Appendix A

Glossary

A-1 LIST OF ACRONYMS AND ABBREVIATIONS

ARDA	Advanced Research and Development Activity
1-D	one dimensional
2-D	two dimensional
2-DEG	two-dimensional electron gas
3-D	three dimensional
ARO	Army Research Office
BEC	Bose-Einstein condensate
BQNP	bounded quantum analogue of NP
BQP	bounded quantum polynomial
CMOS	complementary metal oxide semiconductor
C-NOT	controlled-NOT (gate)
CPB	Cooper pair box
CV	carbon vacancy
CW	continuous wave
DAC	digital to analog converter
dc	direct current
DFS	decoherence-free subspace
EPR	Einstein, Podolsky, Rosen
ESR	electron-spin resonance
FET	field-effect transistors
GHZ	Greenberger, Horne, and Zeilinger
GHz	gigahertz
HOM	Hong, Ou, and Mandel
HSP	hidden subgroup problem
Hz	hertz
IP	interaction proof
kHz	kilohertz
KLM	Knill, Laflamme, and Milburn
LOCC	local operations and classical communication
LOQC	linear-optics quantum computing
MA	Merlin-Arthur (problems)
MEMS	micro-electro-mechanical systems
MHz	megahertz
mK	milliKelvin
MRFM	magnetic resonance force microscope
NMR	nuclear magnetic resonance
NP	nondeterministic polynomial (time)
NRO	National Reconnaissance Office
NSA	National Security Agency
NV	nitrogen vacancy
P	polynomial (time)
PIR	private-information-retrieval (system)
POVM	positive operator value measurement
PPT	positive under partial transposition
PSPACE	problem solvable with polynomial memory
QC	quantum computation/computing
QCPR	Quantum Computing Program Review
Q_{CRYPT}	quantum cryptography
QD	quantum dot
QED	quantum electrodynamics
QFT	quantum Fourier transform
QIP	quantum information processing/processor
QIS	quantum information science
QIST	quantum information science and technology
QIT	quantum information theory
qNOT	quantum-NOT (gate)
QSAT	quantum analog of satisfiable problem
QSPIR	quantum k-server symmetrically private information-retrieval (system)
rf	radio frequency
RSFQ	rapid single flux quantum
SAW	surface-acoustic wave
SET	single-electron transistor
SET	single-electron tunneling
SFQ	single flux quantum
SHB	spectral hole burning
SPD	single-photon detector
SPDC	spontaneous parametric down conversion
SPIR	symmetrically private information-retrieval (system)
SPS	single-photon source
SQUID	superconducting quantum interference device
STM	scanning-tunneling microscopy
SZK	statistical zero knowledge
T	Tesla
TEP	Technology Experts Panel
UV	ultraviolet

A-2 GLOSSARY OF TERMS

Bell inequalities – A set of constraints that certain measurement results must satisfy if the underlying theory is local and realistic; quantum mechanics predicts results that violate these inequalities, thereby disproving local realism.

Bell measurement – A joint measurement on two quantum systems to determine which of the 4 Bell states they are in; to make a completely unambiguous Bell measurement usually requires a strong nonlinear interaction between the systems.

Bell states – For a quantum state with two subsystems (*i.e.*, two qubits), the 4 orthogonal maximally entangled states (*e.g.*, $|00\rangle + |11\rangle$, $|00\rangle - |11\rangle$, $|01\rangle + |10\rangle$, and $|10\rangle - |10\rangle$).

Bose-Einstein condensate – A state of a tenuous, very low-temperature gas in which all the atoms occupy the same motional quantum state; typically all the atoms are essentially at rest.

Cat state – a simultaneous superposition of two different states, usually macroscopic. (This state is classically forbidden.)

cavity quantum electrodynamics – Individual atoms interacting with the strong electromagnetic field inside a small optical-frequency cavity.

coherent control – control which maintains quantum coherence.

computational basis – a set of quantum basis states upon which a computation is done.

correlation – Cosine of the angle between two states.

decoherence – normal loss of quantum coherence (both inherent and due to interactions with the environment).

discriminating single-photon detector – A photon counter that detects one or more photons with high efficiency and can robustly discriminate between 0, 1, 2, or more photons.

entanglement – The property of two or more quantum systems whose total quantum state cannot be written as a product of the states of the individual systems (*c.f.*, separable state); this property introduces nonlocality into quantum theory, and is believed to be an essential ingredient of quantum information processing.

exchange coupling – Basic physical interaction between the spins of electrons whose wave functions overlap, arising from the Pauli exclusion principle.

fault-tolerant quantum computation – a quantum computation that can proceed accurately in spite of errors.

fidelity – The magnitude of the projection of one state on another.

GHZ (Greenberger, Horne, and Zeilinger) and W states – There are two classes of entangled states for a three-qubit system in the sense that a state in one class cannot be transformed into a state in the other class by local operations and classical communication (LOCC). There are two

orthogonal GHZ states (with the form |000⟩ ± |111⟩) and six orthogonal W states (with the form |001⟩ ± |010⟩ ± |100⟩). The GHZ states are pure states specified by the correlation "all qubits have the same value." The W states are specified by the correlation "any two qubits are correlated."

holonomic constraint– a type of constraint on a system of particles, expressible in the form, $f(x_1,x_2,x_3,\ldots,x_N,t) = 0$.

HOM interferometer – A quantum interferometer, first implemented by Hong, Ou, and Mandel, in which single photons enter each of the two input ports of a 50:50 beam splitter. The probability for coincidence counts at the two output ports is zero when temporal and spatial mode-matching is perfect. This is the required test of a single photon source intended for linear-optics quantum computing. Also, the HOM interferometer is useful for polarization Bell-state analysis, as required (*e.g.*, in quantum dense coding and teleportation).

linear optics – Any optical device that is described by a Hamiltonian which is at most quadratic in the field amplitudes. Such devices include phase-shift components, mirrors, beam splitters, and polarizers. The class may be extended to include devices that make use of the second-order susceptibility in which one of the fields is classical (*e.g.*, parametric down conversion with a classical pump field). As the Hamiltonian for a linear optical device is, at most, quadratic in the field amplitudes, the resulting Heisenberg equations of motion are linear in the field amplitudes.

logical qubit – A combination of physical qubits that is more robust against a specific set of noise generators.

magnetic microtrap – A configuration of magnetic fields in which atoms can be trapped in the regions of strongest field strength via the interaction of the atomic magnetic-dipole moments with the magnetic field.

optical dipole force – When an atom is exposed to light, the electric field of the light induces an optical-frequency electric-dipole moment in the atom, and then the electric field exerts a DC optical dipole force on the induced dipole.

optical lattice – A pattern of standing light waves created by the interference of intersecting laser beams; neutral atoms can be trapped in the standing-wave pattern by optical dipole forces.

optical microtrap – A configuration of tightly focused light beams; atoms can be trapped by optical dipole forces in the regions of greatest light intensity.

physical qubit – A system that has observables that behave as the Pauli matrices.

quantum dot – A confining structure for electrons, which can be designed to stably hold a small number of electrons.

quantum error correcting code – a set of quantum operations which tests for errors and corrects errors that are found.

quantum jump detection – experimental detection of a discrete change in a quantum state.

quantum logic operation – a quantum operation which performs reversible logic (NOT, C-NOT, etc.).

quantum measurement – an experimental procedure for determining some or all of the parameters that specify a quantum state.

quantum parallelism – utilization of quantum superposition to do many operations simultaneously.

quantum state and quantum process tomography – In quantum state tomography, a number of measurements are made on an ensemble of identically prepared quantum systems. If the Hilbert space is of finite dimension, then a finite number of measurements suffices to allow one to reconstruct the quantum state of the particles. Quantum process tomography uses similar techniques to characterize a quantum process (*e.g.*, a unitary transformation, decoherence, etc.). This means the effect on any possible input state to the process may be predicted.

qubit – an abbreviation for "quantum bit", the basic computation building block of most quantum computer paradigms. In addition to being able to assume the values "0" and "1", a qubit can also be put into a quantum superposition of 0 and 1 at the same time (*e.g.*, $|0\rangle + |1\rangle$).

Rabi oscillation – a two-state system driven by an electromagnetic wave whose energy equals the energy difference between the two states. (This driven system oscillates periodically between the two states.)

reversible computation – a computation for which the time-reversed sequence can also be realized; (no dissipation occurs)

Rydberg atom – An atom with one valence electron that has been excited to a high-lying (Rydberg) energy level.

scalability – the capability of achieving the same efficiency, almost independent of the number of qubits.

separable state – The description of two or more quantum systems which are not entangled, so that it is possible to write the total state of the joint system as a product of the quantum state of each individual piece

single-photon source – A transform-limited pulsed optical field with one and only one photon per pulse. The pulses must exhibit first-order coherence (i.e., must exhibit self interference) and must enable two-photon interference (*e.g.*, Hong, Ou, and Mandel interferometer) using a delay line.

spontaneous parametric down conversion – The current method of choice for producing pairs of correlated photons. A high-frequency photon is split into two lower-frequency daughter photons via a nonlinear optical crystal. In addition to being able to directly create polarization-entangled pairs, several groups are pursuing it as a means to realizing a single-photon source.

superoperator – general class of quantum operator corresponding to the dynamics of open quantum systems.

superposition – a linear combination of two or more quantum states

teleportation – a quantum communication protocol, whereby an unknown quantum state can be indirectly transmitted from one party to another; the protocol requires sending four classical bits of information, and that the parties share entanglement

Toffoli gate – operator acting on three two-state qubits. Only when the first two qubits are in the down state, does the Toffoli gate flip the third state.

Appendix B

References

B-1 LIST OF REFERENCES FOR THE QUANTUM COMPUTING ROADMAP

Aaronson, S., "Quantum lower bound for the collision problem," *Proceedings of the 34th Annual ACM Symposium on Theory of Computing*, (Association for Computing Machinery Press, New York, 2002) pp. 635–642 [ISBN: 1-58113-495-9, *quant-ph/0111102*].

Aassime, A., G. Johansson, G. Wendin, R.J. Schoelkopf, and P. Delsing, "Radio-frequency single-electron transistor as readout device for qubits: Charge sensitivity and backaction," *Physical Review Letters* **86**, 3376–3379 (2001).

Abe, E., K.M. Itoh, T.D. Ladd, J.R. Goldman, F. Yamaguchi, and Y. Yamamoto, "Solid-state silicon NMR quantum computer," *Journal of Superconductivity: Incorporating Novel Magnetism* **16**, 175–178 (2003).

Abragam A., *The Principles of Nuclear Magnetism* (Clarendon Press, Oxford, 1961).

Abrams, D.S. and S. Lloyd, "A Quantum algorithm providing exponential speed increase for finding eigenvalues and eigenvectors," *Physical Review Letters* **83**, 5162–5165 (1999) [*quant-ph/9807070*].

Aharonov, D. and A. Ta-Shma, "Adiabatic quantum state generation and statistical zero knowledge," (7-Jan-03) preprint *quant-ph/0301023*.

Aharonov, D. and D. Gottesmann, "Improved threshold for fault-tolerant quantum computation," manuscript, 2002.

Aharonov, D. and M. Ben-Or, "Fault tolerant quantum computation with constant error," (14-Nov-96) preprint *quant-ph/9611025*.

Aharonov, D., W. van Dam, J. Kempe, Z. Landau, S. Lloyd, and O. Regev, "On the universality of adiabatic quantum computation," manuscript 2003.

Altepeter, J.B., D. Branning, E. Jeffrey, T.C. Wei, P.G. Kwiat R.T. Thew, J.L. O'Brien, M.A. Nielsen, and A.G. White, "Ancilla-assisted quantum process tomography," *Physical Review Letters* **90**, 193601 (2003).

Altepeter, J.B., P.G. Hadley, S.M. Wendelken, A.J. Berglund, and P.G. Kwiat, "Experimental investigation of a two-qubit decoherence-free subspace," (to appear in *Physical Review Letters* 2004).

Ambainis, A. "Quantum walk algorithm for element distinctness," (1-Nov-03) preprint *quant-ph/0311001*.

Ambainis, A., D. Aharonov, J. Kempe, U.V. Vazirani, "Quantum walks on graphs," *Proceedings of the 33rd ACM Symposium on Theory of Computing (STOC 2001),* (ACM Press, New York, NY, USA, 2001), pp. 50–59 [ISBN: 1-58113-349-9].

Ambainis, A., L.J. Schulman, A. Ta-Shma, U. Vazirani, and A. Wigderson, "The quantum communication complexity of sampling," *Proceedings of the 39th Annual Symposium on the Foundations of Computer Science (FOCS'98)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 1998) pp. 342–351.

Ambainis, A., M. Mosca, A. Tapp, and R. de Wolf, "Private quantum channels," *Proceedings of the 41st Annual Symposium on Foundations of Computer Science (FOCS'00)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 2000) pp. 547–553.

Anglin, J.R. and W. Ketterle, "Bose-Einstein condensation of atomic gases," *Nature* **416**, 211–218 (2002).

Arora, S., R. Impagliazzo, and U. Vazirani, "The principle of local checkability and relativizing arguments in complexity theory," *Proceedings of the 8th Annual Structure in Complexity Theory Conference,* (IEEE Computer Society Press, 1993) [ISBN 0-8186-4070-7].

Atature, M., G. Di Giuseppe, M.D. Shaw, A.V. Sergienko, B.E.A. Saleh, and M.C. Teich, "Multi-parameter entanglement in femtosecond parametric down-conversion," *Physical Review A* **65**, 023808 (2002).

Bacon, D., K.R. Brown, and K.B. Whaley, "Coherence-preserving quantum bits," *Physical Review Letters* **87**, 247902 (2001).

Bacon, D.M., Ph.D. thesis, University of California, Berkeley (2001), Chapter 10.

Barnum, H., C. Crepeau, D. Gottesman, A. Smith, and A. Tapp, "Authentication of quantum messages," *Proceedings of the 43rd Annual Symposium on Foundations of Computer Science (FOCS'02)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 2002) pp. 449–458 [*quant-ph/0205128*].

