

Tuesday, May 16, 2000

# Bye, Bye Schrodinger!

Haken's Synergetics and the Post-Quantum Physics of the Conscious AI<sup>1</sup> Biocomputer

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Twentieth Draft-Under Construction

*"One of the most striking features of any biological system is the enormous degree of coordination among its individual parts"*<sup>3</sup>

## Abstract

Schrodinger's linear quantum equation for simple inanimate systems in statistical ensembles is replaced by a more suitable class of nonlinear post-quantum equations for animate individual complex adaptive systems described by phase coherent complex order parameters, not in an ensemble. These intrinsically mental macroscopic coherent *order parameters*, governed by additional *post-quantum self-control parameters*, which are absent in quantum theory, exist in the sense of Haken's theory of self-organizing open systems far from thermal equilibrium, but extended by me to the realist nonstatistical paradigm first seen in the Bohm ontology. The motion of the "Bohm point", "hidden variable", excluded in the orthodox interpretations, appears explicitly as a convective flow term in the post-quantum equation of motion, and implicitly in the self-control parameters for the catastrophic unfolding of the order parameter landscapes in the sense of V.I. Arnold's<sup>4</sup> generalization of Rene Thom's theory. The post-quantum theory, in contrast to Bohm's deterministic "causal theory", is nonalgorithmically<sup>5</sup> self-determining beyond both determinism and indeterminism "tweaked by Darwinian natural selection pressures" in the sense of Stuart Kauffman's theory<sup>6</sup>. A more detailed physical model with a cosmic connection<sup>7</sup> for the Pribram-Bohm holographic mind-brain conjecture is presented.

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<sup>1</sup> Artificial Intelligence as in Commander Data in Star Trek, Hal 2000 in Kubrik's film and SPECTRA in Andrija Puharich's URI and recently Picknett's and Prince's "The Star Gate Conspiracy". Fact imitating fiction, or fiction pretending to be fact? Do not jump to premature conclusions half-cocked.

<sup>2</sup> Thanks to Saul-Paul Sirag for pointing out the connection of synergy to post-quantum theory.

<sup>3</sup> Hermann Haken, "Information and Self-Organization" p.23 (Springer-Verlag, 2000)

<sup>4</sup> "Topological Methods in Hydrodynamics"

<sup>5</sup> In the sense of Penrose, "The Emperor's New Mind" and "Shadows of the Mind"

<sup>6</sup> "At Home in the Universe"

<sup>7</sup> Our inner mental experience is driven by the large scale cosmological structure of the material universe.

## Preface

One must know what is a useful question to ask of any purported physical theory of [matter, mind and consciousness](#). Such useful questions include:

1. Is there a critical complexity for the generation of consciousness?<sup>8</sup>
2. What is its numerical value?<sup>9</sup>
3. What does it depend on?<sup>10</sup>
4. How does one compute the duration of a single moment of experience?<sup>11</sup>
5. What is that duration?<sup>12</sup>
6. How much power in watts is required for the brain to generate a conscious moment excitation of the mental field?<sup>13</sup>

All these questions are objective, and I have computed their answers given my proposed new laws of Nature. They agree with experiments and common observations and are very plausible.

Physical laws must be based on experimental and experiential evidence.

*"A physical law may be characterized by the statement that it 'might have been otherwise'."*<sup>14</sup>

In fact, it is not otherwise. All things are not possible! However, many more things are possible than are dreamt of in the philosophies of many respectable mainstream scientists to be sure. This is not an excuse for irrational "not even wrong"<sup>15</sup> anything goes "cargo cult"<sup>16</sup> pseudo-science either. Like Dante entering Inferno we need a Virgil to pilot us as we walk the perilous path between science and imagination. A physical law is a constraint on what is possible. A physical law is like God's Commandment to Moses<sup>17</sup> "Thou shalt not ...."

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<sup>8</sup> Yes

<sup>9</sup>  $N_c = 10^{18}$  qubits depending on the value of the Hubble flow parameter H.

<sup>10</sup>  $\left(\frac{e^2}{\hbar c}\right)\left(\frac{mc^2}{HN_c^2}\right) = 2\pi\hbar$  balances height of reaction barrier of matter on mind on the LHS against height of action barrier of mind on matter on the RHS per qubit part inside the collective q\*-bit whole.

<sup>11</sup>  $\tau_c = \frac{1}{HN_c}$

<sup>12</sup>  $\tau_c = \frac{4 \times 10^{17}}{0.7 \times 10^{18}} = 0.57 \text{ sec}$

<sup>13</sup> 5 milliwatts per Hertz of the conscious channel bandwidth. So, 0.57 sec is 1.75 Hertz, i.e. 8.75 milliwatts compared to total human body dissipation of order 100 watts.

<sup>14</sup> Marion, "Classical Mechanics" (1970, Academic Press)

<sup>15</sup> Wolfgang Pauli's term for skim milk masquerading as cream (Gilbert and Sullivan).

<sup>16</sup> Feynman's lecture on "Cargo Cult Science" at Cal Tech.

<sup>17</sup> Today we would say Moses was an ET contactee. ☺

"Thou shalt not violate conservation of energy, linear and angular momentum by internal forces and torques alone without external forces and torques."<sup>18</sup>

That is a physical law. Is it a true physical law under all conditions?<sup>19</sup> That is another issue for debate.

"Thou shalt not generate consciousness unless you achieve a coherent critical complexity of a billion billion electron qubits."

That is a physical law of the post-quantum theory. Is it a true physical law? That is another issue for debate.

*"Once a set of experimental data has been correlated and a postulate has been formulated regarding these phenomena to which the data refer, then various implications can be worked out."<sup>20</sup>*

What are the data?

1. Conscious moments last approximately 1 second that's why 1 second is the smallest unit on a clock. This is obvious.
2. The brain has about one hundred billion nerves. Each nerve has about ten million protein dimers<sup>21</sup> tiled around hollow nanotubes filled with water and electromagnetic fields. Each dimer contains a single-electron transistor quantum switch or quantum dot, a kind of artificial atom where the single electron finds itself in a double well potential. The separation between the minima is about 2 nanometers.
3. A Crick<sup>22</sup> near electric field of 40 Hz<sup>23</sup> that seems to act as a clock for the brain biocomputer.
4. The Hubble flow is now set at 13 billion years from Hubble Space Telescope data on the apparent red shifts of distant radiating objects.
5. The rest mass of the electron is a half million volts.
6. The coupling of the photon to the electron is 1/137.
7. Libet sees "temporal subjective antedating" in mind-brain experiments.

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<sup>18</sup> This would prohibit, in principle, many proposals for the NASA "Breakthrough Propulsion Project".

<sup>19</sup> Does the mechanical action-reaction principle here require central forces?

<sup>20</sup> Marion (1970) *ibid*.

<sup>21</sup> Shown in Hameroff's picture in this paper.

<sup>22</sup> Francis Crick, "The Astonishing Hypothesis"

<sup>23</sup> Post-quantum theory predicts  $10^{36}$  of these virtual longitudinally polarized near field photons in which the frequency/energy is decoupled from the wavenumber/momentum. This is a total field energy of only 6.3 Calories (i.e. large food calories).

8. Radin and Bierman see "presponse" in mind-brain experiments.
9. CIA, DIA et-al funded work in "remote-viewing" included transcending time and causality, seeing into the past and the future as well as the distant "present".<sup>24</sup>
10. Brain correlation experiments, described by Amit Goswami for example, show correlated EEG's in violation of the signal-locality AKA "passion at a distance" of quantum theory.
11. Flying saucers are real and have a superior technology of propellantless propulsion.<sup>25</sup>
12. Contact with Higher Advanced Intelligences is real and has been happening in all of recorded history.
13. Humans are being abducted, mostly against their will, by seemingly non-human creatures in flying saucers.<sup>26</sup>

Are all these facts just a random hodge-podge? Are they all really facts? Can they all be explained by a coherent interesting checkable story?

*"Once a set of experimental data has been correlated and a postulate has been formulated regarding the phenomena to which the data refer, then various implications can be worked out. If these implications are all verified by experiment, there is reason to believe that the postulate is generally true. The postulate then assumes the status of a physical law. If some experiments are found to be in disagreement with the predictions of the law, THEN THE THEORY MUST BE MODIFIED IN ORDER TO BE CONSISTENT WITH ALL KNOWN FACTS"*<sup>27</sup> including 7 -> 13 on the above list.

Now some of my post-quantum postulates include:

- I. H (Hubble) is the universal rate of consciousness generation per qubit.
- II. The de Broglie-Bohm pilot field is not only real, it is the mental field.
- III. Consciousness is generated in the mental field by the direct reaction of the matter it is piloting back on it.<sup>28</sup>

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<sup>24</sup> "Remote Viewers, The Secret History of America's Psychic Spies" by James Schnabel

<sup>25</sup> "Unconventional Flying Objects" by NASA pioneer Paul Hill.

<sup>26</sup> The research of Harvard psychiatrist, Pulitzer Prize Winner, John Mack, for USAF Intelligence.

<sup>27</sup> Caps not in original.

<sup>28</sup> By Bohm's theorem, amplified in Valentini's thesis under Sciama at Cambridge, this violates quantum randomness and signal-locality.

IV. In order for consciousness to be generated, the heights, in units of  $\hbar$ , of two barriers, one for action of mind on matter, the other for reaction of matter back on mind, must be equalized.

V. Coherent complexity i.e.,  $1/N^2$  factor, protected against environmental decoherence lowers the height of the reaction barrier relative to that of the action barrier.

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Let  $\Psi(x, t)$  be an "order parameter"<sup>29</sup>, where  $x$  is configuration space for a dynamical system<sup>30</sup>. The quantum many-particle<sup>31</sup> Schrodinger equation<sup>32</sup> is

$$i\hbar \frac{\partial}{\partial t} \Psi(x, t) = H \Psi(x, t) \quad (1.1)$$

Where the effective Hamiltonian<sup>33</sup> is

$$H = -\sum_{j=1}^N \frac{\hbar^2}{2m_j} \vec{\nabla}_j^2 + V_{eff}(\Psi) \quad (1.2)$$

Where  $V_{eff}(\Psi)$  is a functional of the order parameter. Therefore, we get a nonlinear effective semi-phenomenological Schrodinger equation

$$i\hbar \frac{\partial}{\partial t} \Psi(x, t) = \left( -\sum_{j=1}^N \frac{\hbar^2}{2m_j} \vec{\nabla}_j^2 + V_{eff}(\Psi) \right) \Psi(x, t) \quad (1.3)$$

The convective hydrodynamical time derivative operator for the flow of the *material* Bohm "hidden variable"<sup>34</sup> *piloted*<sup>35</sup> by its attached *mental* order parameter is

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<sup>29</sup> "at such an instability point, in general just a few collective modes become unstable and serve as 'order parameters' which describe the macroscopic pattern. At the same time these macroscopic variables, i.e. the order parameters, govern the behavior of the microscopic parts by the 'slaving principle'. In this way the occurrence of order parameters and their ability to enslave allows the system to find its own structure.

