Qualitative insights on fundamental mechanics

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Abstract. The gap between classical mechanics and quantum mechanics has an important interpretive implication: the Universe must have an irreducible fundamental level, which determines the properties of matter at higher levels of organization. We show that the main parameters of any fundamental model must be theory-independent. Moreover, such models must also contain discrete identical entities with constant properties. These conclusions appear to support the work of Kaniadakis on subquantum mechanics. A qualitative analysis is offered to suggest compatibility with relevant phenomena, as well as to propose new means for verification.

1. Introduction
In most interpretations of quantum mechanics, the act of observation can determine the nature of real physical properties. Probabilistic wave-functions are described as collapsing on single well-defined values during this process. The problem is that observation is an operation that presupposes the existence of an observer (whether it is actually engaged in observation or not). Moreover, the being that is qualified as an observer must also be aware of the fact that it can be observing. In other words, it has to be self-conscious. By default, observation cannot happen without the existence of a self-conscious observer. Yet, human beings are known to exist for a short time in the history of the Universe. Physical properties had to be well-defined for billions of years prior to the emergence of humanity. Hence, we must assume that some sort of self-conscious entity observed the Universe prior to the development of human beings, or else that the principles of logical analysis, which entail this conundrum, must be superseded. None of these options are scientifically valuable, or even informative for the development of physics. This analytical dead-end is a well-known aspect of the measurement problem in quantum mechanics. However, it is remarkable that some physical processes appear to be so closely connected to philosophical concepts.

This link raises an interesting question: when we cannot get satisfactory philosophical implications from physical hypotheses, would it be more useful to do the opposite? Perhaps it is possible to describe the emergence of self-conscious beings in material contexts that do not already involve their operation. If so, it could be useful to identify the class of physical systems that are compatible with such a process. In a separate paper, currently prepared for a philosophical forum, we have shown indeed that self-consciousness can only emerge in few types of material contexts. A structure of a matter, based on discrete and well-defined elementary entities, is required. Moreover, a self-conscious being, which is also endowed with freedom of the will, can only come into existence in a world, in which fundamental constituents of matter produce energy in discrete steps. This description leads to a verifiable model in which energy quanta and the speed of their sources must be constant and indestructible. It is highly consistent
with the foundations of modern physics, in which Planck’s constant and the constant speed of light are central concepts. However, the same description is incompatible with the collapse hypothesis, as presented above. Either we have discovered a way to an alternative self-consistent interpretation, or we have another source of theoretical confusion. The answer depends on the nature of additional physical implications that can be traced to these conclusions.

In order to narrow down the number of possible models, which fit a general description, it is frequently useful to consider a greater number of variables. With regard to fundamental processes, an important aspect is the causal structure of the Universe. Does the Universe have infinitely many levels of material organization, or does it have a fundamental level with irreducible qualities? This question can be answered by taking into account the physical implications of each scenario. The properties of a coherent system with infinite structure can be exhausted by a single set of laws. The features of any level must always reduce to those of lower levels, without any break in causality. In contrast, a system with finite structure requires the existence of two sets of laws. One set of laws must describe the macroscopic dynamics. The second set of laws is required in order to describe the microscopic processes that make it possible. A fundamental level cannot be featureless, if it is to determine anything. Yet, its properties cannot be produced by the same type of interactions that apply to other levels, because of its causative function. This difference between the two types of systems has a clear observable implication: physical laws must operate without exception in the first case, but they must break down at some level of organization in the second. In other words, the unavoidable gap between quantum mechanics and classical mechanics is an important indicator. It shows that our Universe contains a fundamental level, whose properties must be theory-independent. In light of the above, it is acceptable to develop fundamental models without justifying their exact properties, as long as they simplify our understanding of Nature. This is a liberating conclusion, but not without constraints. The fundamental model must be conceived in a way that excludes the necessity of reduction to lower-level mechanics. Also, its properties must be able to produce the entirety of macroscopic phenomena, including the emergence of self-conscious beings. It was mentioned above that fundamental entities must be discrete, and also act as sources of discrete energy, in order to fit the last requirement. The best way to satisfy these criteria is to develop a model with a constant number of elementary entities, whose properties are also constant and unchanging. If the number of elements in a system is not allowed to change, there is no need for a mechanism to explain change. If all the members of a system are identical, there is no need for a mechanism to explain variation. Moreover, their behavior must also be theory-independent. When it comes to energy generation, it is very difficult to imagine a pure particle mechanism, whose details do not depend on lower-level processes. Wave mechanics is much more appropriate for this task. If the elementary entities are embedded in some sort of medium without being able to collide with each other directly, and if they can influence each other’s motion by producing waves on the medium, the causal details become irrelevant again. Every material unit in the universe, from nucleons to galaxies, can be interpreted in terms of forces among their constituents. All the forces can be interpreted in terms of waves that influence the sources. All the waves are reducible to the fundamental process of wave generation by the elementary entities, but no structural breakdown is possible below the elementary level. Discrete action, such as a pluck of a string, cannot be meaningfully separated into functional constituents. Moreover, the exact nature of the medium is irrelevant, as long as it has well-defined properties, and the same applies to the entities that must pluck it to create waves. It does not matter if the elementary entities are simple or complex, or if the medium has one micro-structure or another. It is sufficient just to identify the basic parameters of their dynamics in order to explain any relevant consequence in the observable Universe.

