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The Einstein-Podolsky-Rosen *Gedankenexperiment*, Bell Inequalities, and Experimental Realizations

EDWARD FRY, Texas A&M University

The famous Einstein-Podolsky-Rosen *Gedankenexperiment* (EPR) and the subsequent analysis by John Bell some 30 years later provided the foundation for a burgeoning interest in phenomena based on quantum properties, most importantly the quantum aspect known as entanglement. These phenomena, still in their infancy, include quantum cryptography, quantum teleportation, quantum computing and quantum information processing. An historical background will be presented and Bohm's version of EPR will be discussed. A simple layman's level example of a Bell inequality will be derived. The initial experimental tests of a Bell Inequality during the second "Magic Decade of Quantum Mechanics" involved polarization correlations between two photons in an atomic cascade. Later experiments have used two photons from a down conversion process and have examined, for example, entanglement over large distances. An example of a true experimental realization of Bohm's classic version of EPR will be described. Specifically, the experimental realization involves measurement of angular momentum correlations between two spin one-half mercury atoms (nuclei). The latter are produced by resonant Raman dissociation of a mercury dimer that is in an electronic and nuclear spin singlet state. Determination of the spin one-half angular momentum components of the resulting two spatially separated ^{199}Hg atoms is accomplished simultaneously with their detection via a polarization selective excitation and ionization scheme.