Abstract Submitted
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Quantum-walk analogues of optical phenomena[1] DANIEL D. POWELL, JOSHUA M. GROSSMAN, St. Mary's College of Maryland — Quantum walks (QWs), the counterpart of classical random walks (CRWs), offer the prospect of efficient quantum algorithms as they spread more quickly and more thoroughly through state space than CRWs. Projecting each time step of the discrete infinite-line QW along a second dimension produces probability amplitudes that evolve as the walker traverses this array of coordinates, in analogy to a photon traversing a two-dimensional array of beamsplitters. When we start the walker in a superposition of locations rather than a single point (as if it has passed through a beamsplitter before entering the QW), we observe analogues of optical phenomena in free-space propagation. Starting the particle in a range of adjacent positions produces, in the far field, a probability distribution that fits the diffraction pattern of light from a single finite-width slit, despite the fact that the particle traverses an array of scatterers. Starting the particle in separated positions produces probability distributions that fit multi-slit interference patterns. When the particle starts from a single position and we remove certain beamsplitters after the first step, we observe an even more uniform probability distribution that the standard QW. Removing larger numbers of beamsplitters causes localization of the particle.

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