Quantum Mechanics 101

QM_101.pdf, 21 pages

About '101' in the title

Regarding the Kochen-Specker Theorem, Zeeya Merali (FQXi) wrote on Jul. 24, 2008 @ 19:40 GMT (the link on _cheating at "twenty questions"_ added by me - D.C.):

"The crux of the proof rests on the fact that if you measure the square of the spin of so-called “spin 1” particles along three perpendicular axes, you always uncover the same three values—1,0,1—in various orders. Just over 40 years ago, Kochen and his colleague Ernst Specker showed that with this restriction in place, it's impossible for the particle to have consistently defined spins along every direction you might choose to measure, before the game begins. Even if you just look at 33 possible directions, the particle can't set spin values along each of the 33 direction such that you get you 1, 0, 1, no matter which three perpendicular directions you choose to poke. You can set consistent spins for 30 directions, but the final three must paradoxically be both 1 and 0.

"That's fine for quantum mechanics, where the particle sets its spin on-the-fly. This corresponds to cheating at "twenty questions", where you can keep changing the object in mind, as the questions are being asked."

And John Conway and Simon Kochen wrote (The Strong Free Will Theorem, arXiv:0807.3286v1 [quant-ph], p. 2):

"This “101 property” is paradoxical because it already implies that the quantity that is supposedly being measured cannot in fact exist before its “measurement.”" Watch John Conway's lecture on April 27, 2009, and pay special attention to what he says during 11:30-14:03 and 45:30-45:57.

April 27, 2009
John Conway: *"The Theorem's Implications for Science and Philosophy"*

Hence the title of this essay, 'Quantum Mechanics 101'. It is not intended to induce associations with those introductory-level courses offered in some U.S. universities (e.g., 'Flowers and Gardening 101').

NB: In a nutshell, the failure of '101 property' implies that the properties "possessed" by quantum particles (e.g., spin orientation projected in 3-D space) cannot exist as 'objective reality' *neither* before *nor* after their alleged "measurement" (see Schrödinger's 1935 article below). Surely quantum particles have context-dependant actualized-*able* "projections" at the length scale of tables and chairs, which can be fitted into a Hilbert space. These "projections" are "governed" by a totally incomprehensible, shut-up-and-calculate postulate known as the Born Rule. But we also have a *totally different* phenomenon revealed with Ernst Specker's tripod and KS Theorem, which exposes the intrinsic UNdecidable quantum state interwoven with the context-dependant actualized-*able* "projections".

This is the *dual nature* of 'quantum state': it is *partly* explicable in terms of context-dependant actualized-*able* "projections", and *partly* explicable as an UNdecidable, in terms of binary truth-valued statements ("paradoxically be both 1 and 0"), quantum state (never in plural). Regarding the latter: even the weakest possible "objectification" conjecture, such as the one offered by Peter Mittelstaedt below (P. Mittelstaedt, *The Interpretation of Quantum Mechanics and the Measurement Process*, Cambridge University Press, 2004 (ISBN 0521602815), Ch. 4, p. 67) is not applicable.

Very weak objectification (probability-attribution). For a system S with preparation φ one can attribute probabilities $p(\varphi, a_i)$ of A-values a_i in a consistent way. The values $p(\varphi, a_i)$ refer to the system S and are subject to the well-known probability axioms (e.g. Kolmogorov).

All we can say about the UNdecidable quantum state is what this unique quantum state is not: *it has nothing to do with 'probabilities'*. Period.

Check out the letter by Erwin Schrödinger dated 18 November 1950 below. He was implying precisely the UNdecidable quantum state. Think of it as an implication of Gödel's incompleteness theorems to quantum theory: we should expect to encounter an assertion that cannot be proven (=is not a theorem) within quantum theory, as well as the negation of this assertion that cannot be proven either, simply because the UNdecidable quantum state belongs to a 'meta theory'. If any reasonable formulation of mathematics contains undecidable propositions within it (details from Bob Geroch), how could quantum theory avoid such undecidable propositions?

All this is totally missing in the forthcoming *Compendium of Quantum Physics* (April 16, 2009), although one of the editors, Daniel Greenberger, certainly knows this web site and has replied to my email.

There is nothing essentially new in this essay; it could have been written in November 1950. In order to "measure" an object in the quantum world, the only option we have is to squeeze it to a "point" from the spacetime in STR, but by imposing such "filter" onto the quantum world we inevitably see a wrong picture. Should a quantum particle been localized to a "point" in its natural habitat, its momentum would have to be infinite.

Therefore, we don't have sufficient reason to claim that "god plays dice" in the quantum world, given that fact that we are imposing a "filter" from

STR -- the 'time of facts' -- which is totally alien to QM, and will inevitably introduce severe artifacts to the "projection" of the quantum world on the scale of tables and chairs. Just recall the deceptive picture of localized paths in Wilson cloud chambers (Nevill Mott; see Alessandro Teta, arXiv:0905.1467v1 [math-ph], pp. 9-10).

All this is well-known; I only tried to add more evidence in support of what Schrödinger wrote on 18 November 1950. In order to understand QM, we should keep '*the* quantum state' intact before, during, and after its "measurement" -- the "collapse" from the "eigenvalue-eigenstate link" is an artifact from imposing the wrong (albeit inevitable) "filter" of Minkowski spacetime. There is no 'flow of events' coming from the quantum world and ending up -- irreversibly -- at the scale of tables and chairs. Instead, I suggest reversible quantum-classical transitions, and a new kind of retarded causality (biocausality), to accommodate the quasi-local nature of both quantum and gravitational realms. The time irreversibility and the flow of time are not "already built into quantum mechanics through the quantum measurement process" (George F R Ellis), and there is no such thing as "quantum mechanical arrow of time" (Jonathan Dowling) either.

NB: In the light of the "101 property", the Heisenberg Relations do not refer to anything "uncertain" in the quantum realm, but to the inherent flexibility ("formally undecidable", cf. C. Weedbrook) of quantum objects to negotiate their *next* state relationally, in line with a new form of retarded causality, called biocausality. According to W. Heisenberg (*Physik und Philosophie*, S. Hirzel Verlag, Stuttgart, 2000; translated by M. Kober):

"The Copenhagen interpretation of quantum theory begins with a paradox. Every physical experiment, no matter if it refers to phenomena of daily live or to atomic physics, has to be described by the concepts of classical physics. The concepts of classical physics represent the language in which we describe the configuration of our experiments and determine the results. We cannot replace them by other concepts."