In a self-consistent model, the properties of a fundamental level cannot produce themselves, or come out of nowhere. Yet, no kind of knowledge about them could influence the understanding
of observable physical processes. For example, it is relevant to know that atoms have smaller constituents, because lower-level dynamics is a significant source of variation for atomic properties. On the other hand, it is not relevant to know what kinds of entities produce forces at the fundamental level, as long as they are being produced at constant rates, because such details are inconsequential. Still, the existence of a fundamental level is an observable fact, as mentioned above, because it is revealed by the gap between the properties of macroscopic and microscopic phenomena. This gap forces us to presume the existence of a Law of Nature, which guarantees the constancy of the fundamental properties of the Universe. Accordingly, we must assume that elementary constituents will always move at constant rates at the fundamental level, displaying a constant linear speed (as observed for the speed of light). We must also assume that their action on the hypothesized medium will always be invariant as well, resulting in a constant generation of wave energy in equal increments (as manifested by the observed principle of energy conservation and by the role of Planck’s constant). The interactions between elementary entities have to be mediated, because direct collisions cannot be expected to be constant in all contexts.

The foregoing conclusion raises another question: can the known properties of quantum phenomena be explained with a model based on well-defined identical elementary units? This question has been already answered affirmatively by Kaniadakis, who derived the formalism of orthodox quantum mechanics from a subquantum model involving classical kinetics \[1-3\]. The idea that quantum states could correspond to some sort of classical statistical ensemble is not new, and has always been in the background of quantum theory development. The most well-known models involve either quantum fluid dynamics or quantum Brownian motion. Still, the idea that every quantum could represent a complex structure of interacting classical particles has not been treated rigorously in the past, and Kaniadakis has shown that it can be done without the need for additional assumptions. This simple picture involves well-defined quantities of identical classical particles, which are allowed to interact in any way that conserves their number, momentum, and energy. The dynamics of these systems is described in the phase space by the standard kinetic equation, with the final implication that it is governed by Schrödinger’s equation in the physical space. For clarity, the main elements of this classical kinetics are reproduced below. The important idea to be retained is that quantum mechanics can be interpreted in a manner that does not lead to inconsistencies (i.e. without the hypothesis of mysterious collapse via observation), if the arguments in favor of a fundamental level of matter are validated.

2. Subquantum kinetics
In his paper on the statistical origins of quantum mechanics \[1\], Kaniadakis discussed a subquantum classical model, which could provide ontological support for the orthodox quantum theory. He showed that one-particle quantum mechanics can be developed in the context of N-body classical kinetics in phase-space. For simplicity, he used identical interacting particles with mass \(\mu\) and chose to call them monads. A set of \(N\) monads was analyzed in a \(n\)-dimensional physical space \((n = 1, 2, 3)\), with the assumption that the same set constitutes a statistical ensemble with a distribution function \(f(t, x, v)\) with

\[
\int f \; d^n v \; d^n x = N
\]

in the \(2n\)-dimensional phase space, and obeys the kinetic equation:

\[
\frac{\partial f}{\partial t} + v \frac{\partial f}{\partial x} + \frac{F}{\mu} \frac{\partial f}{\partial v} = C(f)
\]