When control parameters are changed over a wide range, systems may run through a hierarchy of instabilities and accompanying structures." "Information and Self-Organization" (Springer, 2000) A synopsis of Haken's synergetics of non-equilibrium self-organization of open systems by order parameters near instabilities with hysteresis, critical point fluctuations and critical slowing is in Appendix A. A synopsis of Bohm's realist quantum ontology is in Appendix B.

<sup>30</sup> classical, quantum or post-quantum

<sup>31</sup> There are  $N$  point particles in this model.

<sup>32</sup> Galilean relativity, special relativity is not important in the physics of consciousness in most cases.

<sup>33</sup> semi-phenomenological with order parameters like Feynman's treatment of superconductors in Vol III of "Lectures in Physics" for the "macroscopic wave function" of a thermal equilibrium Bose-Einstein condensation of the centers of mass motions of a large number of Einstein-Podolsky-Rosen nonlocally pair-correlated electrons bound by the Frohlich-Bardeen-Cooper-Shrieffer (BCS) electron-phonon coupling. A similar effect can happen in the quantum vacuum with virtual electron-positron pairs. The total charge of a real BCS pair is  $2e$ , the total charge of a virtual vacuum pair is 0. However, a near electric field in the vacuum will generate a nonvanishing virtual electric current because both charge and velocity flip for the positron.

$$\frac{d}{dt} = \frac{\partial}{\partial t} + \sum_{j=1}^N \frac{d\vec{X}_j}{dt} \cdot \vec{\nabla}_j \quad (1.4)$$

where  $\vec{X}_j$  is the actual position in space of the  $j^{\text{th}}$  component of the "Bohm point" <sup>36</sup>  $\vec{X}$  in configuration space. Therefore,

$$\frac{d}{dt} \Psi = \frac{\partial}{\partial t} \Psi + \sum_{j=1}^N \frac{d\vec{X}_j}{dt} \cdot \vec{\nabla}_j \Psi \quad (1.5)^{37}$$

Substitute (1.3) into (1.5) to get

$$\frac{d}{dt} \Psi = \frac{1}{i\hbar} \left( -\sum_{j=1}^N \frac{\hbar^2}{2m_j} \vec{\nabla}_j^2 + V_{\text{eff}}(\Psi) \right) \Psi(x, t) + \sum_{j=1}^N \frac{d\vec{X}_j}{dt} \cdot \vec{\nabla}_j \Psi \quad (1.6)$$

The De Broglie-Bohm pilot equation, notably absent in Bohr-type idealist interpretations, is<sup>38</sup>

$$\frac{d\vec{X}_j}{dt} = \frac{\hbar}{m_j} \text{Im} \frac{\vec{\nabla}_j \Psi}{\Psi} = \frac{1}{m_j} \vec{\nabla}_j S \quad (1.7)$$

Substitute (1.7) in (1.6) to get our basic replacement<sup>39</sup> for the Schrodinger equation for complex quantum systems in the Bohmian ontology combined with Haken's synergetics of self-organizing non-equilibrium open systems.

<sup>34</sup> The billion billion hydrophobically caged electron qubit's positions in their double well potentials that can perhaps be single well at a different self-control parameter?

<sup>35</sup> This explains how thought moves matter. One must also explain how matter reacts back on thought. This change in thought induced by matter is consciousness. Consciousness is not possible in quantum theory. It is a post-quantum effect.

<sup>36</sup> Henry Stapp's term for Bohm's not too "hidden variable" in the realist DeBroglie-Schrodinger-Einstein-Bohm-Vigier tradition opposing the idealism of Bohr-Heisenberg-von Neumann-London-Wigner-Wheeler-Stapp-Penrose-Goswami-Herbert-EHW ...from the still raging "Einstein-Bohr debate". Fred Alan Wolf has recently rejected "collapse" favoring David Deutsch's "many-worlds" and David Albert's "photographs of other worlds" as a way to getting to the strange loop of post-quantum self-control absent in quantum physics which only has external control parameters - no self-control parameters. Neither Fred or I understand Amit Goswami's collapse argument to get the strange loop or, Henry Stapp's attempt to explain intention as collapse.

<sup>37</sup> Note that the equation for the  $\Psi$  landscape explicitly depends on the velocity  $d\vec{X}/dt$  of the material through its configuration space. This is a post-quantum reaction direct feedback term from the convection.

<sup>38</sup> Eq (9) p. 24 "Bohmian Mechanics as the Foundation of Quantum Mechanics" by D. Durr, S. Goldstein & N. Zanghi in Boston Studies in the Philosophy of Science, Vol 184 (Kluwer, 1996)

$$\frac{d}{dt} \Psi = \frac{1}{i\hbar} \left( -\sum_{j=1}^N \frac{\hbar^2}{2m_j} \bar{\nabla}_j^2 + V_{\text{eff}}(\Psi) \right) \Psi(x,t) + \sum_{j=1}^N \frac{\hbar}{m_j} \text{Im} \frac{\bar{\nabla}_j \Psi}{\Psi} \cdot \bar{\nabla}_j \Psi \quad (1.8)$$

In the standard Bohm deterministic "causal theory" splitting the complex Schrodinger equation into two real equations using the polar form of the wave function gives a Hamilton-Jacobi equation with a new non-mechanical nonlocal form-dependent/intensity-independent quantum potential added to the classical potential. The second equation is a hydrodynamic continuity equation of local current conservation in configuration space provided there is zero reaction of the Bohm point on its pilot field. We will see if we can regain modified versions of these two equations in the models we study below. First, I will use an inelegant brute force method made possible by the wonders of Math Text which enable us to do complex algebraic substitutions with much less chance of error.

Example 1<sup>40</sup>

$$V_{\text{eff}}(\Psi) = -\frac{\alpha(X)}{2} |\Psi|^2 + \frac{\beta(X)}{4} |\Psi|^4 \quad (1.9)$$

Note that the self-control parameters  $\alpha(X), \beta(X)$  depend on the actual position of the material configuration (AKA "Bohm point")  $X$  forming a "two-way relation"<sup>41</sup> between it and the mental pilot field  $\Psi(x,t)|_{x=X}$ . Substitute (1.9) in (1.8)

$$\frac{d}{dt} \Psi = \frac{1}{i\hbar} \left( -\sum_{j=1}^N \frac{\hbar^2}{2m_j} \bar{\nabla}_j^2 \Psi - \frac{\alpha(X)}{2} |\Psi|^2 \Psi + \frac{\beta(X)}{4} |\Psi|^4 \Psi \right) + \sum_{j=1}^N \frac{\hbar}{m_j} \text{Im} \frac{\bar{\nabla}_j \Psi}{\Psi} \cdot \bar{\nabla}_j \Psi \quad (1.10)$$

Substitute the polar form of the complex valued order parameter

$$\Psi = R e^{iS/\hbar} \quad (1.11)$$

$$R = |\Psi| \quad (1.12)$$

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<sup>39</sup> This is not merely an empty formal tautology equivalent to the old Schrodinger equation because of the guidance condition (1.7) explicitly bringing in a new "hidden variable" not found in all the other interpretations.

<sup>40</sup> This is like the Landau-Ginzburg model of Type II superconductivity with vortices with quantized magnetic flux  $h/2e = 10^{-7}$  Gauss cm<sup>2</sup>, also spontaneous symmetry breaking in simple Higgs mechanism for generation of rest mass of lepto-quarks in standard model, and like the Jahn-Teller crystal distortion effect.

<sup>41</sup> Bohm and Hiley's term.

$$\begin{aligned} V_{\text{eff}}(\Psi) &= -\frac{\alpha(X)}{2}R^2 + \frac{\beta(X)}{4}R^4 \\ &= -\frac{\alpha(X)}{2}\rho + \frac{\beta(X)}{4}\rho^2 \end{aligned} \quad (1.13)$$

$$\frac{d}{dt}\Psi = \frac{d}{dt}\text{Re}e^{iS/\hbar} = \frac{dR}{dt}e^{iS/\hbar} + \frac{i}{\hbar}R\frac{dS}{dt}e^{iS/\hbar} \quad (1.14)$$

Similarly,

$$\vec{\nabla}_j\Psi = (\vec{\nabla}_jR)e^{iS/\hbar} + iR(\vec{\nabla}_jS/\hbar)e^{iS/\hbar} \quad (1.15)$$

$$\vec{\nabla}_j^2\Psi = (\vec{\nabla}_j^2R)e^{iS/\hbar} + 2i(\vec{\nabla}_jR)\cdot(\vec{\nabla}_jS/\hbar)e^{iS/\hbar} + iR(\vec{\nabla}_j^2S/\hbar)e^{iS/\hbar} - R(\vec{\nabla}_jS/\hbar)^2e^{iS/\hbar} \quad (1.16)$$

$$\begin{aligned} -\sum_{j=1}^N \frac{\hbar^2}{2m_j}\vec{\nabla}_j^2\Psi = \\ -\sum_{j=1}^N \frac{\hbar^2}{2m_j} \left[ (\vec{\nabla}_j^2R)e^{iS/\hbar} + 2i(\vec{\nabla}_jR)\cdot(\vec{\nabla}_jS/\hbar)e^{iS/\hbar} + iR(\vec{\nabla}_j^2S/\hbar)e^{iS/\hbar} - R(\vec{\nabla}_jS/\hbar)^2e^{iS/\hbar} \right] \end{aligned} \quad (1.17)$$

