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Wheeler-Feynman Generalized Bohm Quantum Potential for Open Far-From-Equilibrium Biological Dissipative Structures with Non-Unitary Post-Quantum Retro-Causal Signal Nonlocality

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Abstract

Bohm's micro-quantum ontological interpretation for closed systems in sub-quantal thermal equilibrium is generalized to open macro-quantum coherent systems using the Wheeler-Feynman-Cramer Ansatz. A connection to the Freeman-Vitiello model of the brain is suggested.

We consider the Freeman-Vitiello[i] vacuum manifold of unitarily-inequivalent Bose-Einstein type condensates of Dipole Wave Quanta (DWQ) emergent from water in living systems. The living brain ground state with this "ODLRO" Spontaneous Broken Symmetry (SBS) from the 3D rotation group SO(3) is here modeled using the *retarded* local macro-quantum long-range coherent holographic fractal[1] O(2)[2] order parameter

$$\Psi(x) \equiv \langle x|0\rangle_N \equiv Higgs_{past} e^{iGoldstone_{past}} \equiv R_-(x)e^{iS_-(x)} \qquad (1.1)$$

Here is the *new physics* of far-from-subquantal (A. Valentini[ii]) thermal equilibrium of the matter field classical dynamical degrees of freedom of open dissipative structures. The dual doppelganger Wheeler-Feynman "mirror" (Vitiello) environmental order parameter is

$$\Psi(x)^* \equiv \langle 0|x\rangle_N \equiv Higgs_{future} e^{iGoldstone_{future}} \equiv R_+(x)e^{iS_+(x)} \qquad (1.2)$$

Antony Valentini's "sub-quantum thermal equilibrium" describes the orthodox text book quantum theory of closed systems that conserve information (unitarity) in the sense used by Lenny Susskind's attempt to solve the problem of information loss and recovery from the evaporating black hole.[iii] This limit works very well for scattering experiments with particle beams on inanimate targets. However, its domain of validity cannot be extended to complex living open "dissipative structures" (Prigogine). In the formalism of this paper unitary closed micro-quantum systems without emergent order that obey signal locality (no-cloning theorem needed for quantum cryptography, teleportation, dense coding) correspond to the phase cancellation conditions

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[1] G. Vitiello shows that this order parameter is a squeezed coherent state entangling the advanced/future (Wheeler-Feynman/Cramer transaction) and retarded/past modes with self-similar fractal properties under dilation scale transformations.

[2] For pedagogical simplicity only, it's easy to generalize to O(N) vacuum manifold fibers.

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$$\begin{aligned} &S_{past} + S_{future} = 0 \\ &\partial_\mu \left(S_{past} + S_{future} \right) = 0 \\ &\nabla^2 \left(S_{past} + S_{future} \right) = 0 \\ &\partial_t^2 \left(S_{past} + S_{future} \right) = 0 \end{aligned} \tag{1.3}$$

Let's cut to the chase, the bottom line, without further ado. My original Ansatz for the generalized Bohm quantum potential (in the simpler static limit for now) is

$$Q^* \equiv \kappa \frac{\nabla^2 \sqrt{R_- R_+ e^{i(S_+ + S_-)}}}{\sqrt{R_- R_+ e^{i(S_+ + S_-)}}} \tag{1.4}$$

In the equilibrium micro-quantum unitary limit for a single non-relativistic neutral single particle

$$\begin{aligned} &\kappa \to -\frac{\hbar^2}{2m} \\ &R_+ \to R_- \equiv R \\ &S_+ + S_- = 0 \\ &Q^* \to Q_{Bohm} \equiv -\frac{\hbar^2}{2m} \frac{\nabla^2 R}{R} \end{aligned} \tag{1.5}$$

Unfolding (1.4)

$$Q^* \equiv \kappa \frac{\nabla^2 \sqrt{R_- R_+ e^{i(S_+ + S_-)}}}{\sqrt{R_- R_+ e^{i(S_+ + S_-)}}} = \kappa \frac{\nabla^2 \left(\sqrt{R_- R_+} e^{\frac{i(S_+ + S_-)}{2}} \right)}{\sqrt{R_- R_+} e^{\frac{i(S_+ + S_-)}{2}}} \tag{1.6}$$

