Andrew J. Berglund

Curriculum Vitae, October 2008

Personal

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Employment

9/2008 – Physicist
Nanofabrication Research Group
Center for Nanoscale Science and Technology (CNST)
National Institute of Standards and Technology (Gaithersburg, MD)

10/2006 – 9/2008 National Research Council/NIST Postdoctoral Research Associate
Electron Physics Group, Center for Nanoscale Science and Technology (CNST)
National Institute of Standards and Technology (Gaithersburg, MD)

Education

8/2000 – 9/2006 California Institute of Technology (Pasadena, CA)
Ph.D. in Physics. Advisor: Hideo Mabuchi.
Thesis: *Feedback control of Brownian motion for single-particle fluorescence spectroscopy* (http://etd.caltech.edu/etd/available/etd-10092006-165831/)

9/1996 – 6/2000 Dartmouth College (Hanover, NH)
A.B. *Summa Cum Laude*
Physics Major with High Honors, Mathematics Minor

Honors and Awards

2008	Most Outstanding Poster (Physics), Sigma Xi Postdoctoral Poster Presentation, NIST
2006 – 2008	National Research Council (NRC) Postdoctoral Research Associate Fellowship
2000 – 2003	National Science Foundation Graduate Research Fellowship
2000	Phi Beta Kappa society, Dartmouth College
2000	Presidential scholar, Dartmouth College
2000	Hasseltine Chemistry-Physics prize, Dartmouth College
1999 – 2000	Barry M. Goldwater scholarship
1998	Francis L. Town prize for Physics and Astronomy, Dartmouth College
1997 – 2000	Rufus Choate scholar, Dartmouth College
1996 – 2000	Citations for outstanding coursework in physics, mathematics, literature, music, and computer science, Dartmouth College.

Research Achievements

- *Signal processing algorithms for single-particle tracking:* Developed simple and fast algorithms for extracting nanometer-scale position and orientation from CCD images of single fluorescent particles (with M. D. McMahon, J. J. McClelland and J. A. Liddle)

- *Erbium laser cooling and trapping:* Developed novel methods for cooling and trapping erbium (Er) using magneto-optical and magnetic trapping, including narrow-line cooling methods for strongly magnetic atoms. (with J. J. McClelland, J. L. Hanssen and S. A. Lee).

- *Feedback control of Brownian motion:* Developed closed-loop feedback control methods for tracking the motion of a Brownian particle, using spatial modulation of the fluorescence intensity and lock-in detection. These techniques enable non-invasive resolution of single-particle dynamics over many orders of magnitude in time without (with K. McHale and H. Mabuchi).

- *Tracking-FCS*: Developed new theoretical methods of Fluorescence Correlation Spectroscopy (FCS) for analyzing the fluorescence fluctuations of a single tracked particle under spatially-modulated excitation (with K. McHale and H. Mabuchi).

- *Fast photon statistics of FRET-labeled DNA:* Measured fluorescence intensity correlations from FRET-labeled DNA molecules using Hanbury Brown-Twiss detection. Measurements revealed photon antibunching and nanosecond-scale motional dynamics (with A. Doherty and H. Mabuchi).

- *Statistical estimation in single-molecule spectroscopy:* Developed Bayesian estimation methods for identifying dynamics from noisy fluorescence measurements (with K. McHale and H. Mabuchi).

- *Experimental and theoretical research in entangled-photon systems:* Assisted in demonstration of eavesdropper detection in the Eckert quantum cryptography protocol. Demonstrated the decoherence-free nature of the polarization entangled singlet Bell state in a symmetric environment. Demonstrated open-loop "bang-bang" control of dephasing in a polarization interferometer (with P. G. Kwiat, Los Alamos National Laboratory).

Publications

Refereed articles

A. J. Berglund, M. D. McMahon, J. J. McClelland, and J. Alexander Liddle, *Fast, bias-free algorithm for tracking single particles with variable size and shape*, Opt. Express **16**, 14064 (2008).

A. J. Berglund, J. L. Hanssen, and J. J. McClelland, *Narrow-line magneto-optical cooling and trapping of strongly magnetic atoms*, Phys. Rev. Lett. **100**, 113002 (2008). This paper was featured in NIST Tech Beat and was profiled in a weekly top 5 article at Semiconductor International.

A. J. Berglund, S. A. Lee, and J. J. McClelland, *Sub-Doppler laser cooling and magnetic trapping of Erbium*, Phys. Rev. A **76**, 053418 (2007).

K. L. McHale, A. J. Berglund, and H. Mabuchi, *Quantum dot photon statistics measured by three-dimensional particle tracking*, Nano Lett. **7**, 3535-3539 (2007). This paper was featured in the Jan. 2008 issue of *Photonic Spectra*.