Yes we can. The puzzle of the double-slit experiment -- "the only mystery" of quantum theory, according to Richard Feynman -- is resolved from the outset: Feynman's "uncertainty" principle claiming that "any determination of the alternative taken by a process capable of following more than one alternative destroys the interference between alternatives" refers to a single indivisible pathway connecting the "initial" and "final" states of '*the* quantum state'. The latter is interpreted as 'quantum presentation of Platonic ideas' (see below), which does not destroy the "interference" because it contains all classical alternatives *en bloc*. To be specific, the *quantum presentation of Platonic ideas* reveals itself by two reversible pathways: from 'quantum *being*' to 'context-dependent quantum *becoming*', and back to 'quantum *being*'. The actualized-*able* 'context-dependent quantum *becoming*' unfolds from its source, the 'quantum *being*', and can indeed be modeled with 'rays in a Hilbert space' (compare the latter with Ashtekar and Schilling). But the source itself can't, because it is rooted on 'the ideal monad without windows' (Döring and Isham).

If we model the universe as a brain, all the pieces from the jigsaw puzzle of quantum gravity snap to their places -- effortlessly.

NB: The *only* way to solve the measurement (macro-objectification) problem in QM stems from Henry Margenau: you have a *perfect continuum* of already explicated projections from 'potential reality' (quantum presentation of Platonic ideas), *at all length scales* . All these

***already*-explicated states (cf. the colored states below) show up with '*carpe diem*' unit probability in the local mode of spacetime, where their common source, called 'potential reality' (global mode of spacetime), is *already* vanished completely.**

Stated differently, the *only* way to avoid the non-unitary "collapse" is to endow the potential reality (the ONE meta-qubit state) with a new (to some people) *ontological status*, as known since Plato: *it has nothing to do with 'probabilities'*. There is no other way to solve the problems of QM.

Dead matter makes quantum jumps; the living-and-quantum matter is smarter.

Just don't miss the explanation of 'already' below (notice the atemporal "hand-shaking" mechanism), as well as the discussions of "quantum computing" and Thompson's lamp; summary here.

As to GR, the world of 'potential reality' (=gravitational presentation of Platonic ideas) shows up as some kind of *luxonic world*; cf. Max Tegmark, gr-qc/9702052, footnote 4: "The only remaining possibility is the rather contrived case where data is specified on a null hypersurface. To measure such data, an observer would need to "live on the light cone", i.e., travel with the speed of light, which means that it would subjectively not perceive any time at all (its proper time would stand still)."

In GR, such luxonic world is perhaps equivalent to a point object ($R_{\mu\nu}$ = 0, cf. Stephen J. Crothers) "inside" which there is no *real* mass nor *real* energy *whatsoever* (just like the quantum vacuum) -- mass and energy are in the form of 'potential reality'. Perhaps Cartan's "extrinsic curvature" and the torsion degrees of freedom (Luca Fabbri) may reveal this broader form of 'potential reality'. It isn't some Euclidean tangent space or "fiducial space" at each point of the Riemann manifold, but 'the universe as ONE' acting as '*the* ultimate cutoff'.

In this context, the flexibility of the *wegtransformierbar* gravitational "field" is camouflaged in GR as Cauchy problem for Einstein filed equations being not "well-posed", while the input from 'potential reality' is camouflaged as "gauge-dependent" -- the pseudo-tensors (MTW) are just well-calculated projections from '*the* gravitational field' interpreted as 'gravitational presentation of Platonic ideas' (do you know the origin of inertia?).

From this perspective, Einstein's dictum 'God casts the die, not the dice' can be restored as the guiding principle in quantum and gravitational physics, while the picture below ("spacetime foam") is considered '*not even wrong*'.

Let me try to offer my opinion on Conway-Kochen (more here) and Kochen-Specker theorems, with a little help from Claudia Schiffer: suppose you obtain "observed characteristics of a quantum system" (see Charles G. Torre's Lectures 6 and 32 above), in a case in which the quantum system is (presumably) fully described with a Hilbert space (cf. Diederik Aerts, p. 2) of three or more dimensions (cf. N. Brunner). Suppose the observable characteristics are presented with three possible colors:

blue, red, and green.

The notion of 'color' is like the notions of 'energy' or 'spacetime': we should answer the question of 'color of what?', or else we would be talking like parapsychologists. So, we shall consider some 'colorizable stuff' (=a leg of tripod, after Ernst Specker), in three observable colors:

blue stuff, red stuff, and green stuff.

Now, suppose you've made an observation on the 3-colored quantum system, and the latter showed up its blue stuff , say. You're very pleased with the outcome from your observation, and decide to make the following statement: 'the quantum system showed its *intrinsic* blue stuff.'

According to the usual, two-valued logic of propositions, your statement can be either true or false. And if you subscribe to the alleged "scientific", Marxist-Leninist philosophy, you will be dead certain that you have captured all possible degrees of freedom of the quantum beast, so you can safely push it into a Hilbert space with dimension 3.

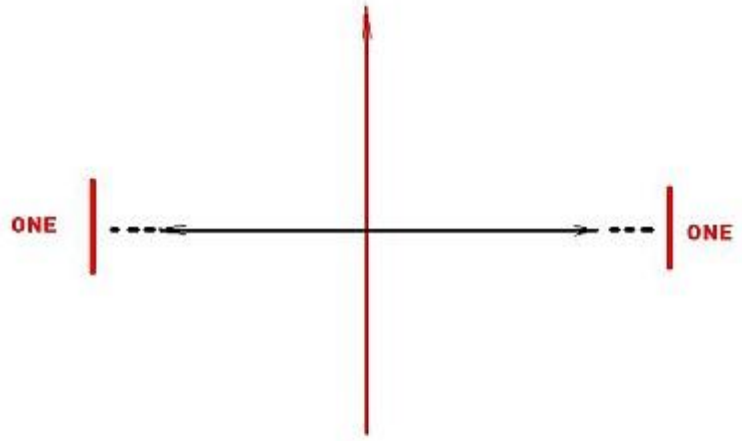
Well, it isn't that simple, sources say. Neither the blue nor the blue stuff are '*intrinsic* properties of *the* quantum system'.

What we observe in the local mode of spacetime are some fleeting "projections" (shadows on Plato's cave) from '*the* quantum system out there' which exists as 'potential reality' (cf. Henry Margenau's Onta; more from Christian de Ronde and Vassilios Karakostas) in the global mode of spacetime.

The difference between the two modes of spacetime can be made as clear as a whistle by providing the truth-values to the proposition 'the quantum system showed its (*intrinsic*?) blue stuff.'

1. In the local mode of spacetime, the Aristotelian logic, the Born Rule, and the unitarity principle hold, so we can claim that the quantum system can indeed be blue , but only to the extent to which it can indeed *show up* as blue , in the particular experimental context set by 'all the rest in the universe'. To explain this proposition, which is the essence of my talk on September 21, 2008, notice that there are two "orthogonal" evolutions of the universe (see the drawing below): the vertical red arrow stands for the arrow of spacetime, driven by DDE (recall the lake metaphor here), while the two horizontal black arrows represent the local mode of spacetime, as time-symmetric snapshot which, from the perspective of an ideal observer in the global mode, would "look" like an *now-at-a-distance* slice of a transcendental tachyon. The ONE state of the whole universe, and subsequently The Aristotelian Connection, are briefly explained here

and here.



