

# Where to quantum walk?

Viv Kendon

School of Physics and Astronomy, University of Leeds,  
Woodhouse Lane, Leeds, LS2 9JT, UK.

Quantum versions of random walks have diverse applications that are motivating experimental implementations as well as theoretical studies. However, the main impetus behind this interest is their use in quantum algorithms, which have always envisaged the quantum walk as a program running on a quantum computer. Recent results showing that quantum walks are “universal for quantum computation” relate entirely to algorithms, and do not imply that a physical quantum walk could provide a new architecture for quantum computers. Nonetheless, quantum walks used to model transport phenomena in spin chains and biomolecules broaden their scope well beyond algorithms, and raise the question of when a physical implementation might provide useful computational outputs. I will discuss the conditions under which a physical quantum walk experiment could provide useful results beyond the reach of classical computation. This is an illuminating case study that links quantum cellular automata and simulation of quantum systems.