SOLUTION TO DAVID CHALMERS'S "HARD PROBLEM"[1]

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Jack Sarfatti was a leading member of the 'Fundamental Fysiks Group' an informal group of physicists in California in the 1970s who, according to a historian of science MIT Physics Professor David Kaiser "Little could Herbert, Sarfatti, and the others know that their dogged pursuit of faster-than-light communication and the subtle reasons for its failure—would help launch a billion dollar industry..... at the heart of today's quantum encryption technology"

ABSTRACT: A completely non-statistical non-linear non-unitary framework in which "God does not play dice …" (Einstein) that describes the physical foundations of consciousness is presented for the first time. At its core is the insight that the missing link between current physical descriptions of reality and a credible physical framework for consciousness is provided by post-quantum mechanics (PQM): the extension of statistical linear unitary quantum mechanics for closed systems to a locally-retrocausal[i] non-statistical non-linear non-unitary theory for open systems through the introduction of a back-reaction potential and its implications. PQM is to orthodox QM as General Relativity (GR) is to Special Relativity (SR). PQM and GR both share the same metaphysical organizing principle that one-way actions without a compensating reaction or back-reaction means an incompleteness in the theoretical model leaving out important physical phenomena. We gleaned the final piece in the puzzle of how consciousness arises from the material world from a result relating to long range collective excitations in microtubules described by Stuart Hameroff in a recent Fetzer Foundation conference in London. Herbert Fröhlich suggested that almost any many-particle system when properly pumped far off thermodynamic equilibrium can be put into a robust macro-quantum coherent state immune from environmental decoherence. Indeed, we suggest that all life forms are an example of Frohlich coherence that is intimately connected with locally-retrocausal PQM back-reaction's violation of the de Broglie guidance equation that was assumed by Bohm in his 1952 pilot wave theory. Using nature as a guide combined with nano-technology points the way to the construction of naturally conscious artificial intelligence machines capable of hacking into current-day quantum cryptographic networks. Furthermore, one can imagine attaining the transhumanist agenda. For example, the consciousness of a genius like Stephen Hawking could be uploaded to the post-quantum Cloud and then downloaded to a healthy body or android.

KEYWORDS: Postquantum mechanics; Consciousness; David Bohm; Herbert Fröhlich; Retrocausality

HISTORY

MIT physics professor David Kaiser in "How The Hippies Saved Physics" describes how Werner Erhard asked one of us (Sarfatti) to solve the hard problem[ii] back in 1974

when he funded the Physics Consciousness Research Group (PCRG).[2]

Our basic ansatz to solve the hard problem is that "active quantum information" Bohm-Aharonov advanced destiny and retarded history physical waves are intrinsically mental. Qualia are excitations in them directly imprinted by the back-reaction of the classical material beables that are missing in all competing non-Bohmian interpretations of quantum mechanics.[iii]

The framework presented combines work by a several authors. Antony Valentini[iv] showed that the breakdown of Born's Rule[v] leads to EPR entanglement signaling, which via ER = EPR[vi] corresponds to particles moving through traversable ER wormhole closed timelike curves (CTC). David Deutsch, Huw Price, Seth Lloyd et-al showed that CTC loops can lead to quantum computations that can solve NP-hard problems. Roderick Sutherland has provided a Lagrangian formalism fully describing Bohm's formalism within Yakir Aharonov's locally retrocausal weak measurement TSVF framework that does not require configuration space for many-particle entangled states.[vii]A back-reaction interaction between advanced and retarded Bohm - Aharonov "active information" pilot waves and their classical "beables" emerges extending orthodox QM to a larger PQM theory when one includes sources for the quantum potential. This implies the quantum pilot wave probability flow is not conserved and therefore leads to a violation of Born's Rule that leads to entanglement signaling in violation of the now familiar no-go theorems of orthodox (waves no particles) quantum cryptography. Therefore, the ansatz ER=EPR applied to quantum systems, and not only to cosmological models, together with local retrocausality and back-reaction leads to entanglement signaling via CTC loops. The emergent description of reality using these assumptions is referred to as PQM. Finally, the supposition of a "sub-quantum hidden variable level" is no longer needed any more than Einstein needed the unobservable classical aether in 1905. The so-called "hidden variables" are, in fact, the classical macroscopic h-independent parts of Sutherland's Lagrangian.

Most researchers believe that irrespective of the specific mechanism leading to the emergence of consciousness, consciousness itself is either embedded, or highly correlated, with the physical structure of the brain. A physical theory of consciousness should also allow for the performance of certain activities that seem to require the solution of NP-hard problems. Hameroff has suggested that based on anesthesia research microtubules are significant in the emergence of consciousness.

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[2] Watch https://www.youtube.com/watch?v=WqCQbOVYH1I&feature=share for details not found in Kaiser's award-winning book.

The framework presented builds on these ideas. It is argued that life in general, and consciousness specifically, emerges as a nonlinear effect of the back-reaction potential under certain conditions. This creates long-distance correlations that play a key role in biological molecules.[viii] Specifically, the back-reaction potential gives rise to consciousness when two conditions are met:

1. Existence of stable qubit system in biological systems, like phosphorus nuclear spins in addition to the trapped electrons in the protein dimer double-well potential of the microtubules, anyonic topological global qubits in 2D surface quantum states. In this context, the role of neurons is to mediate the content of consciousness to the biological systems of the organism.
2. Protection against thermodynamic equilibrium ambient heat by the external pumping of energy through the system inducing robust macro-quantum coherence as first shown by Herbert Frohlich. The key role of external pumping (e.g. metabolic mechanisms in biology of cell and pumping of lasers above threshold) has been emphasized by Harold Morowitz (Yale). The external pump causes an effective local lower non-equilibrium temperature for continuous energy eigenvalues of the qubits, and an effective negative "spin temperature" for discrete energy eigenvalues of the qubits. This is a non-equilibrium dynamical phase transition analogous to the spontaneous symmetry breaking of P.W. Anderson's "More is different" for condensed matter many-real particle system degenerate ground states and for the Higgs-Goldstone mechanism for virtual particle quantum vacua leading to the rest masses of leptons and quarks in the standard model.
3. Viewing microtubules as stabilized pumped non-equilibrium Fröhlich coherent systems rebuts Max Tegmark's decoherence time based criticisms of Stuart Hameroff's MT hypothesis. .