\(F\) is described as an external force that acts on each monad. The interactions among monads are allowed to take any form, as long as their number, momentum and energy are conserved.
Accordingly, the three functions \( g_1(v) = 1 \), \( g_2(v) = v \) and \( g_3(v) = v^2 \) become the collisional invariants of the system and the collisional integral \( C(f) \) satisfies the conditions:

\[
\int C(f) dv = \int v C(f) dv = \int v^2 C(f) dv = 0 .
\] (3)

After several intermediate steps, Kaniadakis multiplied Eq. (2) by the three collisional invariants and integrated with respect to \( v \). This produced three hydrodynamic equations:

\[
\frac{\partial \rho}{\partial t} + \frac{\partial}{\partial x} (\rho \mathbf{u}) = 0 ,
\] (4)

\[
\frac{\partial}{\partial t} (\rho \mathbf{v}_i) + \frac{\partial}{\partial x_j} (\rho \phi_{ij}) + \rho \frac{\partial \mathbf{V}}{\partial x_j} = 0 ,
\] (5)

\[
\frac{\partial}{\partial t} (\rho E) + \frac{\partial}{\partial x} (\rho s) - \rho \frac{\partial V}{\partial t} = 0 ,
\] (6)

where \( \phi_{ij} = \mu u_i u_j + \sigma_{ij} \) is the momentum flux density tensor and \( s_i = E u_i + \sigma_{ij} u_j + h_i \) is the energy flux density vector.

Eq. (4) is the continuity equation for the system which behaves in the physical space as a fluid. This equation implies the conservation of the particle number:

\[
N = \int \rho dv .
\] (7)

Eq. (5) is the Euler equation for the fluid and in absence of external forces \( \partial \mathbf{V}/\partial x = 0 \), implies the conservation of the system total momentum:

\[
\mathbf{P} = \int \mu \rho \mathbf{u} dv .
\] (8)

Finally, Eq.(6) governs the evolution of energy and in the case of time independent forces \( \partial \mathbf{V}/\partial t = 0 \) implies the conservation of the system total energy:

\[
H = \int E \rho dv .
\] (9)

Starting from this foundation, Kaniadakis went on to derive the quantum potential for spin-less systems, as well as the Schrödinger equation. He also showed that the values of physical observables can be calculated as mean values of the associated quantum operators, and even obtained the Heisenberg uncertainty principle. In a subsequent paper [2], Kaniadakis extended this picture to non-relativistic quantum mechanics with spin, and to nonlinear quantum mechanics. Yet another paper developed the model further, producing formal tools for n-particle non-relativistic quantum mechanics [3]. Kaniadakis is currently working on relativistic quantum mechanics in a similar analytical framework.

As a corollary of the above, the orthodox formalism of quantum mechanics is compatible with a lower-level interpretation, involving identical elementary entities. Yet, we have shown in the introduction that only a subclass of this mechanics is plausible for fundamental processes. The constraint to have constant and irreducible properties is favorable only for mediated interaction. Hence, the monads must be described as moving through a medium at constant rates, producing discrete excitations (plucks) at every step. The unit of action, corresponding to these constant energy inputs, can only be equal to Planck’s constant. These excitations are the only allowed source of energy in the Universe, and the only way for the particles to have effects on each other. In the absence of external influences from other sources, the trajectory of any elementary particle
must be rectilinear. The speed of displacement, in this case, would have to correspond to the speed of light. However, note that the medium is elastic and cannot have a fundamental rigid unit of distance. The primary constant is the number of steps in fixed units of absolute time. In other words, energy is the fundamental constant in the model, as it is being constantly produced in identical increments by all the monads. For interpretive purposes, it is more convenient to describe the medium as a string-based 3-brane. This way, discrete wave generation can emerge as a necessary effect of monadic displacement from one string to another. Though, any description that works is acceptable, because the process is supposed to be theory-independent. The factors that determine the exact values of the fundamental parameters are not allowed to have any effect on subsequent physical interactions.