A. J. Berglund, K. McHale and H. Mabuchi, *Fluctuations in closed-loop fluorescent particle tracking*, Opt. Express **15**, 7752-7773 (2007).‡

A. J. Berglund, K. McHale, and H. Mabuchi, *Feedback localization of freely diffusing fluorescent particles near the optical shot-noise limit*, Opt. Lett. **32**, 145-147 (2007).

A. J. Berglund and H. Mabuchi, *Performance bounds on single-particle tracking by fluorescence modulation*, Appl. Phys. B **83**, 127-133 (2006).

A. J. Berglund and H. Mabuchi, *Tracking-FCS: Fluorescence Correlation Spectroscopy of individual particles*, Opt. Express **13**, 8069-8082 (2005).†‡

A. J. Berglund, *Nonexponential statistics of fluorescence photobleaching*, J. Chem. Phys. **121**, 2899 (2004).‡

A. J. Berglund and H. Mabuchi, *Feedback controller design for tracking a single fluorescent molecule*, Appl. Phys. B **78**, 653 (2004).

K. McHale, A. J. Berglund, and H. Mabuchi, *Bayesian estimation for species identification in single-molecule fluorescence microscopy*, Biophys. J. **86**, 3409 (2004).

J. B. Altepeter, P. G. Hadley, S. M. Wendelken, A. J. Berglund, and P. G. Kwiat, *Experimental investigation of a two-qubit decoherence-free subspace*, Phys. Rev. Lett. **92**, 147901 (2004).

A. J. Berglund, A. C. Doherty, and H. Mabuchi, *Photon statistics and dynamics of Fluorescence Resonance Energy Transfer*, Phys. Rev. Lett. **89**, 068101 (2002). [†‡]

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

D. S. Naik, C. G. Peterson, A. G. White, A. J. Berglund, and P. G. Kwiat, *Entangled-state quantum cryptography: Eavesdropping on the Eckert protocol*, Phys. Rev. Lett, **84**, 4733 (2000).

[†] Selected for the *Virtual Journal of Nanoscale Science and Technology*.
[‡] Selected for the *Virtual Journal of Biological Physics Research*.

Non-refereed articles

A. J. Berglund, *Feedback Control of Brownian Motion for Single-Particle Fluorescence Spectroscopy*, Ph.D. Thesis (2006). http://etd.caltech.edu/etd/available/etd-10092006-165831/

A. J. Berglund, *Quantum coherence and control in one- and two-photon optical systems*, undergraduate thesis, (2000). http://arxiv.org/abs/quant-ph/0010001

Selected Oral Presentations

"Erbium laser cooling," Quantum/nanophysics seminar, Department of Physics and Astronomy, Dartmouth College, Hanover, NH (2007).

"Sub-Doppler cooling and magnetic trapping of erbium," Quantum Information and Bose-Einstein Condensation (QIBEC) seminar, NIST, Gaithersburg, MD (2007).

"Tracking a single fluorescent particle in an optical microscope," NIST research seminar, Gaithersburg, MD (2006).

"Tracking-FCS: Correlation spectroscopy of individual particles," American Physical Society March meeting, Baltimore, MD (2006).

"Nonexponential statistics of fluorescence photobleaching," VCU Student/Faculty Mathematics seminar, Richmond, VA (2004).

"Photon correlation spectroscopy of Fluorescence Resonance Energy Transfer," Quantum Electronics and Laser Science (QELS) post-deadline session, Long Beach, CA (2002).

"Photon statistics and dynamics of Fluorescence Resonance Energy Transfer," California NanoSystems Institute (CNSI) seminar, Santa Barbara, CA (2002).

"Optical characterization of fast molecular dynamics," Center for Integrative Multiscale Modeling and Simulations (CIMMS), Pasadena, CA (2001).

Selected Poster Presentations

NIST Sigma Xi Postdoctoral Poster Presentation, Gaithersburg, MD (2008).

International Conference on Laser Spectroscopy (ICOLS), Telluride, CO (2007).

Kavli Nanoscience Institute Inaugural Symposium, Caltech, Pasadena, CA (2005).

BioImage Summer School, Ecole Normale Supérieure, Paris, France (2005).

ARO Institute for Collaborative Biotechnologies (ICB), UCSB, Santa Barbara, CA (2003).

Nanoscale and Molecular Mechanics (NM2) Conference, Maui, HI (2002).

Southwest Quantum Information and Technology (SQuInT) Network, NIST, Boulder, CO (2002).

Center for Integrative Multiscale Modeling and Simulations (CIMMS), Caltech, Pasadena, CA (2002).

Professional Activity

Member of American Physical Society (APS) and Optical Society of America (OSA).

Referee for APS, AIP, and OSA journals.

Member of Nanoparticle Safety Committee and Research Library Advisory Board at NIST.

Member of National Research Council/NIST expert panel for NRC postdoctoral program review.