

Fix Physics! – Reverse Engineer Relativity, Quantum Mechanics and the Standard Model, Get Rid of Outdated Assumptions, Consolidate, and Reconstruct On New First Principles¹

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ABSTRACT

A paradigm shift in physics is now overdue, Physics is founded on mismatched assumptions including three by Einstein such as the photon-as-particle, which has led to the assumption of the physical reality of quantum probability. Others such as a fixed speed of light and flexible spacetime need to be recast in a more physically realistic way. Physics is likened to a badly designed building that is hard to use, impossible to build on, and in danger of collapse in some sections. Seven foundational questions are discussed related to the 'stuff' making up the universe, the unreality of time, a variable speed of light in an ether, gravity warping spacetime, the photon as a particle, and the nature of a particle's wave field, the physical reality behind probability uncertainty and entanglement, and the Standard Model

"...science can appear to be an infallible logic system whose truth is beyond any doubt. Yet by taking note of the role played by hypotheses and their dependence on interlocking assumptions, Poincaré shows how unstable scientific theories actually are...our choice of any hypothesis among a theoretically infinite number that can explain any set of data, is based on "convenience". Consequently there is no reason to believe in the uniqueness of scientific theories, nor even of the real existence of unseen entities postulated by theories ... "

- From a book review of *La Science et l'hypothèse* by Henri Poincaré [1902]³

(I) WHY CHANGE IN PHYSICS IS NECESSARY

The prescription suggested by the title of this essay may not be very easy either to accept or implement, but it is a serious one and may well be necessary and feasible. Is physics broken so as to need fixing? By most measures it must be judged a great success – the results of Quantum Mechanics (QM) and Special and General Relativity (SR and GR) have been proven in countless experiments and technical applications from electronics to satellite telecommunication. The Standard Model (SM) has now been famously buttressed by the discovery of the Higgs particle. The trouble is in that physics uses too many imaginative assumptions about Nature. The nearer we are to understanding how it 'really' works the better. Clever mathematics allows defining the same phenomena in different ways: in geometry a circle is realistically defined by its center and radius, but a relatively complicated algebraic definition is also possible - the latter however gives no idea of its shape. My work on the physics of diffraction has made me realize there was a simpler more natural way to understand it (as energy transport along streamlines) than in the older approaches. This made it possible for me to imagine canceling diffraction by refocusing the streamlines⁴. Over 30 years this developed into a vision of a possible unified physics theory where all its parts emerge from one or two simple, more natural physical assumptions. It is in contrast to this vision that present day physics appears grossly and unnecessarily complicated. A case in point is how (QM) and (GR) have no common ground and describe vastly different

concepts. (QM) describes Nature in terms of probability in tiny units – far from the certainties of our everyday world. (GR) describes the geometry of spacetime warped by gravity. If simpler explanations can be found shouldn't they be adopted? The history of physics shows, 'physically realistic' theories open up new possibilities. Describing planetary motion using Kepler's ellipses rather than Ptolemy's epicycles led directly to Newton's gravity and beyond.

As the Poincaré quote above implies, the most difficult part will be to change people's minds about long-held assumptions. Einstein and his youthful friends at the Bern Academy around 1902 read Poincaré's book: "[it]profoundly impressed us and held us spellbound for weeks on end" ⁵ The book is known⁶ to have influenced Einstein to launch his Kuhnian⁷ paradigm shift in physics. A century later another paradigm shift is now long overdue, but this time around, it is some of Einstein's own foundational assumptions that have to be discarded. Physics was not invented (or discovered) in one go, but was built, one assumption on top of another. Seven of what I consider the most basic concepts (apart from questions in cosmology) will be questioned in this paper. The list comprises most of the basics of physics. It does not mean of course that all of physics is 'wrong' – but that old assumptions that have now lost their justification in terms of new discoveries or theories, need to be reexamined critically and replaced if necessary. As will be discussed below, some may actually be wrong (that the photon is a point particle, rather than a spreading quantum of energy.) Others are brilliant but unnecessary formulations (constant speed of light (c) in flexible spacetime). In criticizing Einstein's assumptions I follow his own great example – till the end he was ready to question his own insights and if need be: "one should start all over again." ⁸ That may be the only way forward.

