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RESEARCH INTERESTS

Investigating fundamental spin-spin interactions as a probe of the nano- and mesoscale physics governing macroscopic observables in material systems ranging from organic semiconductors to colloidal quantum dots. By coherently manipulating the spin identity of optically and electrically generated excited states via electron spin resonance (ESR), insight into their chemical nature, environmental interactions, and possible technological usefulness can be gained.

Also of interest is the technological development of novel and unique experimental probes of such spin states. Combining magnetic resonance techniques with modern advancements in the realms of electronics, optical spectroscopy, and radio frequency control opens new windows on accessing and controlling spin systems.

Current projects focus on the exploration of spin dynamics in organic semiconductors and occurs on two fronts: First, by examining the mechanisms responsible for spin- to charge-current conversion in organics via ferromagnetic resonance-pumped inverse spin Hall effect. Second, electrically-detected magnetic resonance is used to probe local spin-spin interactions, either between charge-carrier pairs or between charge carriers and their local nuclear environment.

RESEARCH EXPERIENCE

Postdoctoral Researcher, University of Utah, Salt Lake City, Utah 2013–PRESENT
Materials Research, Science, and Engineering Center (MRSEC)

- Develop powerful excitation and detection methods for the Inverse Spin Hall Effect.
- Explore spin-current injection schemes and spin- to charge-current conversion mechanisms in organic semiconductors.
- Design and implement a ~\$1.4M, 12.5 Tesla, 330 GHz electro-optical spin resonance facility. [PDF] (*project shelved due to withdrawal of USTAR fund-matching*)
- Advisors: Profs. Christoph Boehme, Z. Valy Vardeny, Brian Saam, Joel S. Miller

The Spin Electronics Group

- Measuring spin-spin interaction energies and pair separations within organic semiconductors via electrical detection of Rabi oscillations under detuning.
- Correlating morphology and magnetic order/disorder in organic semiconductors.
- Develop and refine the measurement and excitation techniques required for observation of exceedingly small electrical and optical signals.
- Advisor: Prof. Christoph Boehme

The Organic Semiconductors and Optical Nanostructures Group

- Spent 4 weeks at the University of Regensburg, Regensburg, Germany to retrofit a wide-field, optical microscopy setup with single-molecule spin-resonance capabilities.
- This work was sponsored by Prof. John M. Lupton, now Chair of the Institute of Experimental and Applied Physics at the University of Regensburg.

EDUCATION

University of Utah, Salt Lake City, Utah 2006–2012
Ph.D. in Condensed Matter Physics, Dept. of Physics & Astronomy

- Thesis: *Optically Active Charge Traps and Chemical Defects in Semiconducting Nanocrystals Probed by Pulsed Optically Detected Magnetic Resonance* [PDF]
- Advisor: Prof. John M. Lupton

Southern Polytechnic State University, Marietta, Georgia

2000–2005

B.Sc in Physics, Dept. of Physics

- Minor (non-traditional) in Electrical Engineering Technology
- Senior Project: *Development of a Wireless Geophone System for Subsurface Depth Seismology*
- Advisors: Dr. James B. Whintont, Dr. Russel S. Patrick, Dr. Michael G. Thackston

TECHNICAL PROFICIENCIES

Techniques

- Electron Spin Resonance (electrical, optical, and absorption detected ESR, both at high and low fields)
- Optical techniques (pulsed electrical/optical excitation for time-gated electroluminescence/photoluminescence spectroscopy)
- Electronic methods of small-signal detection and signal conditioning
- Organic semiconductor device fabrication, glovebox procedures, and thermal evaporation of metals
- Basic chemical handling, wetlab, and cleanroom procedures
- Basic analog/digital electronics, microcontroller programming/interfacing, RF electronics, and associated test equipment

Software

- OriginLab, Python, LabVIEW, Xepir/PulseSPEL, L^AT_EX
- Working experience in AutoCAD/Inventor, Assembly, MATLAB, C/C++