A very important idea, which I tried to express with the drawing above, is that the evolution of the universe in the hypothetical 'local mode of spacetime' consists of fully legitimate and already-correlated "block universes" (think of them as snapshots from a movie reel) stacked on top of each other along the "vertical" arrow of spacetime. An observer cannot notice any violation of the Aristotelian logic, the Born Rule, and the unitarity principle by examining the "horizontal" block universe (never in plural), because the latter is one single, and perfectly correlated (relational ontology), state of all constituents of the universe, in line with the Machian-like rule 'thing globally, act locally'. Thus, no "dynamical dark energy" (DDE) can be "traced back" in this frozen instantaneous slice called 'local mode of spacetime' -- DDE remains totally hidden in the global mode of spacetime. The latter is non-existent in the local mode, thanks to which the local mode stands as a perfect continuum. Perhaps this is the reason why our calculations in QM (the projection postulate) and GR (linearized approximation) work well FAPP. The implications regarding cosmology are outlined here. Notice that in ADM hypothesis the "vertical" & "horizontal" evolution inevitably conflates (which may produce terrible confusion), while in our model the spacetime is "quantized" along its two modes *from the outset*.

Going back to the observed blue stuff , notice that none of the colors is 'an *intrinsic* property of *the* quantum system'. Moreover, the colored-able (colorizable) stuff itself is not 'an *intrinsic* property of *the* quantum system' either.

Here comes 'Quantum Mechanics 101': After you observed a blue stuff , you may call that stuff A and claim that 'stuff A is indeed blue in the particular experimental context', but to quote Erwin Schrödinger:

"... measuring it does *not* mean ascertaining the value (of the *intrinsic* property - D.C.) that it (*the* quantum system - D.C.) *has*."

Namely, the very stuff that you just called A might as well be colored, in another experimental context, in *any* of the other two available colors. (Notice that you can't have such quantum flexibility in Hilbert space with dimension lower than three, and a "vast, unexplored territory" for qutrits renders the so-called quantum computing unfeasible.)

You may also claim that, at the instant in which you made the claim

above, there are two more available colorizable stuff, called B and C, only you can't say anything about their actual colors at the instant in which stuff A turned out to be blue: it would be an *indecidable* and *counterfactual* proposition. And of course you can't employ the latter to run your "quantum computer" when "no one is looking at it", like T.S. Eliot's cat Macavity.

Also, you shouldn't claim that, "after the preparation, the system is in a precise and known state, and it can be treated as isolated from the rest of the universe, at least until the measurement process begins" (cf. Bassi & Ghirardi, footnote 8): due to the global mode of spacetime, we can't have any genuine "isolated" sub-system, but only a context-evoked propensity of *the* quantum system to display its possible "colorizable stuff" -- one-at-a-time only, and only to the extent to which the Aristotelian logic holds for the local mode of spacetime.

The prerequisites for this opinion have been laid out by John Conway and Simon Kochen (the Strong Free Will Theorem, arXiv:0807.3286v1 [quant-ph]; emphasis and links added): "... if indeed we humans have free will, then elementary particles already have their own small share of this valuable commodity. More precisely, if the experimenter can freely choose the directions in which to orient his apparatus in a certain measurement, then the particle's response (to be pedantic – the universe's response near the particle) is not determined by the entire previous history of the universe."

Let's be pedantic, as much as possible: "near" is a crucial issue. It could encapsulate the feedback from 'everything else in the universe', by means of a confirmation (advanced) wave. Also, the crucial fact that particle's response is *not* determined by the *entire* previous history of the universe refers to the genuine flexibility of quantum and gravitational realms: the concept of Final Cause ("the end (*telos*), that for which a thing is done", Aristotle, *Physics* 194b33) complements the relativistic causality, but can only be revealed in the arrow of spacetime.

NB: Notice the new form of retarded causality (called *biocausality*): particle's response is determined by both the *entire* previous history of the universe and its *potential* states determined relationally -- relational ontology -- by 'everything else in the universe'. This is how Aristotelian Final Cause complements the relativistic causality, in both quantum and gravitational realms. In the inanimate world of tables and chairs, the effect of 'potential reality' is vanishing small and can be safely ignored. Wolfgang Pauli wrote about this new form of causality in 1953.

2. In the global mode of spacetime, the *intrinsic* properties of *the* quantum system can be elucidated with their non-Boolean property structure (Kent Peacock, Aristotle's Sea Battle and the Kochen-Specker Theorem, p. 4), namely, a set of three questions and their answer:

Is *the* quantum system itself blue stuff ?
Is *the* quantum system itself red stuff ?
Is *the* quantum system itself green stuff ?

The sole answer is YAIN (both yes and no -- recall Gödel's incompleteness theorems), because *the* quantum system itself is UNspeakable by means of its 'observable characteristics' in the local mode of spacetime. It is simply a Noumenon rooted on the 'monad without windows' and the Aristotelian First Cause. All efforts to reveal '*the* quantum system' would be akin to demonstrating the "darkness" (global mode) of a room with a flashlight (local mode). Or to talking about some totally "uncolored" Kochen-Specker sphere, under the conditions that

every statement about it must be "colored", like finger nails.

To grasp the notion of 'totally uncolored Kochen-Specker sphere', all you need is a brain. Consider, for example, the Platonic idea of 'corner *per se*' (more examples here and here). In English, one of its 'observable characteristics' is the word "corner", but in a different context it can be explicated also with

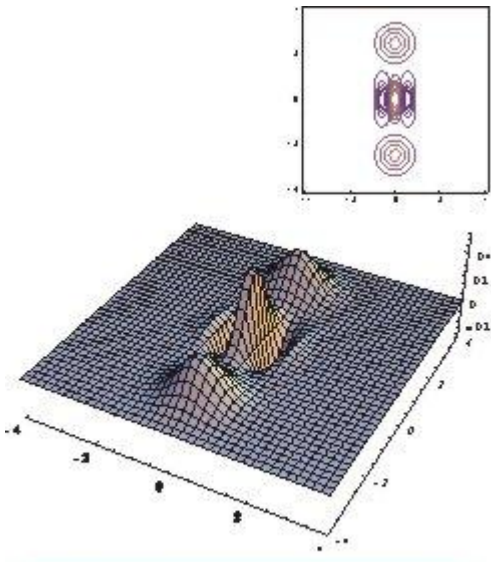
hoek (Dutch)
coin (French)
Ecke (German)
esquina (Spanish)
hörn (Swedish)
***etc*.**

The Platonic idea of 'corner *per se*' will not be changed if I decide to explicate it in Hindi or Chinese, and, most importantly, it is "open" to be associated with brand new things that could *emerge* (cf. John Wheeler) during the cosmological evolution of the universe.

As Alexandre Grothendieck put it, "These “probability clouds”, replacing the reassuring material particles of before, remind me strangely of the elusive “open neighborhoods” that populate the topoi, like evanescent phantoms, to surround the imaginary “points”."