   In summary, recent advances in quantum computing have shown that it is possible to construct a quantum computer using phonons and other quasiparticles to mediate the correlation between different qubits. Hameroff and Penrose suggested that Fröhlich condensate pumped dissipative systems may provide the physical basis for such warm quantum systems. Bandyopadhyay et al. showed recently that microtubules exhibit long range collective phenomenon when certain external frequencies are pumped into the system. .

   The PQM approach together with the latest experimental results on

microtubules and theoretical results from quantum computing lay the foundations for a complete description for a physical theory of consciousness. This work has implications as far as artificial intelligence quantum computing that will be briefly discussed.

SUTHERLAND'S NON-STATISTICAL NON-LINEAR NON-UNITARY LOCALLY RETROCAUSAL WEAK MEASUREMENT LAGRANGIAN ACTION PRINCIPLE IN A NUTSHELL

• No need for configuration space to handle entanglement.
• Bohm pilot wave theory made relativistic using a variation on Aharonov's retrocausal weak measurements in the Lagrangian-based action principle in the block universe.
• Einstein's action-reaction organizing principle formulated as part of the non-statistical post-quantum weak Lagrangian connecting the pilot wave to its beables.

Action-Reaction Signalling

• No-entanglement signaling fails when there is post-quantum action-reaction between pilot wave and its beables.
• The non-statistical retrocausal post-quantum action-reaction piece of the weak Lagrangian must be set to zero in the limiting process to the statistical orthodox quantum theory with the unbiased irreducibly uncontrollably random Born rule in projective strong Von Neumann measurements.

Breakdown of Unitarity[3] in PQM

• Unitarity (conservation of pilot wave current density) happens because the waves have no sources in the QM limit. This violates Einstein's action-reaction organizing idea of General Relativity.
• PQM provides "particle" sources to the pilot waves. Therefore, Unitarity in orthodox quantum mechanics (QM).[4]

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[3] Unitarity means conservation of local Born probability wave function current densities in the evolution of a closed system between strong von Neumann projection operator |ket><bra| (Dirac) measurements. This implies conservation of the spacelike integral of the timelike component of the 4-current density (total probability) at least in flat spacetime.

[4]Bohm's assistant Basil Hiley prefers "theory" to "mechanics", however, we keep "mechanics" to emphasize that consciousness is an excited state of a physical field albeit a quantum information field that interacts with h-independent classical particles and their classical local gauge fields. No non-observable "sub-quantum" hidden variable level (Vigier, Valentini) is needed anymore than Einstein needed the non-observable aether in 1905 Special Relativity. Valentini's "sub-quantum non-equilibrium" for EPR

$$\partial^{\alpha} j_{\alpha} = 0$$

is violated. The "particles" are a source and sink.

Sutherland's post-quantum weak measurement action-reaction "factor" shown directly below when set to zero is de Broglie's guidance constraint.

$$\left(u_{\alpha} \pm \frac{j_{\alpha w}}{\rho_{0 w}} \right)$$

Where u_{α} is the classical h-independent particle beable 4-velocity and $j_{\alpha w}$ is the Aharonov weak value TSV destiny/history pilot wave current density.

For example: Post-quantum free-particle spin ½ Dirac Equation for the retarded history pilot wave <x|i>.[5]The RHS in the equation below is the back-reaction of the particles on their waves missing in QFT

$$\left(i\gamma^{\alpha} \partial_{\alpha} - m \right) \langle x | i \rangle = \sigma_0 \left(u_{\alpha} \pm \frac{j_{\alpha w}}{\rho_{0 w}} \right) \langle x | i \rangle$$

entanglement signaling is, in fact, the classical statistical mechanical level above the Froehlich macro-quantum coherence dynamical phase transition threshold for pumped open systems.

[2]There is a second independent equation for the advanced destiny pilot wave <f|x> that is not the complex conjugate of the retarded history wave. We have two independent active quantum information fields one coming to us back from the future, the other coming to us from the past. It is the former destiny <f|x> that explains spooky quantum entanglement as first shown by Costa de Beauregard. Costa de Beauregard, O. Mechanique quantique, *Comptes Rendus Acadaemie des Sciences*, 1953, 236, 1632–34. This same idea is implicit in both Aharonov's TSV pre & post-selected weak measurement theory and John Cramer's "transactional interpretation" (aka TI). Unfortunately, Cramer confounds his advanced "confirmation" wave with the complex conjugate of his retarded "offer" wave in his unconvincing effort to explain the origin of the Born probability rule. We know from Sutherland's theory that the Born rule is an independent postulate just like Euclid's 5th axiom of a single line through a point in a plane parallel to any line in that same plane. Non-Euclidean geometries violate that axiom whose relevance to physics is strictly contingent and empirical based on observation.

$$\sigma_0 = \frac{1}{u^0}\delta^3\left(\vec{x} - \vec{x}_p(\tau)\right)$$

$$\rho_{0w} = \sqrt{\left(j_{\alpha w} j_w^{\alpha}\right)}$$

$$j^{\alpha}(x)_w = \frac{\langle f|x\rangle \gamma^{\alpha} \langle x|i\rangle}{\langle f|i\rangle}$$

Particle/Beable Eq. of Motion for the Action of the Waves on the Particle's Motion

$$\frac{d\left(\rho_{ow} u^{\alpha}\right)}{d\tau} = \pm \frac{\partial \rho_{0w}}{\partial x^{\alpha}} + u^{\beta}\left(\frac{\partial j^{\alpha}{}_{w}}{\partial x^{\beta}} - \frac{\partial j_{\beta w}}{\partial x^{\alpha}}\right)$$

The two equations (Dirac mind wave equation with beable sources and beable matter equation) form an adaptive self-organizing PQM "mind-matter" feedback-control loop that Michael Towler described in his Cambridge Bohm Pilot Wave Lectures. Towler did not know of Sutherland's work at the time; neither did I.