An architectural analogy is presented in Section II to illustrate the various foundations upon which physics is built. By caricaturing current theories I hope to encourage standing outside the box and looking at things from a little distance, far from the world of over-specialized little cubicles most practicing physicists now inhabit. Seven questionable foundational premises will be discussed in Section III.

(II) THE STATE OF PHYSICS IMAGINED AS A BUILDING

For all its practical success, the intellectual excitement it generates, the tens of thousands of our best minds at work, and a multi-billion dollar infrastructure in laboratories, universities, textbooks and journals, physics is based on a cluster of different mutually ill-fitting theories that sometimes do not share common assumptions, and at other times contradict each other outright. If physics were a building it would be one built over centuries, on several foundations, each with its own materials, architects, style, zoning laws and infrastructure, often totally unrelated to those of the others (Figure 1). Some sections rest firmly on others, but have no access to major parts of the forbidding building. Parts of it, like (SR), are of great beauty, but seem to be made of rooms that keep moving relative to each other. Nice, but is that really necessary? Others like (GR) are cumbersome with warped walls extremely hard to design well. Worse of all (QM) is a set of structures that are improbably hard to enter. To reach a room one has to puzzle which one of an infinite number of corridors to use. To reach GR from QM one has to leave the building completely and re-enter from a separate gate. (SM) is a rooftop zoo used to house hundreds of particles. It is built on a nice octagonal geometrical grid that seems to hold things together, but nobody knows how or why. Floating on a cloud above this jumble, string theorists are building a mighty castle in the air. Occasionally there are calls to demolish this whole affair and build a much simpler and more useful modular structure of interlocking Plancks. The residents of Physics Building are wont to object.

