Bill Poirier

back to namelist

Bill Poirier
Texas Tech University, Lubbock, USA

Quantum Mechanics Without Wavefunctions: When quantum worlds collide

Five years ago, the first paper was published[1] that describes what has come to be known as the “Many Interacting Worlds” (MIW) interpretation of quantum mechanics (QM)[2]. MIW is based on a new mathematical formulation of QM[1,3], in which the wavefunction ?(t, x) is discarded. Instead, the quantum state is uniquely represented as an ensemble, x(t, C), of quantum trajectories or “worlds,” each of which has well-defined real-valued particle positions and momenta at all times. Unlike the Everett many-worlds interpretation (MWI), no world-branching occurs, and nearby trajectories/worlds influence one another dynamically. Indeed, it is through this very interworld interaction that all quantum behavior manifests. The quantum trajectory ensemble x(t, C) satisfies an action principle, leading to a dynamical partial differential equation (via the Euler-Lagrange procedure), as well as to conservation laws (via Noether’s theorem).

The MIW approach offers a direct “realist” description of nature that is beneficial in interpreting quantum phenomena such as entanglement, measurement, spontaneous decay, etc. It provides a useful analysis of the Everett Many Worlds Interpretation (MWI), explaining how the illusion of “world-branching” emerges in that context. It is also amenable to a straightforward relativistic generalization[4], which provides a notion of global simultaneity even for accelerating observers. Moreover, whereas the original MIW theory is fully consistent with Schroedinger wave mechanics, the more recently developed flavors offer the promise of new experimental predictions. These and other developments, e.g. for many dimensions, multiple particles, and spin, will be discussed.

[1] B. Poirier, Chem. Phys. 370, 4 (2010).
[2] B. Poirier, Phys. Rev. X, 4, 040002 (2014).
[3] J. Schiff and B. Poirier, J. Chem. Phys. 136, 031102 (2012).
[4] B. Poirier, arXiv:1208.6260 [quant-ph], (2012).

Download presentation pdf (1MB)

Download abstract pdf