Non-Statistical Non-Linear Non-Unitary PQM →Statistical Linear Unitary QM.

The action-reaction term must be assumed to be zero to justify integrating over the back from the future <f| Aharonov-Dirac destiny "bras". There would be a non-random locally-decodable keyless signal from the actual future <f| when the action-reaction term was sufficiently large not equal to zero.

Secondly, the Born rule connecting destiny <f| Dirac bras with history |i> Dirac kets must be assumed independently.

$$J^{\mu}_{PQM}(x) \equiv \frac{\langle f|x\rangle \hat{J}^{\mu} \langle x|i\rangle}{\langle f|i\rangle}$$

$$J^{\mu}_{QM}(x) = \int_{f} |\langle f|i\rangle|^2 J^{\mu}_{PQM}(x) = \langle i|x\rangle \hat{J}^{\mu} \langle x|i\rangle$$

$$\int_{f} |f\rangle\langle f| = \mathbf{1}$$

$$\langle J^{\mu}_{QM} \rangle \equiv \int_{x} \langle i|x\rangle \hat{J}^{\mu} \langle x|i\rangle \equiv \langle i|\hat{J}^{\mu}|i\rangle$$

The final line above corresponds to Henry Stapp's orthodox statistical quantum theory in which the initial state evolves from past to future in accord with the thermodynamic Arrow of Time and the accelerated expansion of our classical relativity light-signal limited observable universe bounded by observer-dependent past-particle cosmological horizons encoding |i> and future de Sitter event horizons encoding <f|.

See Sutherland's papers cited below for important details especially dealing with the energy-momentum tensor that obeys conservation laws when all degrees of freedom (DOF) waves and particles are included. All non-Bohmian pictures of quantum theory omit the particle DOF. Note in particular Sutherland's paper on locally-retrocausal "Naïve Quantum Gravity" a first step to including classical gauge field beables in addition to the simpler case of classical particle beables described above.

THE RELATION OF PQM BACK-REACTION TO FRÖHLICH COHERENCE

Historical Background[ix]

The antecedents of the PQM model of mind-matter-consciousness draw on the ideas of Morowitz, Prigogine, Fröhlich, I.J. Good, Wheeler and Feynman, Stapp, Hameroff and especially David Bohm.

Toy Math Model Generalized Fröhlich Macro-Quantum Coherence for Many-Particle Complex Systems Externally Pumped Far Off Classical Thermodynamic Equilibrium

Ansatz: The argument in the Boltzmann factor of maximally random equilibrium statistical mechanics generalizes to partially non-random far-off-equilibrium as if there is an effective temperature $T_{non-equil}$

$$\frac{E}{k_B T_{non-equil}} = \frac{E \mp \sigma P \tau}{k_B T_{equil}}$$

$$\frac{T_{equil}}{T_{non-equil}} = 1 \mp \frac{\sigma P \tau}{E}$$

Where for entropy S

$$\frac{1}{T} = \frac{\partial S}{\partial E}$$

E is the target quasi-particle[x] energy of the complex many-particle system driven off thermodynamic equilibrium by the external pump energy flux (Morowitz) whose physical dimensions are [P] = Energy/Area Time. The scattering cross-section for the target quasi-particles to absorb a pump quantum of energy h/τ is σ.

The – sign applies when the target energy E eigenvalues are discrete, e.g., a lattice of magnetic/electric dipole moment spin ½ or "two-level" $E_1 > E_0$ qubits in an external magnetic/electric field (e.g. trapped ion, or protein dimer micro-tubule MT) quantum computer. As the external pump energy flux P of frequency $f = \tau^{-1}$ increases, the effective non-equilibrium "spin temperature" rises to a singularity $\pm\infty$ at a critical P_c in which the two discrete energy eigenvalue states have roughly equal populations. This is a dynamical off-equilibrium phase transition. $P > P_c$ is population inversion (with more higher energy eigenvalue levels occupied than lower) corresponding to a negative spin temperature that is actually hotter than any positive spin temperature.[6] This happens in a laser with a coherent output beam of real target quasiparticles – not necessarily photons.

The + sign applies when the target energy E eigenvalues are continuous. For example, the center of mass (COM) motion of the entangled pair of electrons bound by phonons in a Cooper pair BCS superconductor. Other examples would be any systems of boson quasiparticles with suitable σ coupling of the pump quanta to the target quanta. In this case, the effective non-equilibrium temperature $T_{non-equil}$ is always positive and decreases monotonically to zero as P increases to infinity. Therefore, we expect the non-equilibrium Frohlich coherent phase transition analog to a thermodynamic Bose-Einstein condensate to form when $T_{non-equil}$ falls below the thermodynamic equilibrium critical second order phase transition Tc. The external pump P provides a protective barrier against the ambient environmental temperature decoherence. Indeed, all life forms depend on this kind of protection.

[6] If you couple a hot negative spin temperature to any positive temperature you get over-unity efficiency ε work output for a reversible Carnot engine $\varepsilon = 1 + |T_{positive}/T_{negative}|$.

Ansatz

$$u_\alpha \pm \frac{j_\alpha}{\rho_0} \sim \frac{\sigma c T_{\alpha\beta} u^\beta}{hf^2}$$

Where $T_{\alpha\beta}$ is the stress energy tensor of the external pump that we will assume to be real photons in sharp wave packets peaked at frequency f.

$$P_\alpha \equiv T_{\alpha\beta} u^\beta$$

$$P \equiv \sqrt{P_\alpha P^\alpha}$$

Finally, we have the problem of global anyonic (braid group)[7] topological qubit computers in 2D edge states (e.g. fractional quantum Hall effect) that also require low temperatures to achieve. The generalized Frohlich mechanism presented here may also help achieve room temperature topological qubit quantum (and post-quantum "conscious") computers in addition to the more usual 3D bosonic (permutation group) quasiparticle quantum computers.