The model described above might be easier understood as a literal representation of the Huygens Principle. As a reminder, Huygens showed that every point on the front of a wave can be described as a source of waves. This approach had its difficulties when applied to electromagnetic phenomena, because it could not explain the directionality of waves, or their quantized nature. In contrast, here we assume the operation of elementary entities, which have well-defined directions of motion and produce the waves in discrete identical steps. According to this description, all fields can be interpreted as wave-patterns in the medium, produced by the longitudinal and transverse waves of the sources. The pure form of these waves would be detectable as the zero-point field. They could further assume the shape of electromagnetic fields, when emitted by longitudinal particle associations. Static fields (electric or magnetic) would be produced by transverse associations of elementary particles. Finally, the gravitational force would have to be a complex manifestation of electric properties. In plain terms, the photons are supposed to look like trains of elementary particles, where frequency is determined by the average interval between elementary units. Subatomic particles would resemble micro-galaxies of elementary constituents. It is of note that two symmetric associations, which orbit each other, may cancel each other’s field in their own frame of reference, but not in all other frames that are in relative motion. This residue of electric force would have to manifest as gravity via dynamic effects, according to our interpretation.

3. Overcoming possible objections
The hypothetical existence of a fundamental level with theory-independent properties is not guaranteed to have scientific value. It is worthy of attention only if it uncovers new phenomena in the Universe, without contradicting existing knowledge. These qualities are not immediately obvious, considering that energy conservation does not seem to be obeyed in the preceding description. Moreover, the postulation of a real medium appears to be in conflict with well-known tests of invariance, in particular with the Michelson-Morley experiments. Therefore, it is important to address these concerns before discussing other aspects of this model.

The principle of energy conservation is not above scientific explanation. Ideally, its operation should be reducible to some sort of causal relationship. The question is: should the causal mechanism itself unfold in a manner that displays energy conservation? If it did, would it really be the determining cause? In our opinion, the cause should determine the effects without being determined in turn by them. Circularity is highly undesirable in any good theory. This position appears to be shared by other approaches as well. Hence, the Big Bang is supposed to have produced all the matter in the Universe from a theory-independent state. All of the known laws are supposed to break down in the proximity of that original point. There can no verifiable cause for the Big Bang, and none is being promoted by scientists. In short, the source of energy in the Universe is not explained in any relevant way. Similarly, the hypothesis of a fundamental level of matter cannot propose a theory for the source of energy. Instead of suggesting that it came at once from a single point, this approach merely requires a process of constant generation. Thus, the problem is not to prove that such a mechanism is possible. The relevant part is to
show that it can lead to the manifestation of energy conservation, as it is observed on all other levels of material organization.

As it turns out, energy conservation follows naturally from the described model. The specified medium is supposed to be fundamental, in the sense that all matter is embedded in it. Therefore, it cannot have any kind of rigid barriers to serve as wave breakers. All the waves must propagate away from their floating sources, without ever being reflected, or refracted. Assuming that the waves are produced at constant rates by the sources, and that they spread outwards at constant rates in a homogenous medium, it follows that any finite volume around a source must contain a constant amount of wave energy. Note that wave energy is supposed to be the only kind of energy in the Universe. Therefore, constant generation of waves can only produce the appearance of energy conservation. In any finite volume of space, which contains a finite number of sources, the total energy will have minor fluctuations around a constant finite value, in direct proportion to the number of sources. Energy conservation is thus interpreted as the conservation of sources. All transformation of energy must be reducible in one way or another to a change in the pattern of interaction among sources. This description makes it immediately obvious why the energy of a very long photon is proportionate to its frequency multiplied by Planck’s constant. Frequency is determined by the number of elementary sources in any segment, which produce waves in constant discrete excitations, as they pass by a target or detector. Similarly, subatomic particles have energies that are also proportional to the number of elementary constituents, which explains their De Broglie wavelength. Though, in these cases the excitations are produced via circular patterns of motion, around a common center. Elementary sources must always make a constant number of plucks on the medium. In complex associations their mutual effects induce zitterbewegung, which results in subluminal speeds of displacement relative to the medium. This description can also explain the emergence of other phenomena, such as inertia and variable kinetic energy.

