Curriculum Vitae

Dr. Christoph M. Boehme

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Education

2000 – 2003	**Philipps-Universität, Marburg, Germany** – *Physics (PhD), graduated with distinction, summa cum laude*
1997 – 2000	**North Carolina State University, Raleigh, USA** – *Physics (MSc)*
1994 – 2000	**Ruprecht-Karls-Universität, Heidelberg, Germany** – *Dipl. Phys., graduated with distinction*
1990 – 1993	**Technisches Gymnasium Offenburg, Germany** – *Abitur*

Recent employment history

2019 – 2020	**Interim Department Chair** Department of Physics and Astronomy, University of Utah
2013 –	**Professor** Department of Physics and Astronomy, University of Utah
2010 – 2015	**Associate Department Chair** Department of Physics and Astronomy, University of Utah
2010 – 2013	**Associate Professor** Department of Physics and Astronomy, University of Utah
2006 – 2010	**Assistant Professor** Department of Physics and Astronomy, University of Utah
2002 – 2005	**Research Scientist** Department of Silicon-Photovoltaics, Hahn-Meitner-Institut Berlin, Germany
2000 – 2002	**Research Assistant (Doktorand)** Department of Silicon-Photovoltaics, Hahn-Meitner-Institut Berlin, Germany
1997 – 2000	**Research Assistant** Department of Physics, North Carolina State University, Raleigh, USA (Lucovsky group)

Scholarships and Awards

2018	**University of Utah Distinguished Scholarly and Creative Research Award**
2018	**Student Choice Award for Undergraduate Seminar Spring 2018**
2016	**Silver Medal of the International EPR Society** for Physics and Materials Science
2013	**Student Choice Award for Undergraduate Seminar Fall 2013**
2010	**CAREER Award** of the National Science Foundation
2009	**Presentation** award at the 2009 Four Corners Regional APS Meeting
2004	**HMI Kommunikationspreis:** Communication Award of the HMI Berlin for the most outstanding scientific presentation to a non-scientific audience
2004	**IHK Wissenschaftspreis:** Science award of the Philipps-Universität, Marburg, and the Industrial and Trade Chamber Nordhessen
2003	**Dissertationspreis Adlershof:** Dissertation award of the Humboldt Universität Berlin, the IGAFA und WISTA Berlin
2000	**Phi-Kappa-Phi Academic Honor Society**
1997	**Fulbright-Scholarship**
1994	**Hans-Böckler-Scholarship**

Statement of Research Interest

My research program focuses on the exploration of spin-related electronic processes in condensed matter, including spin-dependent charge transport and recombination but also spin-injection and spin-transport phenomena in presence or absence of charge transport. Goal of these efforts is to allow for coherent spin motion detection of small spin ensembles as needed for materials research and single electron or nuclear spin readout devices as needed for quantum information science.

While some of the studied effects constitute classical spintronics questions, most of this work is focused on the exploration of spin-selection rules of electronic processes, a research domain that, traditionally, has not been part of spintronics. Instead, it has been subject of spin-quantum information research, most significantly spin-based quantum sensing, defect spectroscopy, as well as radical pair chemistry. Spin-selection rules on electronic transitions preferably exist in materials with weak spin-orbit coupling, a natural focus of my work has therefore been on solids composed of carbon and silicon.

Motivators behind this research include the significant technological potential of new spin-based information technologies (both classical and quantum information), spin-based quantum sensors as well as their potential to allow for the continued exploration the fundamental physical behavior of materials.

Among the results of this research over the past decade have been (i) the demonstration that spin-selection rules allow the sensitive detection of coherent spin motion of extremely small electron spin ensembles in semiconductor materials and insulators; (ii) that spin-selection rules can also be utilized for the coherent electrical readout of nuclear spins; (iii) that results (i) and (ii) can be applied for the implementation of a new, very sensitive magnetic resonance spectroscopy of paramagnetic states in condensed matter; (iv) that spin-selection rules can be used for optical and electrical dynamic nuclear polarization schemes (as needed for magnetic resonance imaging); (v) new insights into the nature of charge carrier transport and recombination in organic semiconductors such as π-conjugated polymers or Fullerene derivatives and silicon based materials such as crystalline, microcrystalline, and amorphous silicon, silicon nitride and combinations thereof. (vi) that these results can be used for the invention of new spin-devices, most of all a new class of calibration free absolute thin-film magnetometers which are robust against environmental conditions such as temperature. (vii) the demonstration of pure spin-transport and the existence of the inverse spin-Hall effect in condensed matter with strongly localized charge carrier states.

