DAMOP11-2011-000654

Abstract for an Invited Paper
for the DAMOP11 Meeting of
the American Physical Society

Optimizing the entangling power of Rydberg quantum gates

TOMMASO CALARCO[1], University of Ulm

Optimal control is a versatile tool for quantum information processing since it allows for implementing a desired operation with extremely high fidelity. It can also be used to determine the minimum required gate operation time. In an implementation of quantum information processing based on trapped neutral atoms or molecules as qubit carriers, the main difficulty is encountered in realizing an entangling two-qubit operation such as a controlled NOT. In an optimal control approach, implementation of a CNOT gate can be achieved by maximizing the projection of the actual evolution onto CNOT as a functional of a control such as a laser field. However, for a given encoding of qubits in a physical system, it is a priori not clear whether CNOT is the two-qubit gate that can best be implemented or whether a gate that is equivalent to CNOT up to local, i.e. single-qubit, operations would be a more suitable choice. We have developed a new optimization functional that maximizes the entangling power of a desired two-qubit gate rather than the gate itself. We can thus optimize for all gates that are locally equivalent to the desired two-qubit operation. We apply this new functional to the implementation of fast two-qubit gates with dipolar systems.

[1]in collaboration with M. Mueller, D. Reich, J. Vala, H. Yuan, B. Whaley