Here, the elusive “open neighborhoods” come from the quantum version of Platonic ideas, with their truth value YAIN. (No, you can't achieve this with separable Hilbert spaces and the "proto-measures" in the topos-formulation of quantum theory, as advocated by C. Isham and A. Döring, 0809.4847v1 [quant-ph], Sec. V and Eq. 48.)

To understand the truth value YAIN , read the Shadow Interpretation (SI) of Warren Leffler (arXiv:0906.4992v1 [quant-ph]), and recall the Schrödinger cat state(s) in Wigner presentation, exhibiting an additional, highly nonclassical feature: a fine structured interference pattern with negative regions, called here UNdecidable quantum state or 'quantum version of Platonic ideas'.



$$|\Psi\rangle = |\alpha\rangle + |-\alpha\rangle$$

For Hilbert space of three or more dimensions, we don't even have cat states (or "qubits") anymore (following Wolfgang Pauli, this should be *klassisch nicht beschreibbaren Art von Dreideutigkeit*), and cannot apply the unitary requirement: the UNdecidale states that can be "both 1 and 0" are not definable in any probabilistic fashion *whatsoever* (cf. Schrödinger's letter from 18 November 1950 below).

To cut the long story short, if your brain can hold Platonic ideas, Mother Nature should do it as well. In the context of QM, the example with "corner" above suggests that '*the* quantum state', which carries its *latent* non-commuting measure-*ables* (see Claudia Schiffer), remains intact before, during, and after its observation: Dead matter makes quantum jumps; the living-and-quantum matter is smarter.

Regarding GR, replace 'observable characteristics' with 'Diff(M)-invariant characteristics', and check out the text above, bearing in mind the basic postulates of present-day GR here. Notice that in the local mode of spacetime the "singularities" are expelled from the outset, since they would be equivalent to non-contextual values of quantum observables hanging 'out there' (classical determinism). Hence the problems with the localization of energy and vanishing of the four-divergence of matter energy-momentum tensor, after Equivalence Principle (*e.g.*, Murli Verma, arXiv:0906.4933v1 [gr-qc], Eq. 11), cannot occur *in principle*.

The underling rule of the dynamics of GR is as follows: the 'real universe' (local mode) is emerging from an *uncountably infinite* set of potential "copies" (like the "color" of Ernst Specker's tripod) kept in the global mode of spacetime. Then the active diffeomorphism freedom enables us to move around this *uncountably* infinite set, only one element of which *becomes* real -- one-at-a-time, along the arrow of spacetime. Obviously, in order to "move around" and produce the arrow of spacetime, you need to 'hold onto something' -- the global mode of spacetime.

In other words, the spatio-temporal structure of our universe is not "underdetermined" (M. Iftime, 0809.3596v1 [gr-qc], p. 14) but flexible; the necessary flexibility to produce 'relational ontology' is camouflaged as Cauchy problem for the Einstein filed equations being not "well-posed", and the input from 'potential reality' is camouflaged as "gauge-dependent".

To understand the notion of flexibility in both quantum and gravitational context, recall that the human arm is not pre-determined to *any* specific movement (unlike the arm of a robot, say), thanks to which the human brain can perform *any* movement with it. In our case, the "brain" is 'the whole universe in its ONE state', which "chooses" one explication of its potential states in the local mode of spacetime.

I suppose Charles G. Torre holds different views on QM and GR, and will not tell his students about this web page. One thing for sure -- I haven't yet received his reply (if any) to my email from 25 July 2006.

And by the way, nothing said here is new (*e.g.*, recall the Heraclitian time of W.G. Unruh -- an "explicit (but unmeasureable) time"). The landmark article by Ernst Specker is from 1960. Ten years earlier, in a letter to Einstein dated 18 November 1950, Schrödinger wrote (emphasis added):

"It seems to me that the concept of probability is terribly mishandled these days. Probability surely has as its substance a statement as to whether something is or is not the case — an uncertain statement, to be sure. But nevertheless it has meaning only if one is indeed convinced

that the something in question quite definitely is or is not the case. A probabilistic assertion presupposes the full reality of its subject."

If you agree with Schrödinger, and understand the theorems mentioned above, then you can't squeeze 'the quantum system' into any Hilbert space: its full reality includes both probabilistic assertions modeled with Aristotelian logic (local mode of spacetime), and the potential reality "outside" the Hilbert space, with its negative "probabilities" (R. W. Spekkens, arXiv:0710.5549v2 [quant-ph]).

In simple words, in we replace 'corner *per se*' (see above) with 'cat *per se*', we have

|live cat> + |dead cat> << [cat *per se*]

From this perspective, "quantum theory would be an effective theory which arises from modding out over the gauge transformations" (Steven Weinstein, arXiv:0812.0349v2 [quant-ph]; see also footnote 5 and notice the interpretation of KS Theorem on p. 11 therein, and compare it with 'potential reality' interpreted as "gauge-dependent" stuff here).

To the best of my knowledge, the non-Boolean logic of propositions is acknowledged in all published (on paper) interpretations of QM (cf. Josef M. Jauch's Foundations of Quantum Mechanics, pp. 97-101), but none of them can employ both "quantum logic" (Isham-Döring toposification of quantum theory included) and the Aristotelian logic. Notice that in the interpretation of QM proposed here, these two kinds of logic are considered *complementary*, since they reflect two 'modes of spacetime'.

This new (to theoretical physicists at least) ontology can be elucidated with reversible being <--> becoming transition:

[quantum being] <--> [becoming context-dependant observables]

If we wish to talk about 'modal interpretations of QM', or about the superposition of |cat> & |dog> (E. Joos, quant-ph/9908008 v1, Sec. 3.1), or about the polarization of the quantum vacuum (cf. Robert L. Jaffe, "the deeper question", hep-th/0503158, p. 7), we refer to the quantum becoming only. The full quantum reality includes the quantum being, which is of course "outside" the Hilbert space: see the new "number" phi.

For additional arguments, check out the Gedankenexperiment aimed at deriving the classical limit of QM from STR, bearing in mind that there are no time operators in QM -- the only "time parameter" we can use is from STR, but it corresponds to 'classical reality out there', which in turn contradicts all we know about QM since 1935 Schrödinger paper quoted above. Ergo, we need two kinds of time.

In short, the PR^2 interpretation of QM suggests that the quantum *being* and quantum *becoming* constitute the potential reality in the quantum realm, and are rooted on the ultimate reality of 'the monad without windows' and the Aristotelian First Cause. In the standard interpretation of QM, there is no "chooser" (QM is a theory of choices without a "chooser", cf. P. Pearle, arXiv:quant-ph/9901077v1). The "chooser" is interwoven in the fabric of spacetime from The Beginning -- the whole universe as ONE (cf. The Aristotelian Connection here) -- and the spacetime is being "quantized" from the outset, with two "modes" of spacetime, called 'global' and 'local'. In the latter mode, the spacetime is a *perfect* continuum, and there is no problem to recover the world of tables and chairs -- no "semiclassical approximation" is needed. The "problem of time", as it appears in canonical quantum gravity, is solved with the

Hilbert space problem (cf. C. Kiefer, arXiv:0812.0295v1 [gr-qc]) *en bloc*, because the pitfalls of the Hamiltonian formulation of GR are avoided from the outset. In my "just another crank" opinion, there is no other way to proceed.