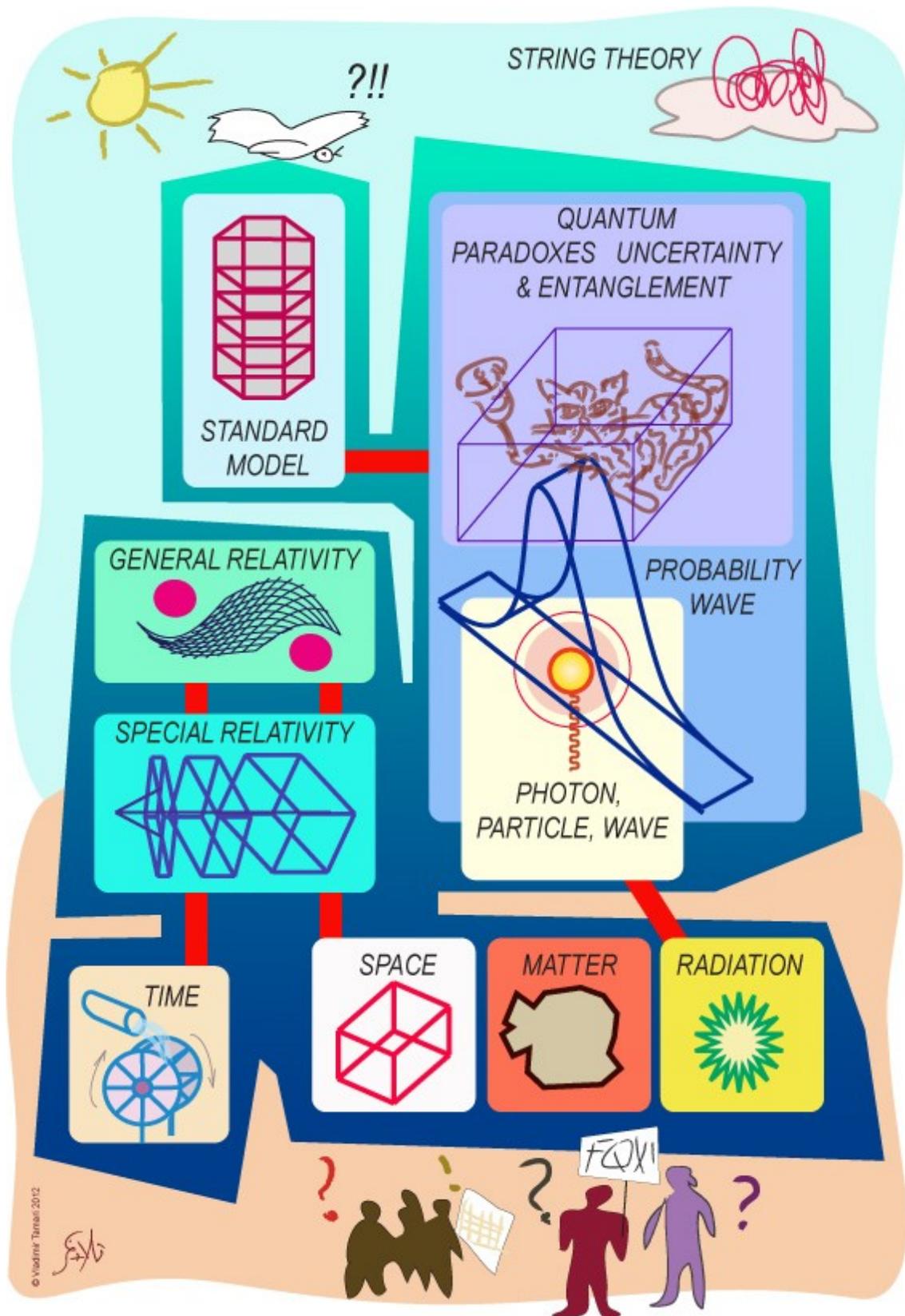
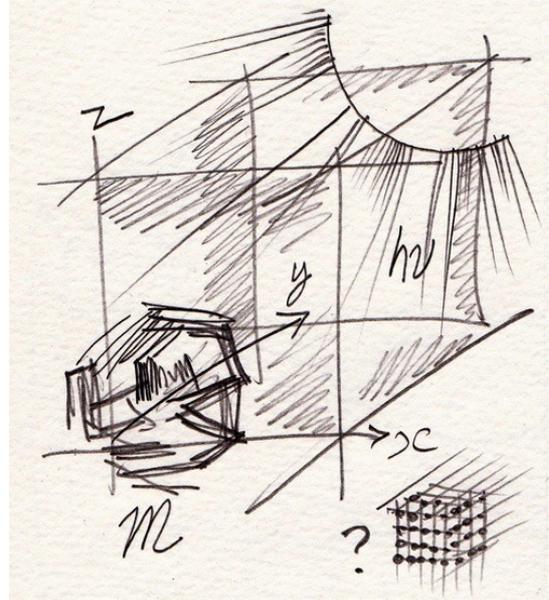


Fig. 1 Physics Building as seen by outsiders is a strange, ungainly, high-maintenance structure parts of which are dangerously unstable. Red 'columns' show well-supported sections. It is impossible for example to go from GR to QM. It seems very unlikely that new floors can be added because the underlying structures were not designed to support anything new. As a desperate measure to bypass the problems attempts are made to build a mighty String castle in the clouds.

(III) SEVEN FOUNDATIONAL QUESTIONS

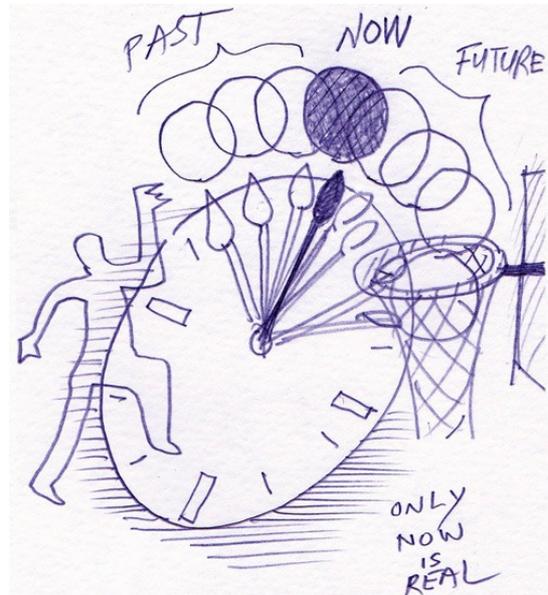
Q1: ARE MATTER, SPACE & RADIATION MADE OF DIFFERENT STUFF?