Now, what about the Michelson-Morley experiments? Didn’t they put to rest all the models that involve classical mediation at the fundamental level? Despite the widespread support for such a position, it is not exactly accurate. Michelson and Morley tested the assumption that light is a wave, propagating inside a physical medium [4]. It is only by virtue of such an assumption that the frequency of light should be Doppler shifted, when the source of light is in motion relative to the medium. Yet, this assumption does not apply to the model introduced above. If light consists of longitudinal associations of elementary particulate sources, which emit waves at every step, then the speed of light is the speed of particles. The latter depends on the energy density of the medium, which explains why gravity could act as a refraction coefficient for light, inducing local invariance. According to this interpretation, Michelson and Morley tested the speed of sources. The speed of waves has yet to be determined, because it reflects an independent process. What is the phenomenon that corresponds to these fundamental waves? It has to be the fields that surround each source. Therefore, in order to determine the speed of these waves, and test them for invariance, the experiment should be aimed at detecting the speed of propagation of changes within static fields (electric, magnetic, or gravitational). Our approach survives the objection of invariance by making a very interesting novel prediction, which is also easily verifiable.

After considering several alternatives, we came to the conclusion that the elementary sources must make two types of waves: longitudinal and transverse. Longitudinal (electric) waves must propagate in the direction of motion the sources, in opposite directions, whereas transverse (magnetic) waves would have to be orthogonal to them. In contrast to the traditional interpretation, which describes electromagnetic waves in terms of mutually generating fields, we just assume that sources are always generating their waves as described. Relative to a stationary detector, the passage of a train of sources must produce the observation of an oscillating field. If so, the waves that constitute the electrostatic and magnetic fields should not be Lorenz
An important problem is to identify their speed. It has to be finite, but there is no reason to expect it to be equal to the speed of light. In fact, we believe that it should be superluminal, or else it is very difficult to explain quantum interference. Very short pulses of light, co-propagating simultaneously, would be unable to interfere with each other if their waves had the speed of light, because the waves would never be able to catch up with the adjacent pulses. Moreover, in inertial systems moving at high speeds relative to the medium, interference would have to be highly anisotropic, contrary to known observations. A similar argument can be invoked to show that gravitational redshift would be impossible within the terms of this model, unless the speed of gravitational waves (which is the speed of electrostatic waves) was higher than the speed of light. Again, the waves would never be able to catch up with the photons, in order to affect their frequency. (In this context, the field is supposed to consist of many waves, constantly propagating away from the source).

An obvious objection to the previous conclusion is that superluminal waves would have been detected by now, had they been so common. However, the usual interpretation of static fields was not conducive to such discoveries, in our assessment. Many scientists believe that there is nothing happening inside a static field. How can anything propagate if it is static? Others believe that static effects are instantaneous all over the universe. Yet another group of physicists appear to believe that such effects must obey the speed of light. The most common interpretation is that a changing electric or magnetic field must instantly generate an electromagnetic wave, which means that changes would propagate at the speed of light. However, even if the radiation does propagate at the speed of light (which we do not dispute), the question that we must answer is the speed of changes inside the field, while it generates the electromagnetic effect. It may be relevant to note here that electromagnetic radiation is always due to the release of elementary sources in our model, which explains why it has the speed of light. The sudden change of a field due to a discharge, or due to a magnetic spike is an independent effect, which must be investigated exhaustively. If such a phenomenon were to be verified, the mentioned hypotheses concerning fundamental mechanics would be confirmed beyond reasonable doubt.

It seems that magnetic fields are the best candidates for initial tests, because they are easier to manipulate. A very strong magnetic pulse could be produced simply by discharging a capacitor through an electromagnet. In order to test the speed of the pulse, an experimenter would have to place two detectors in the same direction, at different distances from the source. Knowing the time of detection and the distance between detectors, it should be easy to calculate the speed of the pulse. The problem, of course, is to achieve the high accuracy that would be required for this task. Rather than using clocks to register the time of detection directly, it may be more convenient to have some electric switch connected to the detector. This way, the effect of the discharge on the detector could be accompanied by the release of a pulse of light. The pulses of light from both detectors should be aimed towards a photodetector, placed in the direction of propagation of the magnetic pulse. Hence, the magnetic pulse would reach the first detector, triggering a co-propagating pulse of light. Then it should reach the second detector, triggering the second pulse of light. If the speed of light is equal to the speed of the magnetic pulse, then the two pulses of light should get to their detector simultaneously. If the speed of the magnetic pulse is superluminal, the second pulse of light should be the first to arrive at the detector. The distance between magnetic detectors should be large enough to overcome any uncertainty in the time of emission of the pulses of light. The interval between photonic detections can be measured with a multi-channel analyzer, or with interferometric methods. Once the speed of the magnetic pulses is verified conclusively, different experiments can be devised to test it for invariance.