Currently, main research topics include:

(i) The exploration of spin-dependent processes in organic and other carbon based semiconductors. Organic and other carbon based semiconductors are materials with most pronounced spin-dependent electronic transitions. In these materials, spin-dependent transitions determine electrical, optical, optoelectronic and magneto-optoelectronic properties. Spin-dependent transport and recombination can determine efficiency limits of organic light emitting diodes and organic solar cells. A thorough qualitative and quantitative knowledge of these effects is therefore crucial for an optimization of these technologies.

We use electrically and optically detected coherent electron spin resonance techniques in order to investigate spin-dependent processes in OLED and organics solar cell materials. As with inorganic materials, the investigation of coherent spin control mechanisms of electric currents may also ultimately lead to organic spin electronics and quantum information devices.

(ii) The exploration of spin-dependent electronic transitions involving phosphorous in a crystalline silicon host matrix. Phosphorous atoms exist in only one isotope (^{31}P) with a nuclear spin s=1/2. Both the nuclear spin and the one donor electron spin of ^{31}P in crystalline silicon have longest nuclear and electron spin coherence times, which is why phosphorous has been suggested as an ideal spin-qubit. We work on the development of a scanning probe microscopy based coherent readout which is aimed to enable a fast, reliable and decoherence free (relaxation free) measurement of a single ^{31}P nuclear, as well as a single phosphorous donor electron spins with atomic resolution and addressability, a major step for the implementation of silicon based scalable spin-quantum information concepts.

(iii) The exploration of spin-currents with and without associated charge currents and related effects such as the inverse spin-Hall effect. The nature of spin transport in materials with localized charge carrier states and charge transport based on hopping and tunneling is still mostly unknown. While the existence of these phenomena has been experimentally well-corroborated in recent years and a broad variety of potential artifact processes mimicking these effects have been debunked, no clear theoretical picture has evolved which can account for these effects. This is a main driving force behind the further experimental exploration of these effects.

(vi) The theoretical development of new electrically (EDMR) and optically (ODMR) detected magnetic resonance schemes. This work is methodological research on the theoretical foundations of, in our research group, most widely used spectroscopy techniques. This research is focused on the development and implementation of new pulse sequences, resonator structures, excitation schemes and sample geometries which are specifically optimized for the execution of EDMR and ODMR spectroscopy.

(v) Semiconductor materials research utilizing spin spectroscopy for the investigation of electronically active defects. We apply both pulsed and continuous wave EDMR, ODMR, and EPR to paramagnetic states in various materials in order to gain insights into the nature of defects, dopants, isotopes, and charge carrier states and thus, the magneto-optoelectronic materials properties. This research is crucial for the understanding of efficiency limitations of electronic devices.

Teaching philosophy

I define successful learning in physics not based on the acquisition of knowledge but on the acquisition of an understanding of physics concepts and the ability to apply these concepts to problem solving. Thus, learning physics requires developing understanding rather than simple memorization of facts. Consequently, teaching physics, compared to other disciplines, is much less focused on solely conveying (“reading”) knowledge but much more on the practice of problem solving, discussion and the repeated regurgitation and revisitation of subjects from as many different perspectives as possible.

In practice, teaching physics means enabling students to apply knowledge to problem solving. This is achieved best through continuous student instructor interaction. When an instructor communicates content, students must have the chance to respond such that the instructor can assess the students’ learning success. One way to implement this is through in-class problem discussions and the careful introduction of questions that challenge students to repeat and apply their knowledge. When such communication checks create a discussion based lecture style, the pace of the class can be regulated to the appropriate level for the class - if topics are presented too fast or in a too complicated manner, the instructor will receive feedback immediately and can adjust the lecture to the needs of the students. As the ability of students to engage in classroom discussion and instructor interaction varies significantly, I regularly and intensively utilize electronic in-class feedback tools, including cell-phone apps and clicker response systems. For me, these have worked excellently for in-class discussions and regularly include the overwhelming majority of students.

In order to allow for sufficient time and space for discussion-based learning, I have increasingly moved in recent years towards inverted classroom teaching styles in lower division non-honors courses. For the undergraduate level, in particular lower-division courses, this can be implemented easily with web-based packages (e.g. smartPhysics). It is important though for the application of such lecture-preparation media that the instructor ensures that the course does not degenerate into a quasi-online course. Online media can always only be aids that remove activities from the classroom which can be carried out outside of the classroom in an equivalent way. They cannot substitute for classroom experiences such as in-depth explanation, discussion, practice and the application of physics knowledge.