Human beings are many orders of magnitude larger than the smallest known constituents of matter. Microscopes can now peer at atoms so at least we can experience them visually, but the nucleus and smaller particles are beyond our experience. We cannot experience radiation except when it falls on objects we can see and touch. As for space, we know it is there because solid objects exist in it, and it is out there in our atmosphere. We can even imagine the vacuum. There are various theories we now use to describe aspects of these entities, but these do not explain what they actually are. Some theories envisage a single universal building block— something, a knot⁹, string¹⁰, loop¹¹ node¹² and others, of which everything in the universe is made, even space, including the vacuum, dark matter and dark energy. A concerted effort should be made to investigate the various suggestions that have been advanced for such a universal entity.



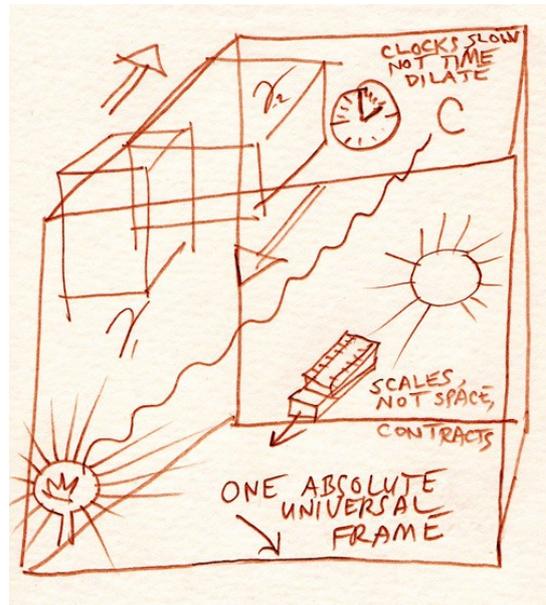
Q2: DOES TIME REALLY EXIST?

Various researchers¹³ have now come to the conclusion that time as a physical phenomenon, let alone a dimension, does not exist: The Universe has only a 'now' state that evolves causally. The 'now' state affects the next 'now' state without otherwise leaving a trace of the original state. Human, animal or computer memory can record local states that have already occurred and this is what we think of as the 'past', but beyond any such record it has no reality whatsoever. By the same token a person, animal or computer can anticipate a future state by extrapolating from the current one. That is deemed to be the 'future', but in physics it has no sense of being real beyond the act of imagination itself. Accepting a timeless universe will cast doubt on the usefulness of the spacetime concept of Special Relativity, even more than is detailed in Q3 below.



Q3: IS THE SPEED OF LIGHT ACTUALLY CONSTANT, SPACETIME FLEXIBLE & THE ETHER NONEXISTENT?

By a brilliant act of imagination and youthful bravado, Einstein in his Special Relativity (SR) proposed a 'solution' to various doubts that were then prevalent about the relationship between moving bodies, light, and the 'ether'. Unfortunately by proposing that the speed of light (c) is constant, Einstein imposed a strange requirement on Nature: Space itself expands and contracts, and time dilates, as measured from a moving inertial frame. He made measurement absolute, i.e. (c) is constant (light being the 'tool' that measures distance and time), but the universe itself became relative – there is no absolute ether in which events occur. This is the exact opposite of what happens in the Lorentz transformations that inspired (SR), whereby the universe is absolute (a universal medium or ether exists) but it is measurement that is relative (clocks slow down as they move, *not time itself*, and measuring rods physically contract, *not space itself*, and c need not be fixed. In any case both in (SR) and in Lorentz' theory, the *measured* speed of light ends up being the same. There is an ingenious but weird logic to Einstein's assumption of a constant speed of light – as if a fruit vendor decided to sell each apple at a single price, offering larger or smaller fruits of better or poorer quality, according to supply and demand, but always at that one price per apple! Later however Einstein declared that (c) has to “vary with position” when light curves in a gravitational field ¹⁴.