In addition to this chief prediction about the speed of waves, the model presented above has several other implications concerning gravitational, electromagnetic, and quantum effects. In many cases, experimental evidence is already available. Where this is the case, it seems that
the model is compatible with the data. The most interesting findings known to us are outlined in the following sections of this presentation.

4. Relevant electromagnetic effects

If basic forces are really produced by outwardly propagating waves, as suggested above, then moving charged and/or magnetized bodies should experience deformations of their fields due to Doppler effects. Moreover, these deformations should be detectable internally, from their own systems of reference. They should manifest as field asymmetries. It is not an excessive task to propose relevant experimental settings, in order to test this conclusion. However, it is instructive to note that the magnetosphere of the Earth has a well-studied dawn-dusk asymmetry. This phenomenon is detectable in the form of diurnal variations in the geomagnetic declination, as well as via measurements of azimuthal distributions of the cosmic showers. It is just as interesting that Jupiter also has a strong dawn-dusk magnetospheric asymmetry, similar to other planets and moons from the Solar system that have been studied. According to our interpretation, all cosmic bodies that have magnetic fields should manifest asymmetries along their axis of motion. In the case of planets that follow counterclockwise orbital and axial rotation, the magnetic field should be stronger on the dawn side. It is important to keep in mind that magnetospheres are very complex fields, subjected to multiple causes for variation. Our preliminary surveys of the relevant literature have not yielded enough information for solid conclusions. For a proper confirmation, all of those magnetic fields should be asymmetric in the predicted direction, and they should also be stable enough to be attributed to constant Doppler effects. Nevertheless, it is already significant that these asymmetries exist, and we want to draw more attention to them.

The interpretation of forces in terms of fundamental waves leads to a new way of understanding electrodynamic phenomena. According to currently accepted theories, magnetism is not really an independent force. It is a relativistic effect of moving charged bodies. With increasing velocity, charge weakens and transforms into magnetism. This relationship is hard to dispute phenomenologically. However, it does not seem to work in all cases. For example, it is a known fact that parallel currents attract, while antiparallel currents repel. If the electrons from parallel currents move with the same velocity, they are practically at rest relative to each other. Instead of magnetic attraction, electric repulsion should be the dominant effect, but this is not the case. Another important feature of modern models is the assumption that charge has fundamental monopoles, and that magnetic monopoles could exist as well. These implications are in direct contrast with the model presented above. Under the assumption of fundamental generation, magnetic and electric waves co-exist at all times, despite the different macroscopic manifestations. Moreover, those waves can only be produced in pairs of opposite polarity, propagating in opposite directions. There can be no magnetic monopoles, or charge monopoles. The structure of charged subatomic particles is supposed to be such that electric waves propagate along the direction of motion. Due to the Doppler effect, the electric field must be denser in the direction of motion, producing an overall surplus of charge in most frames of reference. At the same time, the magnetic waves are orthogonal to the direction of motion and are not distorted like that. Their bi-polarity is always obvious. This description entails that static electrons with similar orientation cancel each other’s magnetic effects (in the rest system of reference), whereas their charge is cumulative. On the other hand, electrons lined sequentially in currents should cancel most of each other’s electric force, exposing their magnetic force relative to moving targets. In conclusion, the assumption of fundamental generation implies that electricity and magnetism do not transform into each other. It is only their manifestation that depends on relativistic considerations. In terms of observations, this means that static configurations of charged particles should have detectable magnetic effects (as in the example with attracting currents). Another implication is that currents of charged particles should have detectable static
fields as well. Such effects have been observed in the past, and they have yet to be conclusively interpreted.