And

$$\begin{aligned} \sum_{j=1}^N \frac{\hbar}{m_j} \text{Im} \left( \frac{\vec{\nabla}_j\Psi}{\Psi} \right) \cdot \vec{\nabla}_j\Psi &= \sum_{j=1}^N \frac{\hbar}{m_j} \frac{\vec{\nabla}_jS}{\hbar} \cdot \vec{\nabla}_j\Psi \\ &= \sum_{j=1}^N \frac{\vec{\nabla}_jS}{m_j} \cdot \left[ (\vec{\nabla}_jR)e^{iS/\hbar} + iR(\vec{\nabla}_jS/\hbar)e^{iS/\hbar} \right] \end{aligned} \quad (1.18)$$

$$\sum_{j=1}^N \frac{\vec{\nabla}_jS}{m_j} \cdot \vec{\nabla}_j\Psi = \sum_{j=1}^N \frac{\vec{\nabla}_jS}{m_j} \cdot \left[ (\vec{\nabla}_jR)e^{iS/\hbar} + iR(\vec{\nabla}_jS/\hbar)e^{iS/\hbar} \right] \quad (1.19)$$

We have two real order parameters R and S coupled together. All terms have a common factor of  $e^{iS/\hbar}$  that cancels out. Split the complex nonlinear partial differential equation (1.10) post-quantum semi-phenomenological model-dependent provisional replacement<sup>42</sup> of the quantum Schrodinger equation into its real and imaginary parts to get, first for the real part:

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<sup>42</sup> It has a total convective time derivative rather than a partial time derivative because we follow the flow of the material Bohm point piloted by its mental quantum information field in configuration space. This is a really new very different physical picture than in the several orthodox interpretations of quantum theory. Bohm, strangely enough, did not appear to consider this? I cannot find it in the Bohmian literature.

$$\frac{dR}{dt} = -\frac{1}{\hbar} \sum_{j=1}^N \frac{\hbar^2}{2m_j} \left[ +2\vec{\nabla}_j R \cdot \vec{\nabla}_j S / \hbar + R (\vec{\nabla}_j^2 S / \hbar) \right] + \sum_{j=1}^N \frac{1}{m_j} \vec{\nabla}_j S \cdot \vec{\nabla}_j R \quad (1.20)$$

$$\frac{dR}{dt} = -\sum_{j=1}^N \frac{1}{2m_j} \left[ +2\vec{\nabla}_j R \cdot \vec{\nabla}_j S + R \vec{\nabla}_j^2 S \right] + \sum_{j=1}^N \frac{1}{m_j} \vec{\nabla}_j R \cdot \vec{\nabla}_j S \quad (1.21)$$

$$\frac{dR}{dt} = -\sum_{j=1}^N \frac{1}{m_j} \left[ \vec{\nabla}_j R \cdot \vec{\nabla}_j S + \frac{1}{2} R \vec{\nabla}_j^2 S \right] + \sum_{j=1}^N \frac{1}{m_j} \vec{\nabla}_j R \cdot \vec{\nabla}_j S \quad (1.22)$$

$$\frac{dR}{dt} = -\sum_{j=1}^N \frac{1}{2m_j} R \vec{\nabla}_j^2 S \quad (1.23)$$

Note the cancellation of terms.

$$\frac{dR}{dt} + \sum_{j=1}^N \frac{1}{2m_j} R \vec{\nabla}_j^2 S = 0 \quad (1.24)$$

This corresponds to the convective post-quantum generalization of the orthodox Bohmian current continuity equation if we multiply by a common factor of  $2R$

$$2R \frac{dR}{dt} + \sum_{j=1}^N \frac{1}{m_j} R^2 \vec{\nabla}_j^2 S = 0 \quad (1.25)$$

$$\frac{d}{dt} R^2 = 2R \frac{dR}{dt} = \frac{d\rho}{dt} \quad (1.26)$$

$$\frac{d\rho}{dt} + \sum_{j=1}^N \frac{1}{m_j} \rho \vec{\nabla}_j^2 S = 0 \quad (1.27)$$

From (1.7)

$$\frac{d\rho}{dt} + \sum_{j=1}^N \rho \vec{\nabla}_j \cdot \frac{d\vec{X}_j}{dt} = 0 \quad (1.28)$$

This is exact convective current conservation following the flow of the material Bohm point through its configuration space beyond ordinary 3D space. However, if you look at a fixed point with the partial time derivative it looks as if current is not conserved! This shows the necessity of the Bohm point compared to orthodox formulations of quantum theory. From the older point of view, there appears to be a new post-quantum "convective" term on the RHS of (1.6). It is proportional to the "speed" of the Bohm

point, so it resembles a kind of "friction" in the configuration space of matter and spacetime vacuum geometry (with nonholonomic plastic torsion<sup>43</sup> as well as holonomic elastic curvature) that can be either positive or negative.

The generalized post-quantum Hamilton-Jacobi equation corresponding to Newton's second law of motion is from the imaginary part of (1.10), i.e.,

$$\frac{dS}{dt} = \left[ \sum_{j=1}^N \frac{1}{2m_j} \left( (\bar{\nabla}_j S)^2 - \frac{\hbar^2 (\bar{\nabla}_j^2 R)}{R} \right) \right] - \frac{\alpha(X)}{2} R^2 + \frac{\beta(X)}{4} R^4 + \sum_{j=1}^N \frac{(\bar{\nabla}_j S)^2}{m_j} \quad (1.29)$$

Note that all the terms in this post-Bohmian Hamilton-Jacobi equation have the dimensions of energy. The last term on the RHS of (1.29) is a non-Bohmian convective term and it adds to a similar Bohmian term to get the term with coefficient 3/2.

$$\frac{dS}{dt} = \left[ \sum_{j=1}^N \frac{3}{2m_j} \left( (\bar{\nabla}_j S)^2 - \frac{\hbar^2 (\bar{\nabla}_j^2 R)}{R} \right) \right] - \frac{\alpha(X)}{2} R^2 + \frac{\beta(X)}{4} R^4 \quad (1.30)$$

Let's stop for a moment from these formal algebraic transformations to look at the Big Picture qualitatively. One starts with an initial position  $\bar{X}(0)$  of the material Bohm point in configuration space beyond ordinary 3D space. We then use the guidance constraint (1.7) to attempt to map out a flow field in which this particular trajectory is imbedded. However, the *self-control parameters* for the flow field landscape depends upon this particular trajectory in a two-way relationship of action and reaction forming the self-determining co-evolution of both the trajectory and the flow landscape. One also introduces a stochastic environmental pumping term, as in Haken's synergetics, to model the "tweaking" of the self-organizing co-evolution by environmental Darwinian natural selection pressures. That is the nonalgorithmic program we are pursuing.

Fourier transform (1.24)

$$\begin{aligned} \frac{dR}{dt} + \sum_{j=1}^N \frac{1}{2m_j} R \bar{\nabla}_j^2 S &= 0 \\ \omega \tilde{R}_{\vec{k}, \omega} + \sum_{j=1}^N \frac{1}{2m_j} \iint dk'_j d\omega' \tilde{R}_{\vec{k}_j, \omega'} (\vec{k}_j - \vec{k}'_j)^2 \tilde{S}_{\vec{k}_j - \vec{k}'_j, \omega - \omega'} &= 0 \end{aligned} \quad (1.31)$$

I use the convolution theorem that the Fourier integral of a product of two functions is the convolution integral of the Fourier integrals of the factor functions. Wave vector and

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<sup>43</sup> Perhaps significantly modifying the Haisch, Rueda, Puthoff ZPF "origin of inertia" SED model as well as Puthoff's "vacuum polarization" model of general relativity, and also Modanese's approach to propellantless propulsion from rotating superconductors that excludes torsion effects as studied by Shipov and Corum.

frequency indices without the j subscripts denote the full configuration space set. When a j subscript appears it is understood that the other components  $l \neq j$  are still there passively. With Bose-Einstein condensation, or its nonequilibrium Frohlich mode analog, the dominant macroscopic quantum phase "superfluid" component reduces to a problem in ordinary 3D space rather than configuration space.

Fourier transform (1.30)

$$\begin{aligned} \frac{dS}{dt} &= \left[ \sum_{j=1}^N \frac{3}{2m_j} \left( (\bar{\nabla}_j S)^2 - \frac{\hbar^2 (\bar{\nabla}_j^2 R)}{R} \right) \right] - \frac{\alpha(X)}{2} R^2 + \frac{\beta(X)}{4} R^4 \\ \omega \tilde{S}_{\vec{k}, \omega} &= \sum_{j=1}^N \frac{3}{2m_j} \iint dk' d\omega' \left( \vec{k}_j \tilde{S}_{\vec{k}_j, \omega} \right) \left( (\vec{k}_j - \vec{k}') \tilde{S}_{\vec{k}_j - \vec{k}', \omega - \omega'} \right) + \dots \end{aligned} \quad (1.32)$$

Which gets very complicated with multiple convolution integrations and is clearly not particularly enlightening. Therefore, attempting to solve this set of coupled nonlinear partial differential equations by Fourier integrals is not a smart way to go. So this was a false start in our search strategy.

