Qualitative insights on fundamental mechanics

Ghenadie N. Mardari
Rutgers University, Piscataway, NJ 08854, U.S.A.
E-mail: g.mardari@rutgers.edu

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. They cannot be predicted,
because they cannot have internal causes. However, it is possible to describe them in the
language of classical mechanics. We invoke philosophical reasons in favor of a specific model,
which treats particles as sources of real waves. Experimental considerations for gravitational,
electromagnetic, and quantum phenomena are outlined.

1. Introduction
Science is built on the assumption of determinism. It makes no sense to even begin to explain a
phenomenon, unless we believe that it is governed by some sort of law. And if we believe that
laws are truly at work (as proven by our successes in science), how can we not also believe that
we can describe them in full? Indeed, the temptation is high, and many philosophers have tried
to come up with the ultimate description of the Universe. However, it is very difficult to find
necessary links between general models and their particular materialization. A model that is
sufficiently abstract to explain all the laws that are conceivable can lead to many possible worlds.
Why do we have one manifestation and not the other? On the other hand, any particular state
could have emerged from various initial configurations. Which is the true one? Philosophers
have tried to overcome these hurdles without lasting success, and now, it seems, it is the turn of
mathematicians. The ability of mathematical models to yield predictions about real phenomena
has mesmerized many great scientists. It has fostered a tacit belief in some sort of mystical
relationship between math and physical reality. And yet, the path to final answers has not
become much easier. Mathematical models are by definition abstract. They have many types of
consequences, but they are impartial to all of them. Hence, quantitative models have also gotten
stuck in a multiplicity of approaches, without any obvious standard for discrimination among
them. It seems fair to conclude that the ultimate solution, if it is at all possible, will not come
by way of pure abstraction, mathematical or otherwise. Some kind of independent standard
must be introduced, in order to bypass irrelevant levels of abstraction. Empirical observations
are helpful for this task, but they require tremendous efforts. If qualitative analysis could offer
plausible shortcuts, by showing were to look for evidence in the first place, the project might
be simplified dramatically. In this presentation, we shall discuss a possible way to identify the
basic principles of material organization with qualitative methods.

Every physical observation limits our theoretical choices in one way or another. In plain
language, the fact that the Earth has mountains constrains our options to the class of models
that can predict the development of planets with mountains on them. However, this limitation is not sufficient for our purposes. We are looking for some kind of process, whose properties are complex enough to require a very specific type of explanation. Hence, there are many ways to describe the possible emergence of matter, just like there are many possible ways to describe the emergence of consciousness. It is only the limits of our imagination that can slow the flow of hypotheses on these issues. However, the exact interplay between consciousness and matter is not a trivial matter. It involves so many difficulties, that only a few scenarios can be plausible. In short, the emergence of a material Universe, in which self-conscious subjects can evolve consistently in well-defined contexts, can only happen in a limited number of ways. If it were possible to identify the fundamental properties, which allow for the possible existence of rational beings, a lot of irrelevant models could be discarded. This argument may sound similar to the anthropic principle, but our angle is slightly different. Instead of trying to explain the reasons for the actual manifestation of the Universe, we aim to identify the fundamental unobservable processes that must be inseparable from it.

A useful technique in this regard is to focus on the problem of structural causality. Is the macroscopic manifestation of the Universe determined by its microscopic properties? There are sufficient scientific observations to warrant a positive answer. If so, how many levels of organization are there? Does the Universe have infinitely many structural levels, or is there a fundamental level where all reductionism must stop? In order to answer this question, we must ask another. What would the Universe look like, in terms of its causal mechanisms, if it had infinitely many levels of organization? From our point of view, the answer is straightforward: an infinite number of levels translate into infinite reductionism, without any break in causality. Every level of organization must be neatly predicted by the properties of the lower level, which is predicted by a still lower level, and so on without end. On the other hand, what if the Universe had a fundamental level, which determined the properties of all superior levels, without being itself reducible to an inferior level? The implication is again unavoidable: a fundamental level must determine the manifestation of all laws, without being itself determined by them. Therefore, its processes should obey a special set of laws. In other words, there should be an unavoidable gap between the mechanics of fundamental processes and that of all other levels of material organization. When we compare the known properties of our Universe with the two descriptions outlined above, it becomes apparent that only one of them is relevant. Quantum mechanics is defined by its odd set of properties, which do not obey the rules of classical processes. The unavoidable gap between classical mechanics and quantum mechanics is a crucial indicator. It shows that the laws of material interaction, and which cannot be reduced to any lower level of organization. Moreover, the properties of this fundamental level must be such as to make the interaction between mind and matter possible, as suggested in the previous paragraph.

