Sbitnev (2016), which shows how the "superfluidic" model of vacuum, in particular the Navier-Stokes equations (Faro, 2020) which describe macroscopic dynamics eddies and motions in fluids may constitute a different mathematical form of the Bohmian interpretation of quantum mechanics and the pilot wave.

In summary, from Sbitnev's work, the Aether in the form of a superfluid vacuum appears mathematically similar to the interpretation of Bohm and Schrödinger's equation, in other words the concept of superfluid vacuum and Bohm's interpretation coincide; therefore, the Superfluid Void represents the "means" that allows correlation information to be spread everywhere in a nonlocal way, which gives rise to phenomena such as entanglement.

5. The functioning of quantum fields is similar to that of neural networks

Physicist Jae-Weon Lee, best known for a theory relating gravity to quantum information, in his article (Lee, 2017), uses the results of previous research that established an exact mathematical analogy between deep learning (a branch of artificial intelligence), and the grouping methods of normalization, used in condensed matter physics and quantum field theory.

Lee (2017) shows that quantum fields behave like neural networks, but since he had previously demonstrated a link between gravity and quantum information, it follows that gravity, as well as quantum, can accumulate and process information through the same mechanisms as neural networks. What Lee's work lacks is the connection of this behavior with a physical substrate. Below we show this connection can be made.

6. From the neural superfluid vacuum to the holographic nature of the universe

Sbitnev (2016) derives the phenomena of quantum mechanics from the equations of fluid mechanics that describe the vortex mode in a superfluid. In turn, the dynamics of the superfluid can be analyzed using a model known as "*Vetri di Spin*", conceived by Parisi

(2018), or through an Ising model, such as illustrated by Dziarmaga (2005). So, from a strictly mathematical point of view these models are presented as an extension of Hopfield's neural model (Hopfield, 1982), in particular we note that Hopfield's model is derived as isomorphism from Ising's (Rojas, 2007).

We deduce that for the description of the dynamics of the superfluid vacuum, we can use a model similar to the Hopfield neural networks (see Liberati & Maccione, 2014), and through these studies, we can inductively deduce the neural behavior of the vacuum, which allows us to provide an explanation for numerous other phenomena starting from the holographic behavior of the Universe, hypothesized by Susskind (1994).

On this line of thought, Pribram (1991) showed in the laboratory what had already been verified by the mathematical structure of neural networks, in other words that the brain operates in intrinsically holographic way (see also Poznanski et al., 2022).

In summary, the neural nature of the superfluid vacuum and the intrinsically holographic behavior of neural networks provide a physical explanation for the phenomenon theorized by Susskind (1994).

7. From the neural nature of the void to non-locality through the phenomenon of percolation in fluids

The holographic behavior determines a conservation of "*nonlocal*" information; in fact, the holographic model provides that information is distributed uniformly everywhere, exactly as it happens for neural networks, and therefore consequently for the distribution of information in a vacuum.

The overcoming of the postulate on which Relativity is based, in other words the non-existence of the Aether, and the existence of a superfluidic vacuum, involves a series of consequences also on the "limits" that are derived from special relativity and among these the light speed limit.

A recent article by Cantor (2016), shows how the form assumed by Lorenz transformations is perfectly homologous to that of the percolation phenomenon in a fluid. Consequently, passing from the relativistic model to classical models of fluid dynamics, the Lorenz transformations, which are the basis for the theoretical formulation of the existence of space-time and of the insurmountable limit of the speed of light,

have a physical explanation in the passage from the superfluid state to that of ordinary fluid which would be observed traveling at a speed close to the limit speed of the specific fluid, in this case the vacuum.

Still from Cantor (2016), it is found that the same "slowing down" of clocks that is observed when a system moves at a speed close to that of light, could be connected to viscous friction due to the transition of superfluid state. This friction would act on all the phenomena of the moving system, and consequently also on those destined to measure time. In other words, the slowing down of time does not depend on the relativistic behavior of time, but only on the collective slowdown of all phenomena due to the viscous friction. A physical explanation is therefore provided for the phenomena related to Lorentz transformations, without the need to theorize a relativistic time and space as occurs in the Einsteinian interpretation.

At this point we can try to go further, also trying to explain the origin of the mechanism of nonlocality and nonlocal propagation, which could be connected to the nature of the vacuum as an uncompressible fluid.