As to banishing the ether it was Einstein himself who reconsidered it. Hoping for a unification of gravity and electromagnetism, he said that “the contrast between ether and matter would fade away, and, through the general theory of relativity, the whole of physics would become a complete system of thought”¹⁵. It is now generally agreed that in order to properly define quantum gravity, the local state of the vacuum has to be defined. In other words, an ether of some sort.

Q4: DOES GRAVITY REALLY WARP SPACE AND TIME?

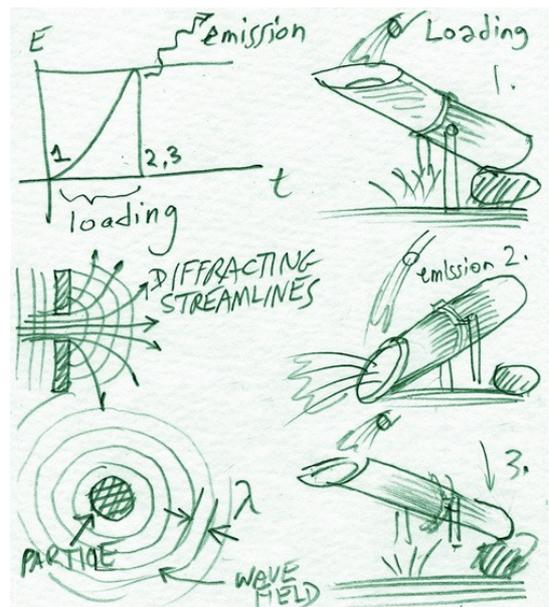
Einstein's greatest contribution to physics was his insight that gravitation and acceleration are identical. But translating this simple idea that even a child in an elevator can experience and understand into the frameworks of flexible space and time of SR has created a nightmare matrix of intractable equations. In 1920 Eddington briefly suggested how a local density of space (ether?) can explain the bending of light in (GR). It does so as if it is curving in an optical medium of gradient index of refraction (n) ¹⁶. In such a medium light slows down in denser regions and, slowing down, it refracts and curves. This is commonly experienced when heat creates layers of less



dense air causing mirages to be seen. To apply Einstein's famous thought experiment (*gedankenexperiment*) about riding a light beam slightly out of its original context, a rider on a light beam will have to slow down in order to take a curve around a massive object, according to the well-know relationship between curvature and acceleration in mechanics. Of course there is more to (GR) than the bending of light, but has the simple concept of gravitational potential acting like an index of refraction (n) been studied enough to see if supplants current concepts of spacetime in (GR) in all its known results?

Q5: IS THE PHOTON A PARTICLE & DO PARTICLES GENERATE WAVE FIELDS?

Using statistical arguments based on his expertise in the thermodynamics of gases, Einstein used Planck's discovery of the quantum of energy (h) to deduce that light too comes in such quanta^{1 7}. He then made a casual observation that these quanta of energy must be concentrated in a point particle (later named the photon). Planck opposed the idea, and offered his loading theory of gradual absorption and sudden emission of light waves^{1 8}. The Compton Effect is taken as proof that the photon is a particle that bounces off the nucleus like a billiard ball. Compton himself^{1 9} and more recently others^{2 0} have offered, an alternative wave explanation of the phenomena in the same paper describing the effect.