*"In a contemplative fashion, and a tranquil frame of mind. Free from every kind of passion, some solution we must find. Quiet calm deliberation disentangles every knot."*

■ Gondoliers, Gilbert & Sullivan

Go back to (1.13) and look at the critical points for this effective potential in order parameter space.

$$\frac{d}{dR} \left( V_{\text{eff}}(\Psi) = -\frac{\alpha(X)}{2} R^2 + \frac{\beta(X)}{4} R^4 \right) = 0 \quad (1.33)$$

$$\frac{d}{dR} V_{\text{eff}}(\Psi) = -\alpha(X)R + \beta(X)R^3 = 0 \quad (1.34)$$

One root is  $R = 0$ , the other two roots are

$$R_c^2 = \frac{\alpha(X)}{\beta(X)} \equiv f(X) \left\{ \left( \frac{N^2 H h}{e^2 m c^2} \right) - 1 \right\} \quad (1.35)$$

$$R_c = \pm \sqrt{\frac{\alpha(X)}{\beta(X)}} = \pm \sqrt{\left\{ f(X) \left( \frac{N^2 H h}{\frac{e^2}{\hbar c} m c^2} \right) - 1 \right\}} \quad (1.36)^i$$

Note that  $Hh/\frac{e^2}{\hbar c} m c^2 = 10^{-36}$ , also  $R = |\Psi|$  must be positive. So we interpret the negative root as a phase shift of  $\pi$  added on to the phase  $S$  of the complex order parameter  $\Psi$ . If we imagine varying the phase  $S$  from 0 to  $2\pi$  we get the *Mexican Hat Potential* in the complex plane familiar in simple models of degenerate vacua in spontaneous broken symmetry giving gapless *Goldstone modes*<sup>44</sup> that get "eaten" in the simple *Higg's model* for the *origin of inertia* of the *lepto-quarks* in the *standard model*.<sup>45</sup>

We need to examine the second derivative at the critical point.

$$\frac{d^2}{dR^2} V_{\text{eff}}(\Psi) = -\alpha(X) + 3\beta(X)R^2 \quad (1.37)$$

First note that when  $\alpha(X) < 0$  the two non-zero roots are imaginary. Therefore, the potential is a single well whose minimum is the root  $R = 0$ , where the second derivative (1.38) is positive. The *bifurcation point*<sup>46</sup> is at  $\alpha(X) = 0$  where the potential flattens out. This is a *critical point phase transition* with *critical slowing down* and *large fluctuations* from a stochastic *Darwinian natural selection pressure* represented by the random forcing "tweaking"<sup>47</sup> function  $F(t)$ . When  $\alpha(X) > 0$  we now have a double well potential. Substitute (1.36) in (1.38)

$$\frac{d^2}{dR^2} V_{\text{eff}}(\Psi) = -\alpha(X) + 3\beta(X) \frac{\alpha(X)}{\beta(X)} = 2\alpha(X) > 0 \quad (1.38)$$

Again giving positive second derivatives showing the two minima of the double well potential. Note that each caged electron qubit in Hameroff's picture below has an effective potential very similar to this toy model. The spin of the electron is not included in this model though it may be another valuable information resource.<sup>48</sup>

Now substitute (1.7) into (1.30)

<sup>44</sup> Assuming no long range static near field Coulomb potentials

<sup>45</sup> Similar math is in the Jahn-Teller effect shown in my paper with A.M.Stoneham (UKAEA, Harwell) Proceedings of the Physical Society of London, 1966 (or 67)?

<sup>46</sup> Plot  $\alpha(X)$  on the horizontal and  $R(X)$  on the vertical to get a bifurcation "fiber" attached to each base point  $X(t)$  for the path of the actual Bohm point in configuration space.

<sup>47</sup> Stuart Kaufmann "At Home in the Universe"

<sup>48</sup> Specifically nonlocal spin-spin correlations as well as local spin-orbit couplings.

$$\begin{aligned}
E(X) &= \\
&= \left[ \sum_{j=1}^N \left( \frac{m_j}{2} \left( \frac{d\vec{X}_j}{dt} \right)^2 - \frac{1}{2m_j} \frac{\hbar^2 (\vec{\nabla}_j^2 R(X))}{R(X)} \right) \right] - \frac{\alpha(X)}{6} R(X)^2 + \frac{\beta(X)}{12} R(X)^4 - \frac{1}{3} \frac{dS(X)}{dt} \quad (1.39) \\
&= 0
\end{aligned}$$

to define the constraint of vanishing total nonlocal energy  $E(X)$ , not in ordinary 3D space, in general, but in higher dimensional configuration space beyond it! Remember that  $X \equiv \vec{X}(t) = [\vec{X}_1(t), \vec{X}_2(t), \dots, \vec{X}_N(t)]$  is the path of the material Bohm point through configuration space coevolving in a strange loop of self-creation with its common shared pool of active quantum information given by the R and S order parameters in contact with it in configuration space. This implies an effective instantaneous synchronized motion of the spatially separated point particles as is common in living matter.<sup>49</sup> The first term on the RHS is the total kinetic energy, the second term is the Bohm quantum potential Q, the third and fourth terms are additional nonlinear terms, and the last term is the total time derivative of the action phase S with dimensions of energy.

The above simple analysis leading to the Mexican Hat potential for the order parameter mental landscape needs to be modified for the motion of the material Bohm point X whose effective potential  $U(X)$  is

$$U(X) = -\frac{1}{2m_j} \frac{\hbar^2 (\vec{\nabla}_j^2 R(X))}{R(X)} - \frac{\alpha(X)}{6} R(X)^2 + \frac{\beta(X)}{12} R(X)^4 \quad (1.40)$$

In general, including the Darwinian stochastic environmental inputs that "tweak" the self-organizing process in adaptive coevolution between mind and matter open to the environment far from thermal equilibrium

$$\frac{1}{3} \frac{dS(X)}{dt} = KE + U(X) + F(t) \quad (1.41)$$

We then have an illusory formal solution<sup>50</sup> for the motion of the material Bohm point

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<sup>49</sup> "the emergence of meaning .... self-creation of meaning ... One of the most striking features of any biological system is the enormous degree of coordination among its individual parts." Haken

<sup>50</sup> For equal mass point particles and for steady state  $\frac{dS(X)}{dt} = 0$ , i.e. sitting on the wave front that the moving Bohm point is deBroglie phase-locked to. This is analogous to D'Alembert's Principle in classical mechanics where the inertial force is in equilibrium with the applied force that effectively reduces motion to statics when we renounce the local inertial frame for a local non-inertial frame comoving with the accelerating particle. In the present case, the particle is piloted by the wave in the de Broglie phase lock where  $\hbar v = mc^2$ . Haisch and Rueda recently derived this aspect in their SED ZPF "origin of inertia".

$$\left(\frac{d\bar{X}}{dt}\right)^2 = \frac{1}{m^2} \left( \frac{\hbar^2 (\bar{\nabla}^2 R(X))}{R(X)} \right) + \frac{\alpha(X)}{12m} R(X)^2 - \frac{\beta(X)}{24m} R(X)^4 \quad (1.42)$$

$$\frac{dX}{\sqrt{\frac{1}{m^2} \left( \frac{\hbar^2 (\bar{\nabla}^2 R(X))}{R(X)} \right) + \frac{\alpha(X)}{12m} R(X)^2 - \frac{\beta(X)}{24m} R(X)^4}} = dt \quad (1.43)$$

$$t(X) = \int \frac{dX}{\sqrt{\frac{1}{m^2} \left( \frac{\hbar^2 (\bar{\nabla}^2 R(X))}{R(X)} \right) + \frac{\alpha(X)}{12m} R(X)^2 - \frac{\beta(X)}{24m} R(X)^4}} \quad (1.44)$$

I say "illusory" because the specifically *post-quantum self-control parameters* are not yet specified. The real theory is nonalgorithmic. The self-control parameters will also need direct tweaking from contingent stochastic environmental fluctuations.

#### Bose-Einstein Condensation, Frohlich Modes and Phased Qubit Arrays

Bose-Einstein condensation of N integer spin particles into the same single-particle quantum wave function  $\zeta(\vec{r}, t)$ <sup>51</sup> is a thermal equilibrium phenomenon caused by conservation of total particle number and the symmetrized N particle wave function in configuration space. The pumped Frohlich modes of electric dipoles in biological membranes is a nonequilibrium analog. In this case the order parameter in configuration space splits into a "superfluid"<sup>52</sup> and a "normal fluid" part

$$\Psi(\bar{X}, t) = \zeta(\vec{r}_1, t) \zeta(\vec{r}_2, t) \dots \zeta(\vec{r}_N, t) + \hat{\Psi}(\bar{X}, t) \quad (1.45)$$

$\zeta$  is a complex function<sup>53</sup> with an amplitude and phase

$$\zeta(\vec{r}_j, t) = |\zeta(\vec{r}_j, t)| e^{i\theta(\vec{r}_j, t)} \quad (1.46)$$

That is, substitute (1.33) into (1.32) to get the mental hologram part of the pilot field of the material brain in ordinary 3D space. The holographic information is encoded in the real phase  $\theta(\vec{r}_j, t)$  field. There is a kind of relative phase rigidity or coherence across space at any fixed moment of time.<sup>54</sup> In contrast, the relative phases for normal fluid

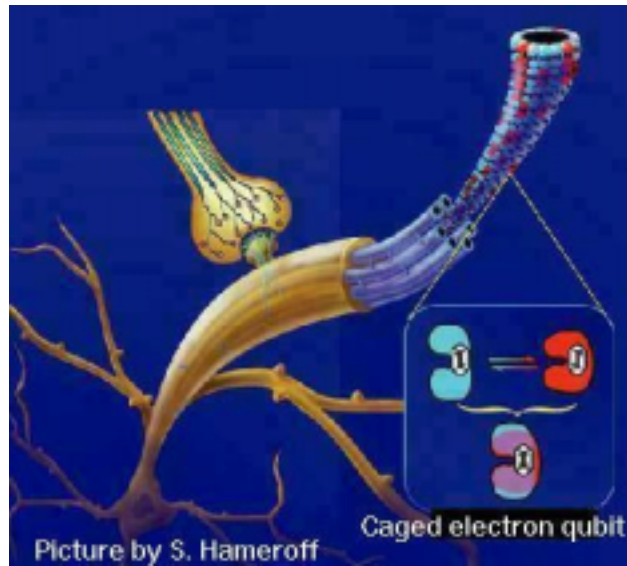
<sup>51</sup>  $\vec{r}$  is the 3-vector of position of a point particle in ordinary 3D space.

<sup>52</sup> Oliver Penrose's "ODLRO" (an older relative of Roger's).

<sup>53</sup> See also Haken's "slaving principle" with "circular causality" in Appendix A.

<sup>54</sup> Remember Galilean relativity with absolute time is a good approximation since  $v/c \ll 1$ .

particle wave functions are random. This is the basis for the "random phase approximation" or "RPA". This is the intuitive "informal" word-picture. Formally,<sup>55</sup> one forms a reduced one-particle "density matrix"  $\rho_1(\vec{r}_1 - \vec{r}_2, t)$ .<sup>56</sup> The RPA means that  $\rho_1(\vec{r}_1 - \vec{r}_2, t)$  decays rapidly to zero beyond a small coherence length. The coherence length is macroscopically large in the superfluid or superconductor in thermal equilibrium and for the non-equilibrium pumped Frohlich modes of the caged electron oscillators as shown in Hameroff's picture



## Appendix A

### Synopsis of Synergetics

*"the behavior of complex systems may, close to their instability points, be governed by very few variables, namely the order parameters."* H. Haken, "Principles of Brain Functioning" (Springer, 1996)

R and S are two such real order parameters coupled together in equations (1.25) and (1.30) which together with the set of guidance equations for the material particles form a coupled dynamical system in the configuration space of the N point particles in that toy model. That is, the N particles and the R and S fields are all of equal ontological status. There is no statistical Ansatz here. The N particles are not independent members of an ensemble, but are all tightly nonlocally connected together by the real R and S fields as well as by any classical forces that I ignore in this toy model.