Hameroff – Tegmark Debate at Fetzer Foundation Bohm Centennial University of London, (Oct 28, 2017)

This debate has been going on for years. Our discussion of generalized Frohlich coherence above argues in favor of Hameroff. Tegmark's argument is clearly irrelevant if we are correct here. Time will tell as what we suggest is clearly Popper falsifiable. Hameroff had the following ace up his sleeve in the recent London debate, that seems to be empirical evidence in accord with what we are suggesting.[xi]

LIVE VISUALIZATIONS OF SINGLE ISOLATED TUBULIN PROTEIN SELF-ASSEMBLY VIA TUNNELING CURRENT: EFFECT OF ELECTROMAGNETIC PUMPING DURING SPONTANEOUS GROWTH OF MICROTUBULE

Anirban Bandyopadhyay Subrata Ghosh Daisuke Fujita SatyajitSahu

[7] The permutation group exchange of a pair of identical fermions in 3D gives a -1 to the entangled Feynman quantum amplitude leading to the Pauli exclusion principle. Similarly, the exchange of a pair of identical bosons in 3D gives a +1. In contrast, the braid group (knot) exchange of two identical anyons gives a complex unimodular phase factor $e^{i\theta}$ (https://en.wikipedia.org/wiki/Frank_Wilczek).

Abstract: *As we bring tubulin protein molecules one by one into the vicinity, they self-assemble and entire event we capture live via quantum tunneling. We observe how these molecules form a linear chain and then chains self-assemble into 2D sheet, an essential for microtubule, -fundamental nano-tube in a cellular life form. Even without using GTP, or any chemical reaction, but applying particular ac signal using specially designed antenna around atomic sharp tip we could carry out the self-assembly, however, if there is no electromagnetic pumping, no self-assembly is observed. In order to verify this atomic scale observation, we have built an artificial cell-like environment with nano-scale engineering and repeated spontaneous growth of tubulin protein to its complex with and without electromagnetic signal. We used 64 combinations of plant, animal and fungi tubulins and several doping molecules used as drug, and repeatedly observed that the long reported common frequency region where protein folds mechanically and its structures vibrate electromagnetically. Under pumping, the growth process exhibits a unique organized behavior unprecedented otherwise. Thus, "common frequency point" is proposed as a tool to regulate protein complex related diseases in the future."*

Endnotes

[i] *Why retrocausality — and why free will?*

> *The 'classic' motivation for retrocausal models in QM stems from Bell's Theorem, and the nonlocality it seems to entail. Nonlocality is often felt to be counterintuitive in itself, and the source of an unresolved tension between quantum theory and special relativity. As Bell himself described the implications of his famous result: "[I]t's a deep dilemma, and the resolution of it will not be trivial ... [T]he cheapest resolution is something like going back to relativity as it was before Einstein, when people like Lorentz and Poincaré thought that there was an aether — a preferred frame of reference — but that our measuring instruments were distorted by motion in such a way that we could not detect motion through the aether."*

As Bell was well aware, the dilemma can be avoided if the properties of quantum systems are allowed to depend on what happens to them in the future, as well as in the past. Like most researchers interested in these issues, however, Bell felt that the cure would be worse than the disease — he thought that this kind of "retrocausality" would conflict with free will, and with assumptions fundamental to the practice of science. (He said that when he tried to think about retrocausality, he "lapsed into fatalism".)

If this objection to retrocausality in QM is well-founded, it raises interesting issues about the nature and origins of this "free will", that turns out to play such a surprising role in the foundations of physics. If the objection is not well-founded, then it is high time it is moved aside, so that the retrocausal approach can be given the attention it otherwise seems to deserve.

Moreover, there are other motivations for exploring retrocausal models in QM, some the focus of considerable current research. Examples include:

- *The proposed retrocausal explanation of the results of 'weak measurements' by Aharonov, Vaidman and others.*
- *The relevance of retrocausality to the issue of the viability of an 'epistemic' interpretation of the quantum state, especially in the light of recent results such as the PBR Theorem.*
- *Recent work throwing new light on the relation between retrocausality in QM, on the one hand, and time-symmetry and other symmetries, on the other.*

For these reasons, too, there is a pressing need for a better understanding of notions of free will and causality, and of their relevance to the retrocausal approach to the quantum world. This conference brought together many of the leading writers and researchers on these topics, to discuss these issues."

Huw Price, http://prce.hu/centre_for_time/jtf/retro.html

[ii] *The hard problem of consciousness (Chalmers 1995) is the problem of explaining the relationship between physical phenomena, such as brain processes, and experience (i.e. phenomenal consciousness, or mental states/events with phenomenal qualities or qualia).*"[ii]

"In physics and mathematics, an ansatz (/ˈænsæts/; German: [ˈʔanzats], meaning: "initial placement of a tool at a work piece", plural ansätze /ˈænsɛtsə/; German:[ˈʔanzɛtsə] or ansatzes) is an educated guess[1] that is verified later by its results."[ii]

[iii] *"Living matter and back-action*

In certain dark corners of the internet, can find speculation of the following nature:

- *Propose the wave function/pilot wave is intrinsically 'mental' and capable of qualia.*
- *Equate the pilot wave with the mental aspect of the universe, generally: the particles are 'matter', and 'mind' the pilot wave. OK, who cares, except…*
- *'Mental' aspect of universe upgradeable to life/consciousness by self-organization. Happens when a physical system uses its own nonlocality in its organization.*
- *In this case a feedback loop is created, as follows: system configures itself so as to set up its own pilot wave, which in turn directly affects its physical configuration, which then affects its non-local pilot wave, which affects the configuration etc.*
- *Normally in QM this 'back-action' is not taken into account. The wave guides the particles but back-action of particle onto wave not systematically calculated. Of course, the back-action is physically real since particle movement determines initial conditions for next round of calculation. But there is no systematic way to characterize such feedback.* [JS There is now in Sutherland's Lagrangian] *One reason this works in practice is that for systems that are not self-organizing the back-action may not exert any systematic effect.*

Well, it's not obviously wrong!