Barrett, MD., B. DeMarco, T. Schätz, V. Meyer, D. Leibfried, J. Britton, J. Chiaverini, W.M. Itano, B. Jelenkovic J.D. Jost, C. Langer, T. Rosenband, and D.J. Wineland, "Sympathetic cooling of $^{9}Be^{+}$ and $^{24}Mg^{+}$ for quantum logic," *Physical Review A* **68**, 042302 (2003).

Bartlett, S.D., B.C. Sanders, S.L. Braunstein, and K. Nemoto, "Efficient classical simulation of continuous variable quantum information processes," *Physical Review Letters* **88**, 097904 (2002).

Bar-Yossef, Z., T.S. Jayram, and I. Kerenidis. "Exponential separation of quantum and classical one-way communication complexity," (to be presented at the 36th Annual ACM Symposium on Theory of Computing [STOC 2004] Chicago, Illinois, USA, June 13–15, 2004).

Bell, J.S., "On the Einstein-Podolski-Rosen paradox," *Physics* **1**, 195–200 (1964), reprinted in *Speakable and Unspeakable in Quantum Mechanics*, (Cambridge University Press, Cambridge, UK, 1987) pp. 14–21

Bell, J.S., "On the problem of hidden variables in quantum mechanics," *Reviews of Modern Physics* **38**, 447–452 (1966).

Benioff, P., "Quantum mechanical models of Turing machines that dissipate no energy," *Physical Review Letters* **48**, 1581–1585 (1982).

Benioff, P., "The computer as a physical system: A microscopic quantum mechanical Hamiltonian model of computers as represented by Turing machines," *Journal of Statistical Physics* **22**, 563–591 (1980).

Ben-Kish, A., B. DeMarco, V. Meyer, M. Rowe, J. Britton, W.M. Itano, B.M. Jelenkovic, C. Langer, D. Leibfried, T. Rosenband, and D.J. Wineland, "Experimental demonstration of a technique to generate arbitrary quantum superposition states of a harmonically bound spin-1/2 particle," *Physical Review Letters* **90**, 037902 (2003).

Bennett, C.H. and G. Brassard, "Quantum cryptography: Public key distribution and coin tossing," *Proceedings of the IEEE International Conference on Computers Systems and Signal Processing*, (IEEE, New York, 1984) pp 175–179.

Bennett, C.H. and S.J. Wiesner, "Communication via one- and two-particle operators on Einstein-Podolsky-Rosen states," *Physical Review Letters* **69**, 2881–2884 (1992).

Bennett, C.H., "Logical reversibility of computation," *IBM Journal of Research and Development* **17**(6), 525–530 (1973).

Bennett, C.H., "Quantum cryptography using any two nonorthogonal states," *Physical Review Letters* **68**, 3121–3124 (1992).

Bennett, C.H., D.P. DiVincenzo, C.A. Fuchs, T. Mor, E. Rains, P.W. Shor, J.A. Smolin, and W.K. Wootters, "Quantum nonlocality without entanglement," *Physical Review A* **59**, 1070–1091 (1999) [*quant-ph/9804053*].

Bennett, C.H., D.P. DiVincenzo, J.A. Smolin, and W.K. Wootters, "Mixed-state entanglement and quantum error correction," *Physical Review A* **54**, 3824–3851 (1996).

Bennett, C.H., D.P. DiVincenzo, J.A. Smolin, B.M. Terhal, and W.K. Wootters, "Remote state preparation," *Physical Review Letters* **87**, 077902 (2001) [*quant-ph/0006044*].

Bennett, C.H., D.P. DiVincenzo, T. Mor, P.W. Shor, J.A. Smolin, and B.M. Terhal, "Unextendible product bases and bound entanglement," *Physical Review Letters* **82**, 5385 (1999) [*quant-ph/9808030*]

Bennett, C.H., E. Bernstein, G. Brassard, and U. Vazirani, "Strengths and weaknesses of quantum computing," *SIAM Journal on Computing* **26**, 1510–1523 (1997).

Bennett, C.H., G. Brassard, C. Crepeau, R. Jozsa, A. Peres, and W. Wootters, "Teleporting an unknown quantum state via dual classical and Einstein-Podolsky-Rosen channels," *Physical Review Letters* **70**, 1895–1899 (1993).

Bennett, C.H., G. Brassard, S. Popescu, B. Schumacher, J.A. Smolin, and W.K. Wootters, "Purification of noisy entanglement and faithful teleportation via noisy channels," *Physical Review Letters* **76**, 722–725 (1996).

Bennett, C.H., H.J. Bernstein, S. Popescu, and B. Schumacher, "Concentrating partial entanglement by local operations," *Physical Review A* **53**, 2046–2052 (1996).

Bennett, C.H., P.W. Shor, J.A. Smolin, and A.V. Thapliyal, "Entanglement-assisted classical capacity of noisy quantum channels," *Physical Review Letters* **83** 3081 (1999).

Bennett, C.H., P.W. Shor, J.A. Smolin, and A.V. Thapliyal, "Entanglement-assisted capacity of a quantum channel and the reverse Shannon theorem," *IEEE Transactions on Information Theory* **48**, 2637–2655 (2002) [*quant-ph/0106052*].

Berggren, K., D. Nakada, T.P. Orlando, E. Macedo, R. Slattery, and T. Weir, "An integrated superconductive device technology for qubit control," *Proceedings of the International Conference on Experimental Methods in Quantum Computation*, (Rinton Press, 2001).

Bergquist, J.C., R.G. Hulet, W.M. Itano, and D.J. Wineland, "Observation of quantum jumps in a single atom," *Physical Review Letters* **57**, 1699–1702 (1986).

Berman, G.P., F. Borgonovi, H.S. Goan, S.A. Gurvitz, and V.I. Tsifrinovich, "Single-spin measurement and decoherence in magnetic-resonance force microscopy," *Physical Review B* **67**, 094425 (2003).

Berman, G.P., G.D. Doolen, D.I. Kamenev, and V.I. Tsifrinovich, "Perturbation theory for quantum computation with a large number of qubits," *Physical Review A* **65**, 012321 (2002).

Berman, G.P., G.D. Doolen, G.V. Lopez, and V.I. Tsifrinovich, "A quantum full adder for a scalable nuclear spin quantum computer," *Computer Physics Communications* **146**(3), 324–330 (2002).

Bernstein, E. and U. Vazirani, "Quantum complexity theory," *Proceedings of the of the 25th Annual ACM Symposium on Theory of Computing*, (Association for Computing Machinery Press, New York, 1993) pp. 11–20 [ISBN: 0-89791-591-7].

Bertet, P., S. Osnaghi, P. Milman, A. Auffeves, P. Maioli, M. Brune, J.M. Raimond, and S. Haroche, "Generating and probing a two-photon Fock state with a single atom in a cavity," *Physical Review Letters* **88**, 143601 (2002).

Bhattacharya, N., H.B. van Linden van den Heuvell, and R.J.C. Spreeuw, "Implementation of quantum search algorithm using classical Fourier optics," *Physical Review Letters* **88**, 137901 (2002).

Birkl, G., F.B.J. Buchkremer, R. Dumke, and W. Ertmer, "Atom optics with microfabricated optical elements," *Optics Communications* **191**, 67–81 (2001).

Blatt, R. and P. Zoller, "Quantum jumps in atomic systems," *European Journal of Physics* **9**, 250–256 (1988).

Blinov, B.B., D.L. Moehring, L.-M. Duan, and C. Monroe, "Observation of entanglement between a single trapped atom and a single photon," *Nature* **428**, 153–157 (2004).

Blinov, B.B., L. Deslauriers, P. Lee, M.J. Madsen, R. Miller, and C. Monroe, "Sympathetic cooling of trapped Cd^+ isotopes," *Physical Review A* **65**, 040304 (2002).

Blum, K., "*Density Matrix Theory and Applications*," 2nd Ed. (Plenum Press, New York, 1996).

Bocko, M.F., A.M. Herr, and M.F. Feldman, "Prospects for quantum coherent computation using superconducting electronics," *IEEE Transactions on Applied Superconductivity* **7**, 3638–3641 (1997).

Bohm, A. and K. Kraus, "*States, Effects and Operations: Fundamental Notions of Quantum Theory*," (Springer-Verlag, Berlin, 1983).

Bollinger, J.J., W.M. Itano, D.J. Wineland, and D.J. Heinzen, "Optimal frequency measurements with maximally correlated states," *Physical Review A* **54**, R4649–4652 (1996).

Boschi, D., S. Branca, F. De Martini, L. Hardy, and S. Popescu, "Experimental realization of teleporting an unknown pure quantum state via dual classical and Einstein-Podolsky-Rosen channels," *Physical Review Letters* **80**, 1121–1125 (1998).

Boulant, N., K. Edmonds, J. Yang, M.A. Pravia, and D.G. Cory, "Experimental demonstration of an entanglement swapping operation and improved control in NMR quantum-information processing," *Physical Review A* **68**, 032305 (2003).

Boulant, N., M.A. Pravia, E.M. Fortunato, T.F. Havel, and D.G. Cory, "Experimental concatenation of quantum error correction with decoupling," *Quantum Information Processing* **1**, 135–144 (2002).

Boulant, N., T.F. Havel, M.A. Pravia, and D.G. Cory, "Robust method for estimating the Lindblad operators of a dissipative quantum process from measurements of the density operator at multiple time points," *Physical Review A* **67**, 042322 (2003).

Boutis, G.S., D. Greenbaum, H. Cho, D.G. Cory, and C. Ramanathan "Spin diffusion of correlated two-spin states in a dielectric crystal," *Physical Review Letters* **92**, 137201 (2004).

Bouwmeester, D., J.-W. Pan, K. Mattle, M. Eibl, H. Weinfurter, and A. Zeilinger, "Experimental quantum teleportation," *Nature* **390**, 575–579 (1997).

Bouwmeester, D., J.-W. Pan, M. Daniell, H. Weinfurter, and A. Zeilinger, "Observation of three-photon Greenberger-Horne-Zeilinger entanglement," *Physical Review Letters* **82**, 1345–1349 (1999).

Boykin, P.O. and V. Roychowdhury, "Optimal encryption of quantum bits," *Physical Review A* **67**(4), 042317 (2003).

Brassard, G., "Quantum communication complexity: A survey," *Foundations of Physics* **33**(11), 1593–1616 (2003) [*quant-ph/0101005*].

Braunstein, S.L., C.M. Caves, R. Jozsa, N. Linden, S. Popescu, and R. Schack, "Separability of very noisy mixed states and implications for NMR quantum computing," *Physical Review Letters* **83**, 1054–1057 (1999).

Brennen, G.K., C.M. Caves, P.S. Jessen, and I.H. Deutsch, "Quantum logic gates in optical lattices," *Physical Review Letters* **82**, 1060–1063 (1999).

Brennen, G.K., I.H. Deutsch, and C.J. Williams, "Quantum logic for trapped atoms via molecular hyperfine interactions," *Physical Review A* **65**, 022313 (2002).

Brennen, G.K., I.H. Deutsch, and P.S. Jessen, "Entangling dipole-dipole interactions for quantum logic with neutral atoms," *Physical Review A* **61**, 062309 (2000).

Briegel, H.J., J.I. Cirac, W. Dür, S.J. van Enk, H.J. Kimble, H. Mabuchi, and P. Zoller, "Physical implementations for quantum communication in quantum networks," *Quantum Computing and Quantum Communications* **1509**, 373–382 (1999).

Briegel, H.J., T. Calarco, D. Jaksch, J.I. Cirac, and P. Zoller, "Quantum computing with neutral atoms," *Journal of Modern Optics* **47**, 415–451 (2000).

Briegel, H.J., W. Dür, J.I. Cirac, and P. Zoller, "Quantum repeaters: The role of imperfect local operations in quantum communication," *Physical Review Letters* **81**, 5932–5935 (1998).

Briegel, H.J., W. Dür, S.J. van Enk, J.I. Cirac, and P. Zoller, "Quantum communication and the creation of maximally entangled pairs of atoms over a noisy channel," *Philosophical Transactions of the Royal Society of London Series A-Mathematical, Physical, and Engineering Sciences* **356**, 1841–1851 (1998).

Brouri, R., A. Beveratos, J.-P. Poizat, and P. Grangier, "Photon antibunching in the fluoresecence of individual colored centers," *Optics Letters* **25**, 1294–1296 (2000).

Buchkremer, F.B.J., R. Dumke, M. Volk, T. Muther, G. Birkl, and W. Ertmer, "Quantum information processing with microfabricated optical elements," *Laser Physics* **12**, 736–741 (2002).

Buck, J.R. and H.J. Kimble, "Optimal sizes of dielectric microspheres for cavity QED with strong coupling," *Physical Review A* **67**, 033806 (2003).

Budker, D., D.F. Kimball, S.M. Rochester, and V.V. Yashchuk, "Nonlinear magneto-optics and reduced group velocity of light in atomic vapor with slow ground state relaxation," *Physical Review Letters* **83**, 1767–1770 (1999).

Buhrman, H., R. Cleve, and A. Wigderson, "Quantum vs. classical communication and computation," *Proceedings of the 30th Annual ACM Symposium on Theory of Computing*, (Association for Computing Machinery Press, New York, 1998) pp. 63–68 [ISBN: 0-89791-962-9].

Buhrman, H., R. Cleve, J. Watrous, and R. de Wolf, "Quantum fingerprinting," *Physical Review Letters* **87**(16), 167902 (2001) [*quant-ph/0102001*].

Burnett, K., P.S. Julienne, P.D. Leff, E. Tiesinga, and C.J. Williams, "Quantum encounters of the cold kind," *Nature* **416**, 225–232 (2002).

Byrd M.S. and D.A. Lidar, "Combined error correction techniques for quantum computing architectures," *Journal of Modern Optics* **50**, 1285–1297 (2003).

Calarco, T., E.A. Hinds, D. Jaksch, J. Schniedmayer, J.I. Cirac, and P. Zoller, "Quantum gates with neutral atoms: controlling collisional interactions in time-dependent traps," *Physical Review A* **61**, 022304 (2000).

