MAR08-2007-001000

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Ensemble encoding of quantum registers: it's easy if you can count to one[1]

KLAUS MOLMER, Lundbeck Foundation Theoretical Center for Quantum Systems Research, University of Aarhus

We present a new encoding of qubits in multi-bit registers which makes use of the collective population of a set of internal states of an ensemble of identical quantum systems. This establishes a linear rather than exponential relationship between the number of bits and the internal state Hilbert space dimension of our basic physical system. The key requirement of our proposal is that we can count to one and restrict the collective populations to the values zero and unity. We propose physical implementations and recipes for one- and two-bit gates with ground state atoms interacting via Rydberg excited states, offering up to 14 bits in a small cloud of cesium atoms, and with polar molecules interacting via a stripline cavity field and a Cooper pair box, offering even larger register sizes.

[1]In collaboration with Etienne Brion, Imperial College; Line Hjortshoj Pedersen, University of Aarhus; Mark Saffman, University of Wisconsin; and Karl Tordrup, University of Aarhus.