Teaching physics beyond the lower-division undergraduate level, and especially at the honors and graduate level, is significantly different compared to introductory physics courses. Here, traditional lecture styles remain much more efficient albeit changes, especially with regard to the use of technologies have taken place in recent years as well. Independent from these developments, application of acquired knowledge is as important for these courses as for introductory courses. Thus, in-class discussion, extensive additional discussion sessions, possibly laboratories, or other kinds of practice sessions which allow students to apply and test their problem solving and problem discussion skills, are crucial for the learning success in these courses as well.

While for the reasons discussed above, I strongly support of the use of electronic learning media, including online resources for pre-lectures, lecture demonstrations and other learning tools, I support these only as long as their benefit compared to non-electronic teaching and learning aids is ensured. Electronics can positively or negatively impact the classroom depending on whether their benefits are understood and appropriately used. An adherence to technology based teaching methods that is not carefully considered and monitored can lead to a waste of resources and adverse learning effects.

Mentoring philosophy

For the research experiences of undergraduate and graduate students as well as postdoctoral researchers, mentoring is a crucial element for their success. While good mentoring practices for each of these mentee groups differ at some level - as they differ for different research environments that entail different work schedules, research group sizes, research methods, and collaborative network structures, I believe there are some universal requirements for good mentoring that are equally important across all mentee groups, disciplines, and research areas:

(i) I believe that one of the most important ingredients for successful mentoring within a scientific research environment is the active promotion of a culture that is committed to diversity. Diversity creates equal opportunities but it also promotes collaboration among researchers such that a culture of equality aimed to generate respect for gender, ethnic, race, age, and other personal traits, will also promote a culture of respect for diversity of ideas, especially opposing ideas (hypothesis), a core element of the scientific process. (ii) I believe that mentees should not be micromanaged, but they should be provided with the resources allowing them to develop, explore and try out their own research ideas. In case these ideas turn out to be insufficiently rewarding, mentees should be given sufficient room to readjust their research direction. Being able to develop the creativity to address complicated problems is a crucial part of a researcher's intellectual development; (iii) I believe mentees should not be left alone with their projects if there is a risk that their research is heading towards a "road to nowhere", i.e. a risk that time is wasted on research that is unlikely to yield useful results. However, the guidance that mentees need for this, should never compromise (ii) and, thus, for me, one challenge of good mentoring is to fulfill both (ii) and (iii) at the same time; (iv) Good mentoring should prepare mentees to be successful after they leave the mentorship relationship, with success not just being defined by academic success – e.g. their graduation, but more importantly, by external recognitions as well as the quality, security and productivity of positions that mentees obtain.

Over the course of my career as a research mentor, I have learned that requirements (i) through (iv) are simultaneously met best when the mentoring process takes place in the course of different, subsequent mentoring stages throughout which the level of time spent with an individual mentee gradually increases, along with intellectual collaboration during the mentor/mentee relationship. Initially, mentees need freedom to develop their ideas, and mentoring may be limited just to advice on how to not waste time by pursuing objectives that are unlikely to be successful as well as advice that mentees directly request. In the later stages, mentoring culminates in a very close and intense, almost daily interaction, when mentees are about to finalize their projects. This approach has allowed me to mentor several (up to 14) research group members simultaneously. While the combined length of these mentorship phases are approximately five years for graduate students, they can be much shorter for other mentee groups such as postdoctoral researchers or undergraduate research interns. Still, the approach to achieve goals (i) through (iv) is similar, only compressed to shorter time scales.

Classes taught at the University of Utah and course instructor evaluations (where available)