Calderbank, A.R. and P.W. Shor, "Good quantum error-correcting codes exist," *Physical Review A* **54**, 1098–1105 (1996).

Carelli, P., M.G. Castellano, F. Chiarello, C. Cosmelli, R. Leoni, and G. Torrioli, "SQUID systems for macroscopic quantum coherence and quantum computing," *IEEE Transactions on Applied Superconductivity* **11**, 210–214 (2001).

Cavity Quantum Electrodynamics, P. Berman, Ed. (Academic Press, Boston, MA, 1994).

Cerf, N.J., C. Adami, and P.G. Kwiat, "Optical simulation of quantum logic," *Physical Review A* **57**, R1477–R1480 (1998).

Chen, P.C., C. Piermarocchi, and L.J. Sham, "Control of exciton dynamics in nanodots for quantum operations," *Physical Review Letters* **87**, 067401 (2001).

Childs, A.M., I.L. Chuang, and D.W. Leung, "Realization of quantum process tomography in NMR," *Physical Review A* **64**, 012314 (2001).

Childs, A.M., R.C. Cleve, E. Deotto, E. Farhi, S. Gutmann, and D.A. Spielman, "Exponential algorithmic speedup by a quantum walk," Proceedings of the 35th ACM Symposium on Theory of Computing (STOC 2003), (ACM Press, New York, NY, USA, 2003), pp. 59–68 [ISBN: 1-58113-674-9].

Chu, S., "Cold atoms and quantum control," *Nature* **416**, 206–210 (2002).

Chuang, I.L. and M.A. Nielsen, "Prescription for experimental determination of the dynamics of a quantum black box," *Journal of Modern Optics* **44**, 2455–2467 (1997).

Chuang, I.L., L.M.K. Vandersypen, X. Zhou, D.W. Leung, and S. Lloyd, "Experimental realization of a quantum algorithm," *Nature* **393**, 143–146 (1998).

Cirac, J.I. and P. Zoller, "A scalable quantum computer with ions in an array of microtraps," *Nature* **404**, 579–581 (2000).

Cirac, J.I. and P. Zoller, "Quantum computations with cold trapped ions," *Physical Review Letters* **74**, 4091–4094 (1995).

Cirac, J.I., P. Zoller, H.J. Kimble, and H. Mabuchi, "Quantum state transfer and entanglement distribution among distant nodes in a quantum network," *Physical Review Letters* **78**, 3221–3224 (1997).

Cirac, J.I., S.J. van Enk, P. Zoller, H.J. Kimble, and H. Mabuchi, "Quantum communication in a quantum network," *Physica Scripta* **T76**, 223–232 (1998).

Cleve, R. and J. Watrous, "Fast parallel circuits for the quantum Fourier transform," *Proceedings of the 41st Annual Symposium on Foundations of Computer Science (FOCS'00)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 2000) pp. 526–536.

Cleve, R., D. Gottesman, and H.-K. Lo , "How to share a quantum secret," *Physical Review Letters* **83**, 648–651 (1999).

Cory, D.G., A.F. Fahmy and T.F. Havel, "Ensemble quantum computing by NMR spectroscopy," *Proceedings of the National Academy of Science (USA)* **94**, 1634–1639 (1997).

Cory, D.G., M. Price, W. Maas, E. Knill, R. Laflamme, W.H. Zurek, T.F. Havel, and S.S. Somaroo, "Experimental quantum error correction," *Physical Review Letters* **81**, 2152–2155 (1998).

Cory, D.G., M.D. Price, and T.F. Havel, "Nuclear magnetic resonance spectroscopy: An experimentally accessible paradigm for quantum computing," *Physica D* **120**, 82–101 (1998).

Cory, D.G., R. Laflamme, E. Knill, L. Viola, T.F. Havel, N. Boulant, G. Boutis, E. Fortunato, S. Lloyd, R. Martinez, C. Negrevergne, M. Pravia, Y, Sharf, G. Teklemarian, Y.S. Weinstein, and Z.H. Zurek, "NMR based quantum information processing: Achievements and prospects," *Fortschritte der Physik [Progress of Physics]* **48**, 875–907 (2000).

Crepeau, C., D. Gottesman, and A. Smith, "Secure multi-party quantum computing," *Proceedings of the 34th ACM Symposium on Theory of Computing (STOC 2002)*, (ACM Press, New York, NY, USA, 2001), pp. 643–652 [ISBN: 1-58113-495-9] [*quant-ph/0206138*].

Cummins, H.K., G. Llewellyn, and J.A. Jones, "Tackling systematic errors in quantum logic gates with composite rotations," *Physical Review A* **67**, 042308 (2003).

Das, R., T.S. Mahesh, and A. Kumar, "Implementation of conditional phase-shift gate for quantum information processing by NMR, using transition-selective pulses," *Journal of Magnetic Resonance* **159**, 46–54 (2002).

DeMarco, B., A. Ben-Kish, D. Leibfried, V. Meyer, M. Rowe, B.M. Jelenkovic, W.M. Itano, J. Britton, C. Langer, T. Rosenband, and D.J. Wineland, "Experimental demonstration of a controlled-NOT wave-packet gate," *Physical Review Letters* **89**, 267901 (2002).

DeMartini, F., A. Mazzei, M. Ricci, G.M. D'Ariano, "Exploiting quantum parallelism of entanglement for a complete experimental quantum characterization of a single qubit device," *Physical Review A* **67**, 062307 (2003).

Deutsch, D. and R. Josza, "Rapid solution of problems by quantum computation," *Proceedings of the Royal Society of London: Series A - Mathematical and Physical Sciences A* **439**, 553–558 (1992).

Deutsch, D., "Quantum theory, the Church-Turing principle and the universal quantum computer," *Proceedings of the Royal Society of London: Series A - Mathematical and Physical Sciences A* **400**(1818), 97–117 (1985).

Deutsch, D., A.K. Ekert, R. Jozsa, C. Macchiavello, S. Popescu and A. Sanpera, "Quantum privacy amplification and the security of quantum cryptography over noisy channels," *Physical Review Letters* **77**, 2818–2821 (1996) [*quant-ph/9604039*].

Deutsch, I.H. and P.S. Jessen, "Quantum-state control in optical lattices," *Physical Review A* **57**, 1972–1986 (1998).

Deutsch, I.H., G.K. Brennen, and P.S. Jessen, "Quantum computing with neutral atoms in an optical lattice," *Fortschritte der Physik [Progress of Physics]* **48**, 925–943 (2000).

Devetak, I. and A. Winter, "Distilling common randomness from bipartite quantum states," *Proceedings of the IEEE International Symposium on Information Theory (ISIT 2003)*, (IEEE, Piscataway, NJ, 2003), p. 403 [ISBN: 0-7803-7728-1].

DeVoe, R.G., "Elliptical ion traps and trap arrays for quantum computation," *Physical Review A* **58**, 910–914 (1998).

DiVincenzo, D.P., D. Bacon, J. Kempe, G. Burkard, and K.B. Whaley, "Universal quantum computation with the exchange interaction," *Nature* **408**, 339–342, 2000.

DiVincenzo, D.P., D.W. Leung, and B.M. Terhal, "Quantum data hiding," *IEEE Transactions on Information Theory* **48**, 580–598 (2002) [*quant-ph/0103098*].

DiVincenzo, D.P., P. Hayden, and B.M. Terhal, "Hiding quantum data," *Foundations of Physics* **33**, 11, 1629–1647 (2003) [*quant-ph/0207147*].

DiVincenzo, D.P., T. Mor, P.W. Shor, J.A. Smolin, and B.M. Terhal, "Unextendible product bases, uncompletable product bases, and bound entanglement," *Communications in Mathematical Physics* **238**, 379–410 (2003) [*quant-ph/9908070*].

Doherty, A.C., A.S. Parkins, S.M. Tan, and D.F. Walls, "Effects of motion in cavity QED," *Journal of Optics B-Quantum and Semiclassical Optics* **1**, 475–482 (1999).

Dorai, K., Arvind, and A. Kumar, "Implementation of a Deutsch-like quantum algorithm utilizing entanglement at the two-qubit level on an NMR quantum-information processor," *Physical Review A* **63**, 034101 (2001).

Duan, L.-M., A. Kuzmich, and H.J. Kimble, "Cavity QED and quantum-information processing with "hot" trapped atoms," *Physical Review A* **67**, 032305 (2003).

Duan, L.-M., B.B. Blinov, D.L. Moehring, and C. Monroe, "Scalable trapped ion quantum computation with a probabilistic ion-photon mapping," (5-Jan-04) preprint *quant-ph/0401020*.

Duan, L.-M., J.I. Cirac, P. Zoller, and E.S. Polzik, "Quantum communication between atomic ensembles using coherent light," *Physical Review Letters* **85**, 5643–5646 (2000).

Dumke, R., M. Volk, T. Muether, F.B.J. Buchkremer, G. Birkl, and W. Ertmer "Micro-optical realization of arrays of selectively addressable dipole traps: A scalable configuration for quantum computation with atomic qubits," *Physical Review Letters* **89**, 097903 (2002).

Dur, W., G. Vidal, and J.I. Cirac, "Three qubits can be entangled in two inequivalent ways," *Physical Review A* **62**, 062314 (2000).

Eckert, K., J. Mompart, X.X. Yi, J. Schliemann, D. Bruss, G. Birkl, and M. Lewenstein, "Quantum computing in optical microtraps based on the motional states of neutral atoms," *Physical Review A* **66**, 042317 (2002).

Eggeling, T. and R.F. Werner, "Hiding classical data in multipartite quantum states," *Physical Review Letters* **89**, 097905 (2002).

Einstein, A., B. Podolsky, and N. Rosen, "Can quantum-mechanical description of physical reality be considered complete?" *Physical Review* **47**, 777 (1935).

Ekert, A.K., "Quantum cryptography based on Bell's theorem," *Physical Review Letters* **67**, 661–663 (1991).

Ekert, A.K., C.M. Alves, D.K.L. Oi, M. Horodecki, P. Horodecki, and L.C. Kwek, "Direct estimations of linear and non-linear functionals of a quantum state," *Physical Review Letters* **88**, 217901 (2002).

Ekert, A.K., J.G. Rarity, P.R. Tapster, and G.M. Palma, "Practical quantum cryptography based on two-photon interferometry," *Physical Review Letters* **69**, 1293–1295 (1992).

Emerson, J., Y.S. Weinstein S. Lloyd, and D.G. Cory, "Fidelity decay as an efficient indicator of quantum chaos," *Physical Review Letters* **89**, 284102 (2002).

Ernst, R.R., G. Bodenhausen, and A. Wokaun, *Principles of Nuclear Magnetic Resonance in One and Two Dimensions* (Clarendon Press, Oxford, 1987).

Eschner, J., Ch. Raab, F. Schmidt-Kaler, and R. Blatt, "Light interference from single atoms and their mirror images," *Nature*, **413**, 495–498 (2001).

Ettinger, M., P. Hoyer, and E. Knill, "The quantum query complexity of the hidden subgroup problem is polynomial," (12-Jan-04) preprint *quant-ph/0401083*.

Farhi, E. and S. Gutmann, Quantum mechanical square root speedup in a structured search problem," (18-Nov-97) preprint *quant-ph/9711035*.

Farhi, E., J. Goldstone, S. Gutman, B. Reichardt, U. Vazirani, "Tunneling in quantum adiabatic optimization," manuscript in preparation 2004.

Farhi, E., J. Goldstone, S. Gutmann, and M. Sipser, "Quantum computation by adiabatic evolution," (28-Jan-00) preprint *quant-ph/0001106*.

Fedichkin, L., A. Fedorov, and V. Privman, "Measures of decoherence," *Proceedings of the 2003 International Society for Optical Engineering (SPIE) Conference on Quantum Information and Computation*, E. Donkor, A.R. Pirich, and H.E. Brandt, Eds., (SPIE, Bellingham Washington, 2003), Vol. 5105, pp. 243–254 [*cond-mat/0303158*].

Feynman, R.P., "Simulating physics with computers," *International Journal of Theoretical Physics* **21**, 467–488 (1982).

Fiete, G.A. and E.J. Heller, "Semiclassical theory of coherence and decoherence," *Physical Review A* **68**, 022112 (2003).

Fischer, T., P. Maunz, P.W.H. Pinkse, T. Puppe, and G. Rempe, "Feedback on the motion of a single atom in an optical cavity," *Physical Review Letters* **88**, 163002 (2002).

Fisk, P.T.H., M.J. Sellars, M.A. Lawn, C. Coles, A.G. Mann, and D.G. Blair, "Very high Q microwave spectroscopy on trapped $^{171}Yb^{+}$ ions: Application as a frequency standard," *IEEE Transactions on Instrumentation and Measurement*, **44**, 113–116 (1995).

Folman, R., P. Krueger, D. Cassettari, B. Hessmo, T. Maier, and J. Schmiedmayer, "Controlling cold atoms using nanofabricated surfaces: Atom chips," *Physical Review Letters* **84**, 4749–4752 (2000).

Fortunato, E.M., L. Viola, J. Hodges, G. Teklemariam, and D.G. Cory, "Implementation of universal control on a decoherence-free qubit," *New Journal of Physics* **4**, 5.1–5.20 (2002).

Fortunato, E.M., M.A. Pravia, N. Boulant, G. Teklemariam, T.F. Havel, and D.G. Cory, "Design of strongly modulating pulses to implement precise effective Hamiltonians for quantum information processing," *Journal of Chemical Physics* **116**, 7599–7606 (2002).

Freedman, M., A. Kitaev, M.J. Larsen, and Z. Wang, "Topological quantum computation," *Bulletin of the American Mathematical Society* **40**, 31–38 (2003) [*quant-ph/0101025*].

Freedman, M., A. Kitaev, M.J. Larsen, and Z. Wang, "Topological Quantum Compu-tation", *Bulletin of the American Mathematical Society* **40**, 31 (2003) [*quant-ph/0101025*].

Friebel, S., C. D'Andrea, J. Walz, M. Weitz, and T.W. Haensch, "CO_2-laser optical lattice with cold rubidium atoms," *Physical Review A* **57**, R20–R23 (1998).