In philosophical terms, we follow the Bootstrap Principle of Geoffrey Chew (*Science* 161 (1968) 762), "Nature is as it is because it is the only possible Nature consistent with itself", and advocate the relational ontology and non-linear dynamics of 'part' and 'whole', namely, the nature of any one thing is determined by the universe as a whole, and *vice versa*. In metaphysical terms, we model the universe as a brain, and put aside the theological question of whether some sort of "mental reflection" (resembling the human mind, cf. John 1:1) may, or may not, emanate from 'the universe as a brain' (theology deals with 'The Universe', while we make just a *model* of it, called 'universe').

As Edward Harrison rightly noticed, "So far, science has failed to make sense of the bootstrap theory." (Edward R. Harrison, *Cosmology: The Science of the Universe*, Cambridge University Press, 2000, ISBN 052166148X, p. 5 and pp. 159-161.)

NB: We need two kinds of time to explain the holistic phenomenon producing quantum (as well as gravitational) waves, without any "quantum jumps". Hence the title of this brief essay, 'Quantum Mechanics 101'. As to GR, the *necessary* condition to produce a 'spacetime' is the physical stuff in it ("Space-time does not claim existence on its own, but only as a structural quality of the field", A. Einstein), but the *sufficient* condition for fixing 'spacetime' is The Aristotelian Connection from 'the whole universe as ONE'.

Now, imagine this. George F R Ellis, Norbert Straumann, Charles G. Torre, Karel Kuchar, Chris Isham, John Baez, Claus Kiefer, Jorge Pullin, John Stachel, Lee Smolin, etc., were searching for HIV vaccine, say. One day they learn that some guy might be proposing a solution to their task, but the theory is posted on a web site only. Would they keep quiet and ignore it, for years?

That's the difference between people who respect their field of research, and those who just play with their hobby.

D. Chakalov
April 8, 2008
Last update: Christmas 2008

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November 26, 2008: Another startling example of those people who do not respect their field of research but just play with it like a hobby is Sean Carroll (never replied to my email sent in the past five years).

Five years ago, he honestly acknowledged that, "In trying to understand the universe in which we apparently live, we are faced with a problem, a puzzle, and a scandal."

"What if Time Really Exists?" -- asked Sean Carroll in his latest essay arXiv:0811.3772v1 [gr-qc], and then elaborated: "What if time exists,

and is eternal, and the state of the universe evolves with time obeying something like (notice the poetry - D.C.) Schrödinger's equation?"

Further, he wrote (p. 3): "What we are not worrying about, for the moment, is what that wave function means -- its interpretation in terms of things we observe around us in the world."

Erwin Schrödinger worried about "that wave function" from the first days of Quantum Mechanics, and during a visit to Bohr's institute in September 1926, he stated the following: "If all this damned quantum jumping (*verdammte Quantenspringerei*) were really to stay, I should be sorry I ever got involved with quantum theory". The reason is simple: you can't keep track on the quantum system if those *verdammte Quantenspringerei* were indeed 'a fact of Nature'. No way.

Regarding quantum evolution in terms of energy eigenstates, notice the crucially important imaginary unit in Eq. 4, p. 6 -- "all of the time evolution is encoded in the phases ...". (Although these "phases" are considered "time dependent", it is completely unclear what kind of time they refer to, and the conventional approach is to declare this "time dependent phase" unobservable, just as the wave amplitude is unobservable -- recall the "negative amplitude" in Wigner presentation.) S. Carroll acknowledged that "we don't actually know what the energy eigenstates are, in terms of easily observable quantities." But you can' t observe *any* energy eigenstate -- you need some brand new QM in which the imaginary unit in the phase would be preserved at the scale of tables and chairs, or somehow *gradually* (?) recovered during the classical-to-quantum transition. In the real world governed by the arrow of spacetime (the Heraclitean time), this transition is perfectly smooth, bi-directional, and reversible -- Nature doesn't employ the *verdammte Quantenspringerei.*

Notice also footnote 4 on p. 7, regarding "the Heraclitean property of non-recurrent change throughout all of eternity" (p. 8), and check out the text here and here.

If S. Carroll wishes to 'invent the wheel' known since Plato -- that's fine with me. But if he isn't telling his students at Caltech anything about what he has learned from this web site -- that's not fair. Hell NO!

Kids have the right to know everything *we* know. I will be happy to explain the global mode of time, starting from an exercise explained in Wiki here. The 'test bed', as usual, was the brain of my teenage daughter, and -- yes, she got it.

By the way, if you trust the so-called "block universe", as explained by George F.R. Ellis and Robert Geroch, the closest match would be the famous story about a multifingered Angel (reference here):

"Jibrael replied that the Angel had been appointed by Allah to count the drops of rain, so that it may be known as to how many drops have fallen down to the earth. I turned towards the Angel and asked him, "Do you know the total amount of the rain-drops which have fallen down on the earth from the day Allah created this world till now"? To which he replied. "O prophet of Allah I swear by my Lord who has chosen You (as a blessing) for mankind, verily I know the total amount of rain-drops fallen on the earth till now. Even to the extent that how many drops have fallen in the wilds, in the prosperous lands, in the gardens and also in the cemetery".

Notice that GR textbooks are *far more* religious: the total number of rain

drops fallen on a Cauchy surface is dead-fixed up to future null infinity (I^+ or Scri), or rather "up to the Cauchy horizon" (George F R Ellis). No matter where you go, you will always 'cross the same river', because the Heraclitean time from the arrow of spacetime is absent there.

There is no third option: either the "block universe" of GR textbooks, or the arrow of spacetime.

However, no living brain can operate in a "block universe", because it will have to function as a Turing machine installed in some IGUS, and the perpetual "encoding of information", by any conceivable "code", will require *decreasing* of the entropy of the "hard drive", until the poor Turing machine develops severe structural damages and breaks down with a stroke. There are many more examples which demonstrate, by *reductio ad absurdum*, how desperately hopeless (and misleading) are the current GR textbooks, but who cares?

Certainly not Prof. Sean Carroll, so let's leave him at Caltech, musing on "a problem, a puzzle, and a scandal."

D. Chakalov
November 28, 2008

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"According to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time."

A. Einstein, *Äther und Relativitätstheorie*, May 5, 1920

(Lisa M. Dolling *et al.*, *The Tests of Time: Readings in the Development of Physical Theory*, Princeton University Press, Princeton, 2003, p. 346)

Note: Einstein's ether is interpreted here as the reference fluid in GR, which exists in the "dark gaps"]between[the points of the underlying manifold. Once we treat spacetime as 'one entity', after Hermann Minkowski, the local mode of time is indissolubly linked to the local mode of space: the 3-D space. The "points" from this 3-D space are made of already-localized propensities (such as blue stuff -- see above), while the additional degree of freedom -- the global mode of spacetime -- refers to a genuine "ether" which cannot be "tracked through time", as noticed by Einstein.

