Nonlinear Sciences > Cellular Automata and Lattice Gases

Discrete-time quantum walks on one-dimensional lattices

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In this paper, we study discrete-time quantum walks on one-dimensional lattices. We find that the coherent dynamics depends on the initial states and coin parameters. For infinite size of lattice, we derive an explicit expression for the return probability, which shows scaling behavior $P(0,t)\sim t^{-1}$ and does not depends on the initial states of the walk. In the long-time limit, the probability distribution shows various patterns, depending on the initial states, coin parameters and the lattice size. The average mixing time M_{ϵ} closes to the limiting probability in linear N (size of the lattice) for large values of thresholds ϵ. Finally, we introduce another kind of quantum walk on infinite or even-numbered size of lattices, and show that the walk is equivalent to the traditional quantum walk with symmetrical initial state and coin parameter.

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