Friedman, J.R., V. Patel, W. Chen, S.K. Tolpygo, and J.E. Lukens, "Quantum superposition of distinct macroscopic states," *Nature* **406**, 43–46, (2000).

Furusawa, A., J. Sorensen, S.L. Braunstein, C. Fuchs, H.J. Kimble, and E.S. Polzik, "Unconditional quantum teleportation," *Science* **282**, 706–709 (1998).

Gacs, P. "Quantum algorithmic entropy," *Journal of Physics A: Mathematical and General* **34**(35), 6859–6880 (2001).

Gershenfeld, N. and I.L. Chuang, "Bulk spin-resonance quantum computation," *Science* **275**, 350–356 (1997).

Gheri, K.M., P. Torma, and P. Zoller, "Quantum state engineering with photonic qubits," *Acta Physica Slovaca* **49**, 523–532 (1999).

Gisin, N., G. Ribordy, W. Tittel, and H. Zbinden, "Quantum cryptography," *Reviews of Modern Physics* **74**, 145–195 (2002).

Gottesman, D. and I. Chuang, "Quantum digital signatures," (8-May-01) preprint *quant-ph/0105032*.

Gottesman, D. and I.L. Chuang, "Demonstrating the viability of universal quantum computation using teleportation and single qubit operations," *Nature* **402**, 390–393 (1999).

Gottesman, D., "An introduction to quantum error correction," in *Quantum Computation: A Grand Mathematical Challenge for the Twenty-First Century and the Millennium*, S. Lomonaco, Jr., Ed., (American Mathematical Society, Providence, Rhode Island, 2002), pp. 221–235 [*quant-ph/0004072*].

Gottesman, D., A.Y. Kitaev, and J. Preskill, "Encoding a qubit in an oscillator," *Physical Review A* **64**, 012310 (2001).

Gottesmann, D., "Stabilizer codes and quantum error correction," Ph.D. thesis, California Institute of Technology (1997) (114 pp. electronic version at *quant-ph/9705052*).

Granata, C., V. Corato, L. Longobardi, M. Russo, B. Ruggiero, and P. Silvestrini, "Josephson device for quantum experiments," *Applied Physics Letters* **80**, 2952–2954 (2002).

Greiner, M., O. Mandel, T. Esslinger, T.W. Haensch, and I. Bloch, "Quantum phase transition from a superfluid to a Mott insulator in a gas of ultracold atoms," *Nature* **415**, 39–44 (2002).

Greiner, M., O. Mandel, T.W. Haensch, and I. Bloch, "Collapse and revival of the matter wave field of a Bose-Einstein condensate," *Nature* **419**, 51–54 (2002).

Grigni, M., L. Schulman, M. Vazirani, and U. Vazirani, "Quantum mechanical algorithms for the nonabelian hidden subgroup problem," *Proceedings of the 33rd ACM Symposium on Theory of Computing (STOC 2001)*, (ACM Press, New York, NY, USA, 2001), pp. 68–74 [ISBN: 1-58113-349-9].

Grover, L., "A fast quantum mechanical algorithm for database search," *Proceedings of the 28th Annual ACM Symposium on Theory of Computing*, (Association for Computing Machinery Press, New York, 1999) pp. 212–219 [ISBN: 0-89791-785-5, *quant-ph/9605043*].

Guest, J.R., T.H. Stievater, G. Chen, E.A. Tabak, B.G. Orr, D.G. Steel, D. Gammon, and D.S. Katzer, "Near-field coherent spectroscopy and microscopy of a quantum dot system," *Science* **293**, 2224–2227 (2001).

Gulde, S., M. Riebe, G.P.T. Lancaster, C. Becher, J. Eschner, H. Häffner, F. Schmidt-Kaler, I.L. Chuang, R. Blatt, "Implementation of the Deutsch-Jozsa algorithm on an ion-trap quantum computer." *Nature* **421**, 48–50 (2003). (new gate demonstrated as part of this)

Gupta, J.A., R. Knobel, N. Samarth, and D.D. Awschalom, "Ultrafast manipulation of electron spin coherence," *Science* **292**, 2458–2461 (2001).

Guthohrlein, G.R., M. Keller, K. Hayasaka, W. Lange, and H. Walther, "A single ion as a nanoscopic probe of an optical field," *Nature* **414**, 49–51 (2001).

Hagley, E., X. Maître, G. Nogues, C. Wunderlich, M. Brune, J.M. Raimond, and S. Haroche, "Generation of Einstein-Podolsky-Rosen pairs of atoms," *Physical Review Letters* **79**, 1–5 (1997).

Hales, L. and S. Hallgren, "An improved quantum Fourier transform algorithm and applications," *Proceedings of the 41st Annual Symposium on Foundations of Computer Science (FOCS'00)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 2000) pp. 515–525.

Hallgren, S., "Polynomial-time quantum algorithms for Pell's equation and the principal ideal problem," *Proceedings of the 34th Annual ACM Symposium on Theory of Computing*, (Association for Computing Machinery Press, New York, 2002) pp. 653–658 [ISBN: 1-58113-495-9].

Hamann, S.E., D.L. Haycock, G. Klose, P.H. Pax, I.H. Deutsch, and P.S. Jessen, "Resolved-sideband Raman cooling to the ground state of an optical lattice," *Physical Review Letters* **80**, 4149–4152 (1998).

Han, D.J., S. Wolf, S. Oliver, C. McCormick, M.T. Depue, and D.S. Weiss, "3D Raman sideband cooling of cesium atoms at high density," *Physical Review Letters* **85**, 724–727 (2000).

Hau, L.V., S.E. Harris, Z. Dutton, and C.H. Behroozi, "Light speed reduction to 17 metres per second in an ultracold atomic gas," *Nature* (London) **397**, 594–598 (1999).

Havel, T.F., S.S. Somaroo, C.-H. Tseng, and D.G. Cory, "Principles and demonstrations of quantum information processing by NMR spectroscopy," *Applicable Algebra in Engineering, Communication, and Computing* **10**, 339–374 (2000).

Haycock, D.L., P.M. Alsing, I.H. Deutsch, J. Grondalski, and P.S. Jessen, "Mesoscopic quantum coherence in an optical lattice," *Physical Review Letters* **85**, 3365–3368 (2000).

Hayden, P., D.W. Leung, P.W. Shor, and A. Winter, "Randomizing quantum states: Constructions and applications," (13-Nov-03) preprint *quant-ph/0307104*.

Hayden, P., R. Jozsa, and A. Winter, "Trading quantum for classical resources in quantum data compression," *Journal of Mathematical Physics* **43**(9), 4404–4444 (2002).

Hemmer, P.R., A.V. Turukhin, M.S. Shahriar, and J.A. Musser, "Raman excited spin coherence in NV-diamond," *Optics Letters* **26**, 361–363 (2001).

Hinds, E.A., M.G. Boshier, and I.G. Hughes, "Magnetic waveguide for trapping cold atoms in two dimensions," *Physical Review Letters* **80**, 645–649 (1998).

Hofmann, H.F. and S. Takeuchi, "Quantum phase gate for photonic qubits using only beam splitters and post-selection," *Physical Review A* **66**, 024308 (2002).

Hofmann, H.F. and S. Takeuchi, "Realization of quantum operations on photonic qubits by linear optics and post-selection," *Proceedings of The Sixth Quantum Information Technology Symposium* May 27th–28th, Kyoto, Japan (2002); also (13-May-02) preprint *quant-ph/0204045*.

Holevo, A.S., "Bounds for the quantity of information transmitted by a quantum communication channel," *Problems of Information Transmission* **9**(3), 177–183 (1973).

Holevo, A.S., "On capacity of a quantum communications channel," *Problems of Information Transmission* **15**(4), 247–253 (1979).

Holevo, A.S., "Problems in the mathematical theory of quantum communication channels," *Reports on Mathematical Physics* **12**(2), 273–278 (1977).

Holevo, A.S., "The capacity of the quantum channel with general signal states," *IEEE Transactions on Information Theory* **IT-44**(#1), 269–273 (1998).

Hong, C.K. and L. Mandel, "Experimental realization of a localized one-photon state," *Physical Review Letters* **56**, 58–60 (1986).

Hong, C.K., Z.Y. Ou, and L. Mandel, "Measurement of subpicosecond time intervals between two photons by interference," *Physical Review Letters* **59**, 2044–2046 (1987).

Hood, C.J., M.S. Chapman, T.W. Lynn, and H.J. Kimble, "Real-time cavity QED with single atoms," *Physical Review Letters* **80**, 4157–4160 (1998).

Hood, C.J., T.W. Lynn, A.C. Doherty, D.W. Vernooy, J. Ye, and H.J. Kimble, "Single atoms bound in orbit by single photons," *Laser Physics* **11**, 1190–1192 (2001).

Horodecki, M., P. Horodecki, and R. Horodecki, "Separability of mixed states: Necessary and sufficient conditions," *Physics Letters A* **223**, 1 (1996).

Horodecki, P., "Separability criterion and inseparable mixed states with positive partial transposition," *Physics Letters A* **232**(5), 333–339 (1997).

Howell, J.C. and J.A. Yeazell, "Linear optics simulations of the quantum baker's map," *Physical Review A* **61**, 012304 (2000).

Howell, J.C., J.A. Yeazell, and D. Ventura, "Optically simulating a quantum associative memory," *Physical Review A* **62**, 042303 (2000).

Huttner, B. and A.K. Ekert, "Information gain in quantum eavesdropping," *Journal of Modern Optics* **41**, 2455–2466 (1994)

Ilchenko, V.S., P.S. Volikov, V.L. Velichansky, F. Treussart, V. Lefèvre-Seguin, J.-M. Raimond, and S. Haroche, "Strain-tunable high-Q optical microsphere resonator," *Optics Communications* **145**, 86–90 (1998).

Imamoglu, A., "High efficiency photon counting using stored light," *Physical Review Letters* **89**, 163602 (2002).

Ip, L., "Solving shift problems and hidden coset problem using the Fourier transform," (7-May-02) preprint *quant-ph/0205034*.

Jaksch, D., C. Bruder, J.I. Cirac, C.W. Gardiner, and P. Zoller, "Cold bosonic atoms in optical lattices," *Physical Review Letters* **81**, 3108–3111 (1998).

Jaksch, D., H.-J. Briegel, J.I. Cirac, C.W. Gardiner, and P. Zoller, "Entanglement of atoms via cold controlled collisions," *Physical Review Letters* **82**, 1975–1978 (1999).

Jaksch, D., J.I. Cirac, P. Zoller, S.L. Rolston, R. Cote, and M.D. Lukin, "Fast quantum gates for neutral atoms," *Physical Review Letters* **85**, 2208–2211 (2000). (Rydberg dipole)

Jaksch, D., V. Venturi, J.I. Cirac, C.J. Williams, and P. Zoller, "Creation of a molecular condensate by dynamically melting a Mott insulator," *Physical Review Letters* **89**, 040402 (2002).

James, D.F.V. and P.G. Kwiat, "Atomic vapor-based high efficiency optical detectors with photon number resolution," *Physical Review Letters* **89**, 183601 (2002).

James, D.F.V., P.G. Kwiat, W.J. Munro, and A.G. White, "Measurement of qubits," *Physical Review A* **64**, 052312 (2001).

Jessen, P.S. and I.H. Deutsch, "Optical lattices," in *Advances in Atomic, Moledular, and Optical Physics,* Vol. 37, B. Bederson and H. Walther, Eds., (Academic, San Diego, 1996), pp. 95–138.

Jones, J.A. and M. Mosca, "Approximate quantum counting on an NMR ensemble quantum computer," *Physical Review Letters*, **83**, 1050–1053 (1999).

Jones, J.A. and M. Mosca, "Implementation of a quantum algorithm on a nuclear magnetic resonance quantum computer," *Journal of Chemical Physics* **109**, 1648–1653 (1998).

Jones, J.A., M. Mosca, and R.H. Hansen, "Implementation of a quantum search algorithm on a quantum computer," *Nature* **393**, 344–346 (1998).

Jones, J.A., V. Vedral, A. Ekert, and G. Castagnoli, "Geometric quantum computation using nuclear magnetic resonance," *Nature* **403**, 869–871 (2000).

Jozsa, R. and N. Linden, "On the role of entanglement in quantum computational speed-up," *Proceedings of the Royal Society of London Series A - Mathematical Physical and Engineering Sciences* **459**(2036), 2011–2032 (2003) [*quant-ph/020114*].

Kane, B.E., "Silicon-based quantum computation," *Progress of Physics* **48**, 1023–1041 (2000).

Kane, B.E.,"A silicon-based nuclear spin quantum computer," *Nature* **393**, 133–137 (1998).

Kaplan, A., M.F. Andersen, and N. Davidson, "Suppression of inhomogeneous broadening in rf spectroscopy of optically trapped atoms," *Physical Review A* **66**, 045401 (2002).

Kash, M.M., V.A. Sautenkov, A.S. Zibrov, L. Hollberg, G.R. Welch, M.D. Lukin, Y. Rostovtsev, E.S. Fry, and M.O. Scully, "Ultraslow group velocity and enhanced nonlinear optical effects in a coherently driven hot atomic gas," *Physical Review Letters* **82**, 5229–5232 (1999).

Kerenidis, I. and R. de Wolf, "Quantum symmetrically-private information retrieval," (10-Jul-03) preprint *quant-ph/0307076*.

Kielpinski, D., C. Monroe, and D.J. Wineland, "Architecture for a large-scale ion-trap quantum computer," *Nature* **417**, 709–711 (2002).

Kim, J., O. Benson, H. Kan, and Y. Yamamoto, "A single-photon turnstile device," *Nature* **397**, 500–503 (1999).

Kim, J., S. Takeuchi, Y. Yamamoto, and H.H. Hogue, "Multiphoton detection using visible light photon counter," *Applied Physics Letters* **74**, 902–904 (1999).

Kim, Y.-H., S.P. Kulik, and Y. Shih, "Quantum teleportation of a polarization state with a complete Bell state measurement," *Physical Review Letters* **86**, 1370–1373 (2001).