[see p.346, Bohm and Hiley's *Undivided Universe).]*

Two-way traffic

Important to note that pilot-wave theory does not take into account any effect of individual particle on its own quantum field (though Bohm and Hiley briefly sketch some ideas about how this might happen, see e.g. Undivided Universe pp. 345-346).

- *Idea that particles collectively affect quantum field of a single particle is contained in the standard notion that shape of quantum field of a particle is determined by shape of environment (which consists of many particles, and is part of the boundary conditions put into the Schr ¨odinger equation before solving it, even in conventional QM).*
- *…. Jack Sarfatti … in particular has emphasized the need for an explanation of how the individual particle influences its own field and has proposed mechanisms for such 'back-action', also emphasizing its importance in understanding the mind- matter relationship and how consciousness arises (see earlier slide).*

- *Assuming that notion of such an influence of the particle on its field can be coherently developed, we can then have two-way traffic between the mental and the physical levels without reducing one to the other. Role of Bohm's model of the quantum system then would be that it provides a kind of prototype that defines a more general class of systems in which a field of information is connected with a material body by a two-way relationship.*
- *Quantum theory is currently our most fundamental theory of matter and Bohm suggests that, when ontologically interpreted, it reveals a proto-mental aspect of matter. This is the quantum field, described mathematically by the wave function, which is governed by the Schr ¨odinger equation. Bohm's suggestion is known as panprotopsychism.. so at least you learned a new word today..!"* http://www.tcm.phy.cam.ac.uk/~mdt26/PWT/lectures/bohm8.pdf
- *"Today there is a wide measure of agreement, which on the physical side of science approaches almost to unanimity, that the stream of knowledge is heading towards a non-mechanical reality; the universe begins to look more like a great thought than like a great machine. Mind no longer appears as an accidental intruder into the realm of matter; we are beginning to suspect that we ought rather to hail it as a creator and governor of the realm of matter..."*
- p. 137, 1937 ed. Sir James Jeans, *The Mysterious Universe*

"Although quantum entanglement has been experimentally verified … it must be stressed that it is not supposed to allow the transmission of information (i.e., no signal is involved). For example, attributing remote viewing to this effect would violate orthodox quantum theory. Theorists have reacted to this in two ways. Some have tried to identify what changes are necessary in quantum theory to allow nonlocal signaling (Valentini 1991, 2002). For example, Josephson and Pallikari-Viras (1991) have a model in which entanglement can be utilized biologically. More generally, Jack Sarfatti (1998) has argued that signal non-locality could still be allowed in some form of 'post-quantum theory' which incorporates consciousness. He regards signal-locality as the micro-quantum limit of a more general non-equilibrium macro-quantum theory (c.f. Bohm & Hiley 1995). The relationship between micro and macro quantum theory is then similar to that between special and general relativity, with consciousness being intrinsically non-local and analogous to curvature.[iii] *His model involves nonlinear corrections to Schrodinger's equation and may permit retrocausal and remote-viewing effects. (Sarfatti 2002)."* Bernard Carr, "Worlds Apart? Can Psychical Research Bridge the Gulf Between Matter and Mind?", Proc. Soc. Psy. Res. Vol 59, Part 221, June 2008.

[iv] *Subquantum Information and Computation*

Antony Valentini

"It is argued that immense physical resources - for nonlocal communication, espionage, and exponentially-fast computation - are hidden from us by quantum noise, and that this noise is not fundamental but merely a property of an equilibrium state in which the universe happens to be at thepresent time. It is suggested that 'non-quantum' or nonequilibrium matter might exist today in the form of relic particles from the early universe. We describe how such matter could be detected and put to practical use. Nonequilibrium matter could be used to send instantaneous signals, to violate the uncertainty principle, to distinguish non-orthogonal quantum states without disturbing them, to eavesdrop on quantum key distribution, and to outpace quantum computation (solving NP-complete problems in polynomial time)."

Xiv:quant-ph/0203049v2

[v] *"One of the most profound and mysterious principles in all of physics is the Born Rule, named after Max Born. One serious mystery of decoherence is where the Born probabilities come from, or even what they are probabilities of."*

https://en.wikiquote.org/wiki/Born_rule

[vi] *The first, admittedly dim, idea of ER = EPR in the PQMG (post-quantum-mechanical gravity) context was published in 1975 in the book Space-Time and Beyond (E.P. Dutton) by one of us (Sarfatti).*

"Each part of three-dimensional space is connected to every other part through basic units of interconnection, called wormholes. Signals move through the constantly appearing and disappearing (virtual) wormhole connections providing instant communication between all parts of space. These signals can be likened to pulses of nerve cells of a great cosmic brain that permeates all parts of space. This is a point of view motivated by Einstein's general relativity in the form of geometrodynamics. A parallel point of view is given in the quantum theory as interpreted by Bohm. In my opinion, this is no accident because I suspect that general relativity and quantum theory are simply two complementary aspects of a deeper theory that will involve a kind of cosmic consciousness as the key concept. Bohm writes of a 'quantum connectedness'"

The book then contains a quote from Bohm and Hiley from "On the Intuitive Understanding of Non-Locality as Implied by Quantum Theory" (preprint, Birkbeck College, University of London, 1974) including the text:

"There has been too little emphasis on what is, in our view, the most

> fundamentally different new feature of all, i.e., the intimate interconnection of different systems that are not in spatial contact. This has been especially clearly revealed through the, by now, well known experiment of Einstein, Podolsky and Rosen …"

A reference to Bell's theorem is also cited in that quote from Bohm and Hiley. It was only many decades later that Lenny Susskind et-al came out with the modern hologram universe idea of ER = EPR based on the AdS/CFT duality in which non-signaling EPR entanglement correlations of conformal field theory fluctuations on local 2D + 1 Rindler horizon "hologram screens" for properly accelerating test particles in the 3D +1 interior (also black hole and cosmological horizons past and future) are mapped to 3D + 1 bulk hologram imaged non-traversable EPR wormholes. Susskind et-al therefore only envisaged the special QM limit of the larger PQM on which current quantum cryptographic technology is based. See also

https://en.wikipedia.org/wiki/ER=EPR

[vii] *Back From the Future*

> (i) ***A series of quantum experiments shows that measurements performed in the future can influence the present. Does that mean the universe has a destiny—and the laws of physics pull us inexorably toward our prewritten fate?***

