Abstract:
We present an efficient quantum algorithm for simulating the evolution of a sparse Hamiltonian $H$ for a given time $t$ in terms of a procedure for computing the matrix entries of $H$. In particular, when $H$ acts on $n$ qubits, has at most a constant number of nonzero entries in each row/column, and $|H|$ is bounded by a constant, we may select any positive integer $k$ such that the simulation requires $O((\log^k n) t^{\{1+1/2k\}})$ accesses to matrix entries of $H$. We show that the temporal scaling can not be significantly improved beyond this, because sublinear time scaling is not possible.