What are the general properties of a fundamental level? By definition, it cannot be reducible to lower levels, and yet it must have some kind of properties. If it had none, it would not be able to determine the properties of superior levels of material organization. Moreover, it must determine those properties, without being in turn determined by them. If not, causality would fail. Consequently, the properties of the fundamental level cannot be determined from inside the Universe. This means that they should also be theory-independent in our models. Accordingly, we do not need to try to explain the total amount of matter in the Universe, or the exact value of Planck’s constant (why this value, and not some other?). Neither do we have to explain why the speed of light is constant, or why it has its exact value. Properties like this cannot be determined from internal processes in a Universe with a fundamental level. In order to understand our world properly, we just need to start from the fact of their existence and look for an underlying mechanism that could incorporate them. The only constraint is that this mechanism must determine the nature of all other processes.
It may seem that we have excessive freedom in choosing the likely properties of the fundamental level. However, if it is to lead to self-conscious beings endowed with freedom, the options are quite limited. In a separate paper (currently prepared for publication in a philosophical journal) we have shown that the following set of properties fit the task in a verifiable manner. Firstly, the Universe must have a well-defined and constant amount of matter. Secondly, it must contain a finite number of discrete active entities (particles), which must also be identical. These entities must move in discrete steps, producing physical effects at every step. Thirdly, this motion and its effects must occur in some sort of elastic medium, via mechanisms that are intelligible in terms of macroscopic analogies. Without claiming that only these properties can lead to a Universe like ours, it is our conclusion that they are essential for the emergence and development of free self-conscious beings in material environments. Any substantial modification to their general description must be justified by showing that it does not undermine this function. In the strongest formulation of our argument, the mere existence of human beings requires the existence of such properties. If the evidence were to contradict their existence, the implication would be that the experienced world is illusory (or else, a flaw in our analysis of self-consciousness would have to be exposed).

The general properties described above can be used to develop a detailed model, in order to verify their implications. Given the constraint to have a fundamental level with theory-independent properties, it is most convenient to use the analogy of a virtual environment, in which the elementary entities come pre-programmed with specific qualities. This approach belongs to the class of models with multiple universes, in which the fundamental properties of “offspring” self-enclosed realms are determined by the effects of “parent” environments. Accordingly, the causes of elementary processes cannot be properly described from inside. Yet, these processes are expected to determine the nature of all the other observables in the Universe. Hence, particles are described as moving through the medium at constant rates, producing discrete excitations (plucks) at every step. The unit of action, corresponding to these constant energy inputs, must be equal to Planck’s constant. These excitations are described as the only source of energy in the Universe, and the only way for the particles to have effects on each other. For consistency, an additional rule is required to rule out direct collisions between them. 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 there is no 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 particles. These identical particles are supposed to enter into various associations on the basis of their mutual effects, producing all known subatomic, atomic, molecular components and so on. Again, the symmetries of the Universe are not expected to evolve from a hypothetical point of conception in the past, but follow directly from the properties of its fundamental constituents.

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.

This description, though unorthodox, is not without precedent in the literature. The hypothesis of sub-quantum mechanics, based on classical interactions between identical constituents, was formally investigated by G. Kaniadakis [1]. The wave aspect of our model resonates with Theocharis’ hypothesis about Maxwell fluxes [2], though his qualitative considerations are quite different. Some aspects of this approach might even resemble A.O. Barut’s self-energy model [3]. Common points with other models no doubt could be found. Hence, it should be possible to work out the formal details of our model in order to prove consistency with verified elements of other theories. However, this report is only about the efforts to overcome the early stages of theory-building. Before proceeding to quantitative analysis, we need to be sure that the qualitative implications are valid enough to make it worthwhile. Consequently, we shall discuss the main features of this model, the most likely objections to them, as well as the most important experimental considerations. We shall argue that our description makes several new predictions, which are highly consistent with the empirical record. In some cases, verifiable implications will be followed by a call for feedback from the audience, especially when the evidence is interesting but sketchy.