*"To describe the behavior of such an order parameter below and above the instability point of a system, a mechanical model has proved to be very useful... We identify the size of the order parameter with the coordinate of a ball that slides down a hill toward the*

<sup>55</sup> Oliver Penrose

<sup>56</sup> for a homogeneous medium

*bottom of a valley ... the speed with which the particle moves is proportional to the size of the slope ... Typical order parameters are subject to fluctuations"*

These are the Darwinian natural selection pressures of the environment that "tweaks" the self-organizing system of the two coupled mental fields R, S and the material Bohm point X in higher dimensional configuration space. The speed  $dX/dt$  of the material Bohm point X is directly proportional to the slope of the S field as a function of configuration space. That is a mapping of points in configuration space to the real line. But the time evolution of S is coupled to the time evolution of R and to the motion of X. In fact all three physical objects, the two mental fields and the material Bohm point "hidden variable", eschewed in all other interpretations of quantum theory, all couple together strongly and co-evolve subject to Darwinian stochastic selection fluctuations that can trigger Thom-Arnold catastrophe-singularities. Only the Bohm ontology fits into this picture naturally! This is the decisive advantage. All other interpretations of quantum theory are impotent and obsolete and are here over thrown as conceptual explanations of Nature, though they are still useful as algorithms for pragmatic computations, e.g. Feynman diagrams. I would not attempt to compute a scattering cross section with Bohmian mechanics, but I use Bohmian mechanics to get a better intuitive picture of the meaning of the cross section or a transition rate for the decay of a nucleus.

*"If the control parameter is changed so that it reaches its critical size, where the instability sets in, the landscape is deformed ... The valley becomes very flat. When the ball is now displaced from the origin, because the driving force is practically zero, it will take a very long time for the ball to relax to the equilibrium point ... This phenomenon is called critical slowing down ... the ball is still subject to fluctuations and the restoring force is very small ... Thus the ball ... displays large fluctuations ... critical fluctuations ... Finally, when the control parameter is set to a value above its critical point, the landscape is qualitatively deformed, and instead of one former valley, two valleys appear .... We are therefore speaking of symmetry breaking instability ... we are dealing with systems far from [thermodynamic] equilibrium .... one speaks of the phenomena of bifurcation" pp. 52-53 plotting the order parameter directly as a function of its control parameter(s).*

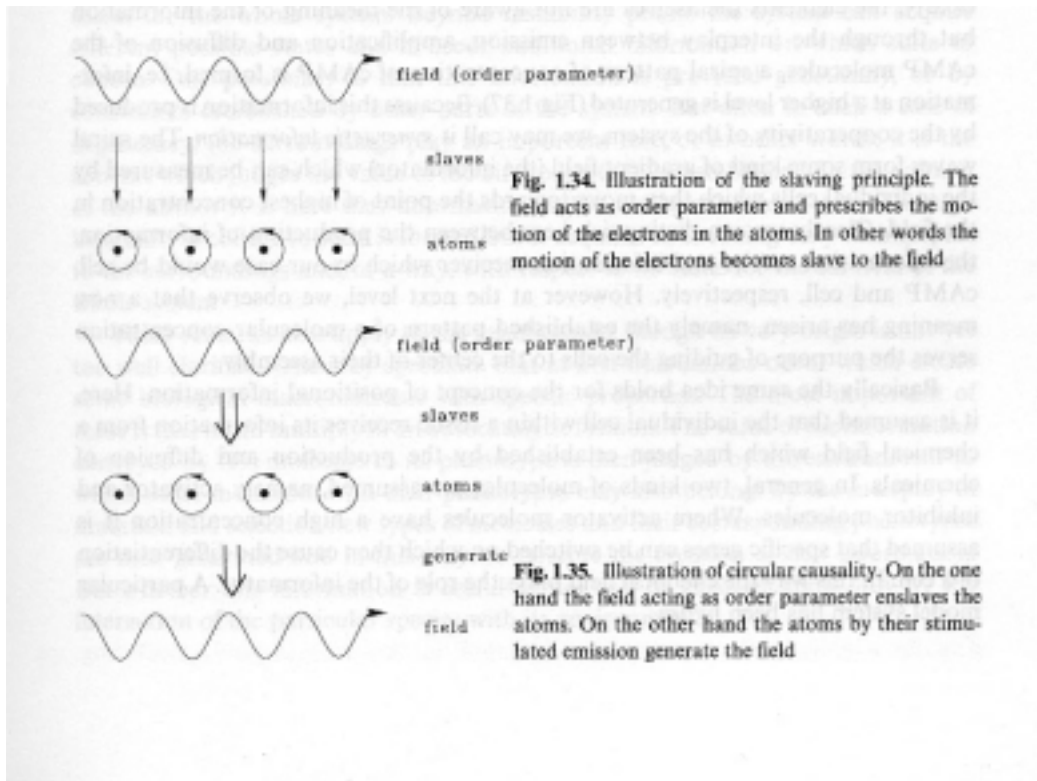
*"The Laser Paradigm or Boats on a Lake ... stimulated emission ... a light avalanche ... different kinds of light waves ... may tend to either grow or decay. A competition between growing waves sets in and is, eventually won by one of them. The amplitude of this wave is the order parameter ... the slaving principle, the order parameter(s) enslave the individual parts; in the present case the individual parts are the gas atoms"*

In the case of Bohm's ontology the order parameter is the quantum informational pilot wave and the individual parts are the actual particles, or "hidden variables"<sup>57</sup>, piloted by it. This picture is unthinkable in all the other interpretations of quantum theory's real meaning.

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<sup>57</sup> The hidden variable may also be a classical electromagnetic or geometrodynamical or torsion field configuration, it need not be only a set of localized mass points with charge.

"Consider a lake on which boats are floating. An electric field may be put in analogy to a water wave and the individual electrons to the boats. When the water wave propagates across the lake, the boats will be pulled up and down according to the wave. Similarly, electrons move according to the oscillations of the electric field strength. This is the *slaving principle* in action.<sup>58</sup> Under the influence of the electric field, the electron starts an oscillation. On the other hand, it is known from electrodynamics that oscillating charges... generate an electric field. Again we find the *circular causality principle*."



Note, Haken is giving a purely classical example, which carries over to the Bohm ontology dualism between the pilot wave and its particle. Bohm's theorem is that quantum randomness requires a breakdown of this circular causality principle<sup>59</sup> between the pilot wave and the particle it pilots.

"We may describe a standing wave on the lake in the form

$$q(z,t) = \xi(t) \sin(2\pi z/\lambda) \tag{1.47}$$

The amplitude  $\xi(t)$  plays the role of the order parameter. Since the wave goes up and down,  $\xi(t)$  depends on time in an oscillatory fashion

<sup>58</sup> and reaction I add.

<sup>59</sup> AKA "action-reaction principle", or "back-action" or "back-reaction" principle.

$$\xi(t) = a \sin(\omega t) \quad (1.48)$$

... Let us consider a boat at position  $z_j$  ... We denote its displacement along the vertical axis at time  $t$  by  $q(z_j, t)$  ...

$$q(z_j, t) = \xi(t) \sin(2\pi z_j / \lambda) \quad (1.49)$$

The variable of the enslaved system, namely the boat with number  $j$ , depends on the size of the order parameter,  $\xi(t)$ , at the same time. In addition, the factor  $\sin(2\pi z_j / \lambda)$  occurs and establishes a specific link between the order parameter  $\xi$  and the variable of the subsystem  $z_j$  .... The spatial part ... can be a more complicated function ... denoting this function by  $v_\mu(z_j)$  ... the problems of synergetics are always nonlinear ...

$$q(z_j, t) = \xi(t) v_1(z_j) + \xi(t)^2 v_2(z_j) + \xi(t)^3 v_3(z_j) + \dots \quad (1.50)$$

Consider a propagating rather than a standing wave....

$$q(z, t) = \xi(t) \sin[2\pi z / \lambda - \theta(z, t)] \quad (1.51)$$

*Phases can be order parameters! ... we can clearly distinguish between the role of order parameters and of the enslaved variables or components. When we perturb the order parameters and then drop the perturbation, the order parameters relax only slowly. When we perturb the individual parts, they relax quickly, i.e., order parameters and parts ... are distinguished by their time scales... Let us consider the neurons<sup>60</sup> as individual enslaved components, and macroscopic actions, such as perception or movement control, as the macroscopic quantities described by order parameters. The individual neurons have time constants of one millisecond, whereas perception, etc. takes place at time scales of about one hundred milliseconds... "*

Haken's analysis above is OK for the superfluid component which reduces to coherent processes in ordinary 3D space, but it is not adequate for the more subtle residual nonlocal form-dependent/intensity independent quantum and post-quantum influences from higher dimensional configuration space beyond classical space-time geometrodynamics.

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<sup>60</sup> Too classical! -- we need to consider the individual caged electron qubits in Hameroff's picture as the "individual enslaved components" for the generation of the conscious order parameter(s).