Notice the *macroquantum* "spinor" half-angle dependence that requires a 4π rotation to return Q^* to its original value The *imaginary part* of Q^* is the *dissipative non-unitary* term responsible for *retrocausal post-quantum signal nonlocality*. Born's probability interpretation breaks down completely in the Freeman-Vitiello macroquantum coherent non-equilibrium open system because of what P.W. Anderson calls "phase rigidity" [iv] absent in sub-quantal equilibrium orthodox quantum theory given by the limiting case (1.5).

$$\nabla^2 \left(\sqrt{R_- R_+} e^{\frac{i(S_+ + S_-)}{2}} \right) = \left(\nabla^2 \sqrt{R_- R_+} + 2i \vec{\nabla} \sqrt{R_- R_+} \cdot \vec{\nabla} \frac{(S_+ + S_-)}{2} - \sqrt{R_- R_+} \nabla^2 \frac{(S_+ + S_-)}{2} \right) e^{\frac{i(S_+ + S_-)}{2}} \tag{1.7}$$

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Therefore, the real non-dissipative and imaginary dissipative parts of the generalized Bohm post-quantum potential are

$$\begin{aligned}\mathrm{Re}\,Q^* &= \frac{1}{\sqrt{R_-R_+}}\left(\nabla^2\sqrt{R_-R_+}\cos\frac{(S_+ + S_-)}{2} - 2\vec{\nabla}\sqrt{R_-R_+}\cdot\vec{\nabla}\frac{(S_+ + S_-)}{2}\sin\frac{(S_+ + S_-)}{2}\right) - \nabla^2\frac{(S_+ + S_-)}{2}\cos\frac{(S_+ + S_-)}{2} \\ \mathrm{Im}\,Q^* &= \frac{1}{\sqrt{R_-R_+}}\left(\nabla^2\sqrt{R_-R_+}\sin\frac{(S_+ + S_-)}{2} + 2\vec{\nabla}\sqrt{R_-R_+}\cdot\vec{\nabla}\frac{(S_+ + S_-)}{2}\cos\frac{(S_+ + S_-)}{2}\right) - \nabla^2\frac{(S_+ + S_-)}{2}\sin\frac{(S_+ + S_-)}{2}\end{aligned} \quad (1.8)$$

Appendix
The subtle relation of Cramer past and future transaction waves to Wheeler-Feynman retarded and advanced waves

Consider the case of a spherical wave from a point source at the $r = ct = 0$ origin of the fiducial invariant light cone of Einstein's 1905 special theory of relativity.

$$\Psi_{past} \sim \frac{e^{2\pi i(kr - \nu t)}}{r} \quad (1.9)$$

as t runs forward in time r increases when the frequency ν is positive.[3] Starting from $r = 0$ at $t = 0$, Ψ_{past} describes an expanding spherical wave front of constant phase. Next consider its complex conjugate

$$\Psi_{future} \equiv \frac{e^{-2\pi i(kr - \nu t)}}{r} = \frac{e^{2\pi i(-kr + \nu t)}}{r} \quad (1.10)$$

Again for positive frequency Ψ_{future} describes the time-reversed "mirror" ("star wave"[4]) a contracting spherical wave starting at r, t returning to $r = 0$ at $t = 0$, i.e. the *zero* phase wave front equation is[5]

$$0 = -kr + \nu t \quad (1.11)$$

Indeed the product $\Psi_{past}\Psi_{future}$ is a *closed loop in time* like a radar echo except the *contracting* echo of the *expanding* radar probe goes back in time. Wheeler and Feynman use this basic idea to describe the past emission of a photon and its future absorption that John Cramer calls a "transaction."[v] The *interference terms* in the double slit experiment are *broken loops in time*. The contracting *retrocausal* spherical (star, echo, mirror) future

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3 k the wave number is always positive.