What, then, could be the global mode of time of the ether? It pertains to the realm of 'potential reality' (see above), for which the generic restrictions on motion in 3-D space -- 'inside vs outside' and 'left vs right' -- do not hold. Stated differently, a 'global observer' would have the kind of 'global view' on objects in 3-D space, similar (but not identical!) to the abilities of a 3-D observer to monitor the dynamics of Flatlanders, as explained in Wikipedia. And since in the *local* mode of time, which corresponds to the local mode of 3-D space, the simultaneous dynamics along all possible directions in 3-D space is inconceivable, an inanimate clock like your wristwatch will inevitably "read" the global mode of time as

"frozen" (cf. the Buridan donkey paradox depicted with the famous Esher drawing below).

In other words, if you are able to move in 3-D space *only and exclusively only* along the local (teleological) mode of time, your cosmological time arrow could only be anti-relativistic, and the genuine "direction" in which 3-D space "expands", producing the elementary timelike displacement, will be omnipresent, hence your poor wristwatch will inevitably halt and "read" such global mode of time as "frozen". Don't trust your wristwatch; it can't read the genuine nonlinear time in GR either.

Perhaps the global mode of spacetime will introduce brand new symmetry groups to GR (cf. M. Iftime), such as (but not limited to) 'space inversion' (notice the possibility for a radical reformulation of George F R Ellis' finite infinity idea).

From the perspective of the local mode of time -- the only kind of time readable by a physical (inanimate) clock -- the global mode of time will look omnipresent and "stand still", like the proper time of a photon "during" its flight (cf. the question of Nicolas Gisin below). One way to obtain the kinematics of such spacetime is to replace the fictitious "4th spatial dimension" (Ned Wright) with the "unite timelike vector" of Matthew Frank, and place this global degree of freedom in the "dark gaps"]between[the points of local 3-D space. The dynamics, due to the arrow of spacetime, will completely seal off the "dark gaps", rendering the local mode of spacetime a perfect continuum, and will produce a pocket of quantum-gravitational propensities -- potential reality -- placed in the potential future of this spacetime arrow. Sorry for repeating this all over again. These ideas are not at all original; recall Charles Howard Hinton's essay of 1880, “What is the fourth dimension?” (reference here).

The subjective presentation of such global mode of time, produced by the human brain, is well known. In the context of the train metaphor, every instant 'now' from the local mode of time keeps an infinite (actual infinity) number of instants 'now' from the global mode of time, but when we "stop the bike" we can see only a kinematical snapshot from the arrow of spacetime, in which the global mode of spacetime has been completely obliterated; hence its effects are "dark". More from Gustav Strömberg.

D. Chakalov
September 6, 2008
Last update: November 30, 2008

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Subject: Categorifying Fundamental Physics, $131,865
Date: Tue, 12 Aug 2008 03:13:33 +0100
From: Dimi Chakalov <dchakalov@gmail.com>
To: John Baez <baez@math.ucr.edu>

Categorifying Fundamental Physics, $131,865: "Our program has three components. First, we are developing a version of quantum mechanics in which Hilbert spaces are replaced by purely combinatorial structures."
http://www.fqxi.org/large-grants/awardee/details/2008/baez

Then you recall a letter by Schrödinger dated 18 November 1950,

http://www.god-does-not-play-dice.net/Szabados.html#Hilbert

... and start from scratch, which in turn may ruin the whole project.

So, if you wish to enjoy the money from FQXi, do NOT click the link above, and never tell anyone that you know this web site since 14 Jan 2002.

D.C.

Note: In January of 2002, John Baez sent me his last email. On Mon, 14 Jan 2002 16:37:33 -0800 (PST), Subject: Re: Feedback? Message-ID: <200201150037.g0F0bXg06772@math-lw-n01.ucr.edu>, baez@math.ucr.edu wrote:

[snip]

> I've repeatedly requested that you not send me email.
> You can save both of us some trouble by taking me off your list.

In January of 2006, he repeated an "argument" against the ether [Ref. 1], which goes back to 1934 [Ref. 2]. But if the quantum vacuum is 'potential reality', it will not pick out a preferred notion of 'rest' -- the only observable effects are "*energy differences*" [Ref. 3] -- yet it could be a perfect ether ("Lichtäther") in the hypothetical global mode of spacetime. No need to speculate about some stress-energy tensor of the vacuum [Ref. 1]; think deeply about QM instead.

The same applies to the confusion with "measuring the curvature of spacetime" [Ref. 3]: it could be a "blue stuff" (more on DDE below). Notice also that the "coincidence" problem is solved from the outset (see also A. Ashtekar), without the need for any anthropic parapsychology (Steven Weinberg). For if you interpret the vacuum energy density as some 'objective reality with positive energy density', its mass density will be about 10^{96} kilograms per cubic meter [Ref. 3]. As Richard Feynman said in 1987, "it suggests that we're missing something in our formulation of the theory of gravity."

Back in 1925, when Goudsmit and Uhlenbeck discovered electron spin, they imagined that the electron would be configured as a sphere in permanent rotation, but then they immediately realized that, given the mass of the electron, a spin momentum of [X] would require the tangential velocity at its "equator" to be many times the speed of light. Regarding the notion of 'spin', Wolfgang Pauli explained it as "eigentümlichen, klassisch nicht beschreibbaren Art von Zweideutigkeit" (quoted from N. Straumann, physics/0010003, p. 7). To understand the quantum vacuum, replace the word "Zweideutigkeit" with Wheeler's "cloud", and kindly -- *very* kindly -- ask John Baez for his professional comments.

Perhaps the geodesic incompleteness, the "black holes" (D. Christodoulou), and other pathologies (Cattoen & Visser) are nothing but artifacts from the current incomplete version of GR: "What general relativity does *not* do is to provide any natural way of imposing *global* constraints on the spacetime — certainly the Einstein equations provide no such nonlocal constraint" (Matt Visser).

Besides, if you agree with Naresh Dadhic that "dynamics of gravity resides

in spacetime curvature which must fully and entirely determine it", you should *either* look for some "extra dimensions" in GR (try also "branes"), *or* work with the potential reality in QM, as suggested at the link above. More from John Coleman.

However, John Baez choose 'neither of the above', and collected $131,865 from FQXi. Hope he will at least try to address the most acute puzzles of GR.

D. Chakalov
September 25, 2008
Last update: October 13, 2008

[Ref. 1] John C. Baez and Emory F. Bunn, The Meaning of Einstein's Equation (January 4, 2006), Sec. 'The Cosmological Constant', http://math.ucr.edu/home/baez/einstein/node8.html

"Still more shocking, it seems that the expansion of the universe may be accelerating rather than slowing down! One possibility is that the energy density and pressure are nonzero even for the vacuum. For the vacuum to not pick out a preferred notion of 'rest', its stress-energy tensor must be proportional to the metric."