## Appendix B

### Synopsis of Bohm's Ontology<sup>61</sup>

First a list of false statements, a veritable brain washing, that drove several generations of highly intelligent philosophically-minded theoretical physicists into irrational lunacy:

*"In contrast to ordinary mechanics, the new quantum mechanics does not deal with a space-time description of the motion of atomic particles ... The difficulties ... seem to require just that renunciation of mechanical models in space and time..." (Bohr, 1934)*

*"the probability function does not in itself represent a course of events in the course of time. It represents a tendency for events and our knowledge of events ... there is no orbit in the ordinary sense." (Heisenberg, 1958)*

*"determinism, which must be dropped and replaced by something else ... no concealed parameters can be introduced ... (Born, 1951)*

*"It is clear that the results of the double slit experiment can in no way be reconciled with the idea that electrons move in paths.... In quantum mechanics there is no such concept as the path of a particle." (Landau and Lifshitz, 1958)*

This orthodoxy that leads to lunacy is summarized by Cushing<sup>62</sup>:

*" 1. No description of quantum phenomena is possible in terms of particle trajectories in a space-time background.*

*2. Probability enters into quantum theory in an ineliminable and essentially nonclassical way (i.e. probabilities cannot be simply epistemic).*

*3. It is in principle impossible to give a deterministic account of quantum phenomena (at the level of individual events or observables themselves).*

*... John Bell very effectively reminded us that it was Bohm's 1952 theory that gave the lie to all of these beliefs by effectively doing the impossible."*

Bohm's basic equations in the simplest case of one particle in a classical potential  $V$ .

$$\Psi = \text{Re}^{iS/\hbar} \quad (1.52)$$

$$i\hbar \frac{\partial \Psi}{\partial t} = H\Psi \quad (1.53)$$

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<sup>61</sup> I follow here James T. Cushing's "The Causal Quantum Theory Program" in Volume 184, Boston Studies in the Philosophy of Science (Kluwer, 1996)

<sup>62</sup> James Cushing is a distant cousin of Saul-Paul Sirag's whose mother is a Cushing.

$$\frac{d\vec{p}}{dt} = \vec{F} = -\vec{\nabla}(V + Q) \quad (1.54)$$

$$\vec{p} = \vec{\nabla}S \quad (1.55)$$

$$Q = \frac{\hbar}{2m} \frac{\vec{\nabla}^2 R}{R} \quad (1.56)$$

(1.55) is the pilot or guidance condition.

*"The precise location of a particle is not predicted or controlled, but has a statistical (ensemble) distribution according to the probability density"*

$$P = |\Psi|^2 \quad (1.57)$$

(1.57) is violated in self-determining post-quantum theory with signal-nonlocality beyond this deterministic Bohm "causal theory" with signal-locality. The initial position  $X(0)$  of the particle is Bohm's "hidden variable". Bohm's causal theory is not subject to von Neumann's impossibility proof because the quantum potential  $Q$  is context-dependent.<sup>63</sup> The particle trajectories are chaotic, i.e. very sensitive to tiny changes in the initial position  $X(0)$ . Bohm's deterministic causal theory has benign nonlocality consistent with Abner Shimony's "passion at a distance". For example, paranormal telepathy, precognition, and remote-viewing are impossible in principle in quantum theory. This is no longer true in post-quantum theory with its malignant nonlocality, AKA signal-nonlocality.

False and/or misleading charges<sup>64</sup> against Bohm's deterministic causal theory that covers<sup>65</sup> orthodox quantum theory include<sup>66</sup>:

1. Bohm's theory is "*ad hoc*".<sup>67</sup>
2. Determinism is devolution to the Dark Age of Newton's and Laplace's "Clock Work Universe" in which we are all soulless automata with no free will.<sup>68</sup>
3. Bohm cannot explain spin.
4. The *action-reaction principle* between the pilot field  $\Psi$  and its particle located at  $X$  at time  $t$  is violated. That is,  $\Psi$  acts on  $X$ , but  $X$  does not directly react back on  $\Psi$ . Indeed such direct reaction of  $X$  back on  $\Psi$  will violate the statistical postulate of Born in (1.57). This charge is actually true in Bohm's causal theory, but it is not a vice. It is a virtue. It is the clue, the cornerstone of the Post-Quantum Temple. It

<sup>63</sup> i.e., form-dependent, intensity-independent, non-mechanical (i.e. no preassigned interactions) as described in detail in Bohm and Hiley's "The Undivided Universe" (1994). In contrast classical force fields are form-independent, intensity-dependent and mechanical.

<sup>64</sup> Leveled, for example, by Nick Herbert and Evan Harris Walker, amongst many others of course.

<sup>65</sup> In the sense of "Heretical Verities" by Thomas E. Phipps, Jr.

<sup>66</sup> Cushing's list.

<sup>67</sup> "*having simply been concocted to yield the same observational consequences as standard quantum mechanics.*" Cushing

<sup>68</sup> A favorite Red Herring of Evan Harris Walker's.

points the way to cross the River Jordan to beyond the domain of validity of quantum theory to The New Jerusalem of post-quantum theory wherein we find consciousness and our possibly immortal souls.

5. Bohm cannot make his causal theory consistent with special relativity and quantum field theory.
6. Bohm's ontology and the pilot constraint gives primacy to the space-time representation spoiling the symplectic phase space symmetry of contact transformations in classical mechanics.<sup>69</sup>
7. Nick Herbert's objection, that since the ground state of the hydrogen atom is a real wave function, the single electron must be at rest in static mechanical equilibrium. That is, the material attractive static near-field Coulomb potential between the electron and the proton nucleus is exactly balanced by the mental repulsive quantum potential.<sup>70</sup> This cannot be correct Nick says because of a similar case with a muon<sup>71</sup> replacing the electron where data allegedly show that the muon must be moving in the ground state. What Nick did not take into account is that

*"Any measurement of the momentum of the particle will always give the value  $p$ <sup>72</sup> since all of the quantum potential energy is converted into the kinetic energy of the particle during the act of measurement.<sup>73</sup> This is just an example of the participatory nature of measurement..."* Brown and Hiley (2000)

*"Upon closer examination, each of these can be seen to be either specious or inconclusive."* Cushing p. 6

Notes on Brown and Hiley's et-al's latest paper cited in footnote 61 below. The following useful equations up to (1.71) are theirs not mine. I summarize them for future reference.

Replace the intrinsically mental<sup>74</sup> wave function  $\Psi$  by the density operator  $\rho$ . This operator is idempotent for a pure state of zero thermodynamic entropy  $\sigma$  i.e.,

$$\rho^2 = \rho \tag{1.58}$$

---

<sup>69</sup> Brown & Hiley quant-phy/0005026 "Schrodinger Revisited ..." This is a synchronicity since I chose title of this paper "Bye Bye Schrodinger" days before Gary Bekkum sent me a notice of Hiley's latest paper. Note that Hiley takes exception to the Cushing-Durr approach as too specialized and does not like the use of the term "mechanics" preferring "non-mechanics".

<sup>70</sup> Bohm's quantum potential Q replaces the zero point energy of localization of the electron as required by the Heisenberg uncertainty principle in the orthodox picture which is seriously incomplete. This is not to be confused with the zero point photon fluctuations that are independent unless you buy the Wheeler-Feynman action-at-a-distance electrodynamics along both advanced and retarded light cones.

<sup>71</sup> Much closer to the proton because the muon is more than 200 times more massive inertially than the electron. The Bohr radius scales as reciprocal of the orbiting inertial rest mass.

<sup>72</sup> In accord with the standard argument based upon the Heisenberg uncertainty principle.

<sup>73</sup> Of the material "momentum observable" a Hermitian linear operator on the Hilbert space of mental quantum information patterns subject to external constraining material boundary conditions.

<sup>74</sup> Use of "mental" is my post-quantum informal interpretive physical postulate not found in Bohm's causal theory ontology that Hiley is basically using even now, although he is looking for ways to formalize the "implicate order" to get beyond the limitations of the causal theory approximation.

$$\sigma = \text{Tr}[\rho \ln \rho] = 0 \quad (1.59)$$

$$i \frac{\partial \rho}{\partial t} + \rho H - H \rho = 0 \quad (1.60)^{75}$$

$$\rho \frac{\partial S}{\partial t} + \frac{1}{2}(\rho H + H \rho) = 0 \quad (1.61)^{76}$$

These equations are electromagnetically gauge invariant. Use the minimal coupling<sup>77</sup>

$$\begin{aligned} H &= \frac{1}{2m} (\vec{P} - e\vec{A})^2 \\ &= \frac{1}{2m} \vec{P}^2 - \frac{e}{2m} (\vec{P} \cdot \vec{A} + \vec{A} \cdot \vec{P}) + \frac{e^2}{2m} \vec{A}^2 \\ &= H_{particle} + H_{coupling} + H_{field} \end{aligned} \quad (1.62)$$

$$S = S_{particle} + S_{coupling} + S_{field} \quad (1.63)$$

$$\rho \frac{\partial S_{coupling}}{\partial t} + \frac{1}{2} [\rho, H_{coupling}]_+ = 0 \quad (1.64)$$

$$\rho \frac{\partial S_{coupling}}{\partial t} = \rho \vec{A} \cdot \frac{d\vec{X}}{dt} \quad (1.65)$$

$$S_{coupling} = \int_{x_0}^x \vec{A} \cdot d\vec{x} \quad (1.66)$$

giving the Bohm-Aharonov effect of a shift in electron wave interference fringes when the electrons are not in direct contact with a magnetic field  $\vec{B} = \vec{\nabla} \times \vec{A}$  localized inside a long thin solenoid although the two possible paths for the same electron encircle this magnetic flux  $\Phi$ <sup>78</sup>

$$\Phi = \oint \vec{A} \cdot d\vec{l} = \iint \vec{\nabla} \times \vec{A} \cdot \vec{n} dx dy \quad (1.67)$$

<sup>75</sup> Flow continuity in configuration space.

<sup>76</sup> Conservation of total energy E in configuration space only when energy is well defined i.e.  $\frac{\partial S}{\partial t} = E$ .

Note that  $\frac{dS}{dt} = \frac{\partial S}{\partial t} + \frac{d\vec{X}}{dt} \cdot \vec{\nabla} S$

<sup>77</sup> One point charge in the EM field.

<sup>78</sup> This means a physically real local vector potential  $\vec{A}$  even though it's not gauge invariant, or, alternatively, a nonlocal action at a distance of the gauge invariant magnetic field on the electron.