By ZeeyaMerali | Thursday, August 26, 2010

http://discovermagazine.com/2010/apr/01-back-from-the-future

The Lagrangian formalism is the essential tool in mainstream theoretical physics. It presupposes Einstein's "block universe" in which past and future are equally real relative to the future. The dynamical action for Feynman's "history" is the integral of the Lagrangian between an initial historical past boundary and a final teleological destiny future boundary. That this is so becomes particularly clear in the recent papers by Huw Price et-al that resurrects Costa de Beauregard's locally retrocausal "zig-zag" explanation of quantum EPR entanglement. The notion of "faster-than-light nonlocality" that violates the spirit if not the letter of Einstein's classical theories of relativity is no longer needed. Local retrocausality explains everything that nonlocality tries to explain and more. Nonlocality cannot explain the temporal entanglement of a future state with the past state of the same quantum system, e.g. our brain's memory and creativity. Yakir Aharonov's TSV theory and John Cramer's TI rely on the "zig-zag", however, they are incomplete non-Bohmian picture lacking independently existing classical beables. Aharonov's "weak

values" show the Bohm particle trajectories in the zero PQM back-reaction limit where they coincide with the pilot wave fluid streamlines in agreement with de Broglie's guidance constraint for closed systems. The latter is violated in the larger PQM regime of open systems externally pumped far off the classical thermodynamic equilibrium branch (Prigogine).

62. arXiv:quant-ph/0006070 [pdf, ps, other]
A Suggestion for a Teleological Interpretation of Quantum Mechanics
EyalGruss
Comments: M.Sc. thesis at The Hebrew University of Jerusalem. Instructed by prof. Yakir Aharonov and prof. Issachar Unna. 37 pages, no figures. minor changes
Subjects: Quantum Physics (quant-ph)

71. arXiv:cond-mat/9406116 [pdf, ps, other]
Negative Kinetic Energy Between Past and Future State Vectors
Daniel Rohrlich, Yakir Aharonov, SanduPopescu, Lev Vaidman
Comments: Talk presented at the Conference on Fundamental Problems in Quantum Theory, Baltimore, MD, June 1994, 10 pp, plain TeX
Subjects: Condensed Matter (cond-mat); Quantum Physics (quant-ph)

11. arXiv:1512.06689 [pdf, other]
Accommodating Retrocausality with Free Will
Yakir Aharonov, Eliahu Cohen, Tomer Shushi
Comments: To be published in a special issue of Quanta addressing time-symmetry in quantum mechanics
Journal-ref: Quanta 5(1) (2016) 53-60
Subjects: Quantum Physics (quant-ph)

14. arXiv:1508.06304 [pdf, other]
Weak values are quantum: you can bet on it
Alessandro Romito, Andrew N. Jordan, Yakir Aharonov, Yuval Gefen
Comments: 6 pages, 1 figure

32. arXiv:1301.6154 [pdf, ps, other]
Peculiar Features of Entangled States with Post-Selection
Yakir Aharonov, Shmuel Nussinov, SanduPopescu, Lev Vaidman
Comments: To be published in PRA
Subjects: Quantum Physics (quant-ph)
Journal-ref: Quantum Studies: Mathematics and Foundations 3, 1-4 (2016)
Subjects: Quantum Physics (quant-ph); Mesoscale and Nanoscale Physics (cond-mat.mes-hall)

15. arXiv:1504.03797 [pdf, other]

Weak Values and Quantum Nonlocality
Yakir Aharonov, Eliahu Cohen
Comments: 11 pages, 2 figures. To be published in "Quantum Nonlocality and Reality", ed. by Mary Bell and Shan Gao, CUP 2015
Subjects: Quantum Physics (quant-ph

36. arXiv:1207.0667 [pdf]
Broadening the scope of weak quantum measurements II: Past and future measurement effects within a double Mach-Zehnder-interferometer setting
Yakir Aharonov, Eliahu Cohen, Avshalom C. Elitzur
Comments: 11 pages, 3 figures. Submitted to Physical Review A
Journal-ref: Phys. Rev. A 89, 052105 (2014)
Subjects: Quantum Physics (quant-ph)

46. arXiv:0706.1232 [pdf, ps, other]
New Insights on Time-Symmetry in Quantum Mechanics
Yakir Aharonov, Jeff Tollaksen
Journal-ref: VISIONS OF DISCOVERY: New Light on Physics, Cosmology, and Consciousness, ed. R. Y. Chiao, M. L. Cohen, A. J. Leggett, W. D. Phillips, and C. L. Harper, Jr. Cambridge: Cambridge University Press, 2007
Subjects: Quantum Physics (quant-ph)

47. arXiv:quant-ph/0607208 [pdf, ps, other]
Non-statistical Weak Measurements
Jeff Tollaksen, Yakir Aharonov
Subjects: Quantum Physics (quant-ph)

48. arXiv:quant-ph/0507269 [pdf, ps, other]
Two-time interpretation of quantum mechanics
Yakir Aharonov, Eyal Y. Gruss
Comments: 8 pages. This supersedes quant-ph/0006070
Subjects: Quantum Physics (quant-ph)

49. arXiv:quant-ph/0503225 [pdf, ps, other]
Quantum Averages of Weak Values
Yakir Aharonov, Alonso Botero
Comments: 13 pages, 6 figures, Revtex 4. Paper has been shortened. Section on large- sample measurements has been removed. The discussion on this topic has been deferred to a future publication.