Fall 2018	**Physics 3220: Physics for Scientists II** **(composite instructor score: 5.8/6)**
Spring 2018	**Physics 3220: Physics for Scientists II** **(composite instructor score: 5.7/6)**
Fall 2017	**Physics 3210: Physics for Scientists I** **(composite instructor score: 5.64/6)**
Spring 2017	**Physics 3220: Physics for Scientists II** **(composite instructor score: 5.6/6)**
Fall 2015	**Physics 1500: Preparation for College Physics (remedial course)** **(composite instructor score: 5.18/6)**
Fall 2014	**Physics 1500 (section I): Preparation for College Physics (remedial course)** **(composite instructor score: 6/6)**
Fall 2014	**Physics 1500 (section II): Preparation for College Physics (remedial course)** **(composite instructor score: 5.66/6)**
Spring 2014	**Physics 1500 (section I): Preparation for College Physics (remedial course)** **(composite instructor score: 4.64/6)**
Spring 2014	**Physics 1500 (section II): Preparation for College Physics (remedial course)** **(composite instructor score: 4.46/6)**
Spring 2013	**Physics 4420: Classical Physics II (Electrodynamics)** **(composite instructor score: 5.79/6)**
Spring 2012	**Physics 4420: Classical Physics II (Electrodynamics)** **(composite instructor score: 5.33/6)**
Spring 2011	**Physics 4420: Classical Physics II (Electrodynamics)** **(composite instructor score: 5.39/6)**
Fall 2010	**Physics 4410: Classical Physics I (classical mechanics)** **(composite instructor score: 5.83/6)**
Spring 2010	**Physics 4420: Classical Physics II (Electrodynamics)** **(composite instructor score: 5.84/6)**
Fall 2009	**Physics 4410: Classical Physics I (Classical mechanics)** **(composite instructor score: 5.92/6)**
Spring 2009	**Physics 6770: Optical Measurement Techniques and Instrumentation lecture** **(composite instructor score: 5.78/6)** **Physics 6775: Optical Measurement Techniques and Instrumentation laboratory** **(composite instructor score: 5.77/6)**
Fall 2008	**Physics 4410: Classical Physics I (Classical mechanics)** **(composite instructor score: 5.5/6)**
Spring 2008	**Physics 6770: Optical Measurement Techniques and Instrumentation lecture** **(composite instructor score: 5.26/6)** **Physics 6775: Optical Measurement Techniques and Instrumentation laboratory** **(composite instructor score: 5.36/6)**
Fall 2007	**Physics 4410: Classical Physics I (Classical mechanics)** **(composite instructor score: 5.51/6)**
Spring 2007	**Physics 6770: Optical Measurement Techniques and Instrumentation** **(composite instructor score: 5.93/6)**
Spring 2006	**Physics 6770: Optical Measurement Techniques and Instrumentation** **(composite instructor score: 4.95/6)**

The work on all classes included the development of an electronic presentation as well as a class website. In all classes, one or more teaching assistants were supervised.

PUBLICATIONS (* = corresponding author)

108. D. L. Baird A. Nahlawi K. Crossley K. J. van Schooten M. Y. Teferi H. Popli G. Joshi S. Jamali H. Malissa J. M. Lupton C. Boehme,
Electric Field Effects on Photoluminescence-Detected Magnetic Resonance of a π-Conjugated Polymer
Phys. Stat. Sol. (B), 1900493 (2020).
https://doi.org/10.1002/pssb.201900493
arXiv: 1806.03805 [cond-mat.mes-hall] (2019).

107. M. Groesbeck, H. Liu, M. Kavand, E. Lafalce, J. Wang, X. Pan, T. H. Tennahewa, H. Popli, H. Malissa, C. Boehme, Z. V. Vardeny
Separation of Spin and Charge Transport in Pristine π-Conjugated Polymers
Phys. Rev. Lett. **124** (6), 067702 (2020).
https://doi.org/10.1103/PhysRevLett.124.067702

106. D.M. Stoltzfus, G. Joshi, H. Popli, S. Jamali, M. Kavand, S. Milster, T. Grünbaum, S. Bange, A. Nahlawi, M. Y Teferi, S. I. Atwood, A. E. Leung, T. A Darwish, H. Malissa, P. L. Burn, J. M. Lupton, C. Boehme
Perdeuteration of poly[2-methoxy-5-(2'-ethylhexyloxy)-1,4-phenylenevinylene] (d-MEHPPV): control of microscopic charge-carrier spin-spin coupling and of magnetic-field effects in optoelectronic devices
J. Mater. Chem. C **8**, 2764 (2020).
https://doi.org/10.1039/C9TC05322K
arXiv: 1909.12213 [cond-mat.mes-hall] (2019).

105. T. Grünbaum, S. Milster, H. Kraus, W. Ratzke, S. Kurrmann, V. Zeller, S. Bange,
C. Boehme and J. M. Lupton
OLEDs as models for bird magnetoception: detecting electron spin resonance in geomagnetic fields
Faraday Discuss. **221**, 92 (2020).
https://doi.org/10.1039/C9FD00047J

104. V. V. Mkhitaryan, C. Boehme, J.M. Lupton, M.E. Raikh
Two-photon absorption in a two-level system enabled by noise
Phys. Rev. B **100** (21), 214205 (2019).
https://doi.org/10.1103/PhysRevB.100.214205