Kitaev, A., "Quantum measurements and the abelian stabilizer problem," *Proceedings of the Electronic Colloquium on Computational Complexity (ECCC-1996)*, **3**(3), ECCC Report TR96-003 (1996) [*quant-ph/9511026*].

Kitaev, A.Y,, "Quantum computations: Algorithms and error correction," *Russian Mathematical Surveys* **52**, 1191–1249 (1997).

Kitaev, A.Y. and J. Watrous, "Parallelization, amplification, and exponential time simulation of quantum interactive proof systems," *Proceedings of the 32nd ACM Symposium on Theory of Computing (STOC 2000)*, (ACM Press, New York, NY, USA 2000), pp. 608–617 [ISBN: 1-58113-184-4].

Kitaev, A.Y., "Quantum coin tossing," MSRI lecture, (available at URL: http://www.msri.org/publications/ln/msri/2002/qip/kitaev/1/).

Klose, G., G. Smith, and P.S. Jessen, "Measuring the quantum state of a large angular momentum," *Physical Review Letters* **86**, 4721–4724 (2001).

Knill E. and R. Laflamme "On the power of one bit of quantum information," *Physical Review Letters* **81**, 5672–5675 (1998).

Knill, E., "Quantum gates using linear optics and post selection," *Physical Review A* **66**, 052306 (2002).

Knill, E., I.L. Chuang, and R. Laflamme, "Effective pure states for bulk quantum computation," *Physical Review A*. **57**, 3348–3363 (1998).

Knill, E., R. Laflamme and G.J. Milburn, "A scheme for efficient quantum computation with linear optics," *Nature* **409**, 46–52 (2001).

Knill, E., R. Laflamme and W.H. Zurek, "Resilient quantum computation: Error models and thresholds," *Proceedings of the Royal Society of London: Series A - Mathematical and Physical Sciences A* **454**, 365–384 (1998).

Knill, E., R. Laflamme, and G.J. Milburn, "Efficient linear optics quantum computation," *Nature* **409**, 46–52 (2001).

Knill, E., R. Laflamme, R. Martinez, and C. Negreverne, "Benchmarking quantum computers: The five-qubit error correcting code," *Physical Review Letters* **86**, 5811–5814 (2001).

Knill, E., R. Laflamme, R. Martinez, and C.-H. Tseng, "An algorithmic benchmark for quantum information processing," *Nature* **404**, 368–370 (2000).

Kobayashi, H. and K. Matsumoto, "Quantum multi-prover interactive proof systems with limited prior entanglement," *Journal of Computer and System Sciences* **66**(3), 429–450 (2003).

Kosaka, H., A.A. Kiselev, F.A. Baron, K.-W. Kim, and E. Yablonovitch, "Electron g-factor engineering in III–IV semiconductors for quantum communication," *Electronics Letters* **37**, 464 (2001).

Kostoff R.N. and R.R. Schaller, "Science and technology roadmaps," *IEEE Transactions on Engineering Management* **48**, 132–143 (2001).

Kozhekin, A.E., K. Mølmer, and E. Polzik, "Quantum memory for light," *Physical Review A* **62**, 033809 (2000).

Kuhn, A., M. Hennrich, and G. Rempe, "Deterministic single-photon source for distributed quantum networking," *Physical Review Letters* **89**, 067901 (2002).

Kuhn, A., M. Hennrich, T. Bondo, and G. Rempe, "Controlled generation of single photons from a strongly coupled atom-cavity system," *Applied Physics B* **69**, 373–377 (1999).

Kuhr, S., W. Alt, D. Schrader, I. Dotsenko, Y. Miroshnychenko, W. Rosenfeld, M. Khudaverdyan, V. Gomer, A. Rauschenbeutel, and D. Meschede, "Coherence properties and quantum state transportation in an optical conveyor belt," *Physical Review Letters* **91**, 213002 (2003).

Kuperberg, A., "Subexponential-time quantum algorithm for the dihedral hidden subgroup problem," (14-Feb-03) preprint *quant-ph/0302112*.

Kurtsiefer, C., S. Mayer, P. Zarda, and H. Weinfurter, "A stable solid-state source of single photons," *Physical Review Letters* **85,** 290–293 (2000).

Kwiat, P.G., "Hyper-entangled states," *Journal of Modern Optics* **44**, 2173–2184 (1997).

Kwiat, P.G., A.J. Berglund, J.B. Altepeter, and A.G. White, "Experimental verification of decoherence-free subspaces," *Science* **290**, 498–501 (2000).

Kwiat, P.G., A.M. Steinberg, R.Y. Chiao, P. Eberhard and M. Petroff, "High efficiency single-photon detectors," *Physical Review A* **48**, R867–R870 (1993).

Kwiat, P.G., E. Waks, A.G. White, I. Appelbaum, and P.H. Eberhard, "Ultrabright source of polarization-entangled photons," *Physical Review A* **60**, R773–R776 (1999).

Kwiat, P.G., J. Altepeter, J. Barreiro, D. Branning, E.R. Jeffrey, N. Peters, and A.P. van Devender, "Optical technologies for quantum information science," *Proceedings of SPIE International Society of Optical Engineering* **5161**, 87–100 (2004).

Kwiat, P.G., J.R. Mitchell, P.D.D. Schwindt, and A.G. White, "Grover's search algorithm: An optical approach," *Journal of Modern Optics* **47**, 257–266 (2000).

Kwiat, P.G., K. Mattle, H. Weinfurter, A. Zeilinger, A.V. Sergienko, and Y.H. Shih, "New high-intensity source of polarization-entangled photon pairs," *Physical Review Letters* **75**, 4337–4341 (1995).

Laflamme, R., D.G. Cory, C. Negrevergne, and L. Viola, "NMR quantum information processing and entanglement," *Quantum Information and Computation* **2**, 166–176 (2002).

Laflamme, R., E. Knill, W.H. Zurek, P. Catasti, and S.V.S. Mariappan, "NMR Greenberger-Horne-Zeilinger states," *The Royal Society Philosophical Transactions: Mathematical, Physical, and Engineering Sciences* **356**, 1941–1948 (1998).

Landauer, R., "Irreversibility and heat generation in the computing process," *IBM Journal of Research and Development* **5**(3), 183–191 (1961).

Lange, W. and H.J. Kimble, "Dynamic generation of maximally entangled photon multiplets by adiabatic passage," *Physical Review A* **61**, 063817 (2000).

Lapaire, G.G., P. Kok, J.P. Dowling, and J.E. Sipe, *Physical Review A* **68,** 042314 (2003).

Law, C.K. and H.J. Kimble, "Deterministic generation of a bit-stream of single-photon pulses," *Journal of Modern Optics* **44**, 2067–2074 (1997).

Leibfried, D., B. DeMarco, V. Meyer, D. Lucas, M. Barrett, J. Britton, W.M. Itano, B. Jelenkovic, C. Langer, T. Rosenband, and D.J. Wineland, "Experimental demonstration of a robust, high-fidelity geometric two ion-qubit phase gate," *Nature* **422**, 412–415 (2003).

Leibfried, D., B. DeMarco, V. Meyer, M. Rowe, A. Ben-Kish, J. Britton, W.M. Itano, B. Jelenkovic, C. Langer, T. Rosenband, and D.J. Wineland, "Trapped-ion quantum simulator: experimental application to nonlinear interferometers," *Physical Review Letters* **89**, 247901 (2002).

Leibfried, D., D.M. Meekhof, B.E. King, C. Monroe, W.M. Itano, and D.J. Wineland, "Experimental determination of the motional quantum state of a trapped atom," *Physical Review Letters* **77**, 4281–4284 (1996).

Leibfried, D., D.M. Meekhof, C. Monroe, B.E. King, W.M. Itano, and D.J. Wineland, "Experimental preparation and measurement of quantum states of motion of a trapped atom," *Journal of Modern Optics* **44**, 2485–2505 (1997).

Leung, D., LM.K. Vandersypen, X. Zhou, M. Sherwood, C. Yannoni, M. Kubinec, and I.L. Chuang, "Experimental realization of a two-bit phase damping quantum code," *Physical Review A* **60**, 1924–1943 (1999).

Leung, D.W., "Quantum Vernam cipher," *Quantum Information and Computation*; **2**(1), 14–34 (2002) [*quant-ph/0012077*].

Levitt, M.H., "Composite pulses," *Progress in NMR Spectroscopy* **18**, 61–122 (1986).

Lewenstein, M., B. Krauss, J.I. Cirac, and P. Horodecki, "Optimization of entanglement witnesses," *Physical Review A* **62**, 052310 (2000).

Lidar D.A., and K.B. Whaley, "Decoherence-free subspaces and subsystems in irreversible quantum dynamics," in *Springer Lecture Notes in Physics*, F. Benatti and R. Floreanini, Eds., (Springer-Verlag, Berlin, 2003) Vol. 622, pp. 83120 [*quant-ph/0301032*].

Linden, N., H. Barjat, R. Kupic, and R. Freeman, "How to exchange information between two coupled nuclear spins: the universal SWAP operation," *Chemical Physics Letters* **307**, 198–204 (1999).

Liu, C., Z. Dutton, C.H. Behroozi and L.V. Hau, "Observation of coherent optical information storage in an atomic medium using halted light pulses," *Nature* **409**, 490–493 (2001).

Lloyd, S. and S.L. Braunstein, "Quantum computation over continuous variables," *Physical Review Letters* **82**, 1784–1787 (1999).

Lloyd, S., "A potentially realizable quantum computer," *Science* **261**, 1569–1571 (1993).

Lloyd, S., M.S. Shahriar, J.H. Shapiro, and P.R. Hemmer, "Long distance, unconditional teleportation of atomic states via complete Bell state measurements," *Physical Review Letters* **87**, 167903 (2001).

Lo, H.-K. and H.F. Chau, "Unconditional security of quantum key distribution over arbitrarily long distances," *Science* **283**, 2050–2056 (1999).

Lo, H.-K., "Classical-communication cost in distributed quantum-information processing: A generalization of quantum-communication complexity," *Physical Review A* **62**, 012313 (2000).

Loss, D. and D.P. Divincenzo, "Exact Born approximation for the spin-boson model," (10-Apr-03) preprint *cond-mat/0304118*.

Loss, D. and D.P. DiVincenzo, "Quantum computation with quantum dots," *Physical Review A* **57**, 120–126 (1998).

Lukin, M.D. and A. Imamoglu, "Nonlinear optics and quantum entanglement of ultraslow single photons," *Physical Review Letters* **84**, 1419–1422 (2000).

Lukin, M.D. and P.R. Hemmer, "Quantum entanglement via optical control of atom-atom interactions," *Physical Review Letters* **84**, 2818–2821 (2000).

Lukin, M.D., M. Fleischhauer, R. Cote, L.M. Duan, D. Jaksch, J.I. Cirac, and P. Zoller, "Dipole blockade and quantum information processing in mesoscopic atomic ensembles," *Physical Review Letters* **87**, 037901 (2001).

Lund, A.P., T.B. Bell, and T.C. Ralph, "Comparison of linear optics quantum-computation control-sign gates with ancilla inefficiency and an improvement to functionality under these conditions," *Physical Review A* **68**, 022313 (2003).

Mabuchi, H. and A.C. Doherty, "Cavity quantum electrodynamics: Coherence in context," *Science* **298**, 1372–1377 (2002).

Mabuchi, H., Q.A. Turchette, M.S. Chapman, and H.J. Kimble, "Real-time detection of individual atoms falling through a high-finesse optical cavity," *Optics Letters* **21**, 1393–1395 (1996).

Madi, Z.L., R. Brüschweiller, and R.R. Ernst, "One- and two-dimensional ensemble quantum computing in spin Liouville space," *Journal of Chemical Physics* **109**, 10603–10611 (1998).

Magniez, F., M. Santha, and M. Szegedy, "Quantum algorithm for detecting triangles," manuscript 2003.

Mahesh, T.S. and A. Kumar, "Ensemble quantum-information processing by NMR: Spatially averaged logical labeling technique for creating pseudopure states," *Physical Review A* **64**, 012307 (2001).

Maklin, Y., G. Schön, and A. Shnirman, "Quantum-state engineering with Josephson-junction devices," *Reviews of Modern Physics* **73**, 357–400 (2001).

Mandel, O., M. Greiner, A. Widera, T. Rom, T.W. Haensch, and I. Bloch, "Coherent transport of neutral atoms in spin-dependent optical lattice potentials," *Physical Review Letters* **91**, 010407 (2003).

Mankins, J.C., "Approaches to strategic research and technology (R&T) analysis and road mapping," *Acta Astronautica* **51**, 3–21 (2002).

Martinis, J.M., S.-W. Nam, J. Aumentado, and C. Urbina, "Rabi oscillations in a large Josephson-junction qubit," *Physical Review Letters* **89**, 117901 (2002).

Mayers, D., "Unconditionally secure quantum bit commitment is impossible," *Physical Review Letters* **78**, 3414–3417 (1997).

Mazzei, A., M. Ricci, F. De Martini, and G.M. D'Ariano, "Pauli tomography: Complete characterization of a single qubit device," *Fortschritte de Physik* **51**, 342 (2003).

McKeever, J., A. Boca, A.D. Boozer, J.R. Buck, and H.J. Kimble, "Experimental realization of a one-atom laser in the regime of strong coupling," *Nature* **425**, 268–271 (2003).

McKeever, J., A. Boca, A.D. Boozer, R. Miller, J.R. Buck, A. Kuzmich, and H.J. Kimble, "Deterministic generation of single photons from one atom trapped in a cavity," *Science* **303**, 1992–1994 (2004).

McKeever, J., A. Boca, A.D. Boozer, R. Miller, J.R. Buck, A. Kuzmich, and H.J. Kimble, "Deterministic generation of single photons from one atom trapped in a cavity" *Science Express Reports* (online 26 February 2004).

McKeever, J., J.R. Buck, A.D. Boozer, A. Kuzmich, H.-C. Nägerl, D.M. Stamper-Kurn, and H.J. Kimble, "State-insensitive cooling and trapping of single atoms in an optical cavity," *Physical Review Letters* **90**, 133602 (2003).