4 Coined by Fred Alan Wolf in *Star Wave: Mind, Consciousness and Quantum Physics* (1984) Harper Perennial (Revised edition January 25, 1989) ISBN 0060963107, ISBN 978-0060963101

5 The future and past spherical waves have the same zero phase wave front equation.

wave caused by the expanding *causal* past wave from slit 1 returns to slit 2 and vice versa, i.e.

$$\Psi_{past1}\Psi_{future2} + \Psi_{past2}\Psi_{future1} \qquad (1.12)$$

The future wave is not the same as the advanced wave although

$$\Psi_{retarded} = \Psi_{past} \qquad (1.13)$$

there is no distinction between the past and retarded spherical waves. Both describe expanding constant phase spherical wave fronts of positive frequency moving forward in time along the future light cone whose origin is at $r = ct = 0$. However, the future wave is not the same as the advanced wave.

$$\Psi_{advanced} \equiv \frac{e^{2\pi i(kr+\nu t)}}{r} \neq \Psi_{future} = \frac{e^{2\pi i(-kr+\nu t)}}{r} \qquad (1.14)$$

Consider the motion of the expanding spherical advanced wave front of zero phase, i.e.

$$kr + \nu t = 0 \qquad (1.15)$$

if the frequency ν is positive, then t must run backwards in time. That is, the advanced expanding spherical wave propagates positive frequency along the past light cone of $r = ct = 0$ and it propagates negative frequency forward in time in an expanding spherical wave front along its future light cone. In contrast, the *retarded expanding* spherical wave propagates positive frequency forward in time along the future light cone and negative frequency backward in time along the past light cone. Alternatively, if you want to think of *contracting* constant phase spherical wave fronts, the advanced wave propagates positive frequency forward in time along the past light cone and negative frequency backwards in time along the future light cone of $r = ct = 0$ in contrast to the *retarded contracting wave* propagating negative frequency forwards in time along its past light cone and positive frequency backwards in time along the future light cone. This last case is the same as the future wave.

This gets confusing because there are so many possibilities, so let's try to make it clearer with some pictures to see the relationships between past and future Cramer transaction waves and Wheeler-Feynman retarded and advanced waves.[6]

[6] Put the word "from" in front of "past" and "future" in your mind.

$\Theta_{ret} \sim kr - vt = 0$ ↖↗ $\Psi_{past+++}$ $v > 0, t > 0$	$\Theta_{ret} \sim kr - vt = 0$ ↘↙ $\Psi_{future+--}$ $v > 0, t < 0$
$\Theta_{ret} \sim kr - vt = 0$ ↙↘ $\Psi_{future--+}$ $v < 0, t < 0$	$\Theta_{ret} \sim kr - vt = 0$ ↗↖ $\Psi_{past-+-}$ $v < 0, t > 0$

$\Theta_{adv} \sim kr + vt = 0$ ↖↗ $\Psi_{past-++}$ $v < 0, t > 0$	$\Theta_{adv} \sim kr + vt = 0$ ↘↙ $\Psi_{future---}$ $v < 0, t < 0$
$\Theta_{adv} \sim kr + vt = 0$ ↙↘ $\Psi_{future+-+}$ $v > 0, t < 0$	$\Theta_{adv} \sim kr + vt = 0$ ↗↖ $\Psi_{past++-}$ $v > 0, t > 0$

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[i] G. Vitiello, W. Freeman; The dissipative quantum model of brain and laboratory observations ; Electr. J. Theor. Phys. **4**, 1-18 (2007)

[ii]

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Subquantum Information and Computation
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Abstract. 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 the present 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).

[iii] http://tinyurl.com/m342ul
http://blogs.discovermagazine.com/cosmicvariance/2009/06/02/susskind-lectures-on- general-relativity/
http://people.bu.edu/pbokulic/papers/BHC-Hawk-PSA.pdf

[iv] http://www.sccs.swarthmore.edu/users/08/bblonder/phys120/docs/anderson.pdf

[v] http://www.npl.washington.edu/ti/