[Ref. 2] P.J.E. Peebles and Bharat Ratra, The Cosmological Constant and Dark Energy, astro-ph/0207347v2, p. 16:

"If the physics of the vacuum looks the same to any inertial observer its contribution to the stress-energy tensor is the same as Einstein's cosmological constant (Eq. [19]). Lemaître (1934) notes this: "in order that absolute motion, i.e., motion relative to the vacuum, may not be detected, we must associate a pressure [X] to the energy density [X] of vacuum"."
See also the "preferred frame" problem in footnote 19, p. 15.

[Ref. 3] John Baez (October 8, 2006), What's the Energy Density of the Vacuum? http://math.ucr.edu/home/baez/vacuum.html

"... quantum field theory only cares about *energy differences*. If you can only measure energy differences, you can't determine the energy density of the vacuum - it's just a matter of convention.
...
"... without measuring the curvature of spacetime, one can only measure energy differences. (...) If we take advantage of this fact we are free to redefine energy density by subtracting off the zero-point energy, leaving an energy density of ZERO (see an elephant on a tightrope below - D.C.). In fact this is what is ordinarily done in quantum field theory."

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Subject: arXiv:0802.4155v2 [quant-ph]
Date: Mon, 22 Sep 2008 06:40:58 +0300
From: Dimi Chakalov <dchakalov@gmail.com>
To: Nicolas Cerf <ncerf@ulb.ac.be>

Cc: Christoph Adami <adami@krl.caltech.edu>

Dear Dr. Cerf,

RE the three arguments in Sec. 2, 'The origin of security', see

http://www.god-does-not-play-dice.net/Szabados.html#Hilbert

Seems to me that the so-called "unconditional security, i.e. the possibility of guaranteeing security without imposing any restriction on the power of the eavesdropper", is a joke.

Regards,

Dimi Chakalov

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Subject: Counterfactual definiteness ?
Date: Tue, 24 Feb 2009 20:03:48 +0200
From: Dimi Chakalov <dchakalov@gmail.com>
To: Guy Blaylock <blaylock@physics.umass.edu>
Cc: Barry Holstein <holstein@physics.umass.edu>,
William J Mullin <mullin@physics.umass.edu>,
Robert Krotkov <krotkov@physics.umass.edu>

Dear Dr. Blaylock,

Regarding footnote 25 in your recent paper, please see

http://www.god-does-not-play-dice.net/Szabados.html#Hilbert

I will appreciate your comments, as well as those by your colleagues.

Kindest regards,

Dimi Chakalov

Note: James Franson mentioned that, as a graduate student at Caltech, "one of the students asked Feynman if he would explain Bell's inequality. Feynman's reply was "There is nothing to it – I will explain it all later". But he never did."

Many physicists have tried to *explain* Bell's inequality, and one very good effort is the article by Guy Blaylock [Ref. 1], submitted to *The American Journal of Physics*.

Regarding counterfactual *definiteness*, check out Bill Unruh [Ref. 2]; otherwise you may develop real headache from reading Anton Zeilinger [Ref. 3] and the like.

The first off headache is produced by the counterfactual notion of (i) '*contextual* realism' -- the belief that, *after* the stage of 'preparation', the attributes of a quantum system should have "gathered" well-defined classical values "out there", which the measurements will just reveal *statistically* -- and (ii) the counterfactual *definiteness* [Ref. 1]. Students are led to believe that in both cases the Born Rule is being applied to things possessing full reality (cf. Schrödinger's letter from 18 November

1950 above), hence the outcomes from observing such things "out there" can be endowed with *definite* truth values -- *either* true *or* false.

To explain the deceitful notion of '*contextual* realism', from the perspective of the PR^2 interpretation of QM suggested above, replace the Schrödinger cat with a squeezable ketchup tube which you keep upside down in your fridge door, such that it has 50% chance to fall off upon opening the door (spin/tube up denoted with + , spin/tube down with -). Then imagine that 'the tube *per se*' -- the quantum presentation of Platonic ideas -- can be filled with paste from green tomatoes, such that its color can be green, but with the same quality of 50% chance to fall off upon opening the door. Thus, you've completed the stage of 'preparation' of 'the tube *per se*' as two *latent* observables (Henry Margenau) -- either 'red ketchup' or 'green tomato paste', with 50% chance for the two "eigenvalues", tube *down* or tube *up*, depending on the colors (see below) inherited from the "two" (in fact, ONE) tube(s). To expose the deceitful counterfactual *definiteness* (e.g., Karl Svozil), consider two fridges with the same 'tube *per se*' -- open fridge 1 and look what you got there (say, red tube +), and *then* you can *infer* what might have been "prepared" in fridge 2 "out there" (green tube -).

However, due to the quantum presentation of Platonic ideas, *any* form of 'realist thinking' is *not* applicable to QM from the outset.

It is this definite truth value inferred from '*contextual* realism', which induces the delusory flavor of some '*probabilistic* realism'. It has been implemented with yes/no structure of Hilbert space dimensions. But if this Hilbert space is taken to have dimensions greater than two, it cannot provide answer to any 'realist' question *whatsoever*, as Erwin Schrödinger anticipated in 1935 and Ernst Specker demonstrated in 1960.

Obviously, something *essential* is missing, perhaps "invisible" with the Born Rule, yet many people choose to ignore this puzzle and endorse the slogan "god plays dice". But then none of them could *understand* Quantum Mechanics, as they could only 'shut up and calculate', hoping that "if we get really deep insight into why the world has quantum mechanics, we might go beyond" (A. Zeilinger). We might go beyond if we understand all possible *artifacts* from the measuring devices working in the realm of STR (the point-like "window" to which an inanimate measuring device -- not the human brain -- is limited to take a glimpse at the quantum world), instead of repeating the mantra "the background Newtonian time appears explicitly in the time-dependent Schroedinger equation" (C. Isham).

May I offer my 'experimental test of non-local realism in 2-D Hilbert space'. I will flip a quantum coin, call A , which has been 'prepared' to display two alternative classical outcomes, + and - . Quantum Mechanics says that (i) I will obtain a random sequence of + and - , and (ii) if I've had an infinite time for this exercise, I would have found that the two outcomes have equal probabilities, which nicely sum up to unity. Fine.

Now, suppose I have my quantum coin A "shared" (entangled) with Claudia Schiffer. She is also flipping it in her home (causally disconnected from mine) and, due to some conservation law (cf. Karl Svozil), the signs obtained by flipping the "two" (in fact, ONE) entangled coins will have to be opposite.

Here some people might say that if Claudia observes + with "her part" from the entangled coin A , I will definitely observe - with "my part" from the entangled coin A , hence speculate about some "non-local

realism" [Ref. 3].

