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Event-By-Event Simulation of Single Neutron Experiments

We discuss a discrete-event approach, which has been shown to give a unified cause-and-effect description of many quantum optics experiments [1] and single-neutron interferometry experiments [2]. The simulation algorithm does not require the knowledge of the solution of a wave equation of the whole system, yet reproduces the corresponding statistical distributions by generating detection events one-by-one. It is shown that single-particle interference and entanglement, two important quantum phenomena, emerge via information exchange between individual particles and devices such as beam splitters, polarizers and detectors. We demonstrate that the simulation method reproduces the results of several single-neutron experiments, including one which has demonstrated a violation of a Bell inequality [3,4] and another recent one [5] which which aims at confirming Ozawa's universally valid error-disturbance relation [6].

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