Similarly for the Aharonov-Casher effect for a neutral particle with a magnetic moment  $\vec{\mu}$  like a neutron passing around<sup>79</sup> a line of static electric charge making electric field  $\vec{E}$

$$H = \frac{1}{2m} (\vec{P} - \vec{E} \times \vec{\mu})^2 - \frac{\mu \vec{E}^2}{m} \quad (1.68)$$

In addition, the Berry topological phase comes about because of cyclic control parameters<sup>80</sup>  $\beta(t)$  modifying the mental  $\Psi$  landscape piloting matter  $\vec{X}$ .<sup>81</sup>

$$\rho \left( \frac{\partial S}{\partial t} + \frac{d\beta}{dt} \frac{\partial S}{\partial \beta} \right) + \frac{1}{2} [\rho, H]_+ = 0 \quad (1.69)$$

$$S_{\text{Berry-phase}} = \int_{t_0}^t \frac{d\beta}{dt} \frac{\partial S}{\partial \beta} dt \quad (1.70)$$

Bohm's individual "beables" or "hidden variables" have well defined momenta and positions simultaneously just like classical particles and also classical force fields in the canonical form. Nevertheless the Heisenberg uncertainty relations are satisfied in statistical averaging of the root mean square ensemble fluctuations for simple systems under appropriate measurement procedures. Brown and Hiley are able to write streamline flow landscape currents in any representation, not only the space-time representation. In general, for the arbitrary q-representation

$$\frac{dq}{dt} = \frac{j_q}{P(q)} \quad (1.71)$$

*"which can be integrated immediately to find a set of streamlines in a general q-space"*

This is not quite true however since Brown and Hiley are implicitly assuming holonomic nonturbulent irrotational reversible flows in configuration space. Post-quantum theory, like non-Riemannian torsion field theory<sup>82</sup> extensions of elastic curvature to include plastic "Star Gate" "crinkling"<sup>83</sup> of the space-geometry corresponding to plastic crystal

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<sup>79</sup> Each neutron takes both paths simultaneously. What happens is that the tiny neutron only takes one path, but the spread out physically real quantum information pilot field takes both paths and then coherently recombines to pilot the final motion of the tiny neutron particle. There is no "central mystery" here as Feynman was brainwashed by Bohr to think.

<sup>80</sup> Both external Darwinian environmental control parameters and internal self-organizing control parameters.

<sup>81</sup> Think of X as the "ball" rolling down the mountainside to the lowest point of the valley.

<sup>82</sup> Einstein's final attempts at a unified field theory in late 30's to early 50's at time of his death.

<sup>83</sup> Eddington cited by James Corum.

dislocations and disclinations<sup>84</sup> requires anholonomic irreversible rotational non-integrability of  $dq/dt$  so that smooth global streamlines do not exist but exhibit fractal turbulence in configuration space. This requires V.I. Arnold's A-D-E finite reflection Weyl group technique<sup>85</sup> for landscape flow singularities and beyond.

*"If the coordinate transformation  $x^i(q^\mu)$  is smooth and single-valued, it is integrable. This property is expressed by Schwarz's integrability condition, according to which derivatives in front of such a function  $x^i(q^\mu)$  commute:*

$$(\partial_\lambda \partial_\kappa - \partial_\kappa \partial_\lambda) x^i(q^\mu) = 0 \quad (1.72)$$

*Then....*

$$e^i_{\kappa,\lambda} = e^i_{\lambda,\kappa} \quad (1.73)$$

*implying that the connection  $\Gamma^\lambda_{\mu\nu}$  is symmetric in the lower indices. In this case it coincides with the Riemann connection, the Christoffel symbol  $\bar{\Gamma}^\lambda_{\mu\nu}$  ... for a space with curvilinear coordinates  $q^\mu$  which can be reached by an integrable coordinate transformation from a flat space, the autoparallels coincide with the geodesics."*

HK then defines the "nonholonomic mapping to spaces with torsion". From  $x^i = x^i(q^\mu)$ <sup>86</sup> we can write the infinitesimal equation

$$dx^i = e^i_\mu(q) dq^\mu \quad (1.74)$$

However, starting from the differential (1.74) we cannot generally go back to the finite  $x^i = x^i(q^\mu)$ . When we can go back from the differential to the finite, the mapping between the flat tangent x-space and the deformed q-manifold is holonomic or integrable. When we cannot go back, the mapping is anholonomic or non-integrable and, in that case, the coordinate differentials in the tangent space are not exact differentials. Therefore, the  $n^2$  coefficients forming the n-Bein<sup>87</sup> need not be integrable in the sense of (1.72) and (1.73). That is, from

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<sup>84</sup> RK Kiehn online and also Hagen Kleinert's "Path Integrals" (World)

<sup>85</sup> Private communications with Saul-Paul Sirag.

<sup>86</sup> The  $x^i$  are in the local flat tangent space to the point  $q^\mu$  in the base manifold that can be curved with torsion, possibly also with an anholonomic object and with any dimension. Latin indices are in the flat tangent space, Greek indices in the deformed base manifold. I have in mind the configuration space of the system point confined to a landscape hypersurface in the Bohm ontology. HK's treatment is more specialized. I do not want to assume a metric for configuration space.

<sup>87</sup> Einstein's term in his later papers on unified field theory.

$$e_i^\mu(q) \equiv \frac{\partial q^\mu}{\partial x^i} \equiv \partial_i q^\mu \quad (1.75)$$

and

$$e_\mu^i(x) \equiv \frac{\partial x^i}{\partial q^\mu} \equiv \partial_\mu x^i \quad (1.76)$$

it is easy to see that the nonholonomic mapping

$$\partial_\mu e_\nu^i(q) - \partial_\nu e_\mu^i(q) \neq 0 \quad (1.77)$$

equivalent to

$$(\partial_\mu \partial_\nu - \partial_\nu \partial_\mu) x^i(q) \neq 0 \quad (1.78)$$

is a "curl" or aetheric rotational flow of the tangent vector fields in the physical space-time geometry that can develop a turbulence. So that the smooth streamline flow implicitly assumed by Einstein in the general relativity of gravity as elastic curvature of space-time breaks down. This is torsion as turbulence.

*"There exists no single-valued function  $x^i(q^\mu)$  for which  $e_\mu^i(q) = \frac{\partial x^i(q)}{\partial q^\mu}$ " HK*

Therefore, with anholonomy and torsion we can no longer say that the mappings  $x^i = x^i(q^\mu)$  and  $q^\mu = q^\mu(x^i)$  are 1-1 reversible.<sup>88</sup> That is, the locally flat tangent Cartesian space to an event  $q$  in the base manifold is like a many-sheeted Riemann surface of a function of a complex variable of parallel flat worlds connected by moving through the branch cut. We obviously live in the flat tangent space<sup>89</sup>. This kind of irreversibility from the nonintegrability of Einstein's n-Beins does remind us also of the possibility of a Star Gate<sup>90</sup> "portal"<sup>91</sup> from one "flatland" to another.<sup>92</sup> We are also

<sup>88</sup> R Kiehn I think also makes this point strongly.

<sup>89</sup> Like Abbott's "Flatlanders".

<sup>90</sup> "we place our emphasis on the non-commutative structure of the algebra ... then attempts to focus on a single phase space ... giving primary relevance to space-time will fail..... we must abandon the Cartesian order and replace it by ... the implicate order .... The ontology ... of process which is to be described by the non-commutative algebra. This is not a process in space-time, but a process from which space-time is to be abstracted. Abstraction here means to 'make manifest' and the order that is made manifest is called the explicate order ... there may be more than one explicate order." Brown and Hiley (2000) This inadequacy of the Cartesian order has been noted by Jacques Vallee in the context of explaining the seeming extra-dimensional advanced propulsion and cloaking technology of the flying saucers.

<sup>91</sup> Eddington in 1921 Proc Roy Soc A99 pp106-7 shows that zero torsion and anholonomy suffices to make the world geometry both "flat in its smallest parts" with "a definite tangent ... ruling out an infinitely crinkled world. Eddington points out that this nonintegrability this "infinitely crinkled" world of the n-beins is a "disharmony between the coordinate order and the structural order". Does this mean non-Hausdorff?

reminded of the eigenfunctions of a quantum operator with parallel processing in the many flatlands. So torsion and anholonomy seem to be giving us a clue about the origin of the weird quantum superposition principle. Remember also that we are not restricted to  $n = 4$  "tetrads" or  $n = 3$  "triads". There is an important distinction that HK is clear on

*"In Einstein's theory of gravitation, torsion is assumed to be absent, i.e., the integrability condition for the  $x^i(q)$  is not violated as in (1.72)"*

There is zero torsion in the holonomic (1.72) of Einstein's earlier Riemannian theory of gravity with the symmetric parallel transport of Levi-Civita. In contrast, the torsion is not zero in the anholonomic later non-Riemannian "unified field theory" with the nonsymmetric parallel transport of Cartan in which

$$(\partial_\mu \partial_\nu - \partial_\nu \partial_\mu) x^i(q) \neq 0 \quad (1.79)$$

Given two non-collinear differential vector displacements  $d\vec{x}, \delta\vec{x}$  in the tangent space. That is,  $d\vec{x} \times \delta\vec{x} \neq 0$  Parallel transport one vector differential by the other. There are two alternative routes. Route 1: parallel transport  $d\vec{x}$  by  $\delta\vec{x}$  to produce  $d\vec{x}'$ . Route 2: parallel transport  $\delta\vec{x}$  by  $d\vec{x}$  to produce  $\delta\vec{x}'$ . The key question is, what is the vector difference  $d\vec{x}' - \delta\vec{x}'$ ? When that vector difference vanishes we have the holonomic case of elastic curvature without plastic torsion. When that vector difference does not vanish to make a "gap" we have anholonomic torsion. Corum shows that a more detailed analysis discloses two kinds of gaps one for the torsion tensor and one for the non-tensor "anholonomic object". We then must ask the direction of  $d\vec{x}' - \delta\vec{x}'$  relative to the normal unit vector  $\hat{n} = \frac{d\vec{x} \times \delta\vec{x}}{dx\delta x}$ . In general  $d\vec{x}' - \delta\vec{x}'$  will have components perpendicular to and parallel to  $\hat{n}$  analogous to dislocation and disclination crystal defects, respectively if I recall correctly? I may be wrong there. Easily checked later.

Given the set of tetrad  $\vec{e}_\mu$  tangent vector flow fields in the curved torsion spacetime geometry, the anholonomic object is simply the set of "structure constants" in the "curl" or "commutator" of the Lie algebra. That is, from Corum<sup>93</sup>

$$[\vec{e}_\mu, \vec{e}_\nu] = \left( \frac{\partial \vec{e}_\nu}{\partial x^\mu} - \frac{\partial \vec{e}_\mu}{\partial x^\nu} \right) = \Omega_{\mu\nu}^\lambda \vec{e}_\lambda \quad (1.80)$$

This goes beyond holonomic general relativity. The 1-forms are now inexact differentials. Hagen Kleinert makes the distinction most clearly

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The order of the coordinatization is no longer invariant under the nonholonomic nonintegrable n-Beins suggesting quantum "discontinuous phenomena". This historical reference is from James Corum.

