Nathaniel P. Stern

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Professional Interests

Condensed matter physics, spin and valley physics in nanomaterials, quantum optics/photonics in quantum-confined systems, magnetism and magnetic materials

Education

- Ph. D. in Physics, **University of California, Santa Barbara**, 2008
- M. A. in Physics, **University of California, Santa Barbara,** 2006
- B. S. in Physics with Honors, **Harvey Mudd College,** 2003

Appointments

- Assistant Professor, Department of Physics and Astronomy, **Northwestern University**, 2011-
- Richard C. Tolman Prize Postdoctoral Fellow, **California Institute of Technology**, 2008-2011

Honors and Awards

- **Office of Naval Research Young Investigator**, U. S. Department of Defense, 2016
- **Searle Faculty Fellow**, Searle Center for Advancing Learning and Teaching, Northwestern University, 2014 - 2015
- **Northwestern University-Argonne Early Career Investigator Award,** ISEN, 2014
- **Early Career Research Award,** U.S. Department of Energy, 2014
- **Alfred P. Sloan Foundation Research Fellowship**, 2013
- **Richard C. Tolman Prize Postdoctoral Fellowship**, Caltech, 2008-2011
- **Fellow, Fannie and John Hertz Foundation**, 2003-2008
- **Fellow, California NanoSystems Institute**, 2005-2008
- **LeRoy Apker Award**, American Physical Society, 2004
- **NSF Graduate Research Fellowship**, declined for Hertz, 2003
- **National Defense Science and Engineering Graduate Fellowship**, declined for Hertz, 2003

Research Overview

My research explores the interconnections between light and mater, primarily at the quantum scale of a single photon. The frontiers of quantum physics lie not only in the manipulation of single particles but in the design of complex systems piece-by-piece; my work studying quantum optical effects in novel materials broadly contributes to this vision by expanding the mechanisms available to link isolated quantum systems together while preserving their unique properties. Progress toward this goal will lead

to understanding of new cooperative quantum phenomena potentially relevant for fundamental materials and optical physics, energy efficient opto-electronics, and enhanced control of information.

My methods combine expertise in low-temperature microscopy, ultra-fast spectroscopy, integrated photonics, and sensitive nano-electronic measurement to study hybrid opto-electronic materials in regimes of light-matter interactions never explored before. Synthesizing a background in spintronics and atomic quantum optics, I bring a unique perspective to discovering new tools for understanding and manipulating fundamental phenomena such as spins, magnetism, and novel symmetries in nanosystems.

SELECTED PUBLICATION LIST

Peer-Reviewed Journal Articles

1. G. Wei, D. A. Czaplewski, E. J. Lenferink, T. K. Stanev, I. W. Jung, and N. P. Stern. *Valley Polarization in Size-Tunable Monolayer Semiconductors Quantum Dots*. U*nder review,* (2015), available at: http://arxiv.org/abs/1510.09135
2. G. Wei, T. Stanev, D. Czaplewski, I. W. Jung, and N. P. Stern. *Silicon-nitride photonic circuits interfaced with monolayer MoS_2*. Applied Physics Letters **107**, 091112 (2015). http://dx.doi.org/10.1063/1.4929779
3. K. B. Chang, B. W. Edwards, L. Frazer, E. J. Lenferink, T. K. Stanev, N. P. Stern, J. C. Nino, and K. R. Poeppelmeier. *Hydrothermal Crystal Growth, Piezoelectricity, and Triboluminescence of $KNaNbOF_5$*. Journal of Solid State Chemistry, (2015) available at: http://www.sciencedirect.com/science/article/pii/S0022459615300621
4. E. J. Lenferink, G. Wei, and N. P. Stern. *Coherent optical non-reciprocity in axisymmetric resonators. Optics Express*, **22**, 16099-16111 (2014).
5. A. Goban, K. S. Choi, D. J. Alton, D. Ding, C. Lacroûte, M. Pototschnig, T. Thiele, N. P. Stern, H. J. Kimble. *Demonstration of a state-insensitive, compensated nanofiber trap*. Phys. Rev. Lett. **109**, 033603, (2012), http://prl.aps.org/abstract/PRL/v109/i3/e033603.
6. C. Lacroûte, K. S. Choi, A. Goban, D. J. Alton, D. Ding, N. P. Stern, and H. J. Kimble. *A state-insensitive, compensated nanofiber trap*. New J. Phys. **14**, 023056, (2012), http://iopscience.iop.org/1367-2630/14/2/023056/
7. D. J. Alton**,** N. P. Stern, Takao Aoki, H. Lee, E. Ostby, K. J. Vahala, and H. J. Kimble. *Strong interactions of single atoms and photons near a dielectric boundary*. Nature Physics, **7,** 159, (2011), http://www.nature.com/nphys/journal/v7/n2/full/nphys1837.html.
8. N. P. Stern, D. W. Steuerman, S. Mack, A. C. Gossard, and D.D. Awschalom. *Time-resolved dynamics of the spin Hall effect*. Nature Physics, **4**, 843, (2008), http://www.nature.com/nphys/journal/v4/n11/full/nphys1076.html
9. N. P. Stern, S. Ghosh, G. Xiang, M. Zhu, N. Samarth, and D. D. Awschalom. *Current-Induced Polarization and the Spin Hall Effect at Room Temperature*. Phys. Rev. Lett, **97** 126603, (2006), http://prl.aps.org/abstract/PRL/v97/i12/e126603
10. R. C. Myers, M. Poggio, N. P. Stern, A. C. Gossard, and D. D. Awschalom. *Antiferromagnetic s–d exchange coupling in GaMnAs*. Phys. Rev. Lett. **95**, 017204, (2005), http://prl.aps.org/abstract/PRL/v95/i1/e017204