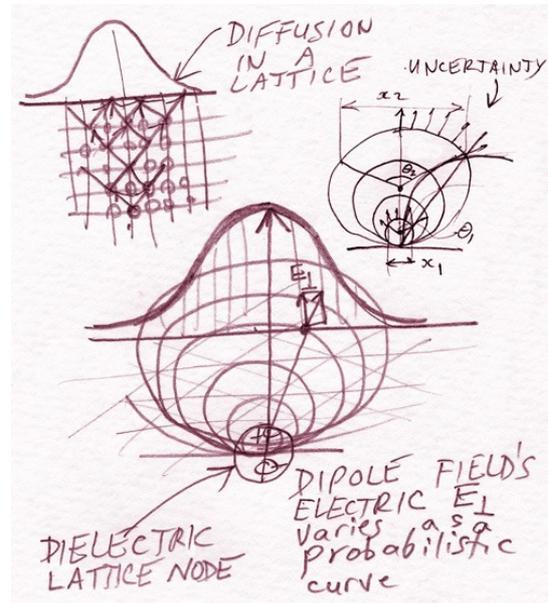
Independently I had my doubts about the photon-as-particle or point because it contradicted my Streamline Diffraction Theory

4 whereby the total energy of a quantum of light follows an infinity of streamlines that spread to fill all of space. I likened the process of gradual absorption but sudden emission to the action of a *shishi-odoshi* (wild-boar scarer) - a clever Japanese garden device that fills with water gradually but tips over suddenly when full, making a loud sound as its end hits a rock.^{2 1} I was thrilled to discover that my musings were confirmed by the important work of Eric Reiter^{2 2} who has experimentally demonstrated (using gamma waves passing through a half-reflecting prism) that the photon cannot be a particle since it is recorded simultaneously in two detectors.

A related question to the photon-as-particle is whether particles such as electrons have surrounding wave fields. This would explain de Broglie's concept that a particle has a wave associated with it. I recently proposed a test for this^{2 3}: Repeat the double slit experiment for particles where the size of the particle is larger than the slits to see whether the particle pushes its wave field through the slits, to diffract, even though the particle itself does not go through.

Q6: WHAT IS THE PHYSICAL BASIS OF QUANTUM PROBABILITY, UNCERTAINTY & ENTANGLEMENT ?

I have concluded that by generating an artificial particle-wave duality, Einstein's photon-as-particle has been the obstacle that has thwarted a true physical interpretation of Schrödinger and de Broglie waves, giving way to the Born probabilistic interpretation and all the puzzlement and weirdness of Quantum Mechanics. Phenomena that ironically Einstein himself decried the loudest in the (EPR) proposal^{2 4} when he and his colleagues accepted the probabilistic reasoning, wondering only how this local phenomenon can be transmitted to two places outside the light cone, yet produce entanglement. Proving Bell's Theorem^{2 5} experimentally showed it could, but the true explanation is that the two photons are in the same state from beginning to end. Probability is just a mathematical interpretation of (QM) that has hypnotized generations of physicists so that State Collapse, Zombie Cats, Spooky Action at a Distance, and other Quantum paradoxes are now accepted as inherent magical states of Nature. Instead, I showed^{2 6} that the distribution of dipole wave energy transfer across an ether-lattice is similar to a probabilistic binomial distribution.