Wrong. One can accept *some* form of 'realism' iff Claudia could somehow force "her part" from the entangled coin to produce a distinctive "ketchup" pattern, +++---+++ , which will in turn force "my part" from the same entangled coin to produce *instantaneously* the opposite "green tomato" pattern, ---+++--- , which will be counterfactual elements of physical reality to Claudia, while her pattern will be counterfactual elements of physical reality to me. It is of course impossible to look at the two patterns *simultaneously* (see John Polkinghorne), hence any statement that implies, or explicitly depends on, such simultaneous observation is 'not even wrong'.

The first and only email I got from Anton Zeilinger was in April 2000, then he decided to ignore my comments and continued to explore his murky philosophy. How many of his students got headaches from it, I wonder.

I hope to hear from Guy Blaylock and his colleagues. I can't imagine how Richard Feynman would have explained the counterfactual pitfalls in Bell's inequality and in the Gedankenexperiment from 1935 [Ref. 1]. But I sincerely hope the interpretation of QM outlined above is headache-free. It also allows quantum systems to have properties that are not "extrinsic" [Ref. 4], such as the formally undecidable quantum presentation of Platonic ideas (cf. the example of 'corner *per se*' above, and use your brain to grasp it).

NB: Notice that with the so-called PR^2 interpretation of QM there is no need to define QM observables with respect to some 'classical world of tables and chairs', hence we can use it in quantum cosmology (Marco Genovese, arXiv:0904.2300v1), firstly, and secondly -- the measurement problem is solved from the outset, by providing smooth bi-directional transitions between the quantum (Chen Ning Yang) and classical realms: the "back bone" to hold onto is the formally undecidable, in the sense of KS Theorem, quantum presentation of Platonic ideas or 'potential reality'.

All this may sound like sheer philosophy, but notice that the *absolute value* of energy stored in the quantum vacuum [Ref. 5] is also 'potential reality', which may be *neutral* to both "charges" of mass, and if the human brain uses the same 'potential reality' and 'nondynamical time parameter' (Unruh & Wald), a (topological?) bridge between the brain and the quantum presentation of Platonic ideas may be possible to establish, with vast technological implications. There are far too many hypotheses involved with this "bridge", and at this point I am only trying to gather indirect evidence in support of it, by proving the alternative hypothesis wrong. Stay tuned.

D. Chakalov
February 25, 2009
Last update: May 17, 2009

References

[Ref. 1] Guy Blaylock, A pedagogical study of the Einstein-Podolsky-Rosen paradox and Bell's inequality, arXiv:0902.3827v1 [quant-ph]

"25 An example of counterfactual reasoning is a statement of the form “If we had made a certain alternative measurement (rather than the one we did make) we would have obtained such-and-such result”. Counter factual

definiteness **implies that a statement such as the former has a definite truth value (is either true or false)."**

[Ref. 2] W. Unruh, Nonlocality, counterfactuals, and quantum mechanics, *Phys. Rev*. A59, 126-130 (1999); arXiv:quant-ph/9710032v2, p. 3.

[Ref. 3] Anton Zeilinger *et al.*, An experimental test of non-local realism, *Nature* 446, 871-875 (2007); arXiv:0704.2529v2 [quant-ph]

"Locality prohibits any influences between events in space-like separated regions, while realism claims that all measurement outcomes depend on pre-existing properties of objects that are independent of the measurement. (...) The logical conclusion one can draw from the violation of local realism is that *at least* one of its assumptions fails. Specifically, either locality or realism or both (here comes the real big mess - D.C.) cannot provide a foundational basis for quantum theory. (...) It is sufficient for our purposes to discuss two-dimensional (the implications from KS Theorem are automatically excluded - D.C.) quantum systems."

[Ref. 4] P. Hajicek, J. Tolar, Intrinsic properties of quantum systems, arXiv:0806.4437v4 [quant-ph]

"All examples that have been listed show that the intrinsic and extrinsic properties are physically inseparably entangled with each other. (...) Still, both kinds of properties are logically clearly distinguished, and we conjecture that the physical in-and-extrinsic tangle does not lead to any logical contradictions.
...
"There are intrinsic properties of Sq that are not classical properties of Sc, e.g., the set of all quantum observables measurable on Sq. Hence, classical properties must be some specific intrinsic properties and the question is, which.
...
p. 17, footnote 12: "In the decoherence theory, another component, the environment, is added at the beginning and traced out at the end. The result is again an improper mixture and the problem remains exactly the same.
...
"To summarize: Our interpretation suggests a new approach to quantum theory of classical properties and of measurement because it allows quantum systems to have also properties that are not extrinsic.

[Ref. 5] Eduard Masso, The Weight of Vacuum Fluctuations, arXiv:0902.4318v1 [gr-qc]

"Provided we only measure energy differences, we can subtract this type of contributions and we do not need to worry when performing calculations (technically we call it normal ordering). However, this procedure is no longer possible in the presence of gravitation for in this case the absolute value of energy matters.

"One expects then a net cosmological constant from the zero-point field fluctuations [2]. It has been known for many years that these contributions exceed the observed value (1) by many orders of magnitude. To solve this problem is one of the present challenges for Physics [3].
The problem presupposes that vacuum fluctuations have the same

gravitational properties (positive energy density -- D.C.) as all other forms of matter."

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Subject: Formally UNdecidable (arXiv:0809.0151v1)
Date: Mon, 5 Jan 2009 01:38:39 +0200
From: Dimi Chakalov <dchakalov@gmail.com>
To: Christian Weedbrook <christian.weedbrook@gmail.com>, mgu@physics.uq.edu.au, alvaro.perales@uah.es, mnielsen@perimeterinstitute.ca
Cc: A.P.A.Kent@damtp.cam.ac.uk, rlaflamme@perimeterinstitute.ca, dgottesman@perimeterinstitute.ca

Dear Dr. Weedbrook,

I greatly admire your article. Please notice that, from the perspective of KS Theorem, 'the quantum state' is 'formally undecidable' as well,

http://www.god-does-not-play-dice.net/Szabados.html#Hilbert

This may have devastating consequences for "quantum computing", since it isn't possible to control 'the quantum state' locally, at the scale of tables and chairs. I hope you are not connected to this "quantum computing" community, and may have the freedom to face the bold facts of QM, as known since 1935.

If you or any of the recipients of this email disagree, please don't hesitate to write me back.

Kindest regards,

Dimi Chakalov

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Subject: Re: Bohmian Mechanics vs KS Theorem
Date: Tue, 17 Mar 2009 17:42:02 +0200
From: Dimi Chakalov <dchakalov@gmail.com>
To: Roderich Tumulka <tumulka@math.rutgers.edu>
Cc: duerr@mathematik.uni-muenchen.de, oldstein@math.rutgers.edu, zanghi@ge.infn.it

On Tue, Mar 17, 2009 at 4:46 PM, Roderich Tumulka <tumulka@math.rutgers.edu> wrote:
>
>
> Because different experiments can be associated with the same
> observable, and the outcome depends on the experiment, not just
> the observable.
>
> Best, Rod