A set of experiments with high voltage discharges, reported by Podkletnov and Modanese [5], is particularly relevant for this presentation. On the one hand, the authors showed that large numbers of electrons, released by a superconducting emitter through a rarified gaseous medium, did not produce lightning sparks. They rather propagated in the form of flat disks, corresponding to the surface shape of the cathode, all the way towards the anode. The electric force should have caused the electrons to fly away from each other, even as they were attracted by the anode, because they were not in relative motion at emission. On the other hand, the discharges have also produced some kind of force beams, which propagated through material obstacles without absorption far beyond the boundaries of the anode. The beams had measurable effects on suspended targets, regardless of their electrical properties (charged and neutral alike). In our opinion, this experiment confirms the existence of static fields along the direction of propagation of electrons in currents. It also appears to support the hypothesis of underlying unity between charge and gravity. Since the publication of the quoted report, Podkletnov has improved his experiment, detecting the effects of these static pulses up to a mile from the site of discharge. He has made public and private claims to the effect that he was able to measure their speed of propagation, but that his findings were too odd to be accepted for publication. The surprise was that the measured speeds were consistently superluminal, exceeding the speed limit for Einstein causality by almost two orders of magnitude. It is highly desirable to have such claims confirmed with independent experiments. Validation may not require costly developments, as suggested by the proposal with magnetic pulses described in the preceding section of this presentation. Until then, we are encouraged by the remarkable consistency between Podkletnov’s findings and the predictions of our qualitative model.

Another important phenomenon that must be mentioned here is the Biefeld-Brown effect. It concerns the fact that asymmetric capacitors display a measurable net force in the direction of the smaller surface. This tendency can be used to extract useful motion from static devices. Several years ago, a French enthusiast posted detailed instructions for several gadgets of this sort, sparking an internet phenomenon called “the Lifter Project” [6]. The term refers to a simple capacitor, built with a large (yet narrow) tinfoil cathode and a thin wire anode, stretched around a light wooden structure. Discharges are prevented by the air gap between the two components, and the whole device lifts into the air, when high differences in potential are applied (usually, between 10-30 kV). The cause of levitation, as shown in several experiments posted on the same site, appears to be the tendency of the charged tinfoil surface to move towards the wire with opposite polarity (which is fixed above it on the same frame). The tinfoil lifts the whole structure up, and even has enough potential left for a small payload. There are more than 350 registered replications of the lifter, built by amateurs from various countries. According to some interpreters, this phenomenon should not be possible, because it appears to violate the principle of momentum conservation. However, this appearance is deceiving, in our opinion. The fundamental particles can never stop their constant motion, while the state of the medium determines the pattern and direction of motion. In the absence of physical constraints, subatomic particles will react to each other’s presence until all forces cancel out. Symmetry must be a final outcome for macroscopic observables, not an inviolable state. Hence, it cannot apply to capacitors with finite capacitance. Asymmetric capacitors will necessarily have unequal amounts of charged entities on each side. With charge being strongest in the direction of motion, according to our model, all particles should end up being oriented towards the side with opposite polarity. The capacitor as a whole is pushed in opposite directions by its two constituent parts, and the side with more charged particles wins. Our conclusion is that thrusters and lifters displaying the Biefeld-Brown effect are similar to boats with two propellers on opposite sides. The net motion of the boat will be in the direction of action of the strongest propeller. The
principle of energy conservation is not violated any more than in any other experiment involving static electricity. If the momentum of subatomic particles was stored from an external source, as commonly suggested by many theories, this phenomenon would have been very difficult to explain. As a corollary, the Biefeld-Brown effect is a strong argument in favor of the hypothesis of constant and indestructible fundamental motion.

5. Relevant quantum effects

Puzzles and paradoxes enjoy a central role in quantum mechanics. This is probably why there are so many published reports on various experiments that study the same phenomenon from different angles. Accordingly, we had more opportunities to test the implications of our hypotheses in this area. Our main conclusions on quantum phenomena have been already presented elsewhere [7], and there is no time to describe them here in detail. Two important features need to be mentioned, though. Quantum mechanics is primarily quantitative, and this may blur important distinctions between different types of phenomena. For example, many types of correlations are often treated as related examples of quantum interference, or entanglement.