REFEREED JOURNAL PUBLICATIONS

- [1] Malissa, H., Kavand, M., Waters, D. P., **van Schooten, K. J.**, Burn, P. L., Vardeny, Z. V., Saam, B., Lupton, J. M., Boehme, C., Room-temperature coupling between electrical current and nuclear spins in OLEDs. *Science* (2014) [*in press*]
- [2] **van Schooten, K. J.**, Boehme, C. & Lupton, J. M. Coherent magnetic resonance of nanocrystal quantum-dot luminescence as a window to blinking mechanisms. *ChemPhysChem* **15**, 1737–46 (2014). doi:[10.1002/cphc.201400081](https://doi.org/10.1002/cphc.201400081) [PDF]
- [3] Her, J. H., Stephens, P. W., Davidson, R. A., Min, K. S., Bagnato, J. D., **van Schooten, K. J.**, Boehme, C. & Miller, J. S. Weak ferromagnetic ordering of the Li⁺[TCNE]^{•−} (TCNE = tetracyanoethylene) organic magnet with an interpenetrating diamondoid structure. *J. Am. Chem. Soc.* **135**, 18060–3 (2013) doi:[10.1021/ja410818e](https://doi.org/10.1021/ja410818e) [PDF]
- [4] **van Schooten, K. J.**, Huang, J., Talapin, D. V, Boehme, C. & Lupton, J. M. Spin-dependent electronic processes and long-lived spin coherence of deep-level trap sites in CdS nanocrystals. *Phys. Rev. B* **87**, 125412 (2013) doi:[10.1103/PhysRevB.87.125412](https://doi.org/10.1103/PhysRevB.87.125412) [PDF]
- [5] **van Schooten, K. J.**, Huang, J., Baker, W. J., Talapin, D. V, Boehme, C. & Lupton, J. M. Spin-dependent exciton quenching and spin coherence in CdSe/CdS nanocrystals. *Nano Lett.* **13**, 65–71 (2013) doi:[10.1021/nl303459a](https://doi.org/10.1021/nl303459a) [PDF]
- [6] Baker, W. J., Ambal, K., Waters, D. P., Baarda, R., Morishita, H., **van Schooten, K. J.**, McCamey, D. R., Lupton, J. M. & Boehme, C. Robust absolute magnetometry with organic thin-film devices. *Nat. Commun.* **3**, 898 (2012) doi:[10.1038/ncomms1895](https://doi.org/10.1038/ncomms1895) [PDF]
- [7] Baker, W. J., McCamey, D. R., **van Schooten, K. J.**, Lupton, J. M. & Boehme, C. Differentiation between polaron-pair and triplet-exciton polaron spin-dependent mechanisms in organic light-emitting diodes by coherent spin beating. *Phys. Rev. B* **84**, 165205 (2011) doi:[10.1103/PhysRevB.84.165205](https://doi.org/10.1103/PhysRevB.84.165205) [PDF]

- [8] Chaudhuri, D., Wettach, H., **van Schooten, K. J.**, Liu, S., Sigmund, E., Höger, S. & Lupton, J. M. Tuning the singlet-triplet gap in metal-free phosphorescent π -conjugated polymers. *Angew. Chem.* **49**, 7714–17 (2010) doi:[10.1002/anie.201003291](https://doi.org/10.1002/anie.201003291) [PDF]
- [9] McCamey, D. R., **van Schooten, K. J.**, Baker, W. J., Lee, S.-Y., Paik, S.-Y., Lupton, J. M. & Boehme, C. Hyperfine-Field-Mediated Spin Beating in Electrostatically Bound Charge Carrier Pairs. *Phys. Rev. Lett.* **104**, 017601 (2010) doi:[10.1103/PhysRevLett.104.017601](https://doi.org/10.1103/PhysRevLett.104.017601) [PDF]
- [10] Boehme, C., McCamey, D. R., **van Schooten, K. J.**, Baker, W. J., Lee, S.-Y., Paik, S.-Y. & Lupton, J. M. Pulsed electrically detected magnetic resonance in organic semiconductors. *Phys. Status Solidi B* **246**, 2750–2755 (2009) doi:[10.1002/pssb.200982357](https://doi.org/10.1002/pssb.200982357) [PDF]
- [11] Walter, M. J., Borys, N. J., **van Schooten, K. J.** & Lupton, J. M. Light-Harvesting Action Spectroscopy of Single Conjugated Polymer Nanowires. *Nano Lett.* **8**, 3330–3335 (2008) doi:[10.1021/nl801757p](https://doi.org/10.1021/nl801757p) [PDF]