2. 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 field 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 invariant. 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, 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.

3. Relevant gravitational effects
The assumption that fundamental entities can only produce a fixed number of excitations per unit of time implies that all of them can serve as clocks for each other. This provides a model
for explaining relativistic effects as well. The epicyclical motion of elementary entities within subatomic particles depends on the speed of motion of the association through the medium. At high velocities, more units of action are required for the completion of each cycle and a smaller proportion of energy is useful for the internal dynamics of the particle. This translates into a slowing down of time, relative to absolute time. Other aspects of the theory of relativity can be explained in classical language as well. However, the main predictions of special relativity are not supported. This comes from the fact that the speed of fundamental waves cannot be invariant, as described. The speed of elementary sources can be locally invariant, because of the total effect of the waves of other sources on them. For interpretive purposes, this means that gravity was the reason for the observed invariance in terrestrial experiments, not the position of the observer. Moreover, this also means that the speed of light cannot be the same in all contexts, even when measured from the same inertial frame (though, it matters how the measurements are made).

According to the preceding comments, the speed of light must be invariant relative to the predominant source of gravity. This has an interesting implication that can be verified. In the interplanetary medium, the Sun should be the predominant source of gravity. Ergo, the speed of light should be constant in the heliocentric system of reference, but not in the system of reference of an interplanetary space probe. If two vessels with synchronized clocks are moving with the same velocity away from the Sun, one behind the other, their radio communications should take different amounts of time in each direction. If the times of emission and detection of each signal are properly recorded, log comparison should reveal that messages always arrived faster from the first ship to the second, than from the second to the first. This is because the second vessel is moving towards the source of the signal (at the time of its emission), whereas the first vessel is moving away from it in the inertial system of the Sun. Considering the number of twin missions to Mars and Venus, it should not be very difficult to verify this conjecture. According to several dissident reports on the internet, such observations have already been made. However, it is preferable to have some sort of authoritative verification on this matter. If anyone from the audience has access to relevant information, or is otherwise qualified to comment on the issue, we would be grateful for any feedback that can be afforded.

A different phenomenon that seems to support the same conclusions is the Pioneer anomaly. This topic has enjoyed a lot of attention among professionals and in the media. Reported initially by Anderson et al. [5], it concerns the fact that all the space probes en route to the edges of the Solar system display an unexpected constant acceleration toward the sun. Recently, this topic has been in the news again, because the anomaly has been extended to include several cases of acceleration towards flown-by planets as well [6]. It is important to note that many theories have been proposed to account for the Pioneer anomaly, but none of them has been accepted as final yet. Of special interest to our discussion is the analysis of Teocharis, who has looked at this phenomenon from the point of view of a model similar to ours. His unpublished paper suggests that it is possible to overcome the anomaly by assuming that the speed of light is locally invariant but not universally constant. By taking into account the possibility that light might travel at different speeds in different gravitational media, one could remove the grounds for concluding that the space probes are accelerating. (References to this and similar unpublished papers can be provided upon request). This hypothesis has yet to be confirmed, but it was formulated without knowledge about the model presented above. Its predictions converge with those of our approach, suggesting compatibility with the experimental record. Hopefully, the Pioneer anomaly will be resolved in the near future in a way that will help us determine the validity of the foregoing considerations.