If, in fact, we assume that the smallest unit of void, which we could call "plankion", has the dimensions of a Plank length, since it is not possible to compress or expand this length, traction or compression phenomena, or in any case, phenomena of a wave-like nature; they would cause the instantaneous propagation of the perturbation.

Think, for example, of a tube of infinite length filled with an incompressible theoretical liquid; in this theoretical condition, the compression effect operated by acting at the mouth of the pipe, propagates instantaneously to the other end regardless of the length of the pipe itself.

Since the type of perturbation in the vacuum is intimately connected to the propagation of gravitational phenomena, as can be deduced by combining the studies of Jae-Weon Lee with those of Sbitnev, it is necessary to hypothesize that gravity represents the mechanism of nonlocal communication between the "plankions", intended as a neural unit and therefore also the physical basis of Bohm's pilot waves.

The neural nature of the vacuum can therefore also explain the instantaneousness of the propagation of correlations through a "pilot wave", and with it the instantaneous correlation in entanglement phenomena.

8. The neural superfluid vacuum as a unification theory

A recent theoretical study by Vanchurin (2020), demonstrates that the bridge that can allow a connection between Relativity and Quantum is represented precisely by the mathematics of neural networks. This work is not able, on its own, however, to provide a physical motivation, but with the reasoning set out so far, we believe we have provided sufficient proof of why the solution for the unification of the two models lies precisely in the mathematics of neural networks. In fact, since the vacuum has a neural nature, it appears evident that it is precisely the neural mechanism, the missing bridge between the two irreconcilable theories of modern physics.

At the same time, it is also clear that the irreconcilability of the relativistic and quantum models lies precisely in the fact that both have set aside the "*transmission medium*", in other words the void, and this also explains why it is necessary to overcome the two models, especially because by eliminating the void it is not possible to understand and study all the phenomena that depend on the superfluid and neural nature of this medium.

9. The distribution of dark matter in galaxies

The hypothesis on the incompressibility of the void, as a "substance" composed of minimal elements, as large as the Planck length, and the typical dynamics of neural networks, which tends to optimize the distribution of information through continuous correction mechanisms in forward and backward, also suggests the possibility that clusters of information associated with groups of neurons-plankions are determined in a vacuum, and that, moreover, preferential communication channels are generated between clusters and between single plankions.

