The Hubbard Fermionic Quantum Walk

Alessandro Tosini

Department of Physics, Universita degli Study di Pavia, Italy
E-mail: alessandro.tosini@unipv.it

ABSTRACT

The anticommutation of Fermionic fields raises the problem of simulating the evolution of Fermionic systems by means of commuting quantum systems, say qubits. Within this scenario some of the authors have shown that local Fermionic modes can be considered as the elementary systems of an operational probabilistic theory whose systems satisfy a parity superselection rule, which inhibits the superposition of states with an even and an odd number of excitations. The parity superselection follows from the locality of Fermionic operations, namely operations on systems that are not causally connected must commute. Here I present an interacting Fermionic quantum walk that provides the quantum circuit counterpart of the Fermionic Hubbard model. The Hubbard Fermionic quantum walk, which consists of two Fermionic quantum walks with the addition of an on-site interaction, is solved analytically via the Bethe-ansatz. The class of eigenfunctions of the interacting walk contains both scattering solutions and bound states, the last ones corresponding to the two particles joined together to form a localized molecular state.