Abstract Submitted
for the DAMOP06 Meeting of
The American Physical Society

Reducing the sensitivity of the Mølmer-Sørensen gate for ion-trap quantum computing to unbalanced laser intensities[1] J.H. WESENBERG, R.B. BLAKESTAD, J. BRITTON, J.D. JOST, E. KNILL, C. LANGER, D. LEIBFRIED, R. OZERI, R. REICHLE, S. SEIDELIN, D.J. WINELAND, NIST —
Geometric gates for ion-trap quantum computing have been experimentally demonstrated (fidelity ≈ 0.97), using a single pair of laser beams driving a Raman transition between motional states[2]. This class of gate operations only works for qubits encoded in states with field-sensitive transitions. Since qubits encoded in states with field-insensitive transitions are less susceptible to decoherence, there is presently a renewed interest in the Mølmer-Sørensen (MS) gate, a geometric gate compatible with field-insensitive states[3]. A fundamental weakness of the MS gate is that it requires two Raman transitions to be driven simultaneously, introducing a new error source in the form of potentially unbalanced strengths of the two pairs of Raman beams. We show that although the MS gate in the originally proposed form is highly sensitive to such an imbalance, a minimal modification allows it to operate at high fidelity, even with poorly balanced laser intensities.

[1]J. H. W. acknowledges support by the Danish Research Agency. S. S. acknowledges support by the Carlsberg Foundation. Work also supported by DTO and NIST.
[2]D. Leibfried et al., Nature 422, 412 (2003).
[3]P. J. Lee et al., quant-ph/0505203

Janus H. Wesenberg
NIST

Date submitted: 23 Feb 2006 Electronic form version 1.4