This hypothesis seems to find confirmation in the observations of the distribution of dark matter in galaxies; in fact, unlike what was expected, the outer parts of a galaxy are not faster than the inner ones, but they have the same rotation speed and seem to be held together by filaments that give rise to the famous spiral tails of galaxies. In practical dark matter seems to be arranged along filaments that act as aggregators
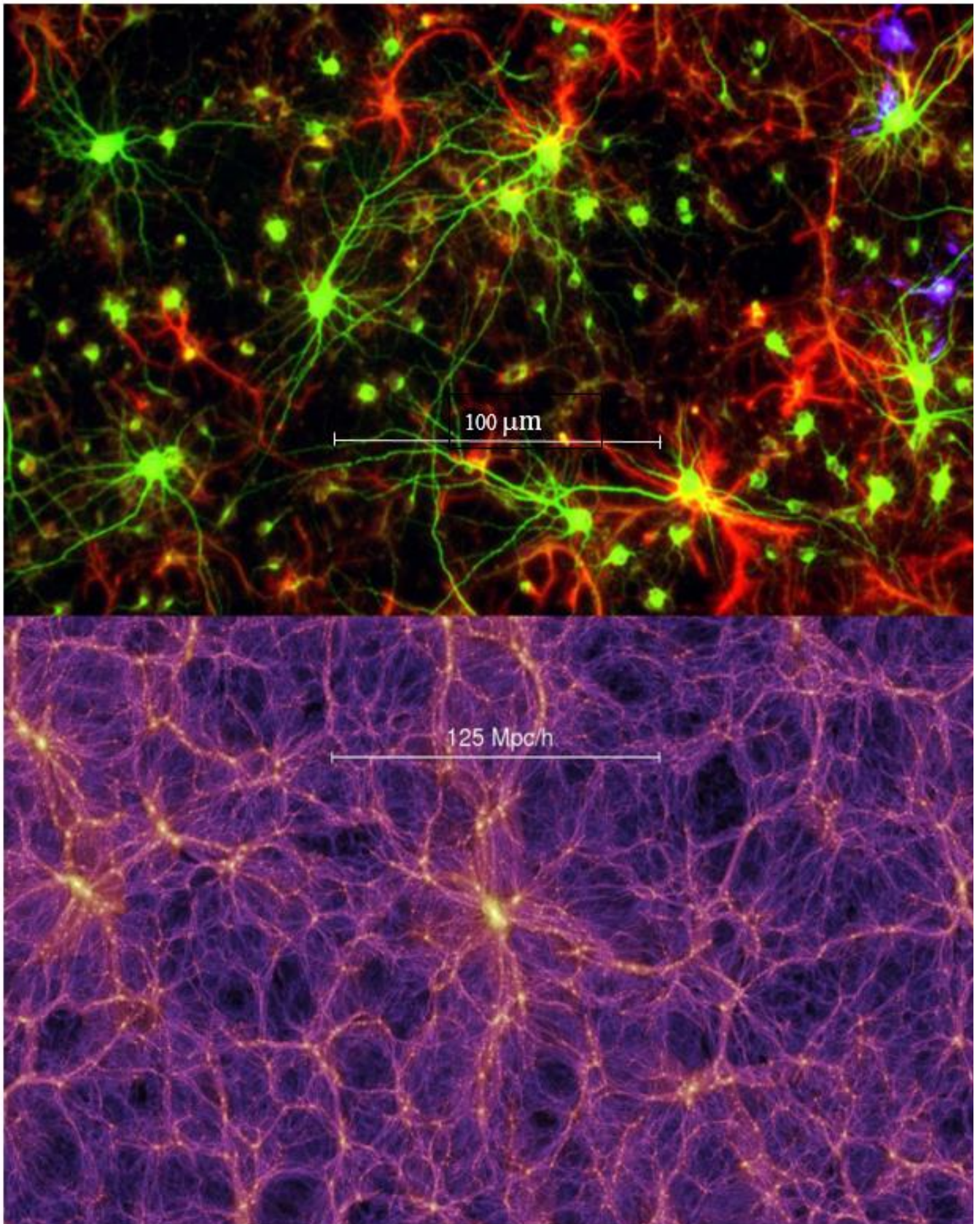
Figure 1 *Distribution of dendrites and axons among the neurons of the human brain compared in units of microns (1 μm=10⁻⁶ meters) with distribution of   dark matter in the universe. The unit measurement Mpc h⁻¹ which represents an indeterminate unit of distance between 4/3 Mpc and 2 Mpc. The megaparsec (Mpc) which is equal to 1 million parsecs about 3.26 light years = 3086 x 10²² meters. Image credit: Center for Brain Injury and Repair, University of Pennsylvania School of Medicine (top) and Springel et al. (2005) (bottom).*

of matter, and it is precisely the latter that makes them visible. These filaments seem to be the ones that organize all matter in the universe, constituting a kind of invisible scaffolding. These "inextensible threads" on which the dark matter is subtended could also correspond to the longitudinal component of the force of gravity, predicted in my symmetrized Maxwell equations (Scala, 2007).

The theory of the superfluid vacuum alone, even noting its neural nature, alone does not explain, in fact, the phenomena connected to dark matter, which may not be connected to a different type of matter, but precisely to the torsional gravitational component, foreseen in my Maxwells symmetrized equations. It would therefore be a different component of gravity, linked to gravity in the same way in which the components of electric and magnetic induction are linked respectively to electric and magnetic fields.

This component, hypothesized solely for symmetry reasons, would generate gravitational effects even without matter being present; and again, this component can be represented as a series of invisible tracks in space that allow an instantaneous propagation of information of a mechanical and quantum type, but not electromagnetic. In practice, it allows the aggregation and mutation of matter and acts as a canvas on which matter in the universe is organized.

A similar result could probably also be obtained by deepening the analysis of the forces acting on the vortex mechanisms in a superfluid, taking into account not only the macroscopic behavior, but also the sub-microscopic neural one.

Another striking similarity is provided by the images showing the distribution of dendrites and axons among the neurons of the human brain compared with the images showing the distribution of dark matter in the Universe, see Vazza & Feletti (2020) and **Figure 1**. This similarity could have a close connection with the neural behavior of the Superfluid Vacuum.

10. Life as a resonance phenomenon of carbon bonds with the structure of the vacuum

The phenomena related to life seem to possess anti-entropic behaviors that are clearly opposite to those typical of classical thermodynamics, showing increases in the degree of order coexisting with the absorption of energy from the environment.