CONFERENCE
TALKS

- [12] **van Schooten, K. J.**, Sun, D., Vardeny, Z. V., & Boehme, C. Artifact free Inverse Spin Hall Effect Measurements in Organic Semiconductor Devices by Pulsed Ferromagnetic-Resonant Spin-Pumping. *Rocky Mountain Conference on Magnetic Resonance* (RMCAC 2014). Copper Mountain, Colorado, USA, July 13–17, 2014.
- [13] **van Schooten, K. J.**, Huang, J., Talapin, D. V., Boehme, C. & Lupton, J. M. Spin-Dependent Light-Harvesting in Nanotetrapods by Controlling Electronic Trap States with Optically Detected Magnetic Resonance. *Nanoscience with Nanocrystals* (NaNaX6). Bad Hofgastein, Austria, May 18–23, 2014.
- [14] **van Schooten, K. J.**, Huang, J., Talapin, D. V., Boehme, C. & Lupton, J. M. Spin-Dependent Light-Harvesting in Nanotetrapods by Controlling Electronic Trap States with Optically Detected Magnetic Resonance. *International Conference on Quantum Dots* (QD2014). Pisa, Italy, May 11–16, 2014.
- [15] **van Schooten, K. J.**, Huang, J., Talapin, D. V., Boehme, C. & Lupton, J. M. Spin-Dependent LightHarvesting in Colloidal Nanocrystals by Controlling Electronic Trap States with Optically Detected Magnetic Resonance. *American Physical Society March Meeting*. Baltimore, Maryland, USA, March 17–22, 2013.
- [16] **van Schooten, K. J.**, Huang, J., Baker, W. J., Talapin, D. V., Boehme, C. & Lupton, J. M. Probing Electronic Trap States in Colloidal Nanocrystals with Optically Detected Magnetic Resonance. *Rocky Mountain Conference on Analytical Chemistry* (RMCAC 2012). Copper Mountain, Colorado, USA, June 16–21, 2012.
- [17] **van Schooten, K. J.**, Baker, W. J., Huang, J., Talapin, D. V., Boehme, C. & Lupton, J. M. Observation of Long Spin Coherence Times in CdSe/CdS Colloidal Nanostructures. *American Physical Society March Meeting*. Dallas, TX, USA, March 22–25, 2011.

CONFERENCE
POSTERS

- [18] **van Schooten, K. J.**, Baker, W. J., Huang, J., Talapin, D. V., Boehme, C. & Lupton, J. M. Long Spin Coherence Lifetimes of Optically Generated Excitations in Colloidal CdS Nanorods. *Optical Probes of Conjugated Polymers and Organic Nanostructures* (OP2011) & *Excited State Processes on Electronic and Bio Nanomaterials* (ESP2011). Santa Fe, NM, USA, June 19–24, 2011
- [19] **van Schooten, K. J.**, Huang, J., Baker, W. J., Talapin, D. V., Boehme, C. & Lupton, J.

M. Long Spin Coherence Lifetimes of Optically Generated Excitations in Colloidal CdS Nanorods. *Fundamental Optical Processes in Semiconductors* (FOPS2011). Lake Junaluska, NC, USA, August 1–5, 2011.

- [20] **van Schooten, K. J.**, Liu, S., Walter, M. J., McCamey, D. R., Scherf, U., Boehme, C., & Lupton, J. M. Time-Resolved Measurements of Spin-Dependent Carrier Recombination in Charge Transfer States of pi-Conjugated Polymers. *237th American Chemical Society National Meeting*. Salt Lake City, UT, USA, March 22–26, 2009.

COLLOQUIA & SEMINARS

- [21] Making Use of Trapped-Carrier Spins in Colloidal Nanocrystals, *Institute of Experimental and Applied Physics Colloquium*, University of Regensburg, Regensburg, Germany, June, 23, 2014.
- [22] Increasing Accessibility to the Inverse Spin Hall Effect by Pulsed Ferromagnetic-Resonant Spin-Pumping, *Materials Research, Science, and Engineering Center* (MRSEC) *Seminar*, University of Utah, Salt Lake City, UT, USA, April 8, 2014.

