Advanced Influences in Bohm's Quantum Realism
under construction

Events 1 and 2 are in configuration space for N entangled quantum parts[1] of the organic quantum whole. This is prior to any kind of superfluid Bose-Einstein condensation of a large number of quantum parts into a single quantum state of a single part. The parts may be real "on mass shell" or virtual "off mass shell". This treatment is globally special relativistic depending on a given slicing or foliation into spacelike surfaces or 3-geometries that form "snapshots" or "points" in Wheeler "superspace". The "whole" may be "quantum" (dead) or "post-quantum" (alive) in the sense of my "back-action" theory.

$$\psi(2) = \mathrm{R}(2)\mathrm{e}^{iS(2)/\hbar} \tag{1.1}$$

$$\psi(2)^* = \mathrm{R}(2)\mathrm{e}^{-iS(2)/\hbar} \tag{1.2}$$

$$S(1,2 \mid x(t)) = \int_{t_1}^{t_2} L\left(x(t), \dot{x}(t)\right) dt \tag{1.3}$$

The integral here is a definite integral in time t for given classical path x(t) through configuration space of 3N dimensions.

$$-S(1,2 \mid x(t)) = S(2,1 \mid x(t)) \tag{1.4}$$

$$\psi(2) = \int K(2,1)\psi(1) \tag{1.5}$$

The integral here is the Feynman integral over all paths x(t) with the same creation and destruction configuration space points 1 and 2.

$$R(2)e^{iS(2)/\hbar} = \int K(2,1)R(1)e^{iS(1)/\hbar} \tag{1.6}$$

$$\int K(2,1) = \sum_{x(t):x_1}^{t_2} e^{iS(2,1)/\hbar} \tag{1.7}$$

$K(2,1)$ is the N-particle Feynman propagator through configuration space. The symbolic sum on the RHS is the Dirac-Feynman heuristic prescription for adding the quantum

[1] Strictly speaking the present simple formalism does not apply to the photons in the actual Clauser-Aspect-Gisin type pair experiments. It does apply to entangled neutrons in, for example neutron interferometers, also to atoms in atom interferometers and to hydrophobically caged electrons inside the microtubules of the brain. Photons require a "super potential" for classical field configurations in an infinite dimensional configuration space rather than a finite dimensional one. The math for classical boson field system points moving on the quantum pilot wave landscape of attractors is a lot more complicated than the N particle mechanics but the idea is the same.

history amplitudes before squaring for indistinguishable alternatives. I now introduce the 1940 Wheeler-Feynman idea further developed by Hoyle and Narlikar, Costa de Beauregard, Cramer, Aharonov and students:

$$\begin{aligned}\psi(x) &= \int K(x,1)\psi(1) + \int K(2,x)\psi(2) \\ &= \psi(x)_{ret} + \psi(x)_{adv}\end{aligned} \tag{1.8}$$

$\psi(x)_{ret}$ is Aharonov's "history quantum state vector" of all past influences on present event x from the moment of creation or "birth 1 of the organic post-quantum whole.[2] $\psi(x)_{adv}$ is Aharonov's "destiny quantum state vector" of all future influences on present event x from the moment of final destruction or "death" of the organic post-quantum whole. You can think of this as a model of your own stream of consciousness.

$$\begin{aligned}\psi(x)^* &= \int K(x,1)^*\psi(1)^* + \int K(2,x)^*\psi(2)^* \\ &= \psi(x)_{ret}{}^* + \psi(x)_{adv}{}^* \\ &= \int K(1,x)\psi(1)^* + \int K(x,2)^*\psi(2)^*\end{aligned} \tag{1.9}$$

$$\begin{aligned}&\left|\psi(x)\right|^2 = \left[\psi(x)_{ret}{}^* + \psi(x)_{adv}{}^*\right]\left[\psi(x)_{ret} + \psi(x)_{adv}\right] \\ &= \left|\psi(x)_{ret}\right|^2 + \left|\psi(x)_{adv}\right|^2 + 2\left|\psi(x)_{ret}\right|\left|\psi(x)_{adv}\right|\cos\left[S_{adv}(x) - S_{ret}(x)\right] \\ &R(x)^2 = R(x)_{ret}{}^2 + R(x)_{adv}{}^2 + 2R(x)_{ret}\,R(x)_{adv}\cos\left[S_{adv}(x) - S_{ret}(x)\right]\end{aligned} \tag{1.10}$$

$$R(x) = \sqrt{R(x)_{ret}{}^2 + R(x)_{adv}{}^2 + 2R(x)_{ret}\,R(x)_{adv}\cos\left[S_{adv}(x) - S_{ret}(x)\right]} \tag{1.11}$$

The Bohm quantum potential in configuration space relative to a given spacelike foliation of 4-dim spacetime into 3-dim nonintersecting spacelike surfaces is then[3]

$$Q(x) \sim \frac{\nabla^2 R(x)}{R(x)} \tag{1.12}$$

[2] The "present" is intermediate between the past "birth" and the future "death" of the possibly arbitrary complex system. As the complexity of the quantum system increases, if a ODLRO Bose-Einstein condensation happens in an open nonequilibrium system, a post-quantum back-reaction of the classical system point directly on its quantum pilot wave can develop with "telepathic" signal nonlocality and the "backward causation" seen in brain experiments by Libet, Radin and Bierman. This does not happen in Bohm's "causal theory" where the quantum potential is "fragile" with signal locality. One has a "weak" nondemolition measurement at x that essentially leaves the complex organic whole intact unlike what happens at 1 and 2.

[3] One also can perhaps generalize (1.12) to include time delays with longitudinal propagating ψ modes in the case of Bose-Einstein condensations. I have not worked this out yet.

The quantum interference between future and past in the present x is the new feature not considered by Bohm and Hiley in the "Undivided Universe". This new feature shows the irrelevancy of recent claims by Gisin et-al that their experiments show a falsification of Bohm's "pilot wave realism". With these advanced influences, Bohm's quantum realism does not predict a vanishing of quantum nonlocality at a critical relative speed of detectors for photon pairs. The reason is the same as in Costa-de Beauregard's "Feynman zig zag" and in John Cramer's "transactional interpretation" of the EPRB Clauser-Aspect class of experiments. The above quantum potential in (1.12) is simply a short hand book keeping formal device to keep track of globally self-consistent loops in time between the two spacelike separated photon destruction spacetime events 2 and the initial common photon pair creation event 1. Simply take the limit $x \to 2$ in that particular problem.

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