Book Chapters

1. "Optical, Electrical, and Magnetic Properties of Spintronic Devices", N. P. Stern and J. Berezovsky, in *Nanotechnology: An Open Text*, coordinated by National Nanotechnology Infrastructure Network, 2006-2008. http://www.nano.umn.edu/nnin_opentext/

2. "Manipulation of Spins and Coherence in Semiconductors," N. P. Stern, J. Berezovsky, S. Ghosh, and D. D. Awschalom, in *Handbook of Magnetism and Advanced Magnetic Materials*, edited by Helmut Kronmüller and Stuart Parkin. Volume 5: Spintronics and Magnetoelectronics, 2007 John Wiley & Sons, Ltd., 2007, pp. 2878-2894.
3. "Spin Coherence in Semiconductors," J. Berezovsky, W.H. Lau, S. Ghosh, J. Stephens, N.P. Stern, and D.D. Awschalom, in *Manipulating Quantum Coherence in Solid State Systems*, edited by Michael E. Flatté and Ionel Ţifrea, NATO Science Series II, Volume 244, 2007 Springer, pp. 129-169.

PROFESSIONAL ACTIVITIES

- **Lifetime Membership:** American Physical Society, SPIE – the international society for optics and photonics
- **Reviewer:** *Nature Publishing Group, Applied Physics Letters, Journal of Applied Physics, European Physical Society, International Journal of Nanotechnology, Optical Society of America, National Science Foundation panelist, DOE Office of Science*
- **Invited Professional Presentations:** Over 20 invited presentations at national and international conferences and professional seminars
- **Public science outreach:** Active participant in distilling science for broader audiences across many venues, expertise, and technical levels. *Pertinent examples*:
  - Public outreach lecture on physics and academic careers to the *Muses of the California Science Center Foundation* (group promoting youth education in California)
  - Interview with *Vox*, on "The complex physics of that viral water bottle trick, explained"
  - Radio interview on "The Tim Dennis Morning Show",
  - Science explanations published in NU alumni publications for communicating science in the everyday world to my local community.

RESEARCH AND PROFESSIONAL EXPERIENCE

- **Assistant Professor, Northwestern University, (2011-)**
  Quantum photonics and magnetism: Investigating quantum interactions of photons with nano-scale magnetic structures by developing lithographic and nanostructure integration techniques.

  Hybrid opto-electronic probes of two-dimensional semiconductors: Developing opto-electronic techniques for control of atomic-scale materials.
- **Tolman Postdoctoral Fellow*, Prof. H. Jeff Kimble, Caltech* (2008-11)**
  Experimental quantum optics with high-Q microresonators as quantum information nodes: Developed real-time atom detection and analyzed atomic trajectories near dielectric surfaces.

  Atom trapping around nanofibers for interfacing atoms with on-chip resonators: Developed local helicity compensation techniques to increase atomic coherence times.
- **Graduate Student Researcher*, Prof. David D. Awschalom, UCSB* (2003-08)**
  Electrical generation of spin polarization in semiconductors: Developed time-resolved measurement and spatial imaging of spin drift and diffusion from spin Hall effect.

  Time-resolved optical measurements of spin dynamics in low-dimensional semiconductors: Ultrafast optical spectroscopy of spin dynamics in quantum confined nanostructures.
- **Undergraduate Student Researcher*, Prof. J. C. Eckert, HMC* (2000-03)**
  Exchange biasing in spin valves with ultra-thin antiferromagnets: Transport measurements of exchange anisotropy in spin valves with ultra-thin IrMn for magnetic memory applications.