Where are the "hidden variables" hidden?

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Abstract

We aim to find a place where hypothetical hidden variables of quantum mechanics might be accommodated. We consider the possibility that hidden variables belong to the Calabi-Yau manifold, the space of six extra dimensions, appearing in the superstring theory.

Quantum mechanics is a very successful theory, yet, there are many conflicting views over its interpretation [1,2]. One of the most difficult interpretational problems is the nature of measurement. Hidden-variable theories are proposals to provide explanations of quantum mechanical measurement through the introduction of (possibly unobservable) hidden variables [3]. The de Broglie–Bohm theory of quantum mechanics (also known as the pilot wave theory), proposed by Louis de Broglie and extended later by David Bohm to include measurements [4], is deterministic and nonlocal. In another hidden-variable (superdeterministic) theory, it is postulated that all systems measured are correlated with the choices of which measurements to make on them. A hidden-variable theory that is superdeterministic can thus fulfill Bell's notion of local causality [5] and still violate the inequalities derived from Bell's theorem [6].

Assuming the hidden-variable ideas as a working hypothesis, we should consider where those additional degrees of freedom might live. A possible solution to this problem may be provided by the supersymmetric string theory (SST) [7,8]. The SST postulates the existence of supersymmetry, strings, and higher dimensions, all unconfirmed. It is usually assumed that six compactified extra dimensions belong to the Calabi-Yau manifold [9,10].

Hidden-variable theory and the SST hypothesis can be combined. More precisely, the compactified dimensions of the Calabi-Yau manifold may be a home of hidden variables. Moreover, the extra dimensions are compactified at about the Planck scale, and thus just below the Planck scale quantum fluctuations can arise. Therefore, due to quantum fluctuations, fractal subsets can be expected

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in the Calabi-Yau manifold. In some variants of the superdeterministic theory, a fractal nature of the state space, violating the Statistical Independence assumption in Bell's theorem, is indeed proposed [6].

In summary, assuming a hidden-variable explanation of quantum mechanics and the superstring hypothesis, we put forward the conjecture that hidden variables, if exist, are an integral (perhaps fractal) part of the Calabi-Yau manifold.

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