We find it important to differentiate between Bell-type polarization correlations and momentum correlations that produce actual fringes. Bell’s inequality is a formal instrument, which has very specific implications about the type of statistics that can violate its predictions. The most common interpretation is that a violation of Bell’s inequality rules out realism. Still, if we assume the existence of a fundamental level of matter with special rules of interaction, then realist models which violate classical statistics are still possible. It is sufficient to allow that entangled quanta violate the Malus law in order to predict violations of Bell’s inequality without non-local interactions. As mentioned above, our model of fundamental mechanics does violate Einstein causality by allowing that waves can propagate faster than light. However, this does not seem to be relevant for polarization entanglement. The initial state of some pairs of photons can be such as to produce stronger correlations than any classically polarized and purified beam. In contrast, interference fringes can only emerge via physical interactions that occur well after emission. Because of the assumption that waves must overlap for this type of phenomena, sources of waves must be close enough for visible effects. Another difference from alternative interpretations is our insistence on the fact that coherence is not sufficient for interference. This consideration enabled us to predict the limits of Young interference, and to extend our conclusions to the interpretation of various non-classical phenomena, such as ghost interference, quantum imaging and quantum erasure. The main advantage of this model is that classical analogies for quantum interactions are always possible, and this enables the development of conclusive new tests for its predictions.

It is always helpful to have experiments that test the indirect implications of one mechanism or another. However, the holy grail of experimental physics is to obtain direct verification of any kind of process. In contrast to earlier assumptions that quantum properties can not be observed, we would like to propose a simple experiment to reveal the main attributes of optical interference. As mentioned repeatedly in this presentation, the photons can be described as trains of elementary entities, which generate waves. It is the waves that guide the photons into fringes. Still, it is the sources (particles) which generate the clicks at the detectors. In other words, it should be possible to develop an experiment with overlapping wave-packets, but non-overlapping sources of waves. In suitable arrangements, classical pulses of light could be detected with time-resolved quantum detectors, in order to obtain interference distributions for independent sets of detection events. What do we mean by that? A coherent laser beam can be chopped into a pulse with well-defined boundaries. The pulse can then be separated in two with a 50-50 non-polarizing beam-splitter. The two smaller pulses can then be suitably guided towards a Young interferometer, along unequal paths. The beginning of the delayed pulse must fall very close to the tail of the preceding pulse without overlapping, such as to make it possible
to distinguish one pulse from another in a time resolved record of detection events. According to our interpretations, the waves from each pulse could have effects on the other. This effect should diminish with the square of the distance, and should be highest within two wave-lengths from any two sources. Consequently, the photons from the front of the first pulse, or the tail of the second pulse should not contain any artifacts. However, the photons that are closest to the boundary between the two pulses should group into fringes, and the effect should obviously diminish with distance. Thus, it is possible to test the reality of these waves and their effects directly. More sophisticated experiments could even produce a dynamic picture of the process of interference. It is also important to note that the waves from the second pulse could only influence the first one if their speed was superluminal. If these waves are real, but their speed is equal to the speed of light, only the second pulse should contain fringes. Therefore, the experiment can test for the reality of waves, and also yield a general indication about their speed.

6. Conclusion
In this presentation we have argued that the Universe must have a fundamental level, whose properties are determined by theory-independent processes. The reality of such a level is supported by several known facts, such as the gap between classical and quantum phenomena, the quantized nature of energy, and the constant speed of light. Furthermore, the fundamental level must contain discrete elementary entities, producing energy in discrete steps, or else it leads to philosophical inconsistencies at higher levels of organization. It was argued that all the energy in the Universe must be in the form of waves, propagating away from the points of excitation, where elementary entities interact with a continuous medium. The most important prediction concerns the speed of those waves. According to our interpretation, this is the speed of propagation of changes in magnetic, electric, and gravitational fields. It probably has to be superluminal in order to be consistent with known observations, but the exact value has yet to be determined. The model was also shown to be consistent with the principle of energy conservation. It does not contradict the results of the Michelson-Morley experiments.

The formal details of this interpretive model have yet to be fully worked out in detail, though it was shown to be a subclass of a more general model (developed by Kaniadakis), which fits well with mainstream theories. It was shown that the model is very well supported by interferometric data, as argued in other presentations as well. It is particularly consistent with several unexplained electromagnetic phenomena, such as the Biefeld-Brown effect, Podkletnov's experiments with high voltage discharges, and possibly with the dawn-dusk asymmetries in the magnetic fields of several planets. To sum up, we have found a way to describe the fundamental processes in the Universe without running into interpretive contradictions. This model is compatible with existing data and even appears to explain some discoveries that could not be fully interpreted before.

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