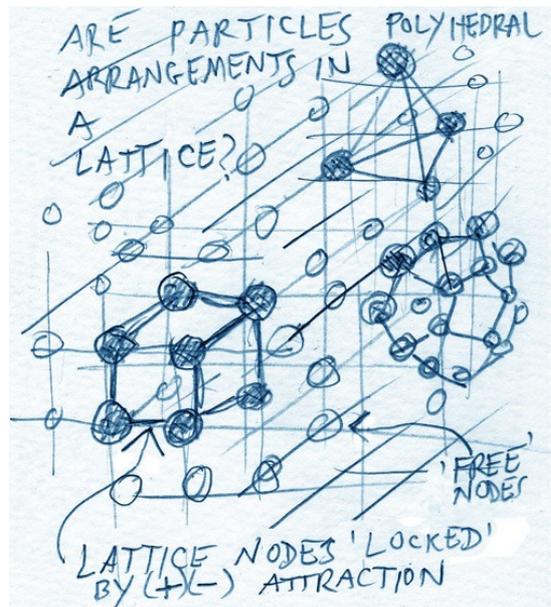


Does Heisenberg's Uncertainty Principle have a physical explanation? Uncertainty is now regarded as an unexplainable aspect of Nature at the smallest scales and has led to the disturbing notion of the vacuum as a chaotic foam of particles coming in and out of existence. As with probability, I have suggested a physically realistic explanation of Uncertainty as the a consequence of the expansion (i.e. diffraction) of dipolar waves in a universal lattice. As the wave spreads its wavefronts (and streamlines) spread the quantum of energy in a wider area (xyz), but the wavefronts also flatten out so their momentum vectors (p) now point in almost the same direction.^{2 7} This is in line with Heisenberg's suggestion that Uncertainty is related to diffraction^{2 8}. Energy transport in the ordered lattice of nodes in an ether shows precisely how and why this is so.

By the same token the whole gamut of quantum paradoxes involving entanglement and measurement, should emerge from models that may be nearer to the way Nature operates at the tiniest scales^{2 9}. Abandoning the idea that quantum states are probabilistic is all that it takes to see that two distant photons emitted from the same source can have the same phase, and that it is in the states of the detecting atoms alone that randomness appears.

Q7: WHAT IS THE PHYSICAL BASIS FOR THE STANDARD MODEL?

For all its impressive success, the Standard Model of particle physics is just a set of glorified rules of thumb describing elementary masses, charges of particles and the forces acting between them. But nobody knows if there is a deeper physical explanation for phenomena such as mutual quarks repulsion then attraction at different distances. String Theory is incomplete and unrealized, but at least it attempts to offer a physical explanation in terms of vibrating strings. Lisi's E8^{3 0} theory attempts to explain the (SM) in the form of a polyhedral network of relationships. But E8 is hampered by incorporating the concept of spacetime in its structure. As in (GR), this greatly complicates the task at hand.



In my Beautiful Universe (BU) ^{1 2} theory I proposed a straightforward explanation for particle properties: polyhedral arrangements of dielectric ether lattice nodes revolving in place at different energies in units of (h) attracting and repelling each other to form local linkages, without resorting to the concept of virtual particles and forces. A model of the structure of the nucleus based on a face-centered-cubic lattice (FCC) – similar to the way grocers stack apples in rows and layers was proposed by Cook^{3 1}. His work lends credence to theories of Nature such as mine based on such a lattice. I have proposed^{3 2} how three magnetic dipoles set at appropriate angles to each other (as a cluster of nodes in a (BU) lattice might be), simulate the repulsive-attractive nature of the Strong Force between quark triplets.

(IV) COMMENTS

These foundational questions are by no means the only ones that one could ask – here are two more: Q8: Are Dark Energy and Dark Matter the same as a repulsive Universal dielectric ether? Q9: If the Ether is made of repulsive particles would the Big Bang start not from a point, but a volume cluster of these particles? Much of the work suggested here in revamping physics has already been done – lurking in obscure passages of books or papers old and new by great physicists – such as the wave explanation of the Compton Effect ^{1 9}. Or by unknown tinkerers, including my own speculative Beautiful Universe (BU) ^{1 2} theory. These ideas should be developed, simulated, and tested. "If physics has become a Gordian knot, we might well usefully take a sword to it!"*

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- 1 This essay was written for the FQXI "Questioning the Foundations" essay contest 2012
<http://fqxi.org/community/forum/topic/1272> (Web:2012, July 1)
- 2 The author's website is at <http://www.ne.jp/asahi/tamari/vladimir/physicsandmath.html>
Some of his physics papers are at: http://vixra.org/author/vladimir_f_tamari
email contact: vladimirtamari(at)hotmail.com
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Other papers on de-diffraction are on the author's website.
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 - 3 2 Tamari, Vladimir *Three Magnetic Dipoles Provide A Physically Realistic Simulation of the Repulsive Attractive Nature of the Strong Force and of the Cabibbo Angle* (2011), http://www.ne.jp/asahi/tamari/vladimir/strong_force_3_dipoles_vladimir_tamari.pdf (Web: 2012 July 3).
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