59. arXiv:quant-ph/0104062 [pdf, ps, other]
Revisiting Hardy's Paradox: Counterfactual Statements, Real Measurements, Entanglement and Weak Values
Yakir Aharonov, Alonso Botero, SanduPopescu, BenniReznik, Jeff Tollaksen
Comments: 7 pages, 1 figure
Subjects: Quantum Physics (quant-ph)

72. arXiv:hep-th/9305001 [pdf, ps, other]
The Schrodinger Wave is Observable after All!
Yakir Aharonov, Lev Vaidman
Comments: 8, TAUP 2020-93#
Subjects: High Energy Physics - Theory (hep-th)
73. arXiv:hep-th/9304147 [pdf, ps, other]
Measurement of the Schrodinger wave of a single particle
Yakir Aharonov, Lev Vaidman
Comments: 12, TAUP 2019-93#
Journal-ref: Phys.Lett. A178 (1993) 38
Subjects: High Energy Physics - Theory (hep-th); General Relativity and Quantum Cosmology (gr-qc)
2. arXiv:1510.06712 [pdf, ps, other]
A Live Alternative to Quantum Spooks
Huw Price, Ken Wharton
Comments: 7 pages; minor revisions
Subjects: Quantum Physics (quant-ph); History and Philosophy of Physics (physics.hist-ph); Popular Physics (physics.pop-ph)
3. arXiv:1508.01140 [pdf, other]
Disentangling the Quantum World
Huw Price, Ken Wharton
Comments: 17 pages, 3 figures; significant revisions in response to referees' comments
Journal-ref: Entropy, v17, 7752-7767 (2015)
Subjects: Quantum Physics (quant-ph); History and Philosophy of Physics (physics.hist-ph); Popular Physics (physics.pop-ph)
4. arXiv:1307.7744 [pdf, other]
Dispelling the Quantum Spooks -- a Clue that Einstein Missed?
Huw Price, Ken Wharton
Comments: 16 pages, 5 figures, 2 boxes
Subjects: History and Philosophy of Physics (physics.hist-ph); Quantum Physics (quant-ph)
1. arXiv:1706.02290 [pdf]
How Retrocausality Helps
Roderick Sutherland
Comments: AIP Conference Proceedings 2016
Subjects: Quantum Physics (quant-ph)
2. arXiv:1509.07380 [pdf]
Interpretation of the Klein-Gordon Probability Density
Roderick Sutherland

Comments: 6 pages
Subjects: Quantum Physics (quant-ph)

3. arXiv:1509.02442 [pdf]
Lagrangian Description for Particle Interpretations of Quantum Mechanics -- Entangled Many-Particle Case
Roderick Sutherland
Comments: 37 pages
Journal-ref: Foundations of Physics, Vol.47, pp. 174-207 (2017)
Subjects: Quantum Physics (quant-ph)
4. arXiv:1509.00001 [pdf]
Energy-momentum tensor for a field and particle in interaction
Roderick Sutherland
Comments: 9 pages
Subjects: Classical Physics (physics.class-ph)
5. arXiv:1502.02058 [pdf]
Naive Quantum Gravity
Roderick I. Sutherland
Subjects: General Relativity and Quantum Cosmology (gr-qc); Quantum Physics (quant-ph)
6. arXiv:1411.3762 [pdf]
Lagrangian Formulation for Particle Interpretations of Quantum Mechanics: Single-Particle Case
Roderick I. Sutherland
Comments: 12 pages
Subjects: Quantum Physics (quant-ph)
7. arXiv:quant-ph/0601095 [pdf]
Causally Symmetric Bohm Model
Rod Sutherland
Comments: 35 pages, 5 figures, new sections 12 and 13 added
Subjects: Quantum Physics (quant-ph)

[viii]Introduction

Jack Sarfatti has been exploring a generalisation of David Bohm's[4] ontological interpretation of quantum mechanics, extended so a particle is not just guided by the quantum potential, but, in turn, through backactivity, *modifies the quantum potential field. Backactivity introduces nonlinearity into the evolution of the wave function, much like the bidirectional nonlinear interaction of spacetime and matter-energy in general relativity.*

The effects of backactivity are negligible in interactions at the atomic scale; divergences from the predictions of conventional quantum mechanics would be manifest only in systems where quantum coherence occurs at the mesoscopic and macroscopic scale. Sarfatti suggests that this post-quantum backactivity may be involved in various phenomena as follows:

Postulates

1. Life in general, and consciousness in particular, depends upon a backactivity-mediated feedback loop operating on macroscopic quantum structures in the cell. Roger Penrose[15] and Stuart Hameroff have suggested the microtubule as the site of this quantum system, but it may be elsewhere.

Life, through homeostasis, maintains the far-from-equilibrium quantum machinery necessary for its own existence. Rocks aren't alive because they have no structures which prevent thermal decoherence of the wave function.

There is, then, an élan vital*, and it consists of backactivity operating in macromolecular quantum systems assembled within the cell.*

2. Backactivity is the missing puzzle-piece needed to unify quantum mechanics and general relativity. Linear quantum mechanics operating in a background spacetime cannot possibly describe the effects of spacetime curvature due to mass-energy or curvature acting on itself. Macroscopic quantum systems employing backactivity may produce strong spacetime curvature or interactions with the zero-point vacuum energy not predicted by orthodox quantum mechanics or general relativity. Per item (1) above, a "macroscopic quantum system employing backactivity" is, necessarily, alive.

3. Development of a comprehensive and consistent post-quantum theory incorporating backactivity may, then, permit development of technologies impossible without such effects, for example:

- *Communication across spacelike-separated intervals.*
- *Faster-than-light travel with an Alcubierre-like "warp drive"[1] without the need for exotic, negative energy, matter.*
- *Access to the zero-point energy of the vacuum.*

If Haisch, Rueda, and Puthoff's suggestion[11] that interaction with the zero-point energy is the source of inertia (as opposed to the Mach/Einstein view that it is caused by the dragging of inertial frames by distant galaxies), then technologies employing backactivity might be able to modify inertia.