These phenomena have not yet found an explanation, except not wanting to admit the existence of "delayed potentials" or "feedbacks" that travel in the opposite direction to that of propagation of the phenomenon, or even through an inversion of the "cause-effect" principle and of time, as proposed by the "syntropic" mechanism theorized by Luigi Fantappié (see Arcidiacono, 2005). It is necessary to look elsewhere for the origin of these behaviors, and the neural nature of the vacuum may be the answer to this anomaly of the birth and evolution of life with respect to the laws of thermodynamics.

It is necessary to understand why only the carbon-based structures seem to "resonate" with the structures and with the dynamic behavior of the vacuum. This could have to do with a formal resonance between the tetrahedral structure of bonds such as methane CH_4, considered the element from which life originates, and a possible tetrahedral organization of the "plankions", and some resonance entrapment mechanism, that the C-H bonds exert on neural clusters of "plankions"; probably related to the proportionality between the mean bond distance and the size of these clusters.

In this hypothesis it is possible that the interrelation between the clusters of "neural planks" aggregated to the carbon-based molecules, constitutes an "attractor" that favors the neural dynamics, which are reflected in mechanical correlations that lead to the birth of polymers.

In some studies, (Parker, et al. 2015) conducted on the possibility that the conditions useful for the birth of life can occur in the formation processes of galaxies, a fundamental role has been attributed to acetylene. This organic compound has a bond distance between Carbon and Hydrogen of 1.06 Å and allow us to show a particular analogy with harmony in music. In the theory of musical harmony, a string of length L produces a vibration with a wavelength $\lambda = 2L$; the wavelength of a fifth harmonic is $2/3 \lambda$. Therefore, the average value of the C-H bond length in acetylene (1.06×10^{-10} m) is very close to the fifth harmonic of wave with wavelength equal to the Plank length ($1,616252 \times 10^{-35}$ m) less than a factor of 1×10^{-25} m. This, of course, is still only a hypothesis, which needs experimental proof.

We will try, below, for a possible indirect experimental verification of this phenomenon by showing clues that lead us to believe that the mechanism through which correlation signals

propagate in a vacuum is the quantum tunneling effect.

11. The quantum tunneling effect as propagation signal of correlation phenomena in the vacuum neural network

We hypothesized the existence of a correlation between the dark energy distribution and the connections of vacuum neural network nodes. Moreover we have also hypothesized, that these "traces" are correlated to the Bohm's "pilot waves" in terms minimum energy paths related to negative potential.

If this were the case, events such as tunneling quantum leaps could occur when an electron in an atomic orbital intersects one of these "paths". When this happens, the necessary energy required for the electron to rise to the higher energy level is reduced. The electron, therefore, moves to this level and, subsequently, in returning to the orbital of origin, it emits a photon.

According to this hypothesis, quantum leaps due to the tunnel effect could be the indirect signal of an interaction between matter and the correlations mapped by the topological structure of the neural vacuum's tissue. Furthermore, this hypothesis could provide a possible explanation for the phenomena observed in the Global Consciousness Experiment carried out starting from 1998 at Princeton University, and subsequently carried out by the Institute of Noetic Sciences (Nelson, et al., 1998).

The experiment is based on the use of Random Number Generators (RNGs) consisting of electronic devices that use the quantum tunneling effect to produce a random series of 0 and 1. During the experiments it has been observed that, every time events with a great collective emotional impact occur, there is a violation of the law of large numbers, i.e. the number of 1s or 0s produced by RNGs, distributed in various areas of the world, exceeds what one would expect for a purely random phenomenon. The hypothesis formulated by the group that conducted the experiments is that this violation is caused by a great collective emotion. This hypothesis, however, does not explain why statistical anomalies often begin even two or three days earlier than upon occurrence of the triggering event. We have theorized that the real causes could be, instead, that in the topology of the neural vacuum have been produced correlations between signals , able to generate the prediction of the event that is about to happen. This prediction manifests itself with a surplus of active connections between the nodes of the network that the RNGs measure by detecting a corresponding surplus of quantum leaps due to the Tunnel effect. Thus producing numbers that violate the statistic.

In the same way, using tunnel effect electronic instrumentation (RNG, photomultipliers in shielded chambers, quantum dot arrays, etc.) could prove the correlation between the vacuum and relevant biological phenomena, such cellular reproduction or growth.

12. Syntropy and neural behavior of superfluid vacuum

Reference was made to the syntropic theory of Luigi Fantappié in Arcidiacono (2005), where the Italian mathematician, starting from giving physical concreteness to the negative energy solutions of the relativistic energy / moment equation, theorizes the existence of a mechanism of anti-causal propagation linked to a particular type of waves which travels from the future towards the past, and which determine today the effects of causes placed in the future.