Meekhof, D.M., C. Monroe, B. King, W.M. Itano, and D.J. Wineland, "Generation of nonclassical motional states of a trapped atom," *Physical Review Letters* **76**, 1796–1799 (1996); erratum, **77**, 2346 (1996).

Mehring, M., J. Mende, and W. Scherer, "Entanglement between an electron and a nuclear spin 1/2," *Physical Review Letters* **90**, 153001 (2003).

Meyer, V., M.A. Rowe, D. Kielpinski, C.A. Sackett, W.M. Itano, C. Monroe, and D.J. Wineland, "Experimental demonstration of entanglement-enhanced rotation angle estimation using trapped ions," *Physical Review Letters* **86**, 5870–5873 (2001).

Michler, P., A. Kiraz, C. Becher, W.V. Schoenfeld, P.M. Petroff, L. Zhang, E. Hu, and A. Imamoglu, "A quantum dot single-photon turnstile device," *Science* **290**, 2282–2285 (2000).

Migdall, A.L., D. Branning, S. Castelletto, and M. Ware, "Tailoring single and multiphoton probabilities of a single photon on-demand," *Physical Review A* **66**, 053805 (2002).

Milner, V., J.L. Hanssen, W.C. Campbell, and M.G. Raizen, "Optical billiards for atoms," *Physical Review Letters* **86**, 1514–1517 (2001).

Mitchell, M.W., C.W. Ellenor, S. Schneider, and A.M. Steinberg, "Diagnosis, prescription and prognosis of a Bell-state filter by quantum process tomography," *Physical Review Letters* **91**, 120402 (2003).

Mohseni, M., J.S. Lundeen, K.J. Resch, A.M. Steinberg, "Experimental application of decoherence-free subspaces in a quantum-computing algorithm" *Physical Review Letters* **91**, 187903 (2003).

Monroe, C., "Quantum information processing with atoms and photons," *Nature* **416**, 238–246 (2002).

Monroe, C., D. Leibfried, B.E. King, D.M. Meekhof, W.M. Itano, and D.J. Wineland, "Simplified quantum logic with trapped ions," *Physical Review A* **55**, R2489–2491 (1997).

Monroe, C., D.M. Meekhof, B.E. King, W.M. Itano, and D.J. Wineland, "Demonstration of a fundamental quantum logic gate," *Physical Review Letters* **75**, 4714–4717 (1995).

Mosca, M., A. Tapp, and R. de Wolf, "Private quantum channels and the cost of randomizing quantum information," (22-Mar-00) preprint *quant-ph/0003101*.

Mundt, A.B., A. Kreuter, C. Becher, D. Leibfried, J. Eschner, F. Schmidt-Kaler, and R. Blatt, "Coupling a single atomic quantum bit to a high finesse optical cavity," *Physical Review Letters* **89**, 103001 (2002).

Münstermann, P., T. Fischer, P. Maunz, P.W.H. Pinkse, and G. Rempe, "Observation of cavity-mediated long-range light forces between strongly coupled atoms," *Physical Review Letters* **84**, 4068–4071 (2000).

Münstermann, P., T. Fischer, P. Maunz, P.W.H. Pinkse, and G. Rempe, "Dynamics of single-atom motion observed in a high-finesse cavity," *Physical Review Letters* **82**, 3791–3794 (1999).

Munstermann, P., T. Fischer, P.W.H. Pinkse, and G. Rempe, "Single slow atoms from an atomic fountain observed in a high-finesse optical cavity," *Optics Communications* **159**, 63–67 (1999).

Myrgren E. and K.B. Whaley, "Implementing a quantum algorithm with exchange-coupled quantum dots: A feasibility study," Quantum Information Processing, **2**(5), 1 (2003) [*quant-ph/0309051*].

Nägerl, HC., D. Leibfried, H. Rohde, G. Thalhammer, J. Eschner, F. Schmidt-Kaler, and R. Blatt, "Laser addressing of individual ions in a linear ion trap," *Physical Review A* **60**, 145–148 (1999).

Nagourney, W., J. Sandberg, and H. Dehmelt, "Shelved optical electron amplifier: Observation of quantum jumps," *Physical Review Letters* **56**, 2797–2799 (1986).

Nakamura, Y., Y.A. Pashkin, and J.S. Tsai, "Coherent control of macroscopic quantum states in a single-Cooper-pair box," *Nature* **398**, 786–788 (1999).

Nakamura, Y., Y.A. Pashkin, and J.S. Tsai, "Rabi oscillations in a Josephson-junction charge two-level system," *Physical Review Letters* **87**, 246601 (2001).

Nelson, R.J., D.G. Cory, and S. Lloyd, "Experimental demonstration of Greenberger-Horne-Zeilinger correlations using nuclear magnetic resonance," *Physical Review A* **61**, 022106 (2000).

Neuhauser, W., M. Hohenstatt, P.E. Toschek, and H. Dehmelt, "Localized visible Ba^+ mono-ion oscillator," *Physical Review A* **22**, 1137–1140 (1980).

Nielsen, M.A. and I.L. Chuang, *Quantum Computation and Quantum Information*, (Cambridge University Press, Cambridge, UK, 2000), Sec. 8.2.

Nielsen, M.A., "Conditions for a class of entanglement transformations," *Physical Review Letters* **83**(2), 436–439 (1999).

Nielsen, M.A., E. Knill, and R. Laflamme, "Complete quantum teleportation using nuclear magnetic resonance," *Nature* **396**, 52–55 (1998).

O'Brien, J.L., G.J. Pryde, A.G. White, T.C. Ralph, and D. Branning, "Demonstration of an all-optical quantum controlled-NOT gate," *Nature* **426**, 264 (2003).

Ollerenshaw, J.E., D.A. Lidar, and L.E. Kay, "Magnetic resonance realization of decoherence-free quantum computation," *Physical Review Letters* **91**, 217904 (2003).

Ou, Z.Y. and L. Mandel, "Violation of Bell's inequality and classical probability in a two-photon correlation experiment," *Physical Review Letters* **61**, 50–53 (1988).

Pachos, J. and H. Walther, "Quantum computation with trapped ions in an optical cavity," *Physical Review Letters* **89**, 187903 (2002).

Pan, J.-W., D. Bouwmeester, H. Weinfurter, and A. Zeilinger, "Experimental entanglement swapping: Entangling photons that never interacted," *Physical Review Letters* **80** 3891–3894 (1998).

Pan, J.-W., M. Daniell, S. Gasparoni, G. Weihs, and A. Zeilinger, "Experimental demonstration of four-photon entanglement and high-fidelity teleportation," *Physical Review Letters* **86**, 4435–4438 (2001).

Pazy, E., E. Biolatti, T. Calarco, I. D'Amico, P. Zanardi F. Rossi, and P. Zoller "Spin-based optical quantum gates via Pauli blocking in semiconductor quantum dots," (19-Sep-2001) preprint *cond-mat/0109337*.

Peil, S., J.V. Porto, B. Laburthe-Tolra, J.M. Obrecht, B.E. King, M. Subbotin, S.I. Rolston, and W.D. Phillips, "Patterned loading of a Bose-Einstein condensate into an optical lattice," *Physical Review A* **67**, 051603(R) (2003).

Pellizzari, T., "Quantum networking with optical fibers," *Physical Review Letters* **79**, 5242–5245 (1997).

Pellizzari, T., S.A. Gardiner, J.I. Cirac, and P. Zoller, "Decoherence, continuous observation, and quantum computing: A cavity QED model," *Physical Review Letters* **75**, 3788–3791 (1995).

Peres, A., "Separability criterion for density matrices," *Physical Review Letters* **77**, 1413 (1996).

Perrin, H., A. Kuhn, I. Bouchoule, and C. Salomon, "Sideband cooling of neutral atoms in a far-detuned optical lattice," *Europhysics Letters* **42**, 395–400 (1998).

Phillips, D.F., A. Fleischhauer, A. Mair, R.L. Walsworth, and M.D. Lukin, "Storage of light in atomic vapor," *Physical Review Letters* **86**, 783–786 (2001).

Piermarocchi, C., P. Chen, L.J. Sham, and D.G. Steel, "Optical RKKY interaction between charged semiconductor quantum dots," *Physical Review Letters* 89, 167402 (2002).

Pinkse, P.W.H., T. Fischer, P. Maunz, and G. Rempe, "Trapping an atom with single photons," *Nature* **404**, 365–368 (2000).

Pittman, T.B. and J.D. Franson, "Cyclical quantum memory for photonic qubits," *Physical Review A* **66**, 062302 (2002).

Pittman, T.B. and J.D. Franson, "Violation of Bell's inequality with photons from independent sources" *Physical Review Letters* **90**, 240401 (2003).

Pittman, T.B., B.C. Jacobs and J.D. Franson, "Demonstration of feed forward control for linear optics quantum computation," *Physical Review A* **66**, 052305 (2002).

Pittman, T.B., B.C. Jacobs and J.D. Franson, "Demonstration of non-deterministic quantum logic operations using linear optical elements," *Physical Review Letters* **88**, 257902 (2002).

Pittman, T.B., B.C. Jacobs, and J.D. Franson, "Probabilistic quantum logic operations using polarizing beam splitters," *Physical Review A* **64**, 062311 (2001).

Pittman, T.B., B.C. Jacobs, and J.D. Franson, "Single photons on pseudo-demand from stored parametric down-conversion," *Physical Review A* **66**, 042303 (2002).

Plenio, M.B. and P.L. Knight, "Decoherence limits to quantum computation using trapped ions," *Proceedings of the Royal Society of London, Series A – Mathematical and Physical Sciences*, **453**, 2017–2041 (1997).

Poulin, D., R. Blume-Kohout, R. Laflamme, and H. Ollivier, "Exponential speed-up with a single bit of quantum information: Testing the quantum butterfly effect," (6-Oct-03) preprint *quant-ph/0310038*.

Poyatos, J.F., J.I. Cirac and P. Zoller, "Complete characterization of a quantum process: the two-bit quantum gate," *Physical Review Letters* **78**, 390–393 (1997).

Pravia, M.A., E.M. Fortunato, Y. Weinstein, M.D. Price, G. Teklemariam, R.J. Nelson, Y. Sharf, S.S. Somaroo, C.-H. Tseng, T.F. Havel, and D.G. Cory, "Observations of quantum dynamics by solution-state NMR spectroscopy," *Concepts in Magnetic Resonance* **11**, 225–238 (1999).

Pravia, M.A., N. Boulant, J. Emerson, A. Farid, E.M. Fortunato, T.F. Havel, R. Martinez, and D.G. Cory, "Robust control of quantum information," *Journal of Chemical Physics* **119**, 9993–10001 (2003).

Preskill, J., "Reliable quantum computers," *Proceedings of the Royal Society of London: Series A – Mathematical and Physical Sciences A* **454**, 385–410 (1998).

Preskill, J., Lecture notes for Caltech graduate course "Quantum Computation" Physics 219/ Computer Science 219 (available at URL: http://www.theory.caltech.edu/people/preskill/ph229/#lecture).

Price, M.D., S.S. Somaroo, C.H. Tseng, J.C. Gore, A.F. Fahmy, T.F. Havel, and D.G. Cory, "Construction and implementation of NMR quantum logic gates for two spin systems," *Journal of Magnetic Resonance* **140**, 371–378 (1999).

Protsenko, I.E., G. Reymond, N. Schlosser, and P. Grangier, "Operation of a quantum phase gate using neutral atoms in microscopic dipole traps," *Physical Review A* **65**, 052301 (2002).

Rafac, R.J., B.C. Young, J.A. Beall, W.M. Itano, D.J. Wineland, and J.C. Bergquist, "Sub-dekahertz ultraviolet spectroscopy of $^{199}Hg^{+}$," *Physical Review Letters* **85**, 2462–2465 (2000).

Raimond, J.M., M. Brune, and S. Haroche, "Manipulating quantum entanglement with atoms and photons in a cavity," *Reviews of Modern Physics* **73**, 565–582 (2001).

Rains, E.M., "Rigorous treatment of distillable entanglement," *Physical Review A* **60**, 173 (1999).

Raithel, G., W.D. Phillips, and S.L. Rolston, "Collapse and revivals of wave packets in optical lattices," *Physical Review Letters* **81**, 3615–3618 (1998).

Ralph, T.C., A. Gilchrist, G.J. Milburn, W.J. Munro, and S. Glancy, "Quantum computation with optical coherent states," *Physical Review A* **68**, 042319 (2003).

Ralph, T.C., A.G. White, and G.J. Milburn "Simple scheme for efficient linear optics quantum gates," *Physical Review A* **65**, 012314 (2002).

Ramanathan, C., H. Cho, P. Cappellaro, G.S. Boutis, and D.G. Cory, "Encoding multiple quantum coherences in non-commuting bases," *Chemical Physics Letters* **369**, 311–317 (2003).

Rauschenbeutel, A., G. Nogues, S. Osnaghi, P. Bertet, M. Brune, J.M. Raimond, and S. Haroche, "Coherent operation of a tunable quantum phase gate in cavity QED," *Physical Review Letters* **83**, 5166–5169 (1999).

Rauschenbeutel, A., G. Nogues, S. Osnaghi, P. Bertet, M. Brune, J.-M. Raimond, and S. Haroche, "Step-by-step engineered multiparticle entanglement," *Science* **288**, 2024–2028 (2000).

Rauschenbeutel, A., P. Bertet, S. Osnaghi, G. Nogues, M. Brune, J.M. Raimond, and S. Haroche, "Controlled entanglement of two field modes in a cavity quantum electrodynamics experiment," *Physical Review A* **64**, 050301 (2001).

Raussendorf, R. and H.J. Briegel, "A one-way quantum computer," *Physical Review Letters* **86**, 5188 (2001).

Raz, R., "Exponential separation of quantum and classical communication complexity," *Proceedings of the 31st ACM Symposium on Theory of Computing (STOC 1999),* (ACM Press, New York, NY, USA, 2001), pp. 358–367.

Razborov, A.A., "An upper bound on the threshold quantum decoherence rate," manuscript.