I don't know whether these suggestions are correct—nobody does at present, but there's nothing in any of them which seems inaccessible to experiment in the relatively near future. Let's assume calculations are done, predictions are made, experiments are performed, and the experimenters win the Nobel prize, shafting the theorists once again—that backactivity is shown to exist and indeed both accounts for life and permits the unification of quantum mechanics and general relativity.

https://ricochet.com/archives/saturday-night-science-flying-saucers-explained/

https://twitter.com/Fourmilab

[ix] *"Harold Joseph Morowitz (December 4, 1927 – March 22, 2016) was an American* biophysicist *who studied the application of* thermodynamics *to* living systems.[1][2] *Author of numerous books and articles, his work includes technical* monographs *as well as essays.*[3][4] *The* origin of life *was his primary research interest for more than fifty years.*[5] *He was the Robinson Professor of Biology and Natural Philosophy at* George Mason University *after a long career at Yale.*[6]

Some leading biophysicists have suggested that Morowitz may have discovered a "fourth law of thermodynamics" when, in 1968, he found that, "in steady-state systems, the flow of energy through the system from a source to a sink will lead to at least one cycle in the system."[10] *Eric D. Schneider, for example, says, "Morowitz's cycling theorem is the best candidate for a fourth law of thermodynamics."*[11]

The origin of life

Morowitz's book Energy Flow in Biology *laid out his central thesis that "the energy that flows through a system acts to organize that system,"*[12] *an insight later quoted on the inside front cover of The Last Whole Earth Catalog. He was a vigorous proponent of the view that life on earth emerged deterministically from the laws of chemistry and physics,*[13] *and so believed it highly probable that life exists widely in the universe.*[5][14]

https://en.wikipedia.org/wiki/Harold_J._Morowitz

Herbert Fröhlich (9 December 1905 – 23 January 1991) FRS[2] *was a German-born British physicist.*[4][5] *Fröhlich proposed a theory of coherent excitations in biological systems known as Fröhlich coherence. A system that attains this state of coherence is known as a Fröhlich condensate.*[10][11][12]

1. *Long Range Coherence and Energy Storage in Biological Systems – H. Frohlich, Long Range Coherence and Energy Storage in Biological Systems,* Int. J. Quantum Chem., *v.II, 641–649 (1968)*
2. *Jump up ^ Coherent Excitations in Biological Systems – Herbert Fröhlich and F. Kremer* Coherent Excitations in Biological Systems *(Springer-Verlag, 1983) ISBN 978-3-642-69186-7*
3. *Jump up ^ Biological Coherence and Response to External Stimuli – Herbert Fröhlich, editor* Biological Coherence and Response to External Stimuli *(Springer, 1988) ISBN 978-0-387-18739-6*

https://en.wikipedia.org/wiki/Herbert_Fröhlich

Viscount Ilya Romanovich Prigogine (/ˈpriːɡoʊʒiːn, -ɡoʊdʒiːn/; Russian: Илья Романович Пригожин, Ilya Romanovich Prigozhin;25 January [O.S. 12 January] 1917 – 28 May 2003) was a Belgian physical chemist and Nobel Laureate noted for his work on dissipative structures, complex systems, and irreversibility.

Prigogine is best known for his definition of dissipative structures and their role in thermodynamic systems far from equilibrium, a discovery that won him the Nobel Prize in Chemistry in 1977. In summary, Ilya Prigogine discovered that importation and dissipation of energy into chemical systems could reverse the maximization of entropy rule imposed by the second law of thermodynamics.[18]

Dissipative structures theory

Dissipative structure theory led to pioneering research in self-organizing systems, as well as philosophical inquiries into the formation of complexity on biological entities and the quest for a creative and irreversible role of time in the natural sciences. See the criticism by Joel Keizer and Ronald Fox.[19]

Prigogine's formal concept of self-organization was used also as a "complementary bridge" between General Systems Theory and thermodynamics, conciliating the cloudiness of some important systems theory concept with scientific rigour

https://en.wikipedia.org/wiki/Ilya_Prigogine

Philip Warren Anderson (born December 13, 1923) is an American physicist and Nobel laureate. Anderson has made contributions to the theories of localization, antiferromagnetism, symmetry breaking (including a paper in 1962 discussing symmetry breaking in particle physics, leading to the development of the Standard Model around 10 years later), and high-temperature superconductivity, and to the philosophy of science through his writings on emergent phenomena.[2][3][4][5][6]

Anderson has also made conceptual contributions to the philosophy of science through his explication of emergent phenomena. In 1972 he wrote an article called "More is Different" in which he emphasized the limitations of reductionism and the existence of hierarchical levels of science, each of which requires its own fundamental principles for advancement.[16]"

https://en.wikipedia.org/wiki/Philip_Warren_Anderson

[x] *"In physics, **quasiparticles** and **collective excitations** (which are closely related) are emergent phenomena that occur when a microscopically complicated system such as a solid behaves as if it contained different weakly interacting particles in free space. For example, as an electron travels through a semiconductor, its motion is disturbed in a complex way by its interactions with all of the other electrons and nuclei; however it approximately behaves like an electron with a different mass (effective mass) traveling unperturbed through free space. This "electron" with a*

different mass is called an "electron quasiparticle".[1] *In another example, the aggregate motion of electrons in the* valence band *of a* semiconductor *or a hole band in a metal*[2] *is the same as if the material instead contained positively charged quasiparticles called* holes*. Other quasiparticles or collective excitations include* phonons *(particles derived from the vibrations of atoms in solid),* plasmons *(particles derived from* plasma oscillations*), and many others.These particles are typically called "quasiparticles" if they are related to* fermions*, and called "collective excitations" if they are related to* bosons*,*[1] *although the precise distinction is not universally agreed upon.*[3] *Thus, electrons and* holes *are typically called "quasiparticles", while phonons and plasmons are typically called "collective excitations".The quasiparticle concept is most important in* condensed matter physics *since it is one of the few known ways of simplifying the* quantum mechanical many-body problem*."*https://en.m.wikipedia.org/wiki/Quasiparticle

[xi] https://tinyurl.com/y8n4ftea