To demonstrate how this seemingly bizarre behavior is exactly the way a neural network operates, we observe that the neural mechanism, like the one with which our brain operates, is an intrinsically predictive mechanism; in fact, the neural network uses what has been previously learned to predict what will happen in the future when conditions similar to those of past events arise. Consequently, its internal behavior is always linked to the indirect effect of a forecast of possible output "data", once certain input "data" have been assigned.

It is therefore clear that the comparison between what the neural network predicts will happen, and what really happens, determines the "correction" mechanism of the internal weights, which are the basis for learning the neural network itself as per Hopfield's algorithm (Hopfield, 1982).

Basically, the response of a neural network is based on a mechanism similar to that theorized by Fantappié, in which the network predicts the future by placing a cause in the internal representation space of possible futures and determining what are the effects and data that today, are able to lead to that result. In other words, its behavior today is due to what the network predicts for the future. All this is possible since the

evolution time of the phenomena in the internal representation space of the neural network is faster than the time with which the phenomena evolve in the real world. This allows to get predictions before events happen.

13. Concluding remarks

The tendency of modern physics to prefer and preserve models that have historically proved to be functional, over new models that by their very nature are incomplete and not yet sufficiently verified, can be justified as long as these models allow us to read and interpret most of phenomena, but above all to foresee new ones in a complete and correct way.

When, however, the model explains only a tenth of the observable, as happens with relativity applied to astrophysics, and numerous observations undermine the basic postulates it is based on, as in the case of the postulate on non-existence of the Aether on which Relativity is based, invalidated by continuous clues to the existence of a vacuum with a superfluid nature, setting aside the model should no longer be a possibility, but an obligation of science.

After all, we would never have had a Copernican revolution like the one introduced by Einstein if Physics had not courageously embraced his ideas, probably adopting a perhaps even excessive trust, after all, based on a single experiment, the one conducted by Michelson and Morley. The possibility of deducing from that experiment, carried out two centuries ago, a proof of the non-existence of the Aether, or if we want of the vacuum as a fluid, due to the lack of the entrainment phenomenon, is now being questioned by studies on its superfluidic nature.

If models become a limit to the observation of new phenomena, and harness research instead of favoring it, and if they become a yardstick for evaluating the investment opportunity of human and economic resources, science has abdicated the Galilean approach by returning to the Ptolemaic one. In the Ptolemaic world, in fact, the model was considered indisputable, and was the yardstick for evaluating the very existence of phenomena. When the phenomena did not fit the model, such as the elliptical shape of the orbits or the centrality of the sun, it was preferred to create complex circular patterns by correcting the model instead of accepting the error inherent in the model itself and evaluating its overcoming.

If the Ptolemaic system was supported by reasons of a religious nature, what are the reasons today for not calling the relativistic model into question, despite heavy doubts about the validity of its founding postulate?

In this work a simple logical deduction has been proposed which can be summarized as follows: if the vacuum has a superfluid nature (Liberati & Maccione, 2014; Sbitnev, 2016), since the dynamics of the superfluid can be described through an Ising model (Dziarmaga, 2005) and since the Ising model is an isomorphism of the Hopfield neural model (Rojas, 2007), it can be deduced that the dynamics of the Superfluid Vacuum have a neural behavior; this fact also explains why the neural model represents the bridge that binds relativity and quantum (Vanchurin, 2020).

By accepting the superfluidic nature of the vacuum, which we could call the "return of the Aether", we could finally find a physical substrate for the various phenomena of both the macroscopic and the microscopic world, using the principles of fluid dynamics (Sbitnev, 2016), which implements the existence of forces and behaviors not yet observed and not foreseen by relativistic mechanics, but which are typical of fluid mechanics.

We could, for example, consider possible the existence of longitudinal waves in the vortices of this superfluid, which could be associated with a torsional component of Gravity (Scala, 2007). This new type of waves, not yet observed, should correspond to the "pilot waves" of Bohm's theory, and could provide a physical explanation for the phenomena now explained by theorizing the existence of dark matter, flux and energy.

The same limit of the speed of light would find a correspondence in the mechanics of fluids, with the limit of the speed of a body in a fluid medium, and even the Lorentz transformations could find physical explanation in the percolation phenomenon (Cantor, 2016) which would also allow us to understand the phenomenon of the contraction of time, as a result of a slowing down of the phenomena that measure time, without resorting to relativistic time.

