

Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Quantum simulation of time-dependent Hamiltonians and the convenient illusion of Hilbert space¹ ROLANDO SOMMA, Los Alamos National Laboratory, DAVID POULIN, University of Sherbrooke, ANGIE QARRY, FRANK VERSTRAETE, University of Vienna — We consider the manifold of all quantum many-body states that can be generated by arbitrary time-dependent local Hamiltonians in a time that scales polynomially in the system size, and show that it occupies an exponentially small volume in Hilbert space. This implies that the overwhelming majority of states in Hilbert space are not physical as they can only be produced after an exponentially long time. We establish this fact by making use of a time-dependent generalization of the Suzuki-Trotter expansion, followed by a counting argument. This also demonstrates that a computational model based on arbitrarily rapidly changing Hamiltonians is no more powerful than the standard quantum circuit model.

¹We acknowledge support from NSF, NSERC, and FQRNT

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Date submitted: 18 Nov 2010

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