Recher, P., E.V. Sukhorukov, and D. Loss, "Quantum dot as spin filter and spin memory," *Physical Review Letters* **85**, 1962–1965 (2000).

Redman, D.A., S.W. Brown, and S.C. Rand, "Origin of persistent hole burning of N-V centers in diamond," *Journal of the Optical Society of America B* **9**, 768 (1992).

Regev, O., "Quantum computation and lattice problems," *Proceedings of the 43rd Annual Symposium on the Foundations of Computer Science (FOCS'02)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 2002), pp. 520–530.

Reichardt, B., "The quantum adiabatic optimization algorithm and local minima," (to be presented at the 36th Annual ACM Symposium on Theory of Computing [STOC 2004] Chicago, Illinois, USA, June 13–15, 2004).

Reichel, J., W. Haensel, P. Hommelhoff, and T.W. Haensch, "Applications of integrated magnetic microtraps," *Applied Physics B – Lasers and Optics* **72**, 81–89 (2001).

Rohde, H., S.T. Gulde, C.F. Roos, P.A. Barton, D. Leibfried, J. Eschner, F. Schmidt-Kaler and R. Blatt, "Sympathetic ground-state cooling and coherent manipulation with two-ion crystals," *Journal of Optics B: Quantum and Semiclassical Optics* **3**, S34–S41 (2001).

Rolston, S.L. and W.D. Phillips, "Nonlinear and quantum atom optics," *Nature* **416**, 219–224 (2002).

Roos, C.F., G.P.T. Lancaster, M. Riebe, H. Häffner, W. Haensel, S. Gulde, C. Becher, J. Eschner, F. Schmidt-Kaler, and R. Blatt, "Tomography of entangled massive particles," (29-Jul-03) preprint *quant-ph/0307210*.

Roos, Ch., Th. Eigher, H. Rohde, H.C. Nägerl, J. Eschner, D. Leibfried, F. Schmidt-Kaler, and R. Blatt, "Quantum state engineering on an optical transition and decoherence in a Paul trap," *Physical Review Letters* **83**, 4713–4716 (1999).

Rowe, M.A., A. Ben-Kish, B. DeMarco, D. Leibfried, V. Meyer, J. Beall, J. Britton, J. Hughes, W.M. Itano, B. Jelenkovi, C. Langer, T. Rosenband, and D.J. Wineland, "Transport of quantum states and separation of ions in a dual RF ion trap," (to be published in *Quantum Information and Computation*).

Rowe, M.A., D. Kielpinski, V. Meyer, C.A. Sackett, W.M. Itano, C. Monroe, and D.J. Wineland, "Experimental violation of a Bell's inequality with efficient detection," *Nature*, **409**, 791–794 (2001).

Sackett, C.A., D. Kielpinski, B.E. King, C. Langer, V. Meyer, C.J. Myatt, M. Rowe, Q.A. Turchette, W.M. Itano, D.J. Wineland, and C. Monroe, "Experimental entanglement of four particles," *Nature* **404**, 256–259 (2000).

Santori, C, M. Pelton, G. Solomon, Y. Dale, and Y. Yamamoto, "Triggered single photons from a quantum dot," *Physical Review Letters* **86**, 1502–1505 (2001).

Santori, C., D. Fattal, J. Vuckovic, G.S. Solomon, and Y. Yamamoto, "Indistinguishable photons from a single-photon device," *Nature* **419**, 594–597 (2002).

Sasaki, M., K. Kato, M. Izutsu, and O. Hirota, "Quantum channels showing superadditivity in classical capacity," *Physical Review A* **58**, 146–158 (1998).

Sauer, J.A., K.M. Fortier, M.S. Chang, C.D. Hamley, and M.S. Chapman, "Cavity QED with optically transported atoms," (4-Sep-03) preprint *quant-ph/0309052*.

Sauer, J.A., M.D. Barrett, and M.S. Chapman, "Storage ring for neutral atoms," *Physical Review Letters* **87**, 270401 (2001).

Sauter, Th., W. Neuhauser, R. Blatt, and P.E. Toschek, "Observation of quantum jumps," *Physical Review Letters* **57**, 1696–1698 (1986).

Schack, R. and C.M. Caves, "Classical model for bulk-ensemble NMR quantum computation," (30-Apr-99) preprint *quant-ph/9903101*.

Scheunemann, R., F.S. Cataliotti, T.W. Haensch, and M. Weitz, "An optical lattice with single lattice site optical control for quantum engineering," *Journal of Optics B – Quantum and Semiclassical Optics* **2**, 645–650 (2000).

Scheunemann, R., F.S. Cataliotti, T.W. Haensch, and M. Weitz, "Resolving and addressing atoms in individual sites of a CO_2-laser optical lattice," *Physical Review A* **62**, 051801(R) (2000).

Schlosser, N., G. Reymond, I. Protsenko, and P. Grangier, "Sub-Poissonian loading of single atoms in a microscopic dipole trap," *Nature* **411**, 1024–1027 (2001).

Schmidt-Kaler, F., H. Häffner, M. Riebe, S. Gulde, G.P.T. Lancaster, T. Deuschle, C. Becher, C.F. Roos, J. Eschner, and R. Blatt, "Realization of the Cirac-Zoller controlled-NOT quantum gate," *Nature* **422**, 408–411 (2003).

Schmidt-Kaler, F., H. Häffner, S. Gulde, M. Riebe, G. Lancaster, J. Eschner, C. Becher, and R. Blatt, "Quantized phase shifts and a dispersive universal quantum gate," (29-Jul-03) preprint *quant-ph/0307211*.

Schrader, D., S. Kuhr, W. Alt, M. Müller, V. Gomer, and D. Meschede, "An optical conveyor belt for single neutral atoms," *Applied Physics B – Lasers and Optics* **73**, 819–824 (2001).

Schrodinger, E., "Die gegenwartige Situation der Quantenmechanik," *Nature* **23**, 807, 823, 844, (1935).

Schumacher, B. and M. Westmoreland, "Sending classical information via noisy quantum channels," *Physical Review A* **56**, 131–138 (1997).

Schumacher, B., M. Westmoreland, and W.K. Wootters, "Limitation on the amount of accessible information in a quantum channel," *Physical Review Letters* **76**, 3452–3455 (1997).

Shahriar, M.S., P.R. Hemmer, S. Lloyd, P.S. Bhatia, and A.E. Craig, "Solid-state quantum computing using spectral holes," *Physical Review A* **66**, 032301 (2002).

Sharf, Y., D.G. Cory, S.S. Somaroo, T.F. Havel, E. Knill, R. Laflamme and W.H. Zurek, "A study of quantum error correction by geometric algebra and liquid-state NMR spectroscopy," *Molecular Physics* **98**, 1347–1363 (2000).

Sharf, Y., T.F. Havel, and D.G. Cory, "Spatially encoded pseudopure states for NMR quantum-information processing," *Physical Review A* **62**, 052314 (2000).

Shih, Y.H. and C.O. Alley, "New type of Einstein-Podolsky-Rosen-Bohm experiment using pairs of light quanta produced by optical parametric down conversion," *Physical Review Letters* **61**, 2921–2924 (1988).

Shimizu, Y., N. Shiokawa, N. Yamamoto, M. Kozuma, T. Kuga, L. Deng, and E.W. Hagley, "Control of light pulse propagation with only a few cold atoms in a high-finesse microcavity," *Physical Review Letters* **89**, 233001 (2002).

Shirman, A. and G. Schön, "Dephasing and renormalization in quantum two-level systems," in *Proceedings of NATO ARW Workshop on Quantum Noise in Mesoscopic Physics*, Y.V. Nazarov, Ed., (Kluwer Academic Publishers, Dordrecht, The Netherlands, 2002), [ISBN 1-4020-1239-X, *cond-mat/0210023*].

Shor, P.W. and J. Preskill, "Simple proof of security of the BB84 quantum key distribution protocol," *Physical Review Letters* **85**, 441–444 (2000).

Shor, P.W., "Algorithms for quantum computation: discrete logarithms and factoring," *Proceedings of the 35th Annual Symposium on the Foundations of Computer Science (FOCS'94)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 1994) pp. 124–134;
[revised version at *quant-ph/9508027*].

Shor, P.W., "Capacities of quantum channels and how to find them," *Mathematical Programming* **97**(1-2), 311–335 (2003).

Shor, P.W., "Equivalence of additivity questions in quantum information theory," (7-May-03) preprint *quant-ph/0305035*.

Shor, P.W., "Fault-tolerant quantum computation," *Proceedings of the 37th Annual Symposium on the Foundations of Computer Science (FOCS'96)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 1996) pp. 56–67.

Shor, P.W., "Scheme for reducing decoherence in quantum computer memory," *Physical Review A* **52**, R2493–R2496 (1995).

Shor, P.W., J.A. Smolin, and B.M. Terhal "Nonadditivity of bipartite distillable entanglement follows from conjecture on bound entangled Werner states," *Physical Review Letters* **86**, 2681–2684 (2001).

Simmonds, R.W., K.M. Lang, D.A. Hite, D.P. Pappas, and J.M. Martinis, "Decoherence in Josephson qubits from junction resonances," (18-Feb-04) preprint *cond-mat/0402470*.

Simon, D., "On the power of quantum computation," *Proceedings of the 35th Annual Symposium on the Foundations of Computer Science (FOCS'94)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 1994) pp. 116–123.

Slichter C.P., *Principles of Magnetic Resonance* (Springer-Verlag, New York, 1980).

Somaroo, S., C.H. Tseng, T. Havel, R. Laflamme, and D.G. Cory, "Quantum simulation of a quantum computer," *Physical Review Letters* **82**, 5381–5384 (1999).

Sørensen, A. and K. Mølmer, "Entanglement and quantum computation with ions in thermal motion," *Physical Review A* **62**, 022311 (2000).

Sørenson, A. and K. Mølmer, "Spin-spin interaction and spin squeezing in an optical lattice," *Physical Review Letters* **83**, 2274–2277 (1999).

Spekkens, R.W. and T. Rudolph, "Degrees of concealment and bindingness in quantum bit commitment protocols," *Physical Review A* **65**, 012310 (2002).

Steane, A.M. "Quantum computing and error correction," in *Decoherence and Its Implications in Quantum Computation and Information Transfer*, Gonis and Turchi, Eds. (IOS Press, Amsterdam, 2001), pp. 284–298 [*quant-ph/0304016*].

Steane, A.M. and B. Ibinson, "Fault-tolerant logical gate networks for CSS codes," (4-Nov-03) preprint *quant-ph/0311014*.

Steane, A.M. and D.M. Lucas, "Quantum computation with trapped ions, atoms and light," in *Scalable Quantum Computers*, S.L. Braunstein and H.K. Lo Eds., (Wiley-VCH, Berlin, 2001), pp. 69–88.

Steane, A.M. and W. van Dam, "Physicists triumph at 'Guess my number'," *Physics Today* **53**(2), 35–39 (2000).

Steane, A.M., "Error correcting codes in quantum theory," *Physical Review Letters* **77**, 793–797 (1996).

Steffen, M., W. van Dam, T. Hogg, G. Breyta, and I.L. Chuang, "Article title," *Physical Review Letters* **90**, 067903 (2003).

Stevens, M.J., A.L. Smirl, R.D.R. Bhat, J.E. Sipe, and H.M. van Driel, "Coherent control of an optically injected ballistic spin-polarized current in bulk GaAs," *Journal of Applied Physics* **91**, 4382–4386 (2002).

Stoff, M.E., A.J. Vega, and R.W. Vaughan, "Explicit demonstration of spinor character for a spin-1/2 nucleus via NMR interferometry," *Physical Review A* **16**, 1521–1524 (1977).

Strekalov, D.V., T.B. Pittman, A.V. Sergienko, Y.H. Shih, and P.G. Kwiat, "Post selection-free energy-time entanglement," *Physical Review A* **54**, R1–R4 (1996).

Suter, D. and K. Lim, "Scalable architecture for spin-based quantum computers with a single type of gate," *Physical Review A* **65**, 052309 (2002).

Takeuchi, S., "Analysis of errors in linear-optics quantum computation," *Physical Review A* **61**, 052302 (2000).

Takeuchi, S., "Experimental demonstration of a three-qubit quantum computation algorithm using a single photon and linear optics," *Physical Review A* **62**, 032301 (2000).

Takeuchi, S., J. Kim, Y. Yamamoto, and H.H. Hogue, "Development of a high-quantum-efficiency single-photon counting system," *Applied Physics Letters* **74**, 1063–1065 (1999).

Tamaki, K., M. Koashi, and N. Imoto, "Unconditionally secure key distribution based on two nonorthogonal states," *Physical Review Letters* **90**, 167904 (2003).

Teklemariam, G., E.M. Fortunato, M.A. Pravia, T.F. Havel, and D.G. Cory, "Experimental investigations of decoherence on a quantum information processor," *Chaos, Solitons, and Fractals* **16**, 457–465 (2002).

Teklemariam, G., E.M. Fortunato, M.A. Pravia, T.F. Havel, and D.G. Cory, "NMR analog of the quantum disentanglement eraser," *Physical Review Letters* **86**, 5845–5849 (2001).

Teklemariam, G., E.M. Fortunato, M.A. Pravia, Y. Sharf, T.F. Havel, D.G. Cory, A. Bhattaharyya, and J. Hou, "Quantum erasers and probing classifications of entanglement via nuclear magnetic resonance," *Physical Review A* **66**, 012309 (2002).

Terhal, B.M., "A family of indecomposable positive linear maps based on entangled quantum states," *Linear Algebra Applications* **323**, 61–73 (2000) [*quant-ph/9810091*].

Tian, L. and S. Lloyd, "Resonant cancellation of off-resonant effects in a multilevel qubit," *Physical Review A* **62**, 050301 (2000).

Tian, L., L. Levitov, C.H. van der Wal, J.E. Mooij, T.P. Orlando, S. Lloyd, C.J.P.M. Harmans, and J.J. Mazo, "Decoherence of the superconducting persistent current qubit," in *Quantum Mesoscopic Phenomena and Mesoscopic Devices in Microelectronics*, I.O. Kulik and R. Ellialogulu, Eds. (Kluwer Academic Publishers, Dordrecht, Netherlands, 2000) Part VII, #28.