The same gravity could be explained through the phenomena related to the different density of the superfluid vacuum (Sbitnev & Fedi, 2015). At this

point it is necessary to understand if science will decide to abandon its "comfort zone", and will begin to offer more space to new research directions, even when they are daring, without expecting total completeness and consistency impossible at the moment, especially when it deals with new research paths, for which in-depth laboratory experiments are required for their validation.

References

Arcidiacono, G. (2005) *Fantappié e gli Universi.* Di Renzo Editore, Roma (*In Italian*).

Cantor, J. (2016) Is the Lorentz factor a probability function in superfluid spacetime? *Applied Physics Research* **8**, 1-4

Dziarmaga, J. (2005) Dynamics of quantum phase transition: exact solution in quantum Ising model. *Physics Review Lett*ers **95**, 245701

Faro, A. (2020) Navier-Stokes Equation (An overview and the simplification). *ResearchGate Preprint.*

Hopfield, J. J. (1982) Neural networks and physical systems with emergent collective computational abilities. *Proceedings National Academy of Sci*ences (USA) **79**, 2554–2558.

Irastorza, I. G. (2022) An introduction to axions and their detection. SciPost Physics Lecture Notes 45.

Mahler, D. H., Rozema, L A, Bonsma-Fischer & Steinberg, A. (2016) Experimental nonlocal and surreal Bohmian trajectories. *Science Advances* **2**, e1501466

Lee, J. W. (2020) Quantum fields as deep learning. *Journal of the Korean Physical Society* **76**, 684–687

Liberati, S. & Maccione, L. (2014,) Astrophysical Constraints on Planck Scale Dissipative Phenomena. *Physical Review Letters* **112**, 151301.

Nelson, R.D., Jahn,R.G., Dunne, B.J., Dobyns, Y.H. & G.J. Bradish (2007) Field REG II: Consciousness field effects: replications and explorations. *Explore* **3**, 279-293.

Parisi, G (2007) Course 3 Mean field theory of spin glasses: Statics and dynamics.In, Complex Systems. Edited by Jean-Philippe Bouchaud, Marc Mézard & Jean Dalibard. Les Houches Book Series, Volume 85, 131-178.

Parker,D.S.N., Kaiser,R.I., Kostko,O., Troy, T.P. *et al.* (2015) Gas phase synthesis of (iso)quinoline and its role in formation of nucleobases in interstellar medium. *Astrophysical Journal* **803**, 53.

Poznanski,R.R., Alemdar,E., Cacha,L.A., Sbitnev, V.I. & Brändas, E.J. (2022) The activity of information in biomolecular systems: a fundamental explanation of holonomic brain theory. *Journal of Multiscale Neuroscience* **1**, 109-133.

Pribram, K. (1991) *Brain and Perception: Holonomy and Structure in Figural Processing*. Laurence Erlbaum Associates.

Rojas, R. (2007) The Hopfield Model. Springer-Verlag, Berlin, New York.

Sbitnev, V.I (2015) Physical vacuum is a special superfluid medium. In, *Selected Topic in Applications of Quantum Mechanics.* Edited by Mohammad Reza Pahlavani. Intech Open, UK.

Sbitnev, V.I. & Fedi, M. (2015) Special and general relativity according to superfluid quantum space, In, Abraao Jesse Capistrano de Souza (Ed.) *Trends in Modern Cosmology.* Intech Open Publishers.

Scala, S. (2007) Simmetrizzazione delle equazioni di Maxwell con l'introduzione del campo gravitazionale, un'idea bizzarra? In *Episteme - Physis e Sophia nel III millennio* N. 6 Parte II - 21 dicembre 2002 Edited by Università di Perugia (*In Italian*).

Springel, V., White,S.D.M., Jenkins,A., Frenk,C.S., Yoshida,N. *et al.* (2005) Simulations of the formation, evolution and clustering of galaxies and quasars. *Nature* **435**, 629-636.

Susskind, L. (1995) The world as a hologram. *Journal of Mathematical Physics* **36**, 6377-6396.

Vanchurin, V. (2020) The world as a neural network. *Entropy* **22**, 1210.

Vazza,F. & Feletti, A. (2020) The quantitative comparison between the neuronal network and the cosmic web. *Frontiers in Physics* **8**, 525731.