<sup>92</sup> 1943 "Philadelphia Experiment" that James Corum and Robert Dickson Crane do not debunk as Jacques Vallee did. Corum has found serious errors in Vallee's assesment here (private communication).

<sup>93</sup> eq 12 "On the distinction between torsion and anholonomy"

"The main effect of matter in Einstein's theory of gravitation manifests itself in the violation of the integrability condition for the derivative of the coordinate transformation  $x^i(q)$ , namely

$$(\partial_\mu \partial_\nu - \partial_\nu \partial_\mu) \partial_\lambda x^i(q) = 0 \quad (1.81)$$

A transformation<sup>94</sup> for which  $x^i(q)$  itself is integrable, while the first derivatives  $\partial_\mu x^i(q) = e^i_\mu = \bar{e}_\mu$  are not, carries a flat-space region into a purely curved one."<sup>95</sup>

Note that Einstein's 1915-18 theory of gravity violates (1.81), i.e.

$$(\partial_\mu \partial_\nu - \partial_\nu \partial_\mu) \partial_\lambda x^i(q) \neq 0 \quad (1.82)$$

but obeys<sup>96</sup>

$$(\partial_\mu \partial_\nu - \partial_\nu \partial_\mu) \bar{x}(q) = 0 \quad (1.83)$$

This is why Einstein's traditional theory, used by Penrose<sup>97</sup>, Hawking<sup>98</sup>, Thorne<sup>99</sup>, Alcubierre<sup>100</sup>, Puthoff<sup>101</sup>, Davis<sup>102</sup> et-al, is seriously incomplete physically leading us all up the wrong primrose path away from the objective of making Star Trek Real and reverse engineering of allegedly alien ET flying saucers. That is, the text book orthodoxy for general relativity corresponds to a trivial commutative Lie algebra. Brown and Hiley in their latest paper give primacy to the non-commutative Lie algebra for which V.I. Arnold's topological hydrodynamical flow on the Lie group manifolds apply with torsion as anholonomic irreversible turbulence beyond where Brown and Hiley have yet dared to go.

Nevertheless, Brown and Hiley can, in their smooth reversible irrotational streamline holonomic limit, use the momentum-energy representation for example. They can use intermediate "fractional Fourier transform" representations corresponding to the full classical symplectic x-p phase space symmetry of contact transformations with invariant

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<sup>94</sup> holonomic

<sup>95</sup> 10.2.2 p. 425 "Nonholonomic Mapping to Spaces with Torsion" in "Path Integrals" by Hagen Kleinert (World).

<sup>96</sup>  $x^i(q) = \bar{x}(q)$

<sup>97</sup> blackholes

<sup>98</sup> quantum cosmology "universe has no boundary"

<sup>99</sup> traversable wormhole in Sagan's "Contact"

<sup>100</sup> warp drive with exotic matter of negative energy density

<sup>101</sup> "metric engineering", Sakharov ZPF origin of gravity and inertia, polarizability of vacuum

<sup>102</sup> brute force laser zapping attempt to make inconsequential amount of exotic matter for an impracticably short time with a huge amount of energy

Poisson brackets. This is a degenerate limiting case however. The full noncommuting quantum Lie algebra requires distinct "shadow phase spaces" for each arbitrary choice of basis. The shape, even the existence of the quantum potential is basis-dependent. For example, an unsqueezed Glauber coherent state in number and phase has zero quantum potential in the "momentum representation", but it has a non-zero quantum potential in the "position representation".

M.R. Brown's Ph.D. dissertation<sup>103</sup> under Basil Hiley at Birkbeck College<sup>104</sup>, University of London has some interesting results. *Quantum hydrodynamics*<sup>105</sup> is useful in the practical engineering of *semi-conductor devices*<sup>106</sup> and will play an increasingly important role in *nano-electronics engineering*. One can get to the Bohm quantum potential in configuration space from a projection of the Wigner wavelet in phase-space. You can get analogous results in momentum space as well, in fact in any combination of momentum and position variables like in classical contact, or canonical, transformations with invariant Poisson brackets. Quantum effects do break the classical symplectic symmetry. See Brown's dissertation for the general case. I am here only interested in positional configuration space. One also apparently gets a nonlocal form-dependent intensity-independent internal stress-energy tensor<sup>107</sup> in configuration space. Suppose one has an ordered thermal equilibrium ferromagnet or ferroelectric, or a non-equilibrium Frohlich electric dipole mode pumped by an oscillating near field (not a radiation field) will the nonlocal macro-phase coherent quantum order result in nonclassical internal non-central anisotropic local stress-energy tensor fields in ordinary 3-space?

According to Brown's dissertation, the *representation-independent* linear Schrodinger equation is

$$i\hbar \frac{\partial \Psi}{\partial t} = (T(\hat{p}) + V(\hat{x})) \Psi \quad (1.84)$$

Where  $\hat{p}, \hat{x}$  are the usual Hermitian momentum and position observables. There is no bifurcation yet to macroscopic quantum phase-coherent order parameters that fit Haken's synergetic program. T and V are the kinetic and potential parts. In configuration space  $\hat{x} = x, \hat{p} = -i\hbar \vec{\nabla}_x, \Psi = \text{Re}^{iS/\hbar}, |\Psi|^2 = \rho$  gives:

$$\frac{\partial S}{\partial t} + \text{Re} \left\{ \frac{T\Psi}{\Psi} \right\} + V(x) = 0 \quad (1.85)$$

"Re" means "real part of". "Im" means "imaginary part of".

<sup>103</sup> quant-ph/9703007 "The quantum potential: symplectic breakdown and dispersion.

<sup>104</sup> I was Honorary Research Fellow at Birkbeck with Bohm in 1971.

<sup>105</sup> Hiley's model is only for irrotational reversible holonomic quantum hydrodynamics corresponding to the deterministic causal theory approximation. Self-organizing post-quantum topological hydrodynamics is rotational irreversible anholonomically torsioned or turbulent.

<sup>106</sup> Ferry, Zhou, Phys. Rev. B, 48(11), 7944 (1993), Gardner, Ringhofer, Phys. Rev. E 53(1), 157 (1996)

<sup>107</sup> T. Takabayasi, Prog. Theor. Phys. 11, 4-5, 341 (1954), Muga et-al, Physica Scripta, 47, 732 (1993)

$$\frac{\partial \rho}{\partial t} - \frac{2\rho}{\hbar} \text{Im} \left\{ \frac{T\Psi}{\Psi} \right\} = 0 \quad (1.86)$$

$$\text{Re} \left\{ \frac{T\Psi}{\Psi} \right\} = T_q(x) + T_c(x) \quad (1.87)$$

$T_q(x)$  is the quantum kinetic part. It is a series expansion in even powers of  $\hbar$ . The classical kinetic part is

$$T_c(x) = T(\vec{\nabla}_x S) \quad (1.88)$$

and is independent of  $\hbar$ . Brown gives

$$T_q(x) = \frac{1}{R} \sum_m^M \sum_{k=0, k+m \in \mathbb{Z}_c}^{< m} a_m (-1)^m (-1)^{k+m/2} \hbar^{m-k} \frac{1}{k!} \left[ \frac{\partial^m (RS^k)}{\partial x^m} \right] \quad (1.89)$$

$$T_c(x) = \sum_m^M a_m \left( \frac{\partial S}{\partial x} \right)^m \quad (1.90)$$

The continuous trajectory of the material Bohm point in the causal theory approximation in the configuration space representation has the effective Hamiltonian

$$H_x = T_c + T_q + V \quad (1.91)$$

Therefore, Bohm's quantum potential Q in this case is entirely from the non-classical kinetic part. This is why Q gets converted to kinetic energy in momentum measurements on stationary states where the particle is at rest when unperturbed by an external probe.

$$T_q(x) = \frac{-\hbar^2}{2mR} \vec{\nabla}_x^2 R = M_d(x) + \Xi_l(x) \quad (1.92)$$

$$M_d(x) = \frac{-\hbar^2}{8m} (\vec{\nabla}_x^2 \ln \rho) \quad (1.93)$$

is the "Wigner potential".

$$\Xi_l(x) = \frac{-\hbar^2}{8m} \left( \frac{\vec{\nabla}_x^2 \rho}{\rho} \right) \quad (1.94)$$

is the "Ferry-Zhou" potential used phenomenologically apparently in semi-conductor device engineering design. Let  $W(x, p)$  be the Wigner "wavelet" quantum phase space density.

$$\rho(x) \equiv \int W(x, p) dp \quad (1.95)$$

$$P^{(1)}(x) \equiv \int p W(x, p) dp \quad (1.96)$$

$$P^{(2)}(x) \equiv \int p^2 W(x, p) dp \quad (1.97)$$

$$\langle p(x) \rangle \equiv \frac{P^{(1)}(x)}{\rho} \quad (1.98)$$

$$\langle p(x)^2 \rangle \equiv \frac{P^{(2)}(x)}{\rho} \quad (1.99)$$

$$\langle p(x)^2 \rangle - \langle p(x) \rangle^2 = \frac{-\hbar^2}{4} \bar{\nabla}_x^2 \ln \rho = 2mM_d(x) \quad (1.100)$$

Thus, the Wigner potential piece of the Bohm quantum potential  $Q$  in configuration space is the energy of momentum dispersion, i.e. proportional to the mean square deviation of the of the momentum fluctuation. In addition the remaining Ferry-Zhou piece  $\Xi_l(x)$  of the Bohm quantum potential  $Q$  is the "spatial localization energy".

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<sup>i</sup> For example normalize  $\Psi$  to be dimensionless, i.e.,  $\int |\Psi|^2 d^{3N}x = L^{3N}$ , where  $\rho = |\Psi|^2$ . We can try a

model where, for example,  $\frac{\alpha}{\beta} = f(X) \left( \frac{N^2 H h}{\frac{e^2}{\hbar c} m c^2} - 1 \right)$ . This ratio is negative, corresponding to a single

well potential whose minimum is at zero in order parameter space, until  $N$  goes critical at  $10^{18}$  for the electron mass. This is the bifurcation point transition to a double well potential with the emergence of a coherent mental macroscopic order parameter  $R$  not equal to zero.