Traub, J. and H. Wozniakowski, "Path integration on a quantum computer," *Quantum Information Processing* **1**, 365–388 (2002) [*quant-ph/0109113*].

Tseng, C.H., S.S. Somaroo, Y.S. Sharf, E. Knill, R. Laflamme, T.F. Havel, and D.G. Cory, "Quantum simulation of a three-body interaction Hamiltonian on an NMR quantum computer," *Physical Review A* **61**, 12302–12308. (2000).

Turchette, Q.A., C.J. Hood, W. Lange, H. Mabuchi, and H.J. Kimble, "Measurement of Conditional Phase-Shifts for Quantum Logic," *Physical Review Letters* **75**, 4710–4713 (1995).

Turukhin, A.V., V.S. Sudarshanam, M.S. Shahriar, J.A. Musser, B.S. Ham, and P.R. Hemmer, "Observation of ultraslow and stored light pulses in a solid," *Physical Review Letters* **88**, 023602 (2002).

van Dam, W. and G. Seroussi, "Efficient quantum algorithms for estimating Gauss sums," (23-Jul-02) preprint *quant-ph/0207131*.

van Dam, W. and S. Hallgren, "Efficient quantum algorithms for shifted quadratic character problems," (15-Nov-00) preprint *quant-ph/0011067*.

van Dam, W. and U. Vazirani, "Limits on quantum adiabatic optimization," 5th Workshop on Quantum Information Processing (QIP 2002), IBM T.J. Watson Research Center, Yorktown Heights, New York, USA, January 14–17, 2002.

van Dam, W., M. Mosca, and U. Vazirani, "How powerful is adiabatic quantum computation?" *Proceedings of the 42nd Annual Symposium on the Foundations of Computer Science (FOCS'01)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 2001), pp. 279–287.

van der Wal, C.H., A.C.J. ter Haar, F.K. Wilhelm, R.N. Schouten, C.J.P.M. Harmans, T.P. Orlando, S. Lloyd, and J.E. Mooij, "Quantum superposition of macroscopic persistent-current states," *Science* **290**, 773–777 (2000).

van Enk, S.J., H.J. Kimble, J.I. Cirac, and P. Zoller, "Quantum communication with dark photons," *Physical Review A* **59**, 2659–2664 (1999).

van Enk, S.J., J.I. Cirac , P. Zoller , H.J. Kimble and H. Mabuchi, "Quantum state transfer in a quantum network: a quantum-optical implementation," *Journal of Modern Optics* **44**, 1727–1736 (1997).

van Enk, S.J., J.I. Cirac, and P. Zoller, "Ideal quantum communication over noisy channels: A quantum optical implementation," *Physical Review Letters* **78**, 4293–4296 (1997).

van Enk, S.J., J.I. Cirac, and P. Zoller, "Photonic channels for quantum communication," *Science* **279**, 205–208 (1998).

van Enk, S.J., J.I. Cirac, and P. Zoller, "Purifying two-bit quantum gates and joint measurements in cavity QED," *Physical Review Letters* **79**, 5178–5181 (1997).

Vandersypen, L.M.K., C.S. Yannoni, M.H. Sherwood, and I.L. Chuang, "Realization of logically labeled effective pure states for bulk quantum computation," *Physical Review Letters* **83**, 3085–3088 (1999).

Vandersypen, L.M.K., M. Steffen, G. Breyta, C.S. Yannoni, M.H. Sherwood, and I.L. Chuang, "Experimental realization of Shor's quantum factoring algorithm using nuclear magnetic resonance," *Nature* **414**, 883–887 (2001).

Varcoe, B.T.H., S. Brattke, M. Weidinger, and H. Walther, "Preparing pure photon number states of the radiation field," *Nature* **403**, 743–746 (2000).

Vedral, V., "The role of relative entropy in quantum information theory," *Reviews of Modern Physics* **74**, 197 (2002).

Vedral, V., M.B. Plenio, M.A. Rippin, and P.L. Knight, "Quantifying entanglement," *Physical Review Letters* **78**, 2275–2279 (1997).

Verevkin, A., J. Zhang, R. Sobolewski, A. Lipatov, O. Okunev, G. Chulkova, A. Korneev, K. Smirnov, G.N. Gol'tsman, and A. Semenov, "Detection efficiency of large-active-area NbN single-photon superconducting detectors in the ultraviolet to near-infrared range," *Applied Physics Letters* **80**, 4687–4689 (2002).

Vernooy, D.W. and H.J. Kimble, "Well-dressed states for wave-packet dynamics in cavity QED," *Physical Review A* **56**, 4287–4295 (1997).

Vidal, G. and J.I. Cirac, "Irreversibility in asymptotic manipulations of entanglement," *Physical Review Letters* **86**, 5803–5806 (2001).

Vidal, G. and R. Tarrach, "Robustness of entanglement," *Physical Review A* **59**(1), 141–155 (1999).

Vidal, G., "Efficient simulation of one-dimensional quantum many-body systems," (14-Oct-03) preprint *quant-ph/0310089*.

Vidal, G., "Entanglement monotones," *Journal of Modern Optics* **47**, 355 (2000).

Vidal, G., J.I. Latorre, E. Rico, and A.Y. Kitaev, "Entanglement in quantum critical phenomena," *Physical Review Letters* **90**, 227902 (2003) [*quant-ph/0211074*].

Viola L. and E. Knill, "Robust dynamical decoupling of quantum systems with bounded controls," *Physical Review Letters* **90**, 037901 (2003).

Viola, L., E.M. Fortunato, M.A. Pravia, E. Knill, R. Laflamme, and D.G. Cory, "Experimental realization of noiseless subsystems for quantum information processing," *Science* **293**, 2059–2063 (2001).

Viola, L., E.M. Fortunato, S. Lloyd, C.-H. Tseng, and D.G. Cory, "Stochastic resonance and nonlinear response by NMR spectroscopy," *Physical Review Letters* **84**, 5466–5470 (2000).

Viola, L., S. Lloyd, and E. Knill, "Universal control of decoupled quantum systems," *Physical Review Letters* **83**, 4888–4891 (1999).

Vion, D., A. Aassime, A. Cottet, P. Joyez, H. Pothier, C. Urbina, D. Esteve, and M.H. Devoret, "Manipulating the quantum state of an electrical circuit," *Science* **296**, 886–889 (2002).

Vion, D., A. Aassime, A. Cottet, P. Joyez, H. Pothier, C. Urbina, D. Esteve, and M.H. Devoret "Manipulating the quantum state of an electrical circuit," *Science* **296**; 886–889 (2002).

Vitanyi, P.M.B., "Quantum Kolmogorov complexity based on classical descriptions," *IEEE Transactions on Information Theory* **47**(6), 2464–2479 (2001).

Vrijen, R. and E. Yablonovitch, "A spin-coherent semiconductor photodetector for quantum communication," *Physica E: Low-dimensional Systems and Nanostructure* **10**, 569–575 (2001).

Vuckovic, J., D. Fattal, C. Santori, G.S. Solomon, and Y. Yamamoto, "Enhanced single-photon emission from a quantum dot in a micropost microcavity," *Applied Physics Letters* **82**, 3596–3598 (2003).

Vuckovic, J., M. Lonar, H. Mabuchi, and A. Scherer, "Design of photonic crystal microcavities for cavity QED," *Physical Review E* **65**, 016608 (2002).

Vuletic, V., C. Chin, A.J. Kerman, and S. Chu, "Degenerate Raman sideband cooling of trapped cesium atoms at very high densities," *Physical Review Letters* **81**, 5768–5771 (1998).

Waks, E., K. Inoue, E. Diamanti, and Y. Yamamoto, "High efficiency photon number detection for quantum information processing," (10-Aug-03) preprint *quant-ph/0308054*.

Walther, H., "Generation and detection of Fock-states of the radiation field," *Zeitschrift Fur Naturforschung Section A (Journal of Physical Sciences – A)* **56**, 117–123 (2001).

Walther, H., "Generation of photon number states on demand," *Fortschritte Der Physik (Progress of Physics)* **51**, 521–530 (2003).

Warren, W.S., "The Usefulness of NMR Quantum Computing," *Science* **277**, 1688–1690 (1997); see also response by N. Gershenfeld & I.L. Chuang, *ibid*, p. 1688.

Warren, W.S., D.P. Weitekamp, and A. Pines, "Theory of selective excitation of multiple-quantum transitions," *Journal of Chemical Physics* **73**, 2084–2099 (1980).

Watrous, J. "Limits on the power of quantum statistical zero-knowledge," *Proceedings of the 43rd Annual IEEE Symposium on Foundations of Computer Science (FOCS'02)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 2002) pp. 459–468.

Watrous, J. "Quantum simulations of classical random walks and undirected graph connectivity," *Journal of Computer and System Sciences*, **62**(2), 376–391, (2001) [A preliminary version appeared in *Proceedings of the 14th Annual IEEE Conference on Computational Complexity*, pp. 180–187, (1999)].

Watrous, J., "On quantum and classical space-bounded processes with algebraic transition amplitudes," *Proceedings of the 40th Annual Symposium on the Foundations of Computer Science (FOCS'99)*, (IEEE Computer Society Press, Los Alamitos, California, USA, 1999) pp. 341–351.

Weinstein, Y., S. Lloyd, J.V. Emerson, and D.G. Cory, "Experimental implementation of the quantum Baker's map," *Physical Review Letters* **89**, 157902 (2002).

Weinstein, Y.S., M.A. Pravia, E.M. Fortunato, S. Lloyd, and D.G. Cory, "Implementation of the Quantum Fourier Transform," *Physical Review Letters* **86**, 1889–1891 (2001).

Weinstein, Y.S., S. Lloyd, J. Emerson, and D.G. Cory, "Experimental implementation of the quantum Baker's map," *Physical Review Letters* **89**, 157902 (2002).

White, A.G., D.F.V. James, P.H. Eberhard, and P.G. Kwiat, "Non-maximally entangled states: Production, characterization, and utilization," *Physical Review Letters* **83**, 3103–3107 (1999).

Wiesner, S., "Conjugate coding," *SIGACT News* **15**, 78–88, (1983).

Wineland, D.J., C. Monroe, W.M. Itano, D. Leibfried, B.E. King, and D.M. Meekhof, "Information issues in coherent quantum-state manipulation of trapped atomic ions," *Journal of Research of the National Institute of Standards and Technology* **103**(3), 259–328 (1998).

Wineland, D.J., J.C. Bergquist, J.J. Bollinger, R.E. Drullinger, and W.M. Itano, "Quantum computers and atomic clocks," *Proceedings of the 6th Symposium Frequency Standards & Metrology*, P. Gill, Ed., (World Scientific, Singapore, 2002), pp 361–368.

Wineland, D.J., M. Barrett, J. Britton, J. Chiaverini, B. DeMarco, W.M. Itano, B. Jelenkovic, C. Langer, D. Leibfried, V. Meyer, T. Rosenband, and T. Schätz, "Quantum information processing with trapped ions," *Philosophical Transactions of the Royal Society of London A* **361**, 1349–1361 (2003).

Winter, A. and S. Massar, "Compression of quantum measurement operations," *Physical Review A* **64**, 012311 (2001).

Wooters, W.K. and W.H. Zurek, "A single quantum cannot be cloned," *Nature* **299**, 802–803 (1982).

Yamamoto, T., Y.A. Pashkin, O. Astafiev, Y. Nakamura, and J.S. Tsai, "Demonstration of conditional gate operation using superconducting charge qubits," *Nature* **425**, 941–944 (2003).

Yannoni, C.S., M.H. Sherwood, D.C. Miller, I.L. Chuang, L.M.K. Vandersypen, and M.G. Kubinic, "Nuclear magnetic resonance quantum computing using liquid crystal solvents," *Applied Physics Letters* **75**, 3563–3565 (1999).

Ye, J., D.W. Vernooy, and H.J. Kimble, "Trapping of single atoms in cavity QED," *Physical Review Letters* **83**, 4987–4990 (1999).

Yepez, J., "Lattice-gas quantum computation," *International Journal of Modern Physics C* **9**, 1587–1596 (1998);

Yepez, J., "Quantum computation of fluid dynamics," Quantum Computing and Quantum Communications, First NASA International Conference (QCQC'98), Palm Springs, California, USA, February 17–20, 1998, published in *Lecture Notes in Computer Science* **1509**, 34–60 (1999)

Yi, X.X., X.H. Su, and L. You, "Conditional quantum phase gate between two 3-state atoms," *Physical Review Letters* **90**, 097902 (2003).

You, L. and M.S. Chapman, "Quantum entanglement using trapped atomic spins," *Physical Review A* **62**, 152302 (2000).

You, L., "Motional effects of trapped atomic or ionic qubits," *Physical Review A* **64**, 012302 (2001).

You, L., X.X. Yi, and X.H. Su, "Quantum logic between atoms inside a high-Q optical cavity," *Physical Review A* **67**, 032308 (2003).

Yu, Y., S. Han, X. Chu, S.-I. Chu, and Z. Wang, "Coherent temporal oscillations of macroscopic quantum states in a Josephson junction," *Science* **296**, 889–892 (2002).

Yuan, Z., B.E. Kardynal, R.M. Stevenson, A.J. Shields, C.J. Lobo, K. Cooper, N.S. Beattie, D.A. Ritchie, and M. Pepper, "Electrically driven single-photon source," *Science* **295**, 102–105 (2002).

Zhang, W. and D.G. Cory, "First direct measurement of the spin diffusion rate in a homogenous solid," *Physical Review Letters* **80**, 1324–1327 (1998).

Zhu, X.W., X.M. Fang, M. Feng, F. Du, K.L. Gao, and X. Mao, "Experimental realization of a highly structured search algorithm," *Physica D* **156**, 179–185 (2001).

Zurek, W.H., "Decoherence, einselection, and the quantum origins of the classical," *Reviews of Modern Physics* **75**, 715–775 (2003).