Can Minkowski Spacetime See Quantum Superposition?

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March 11, 2017

Abstract

Compared to the clear physical principles leading to Minkowski Spacetime, quantum mechanics looks like a patchwork collection of assumptions needed to construct an algorithm. The lack of a clear ontological basis for quantum mechanics makes it difficult to ask questions about the relationship between spacetime and quantum theory from within quantum mechanics itself. It then makes sense to ask a question, like the one in the title, that probes quantum mechanics from a clear classical perspective.

At least in the case of 1+1 dimensions, the actual answer to the question in the title is an emphatic yes! If the concept of the worldline is modified to consider that massive particles are clocks that 'tick' using a simple binary signal, the Dirac equation may be obtained directly and a reason for the intermediary 'wavefunction' as a square root of a probability density function emerges without artifice.

As a test case, the particle-as-binary-clock model is discussed in the context of the Young double slit experiment where it is shown that the superposition of wavefunctions rather than probability density functions happens as an extension of Einstein's first postulate. Superposition in this case functions as a relativistic *filter* that ensures that the appropriate probability density function for arrival at detectors accounts for the arrival of Lorentz equivalent worldsignals from the two alternative slits. There are two special features of this that are of particular importance. The first is that the non-local aspects of quantum mechanics are here tied directly to the first-postulate underpinning of spacetime. The second is that in this view, quantum propagation is a direct consequence of time dilation and *would not exist in the absence of the Lorentz transfomation.*