BOOKS

- [23] **K. J. van Schooten**, *Optically Active Charge Traps and Chemical Defects in Semiconducting Nanocrystals Probed by Pulsed Optically Detected Magnetic Resonance*, Springer, Cham, Switzerland, 2013. ISBN:9783319005898

PAPERS IN PREPARATION

- [24] **van Schooten, K. J.**, Baird, D. L., Limes, M. E., Lupton, J. M., Boehme, C. Probing spin-spin interactions in intermolecular electron-hole pairs of a conjugated polymer through electrically detected spin-beating (2014) [*under review*]
- [25] Sun, D., **van Schooten, K. J.**, Malissa, H., Kavand, M., Boehme, C., Vardeny, Z. V. Spin-orbit dependence of spin-Hall angles in organic semiconductors [*in preparation*]

ACADEMIC SERVICE

- Graduate Student Advisory Council, Chair** 2011-2012
College of Science, University of Utah, Salt Lake City, Utah
- Graduate Student Advisory Council, Vice-Chair** 2010-2011
College of Science, University of Utah, Salt Lake City, Utah
- Academic Misconduct Committee, Graduate Representative** 2008-2010
College of Science, University of Utah, Salt Lake City, Utah
- Academic Appeals Committee, Graduate Representative** 2008-2010
College of Science, University of Utah, Salt Lake City, Utah
- IEEE Student Organization, Activities Director** 2002-2003
Electrical and Computer Engineering Technology, Southern Polytechnic State University, Marietta, Georgia

TEACHING EXPERIENCE

- University of Utah**, Salt Lake City, Utah 2006–2009
Graduate Teaching Assistant, Dept. of Physics & Astronomy
- Courses: Modern Physics (grading, office hours, class 1 day/week), Electronics I (grading, office hours, practical lab), Solid State II (grading, office hours)
 - *Outstanding Teaching Assistant of the Year* award winner each year with TA duties
- Southern Polytechnic State University**, Marietta, Georgia 2003–2005
University Staff Tutor, Campus-wide
- Courses: Physics (all levels), Calculus (I-III), Pre-Calculus
 - Hired as the only staff Physics tutor for the University, and one of two Calculus tutors

HONORS &
AWARDS**Ph.D. dissertation published in Springer Theses Series**

SPRING 2013

Optically Active Charge Traps and Chemical Defects in Semiconducting Nanocrystals Probed by Pulsed Optically Detected Magnetic Resonance, ISBN:9783319005898

2nd Place Best Graduate Student Oral Presentation

AUGUST 4, 2012

Probing Electronic Trap States in Colloidal Nanocrystals with Optically Detected Magnetic Resonance. Student Research Symposium, Dept. Physics & Astronomy, University of Utah

1st Place Best Graduate Student Oral Presentation

AUGUST 13, 2011

Long Spin Coherence Lifetimes of Optically Generated Excitations in Colloidal CdS Nanorods. Student Research Symposium, Dept. Physics & Astronomy, University of Utah

Outstanding Teaching Assistant

2008-2009

Course: Solid State Physics II (PHYS 5520). Taught by: Prof. John Lupton. Dept. Physics & Astronomy, University of Utah

Outstanding Teaching Assistant

2007-2008

Course: Intro to Quantum and Relativity (PHYS 3740). Taught by: Prof. John Lupton. Dept. Physics & Astronomy, University of Utah

Outstanding Teaching Assistant

2006-2007

Course: Intro to Quantum and Relativity (PHYS 3740). Taught by: Prof. John Lupton. Dept. Physics & Astronomy, University of Utah

Outstanding Teaching Assistant

2005-2006

Course: Intro to Quantum and Relativity (PHYS 3740). Taught by: Prof. David Ailion. Dept. Physics & Astronomy, University of Utah

PROFESSIONAL
AFFILIATIONS

American Physical Society, Member

2008—PRESENT

American Chemical Society, Member

2006—PRESENT