Nonlinear Wave Function Theory

Non-Linear Wave Function, Linear Density Operator Evolution

There are many constraints that can be considered regardless of whether or not a closed system constitutes a measurement device. Consider the imposition of the results of Chapter 3 for which unitary Schrödinger evolution cannot account for the results of measurement.

From the results of Chapter 3, we know that a measurement process exists and this process is necessarily non-Schrödinger. The reasoning behind the result of Chapter 3 for which unitary Schrödinger evolution cannot account for the results of measurement was due to the dichotomy of the entanglement prediction under unitary Schrödinger evolution versus the product state under measurement. Hence a unitary operation that is not a Schrödinger unitary operation would have to be capable of resolving this dichotomy. However, it is easy to see that any linear map, be it unitary or non-unitary, cannot resolve the dichotomy required to result in a single product state for all superposition input states. That is, for any linear map, the same issue of entanglement versus product state will arise as in Chapter 3, and this will again lead to a measurement problem. Hence there only remains the consideration of non-linear wave function operations.

Generally, the solution to the measurement problem lives in the class of non-linear evolution in wave function. However, linearity in density operator is preserved in conventional quantum mechanics in both the deterministic unitary postulate of von Neumann as well as the nondeterministic measurement postulate. In both cases of conventional quantum mechanics and as well due to the no-signaling arguments by Wald in [646], Gisin in [251], and further extended in [647] [648], there is good rationale for taking quantum dynamics to be described by linear density operator evolution. This will be further discussed in a future volume in the Progress in Physics of Quantum Measurement Series.