Another relevant gravitational effect is the inevitable anisotropy in the field of moving cosmic bodies. In a classical medium, a moving source must experience a Doppler shift. Hence, the field of any planet must be asymmetric along several axes, corresponding to its motion as part of
the galaxy, star system, as well as its orbital motion. Though, it is hard to say if the anisotropy of a large association of bodies can be detected from inside in a straightforward manner. The only pattern of motion that is individual for a planet is its orbital motion. Accordingly, the gravitational field of all planets must contain a detectable dawn-dusk asymmetry, which should be stable against all local sources of variation (such as changes of mass distribution due to tides, ocean currents, etc.). Such an asymmetry for the planet Earth should not be difficult to verify, considering the amount of data that is already available. With the GRACE project \cite{7} successfully under way, and several other missions in the pipeline, the hypothesis of a dawn-dusk asymmetry in the field of our planet should be verified beyond any reasonable doubt. Moreover, the gravitational field should be stronger on the dawn side (in the direction of motion), if our model is to be validated. We hope that scientists with competence in this area of research would respond to our hypothesis by checking the data for relevant indicators.

It is also important to note that all the planets from the Solar system should have the mentioned asymmetry in their gravitational fields. Therefore, the hypothesis is also verifiable with astronomical observations, by virtue of gravitational lensing. It is known that Jupiter is massive enough to deflect the apparent position of distant sources of radiation. Moreover, current technology allows for very accurate measurements of these effects, as demonstrated in a recent experiment. Kopeikin and Fomalont \cite{8} have tried to use their observation for an estimate of the speed of gravitational waves. Their interpretation was a little ambiguous and is still open for debate. However, the important fact is that current technology appears to be able to detect even small effects. This means that it should be possible to use already existing data, in order to see if the gravitational lensing of Jupiter varies before and after eclipsing a source of light. In response to our questions by e-mail, the authors claimed that their data was not used to test for the specified type of anisotropy. It would be very important if someone did perform the necessary analysis, because Jupiter also has other interesting asymmetries in its fields. For example, radio images of the gas giant contain remarkable lobes, which appear anisotropic in most prints that were examined by us. (See, for example, ref. \cite{9}). This is probably indicative of the dawn-dusk asymmetry in the magnetic field of Jupiter, which is independently verified, and which is also consistent with the implications of our model.

To sum up, the gravitational implications of our take on fundamental mechanics appear quite odd, compared to other models. However, they have the virtue of being easily verifiable. In some cases the data is already available for analysis. At the same time, we do not know of any experimental fact that contradicts this model. Therefore, it is a fruitful avenue of research, because it could illuminate many aspects of fundamental physics without large-scale financial investments.

4. Relevant electromagnetic effects

As suggested in the previous section, 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 [10], 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 rarefied 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 at the beginning 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” [11]. 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 [12], 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 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 assuming 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. This level must contain discrete elementary particles, producing energy in discrete steps, or else it leads to philosophical
inconsistencies at higher levels of organization. All the energy in the Universe must be in the form of waves, propagating away from the points of excitation, where particles interact with a fundamental 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 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.

In our opinion, this approach 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. Preliminary reports appear to support the implications for gravitational effects, even though the evidence is still inconclusive in this area. Additional research on the Pioneer anomaly, the hypothesized dawn-dusk asymmetries in the gravity of the Earth and Jupiter, and other related phenomena, could cover this gap in the near future. To sum up, we have found a way to simplify our understanding of fundamental processes in the Universe and to explain novel recent discoveries that do not always seem to fit earlier models.

References

1. Kaniadakis G 2002 Physica A 307 172
2. Theocharis T 1983 Lettere Al Nuovo Cimento 36 325
3. Barut A O and Van Hulie J F 1985 Phys. Rev. A 32 3187
4. Michelson A A and Morley E W 1887 Amer. J. Sci. 34 333
5. Anderson J D, Laing P A, Lau E L, Liu A S, Nieto M M and Turyshev S G 1998 Phys. Rev. Lett. 81 2858
6. Anderson J D, Campbell J K and Nieto M M 2005 Preprint astro-ph/0608087
7. http://www.csr.utexas.edu/grace/
8. Fomalont E B and Kopeikin S M 2003 Astrophys. J. 598 704
9. http://rst.gsfc.nasa.gov/sect19/
10. Podkletnov E and Modanese G 2003 J. Low Temp. Phys. 132 239
11. http://jnaudin.free.fr/lifters/main.htm
12. Mardari G N 2006 AIP Conf. Proc. 810 360