103. D. Sun, C. Zhang, M. Kavand, J. Wang, H. Malissa, H. Liu, H. Popli, J. Singh, S. R. Vardeny, W. Zhang, C. Boehme, and Z. V. Vardeny
Surface-enhanced spin current to charge current conversion efficiency in $CH_3NH_3PbBr_3$-based devices
J. Chem. Phys. **151**, 174709 (2019).
https://doi.org/10.1063/1.5125230

102. M. Y. Teferi, J. Ogle, G. Joshi, H. Malissa, S. Jamali, D. L., Baird, J. M. Lupton, L. Whittaker-Brooks, and C. Boehme
Tuning effective hyperfine fields in PEDOT:PSS thin films by doping
Phys. Rev. B **98**, 241201(R) (2018).
https://dx.doi.org/10.1103/PhysRevB.98.241201
arXiv:1804.05139v1 [cond-mat.mes-hall]

101. D. Sun, Y. Zhai, K. J van Schooten, C. Zhang, M. Kavand, H. Malissa, M. Groesbeck, R. Menon, C. Boehme, and Z. V. Vardeny
Sign reversal of magnetoresistance and inverse spin Hall effect in doped conducting polymers
J. Phys.: Condens. Matter **30** 484003 (2018).
https://dx.doi.org/10.1088/1361-648X/aae86f

100. G. Joshi, M. Y. Teferi, S. Jamali, M. Groesbeck, J. van Tol, R. McLaughlin, Z. V. Vardeny, J. M. Lupton, H. Malissa, C. Boehme*
High-Field Magnetoresistance of Organic Semiconductors
Phys. Rev. Applied **10** (2), 024008 (2018).
https://doi.org/10.1103/PhysRevApplied.10.024008
arXiv:1804.09297 [cond-mat.mes-hall]

99. Z. Zhang, H. Li, R. Miller, S. Jamali, H. Malissa, Q. Zhang, J. Yin, C. Boehme, J. C. Grossman, and S. Ren,
Freestanding organic charge-transfer conformal electronics

Nano Lett. **18**, (2018).
https://pubs.acs.org/doi/abs/10.1021/acs.nanolett.8b01342

98. G. Joshi, M. Y. Teferi, R. Miller, S. Jamali, D. L. Baird, J. v. Tol, H. Malissa, J. M. Lupton*, C. Boehme*
Isotropic effective charge-carrier g-tensors in PEDOT:PSS
J. Am. Chem. Soc. **140**, 6758 (2018).
https://doi.org/10.1021/jacs.8b03069

97. P. Klemm, S. Bange, H. Malissa, C. Boehme*, and J. M. Lupton,
Temperature and current dependence of the magnetoresistive behavior of poly(styrene-sulfonate)-doped poly(3,4-ethylenedioxythiophene) (PEDOT:PSS).
J. Photon. Energy **8** (3), 032216 (2018).
http://dx.doi.org/10.1117/1.JPE.8.032216.

96. H. Malissa, R. Miller, D. L. Baird, S. Jamali, G. Joshi, M. Bursch, S. Grimme, J. van Tol, J. M. Lupton, and C. Boehme,
Revealing weak spin-orbit coupling effects on charge carriers in a π-conjugated polymer
Phys. Rev, B **97**, 161201 (R) (2018) (Rapid Communication).
https://doi.org/10.1103/PhysRevB.97.161201
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Physical Review B: Condensed Matter, Then and Now

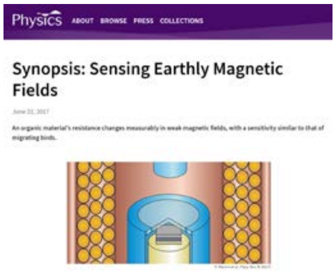
Materials Research in the *Physical Review* Journals

Revealing weak spin-orbit coupling effects on charge carriers in a π-conjugated polymer

95 H. Liu, C. Zhang, H. Malissa, M. Groesbeck, M. Kavand, R. McLaughlin, S. Jamali, J. Hao, D. Sun, R. A. Davidson, L. Wojcik, J. S. Miller, C. Boehme, Z. Valy Vardeny,
Organic-based Magnonics,
Nature Mater. **17,** 308 (2018),
http://dx.doi.org/10.1038/s41563-018-0035-3

94. H. Malissa, C, Boehme
Pulsed inverse spin--Hall effect spectroscopy of spin-transport in organic semiconductors
World Scientific Reference on Spin in Organics **2**, Eds: Z.V. Vardeny, M. Wohlgenannt), World Scientific (Singapore) 137 – 166 (2017).
http://www.worldscientific.com/worldscibooks/10.1142/10680-vol2

93. C. Boehme
Window of opportunity
Nature Phys. **13**, 928 (2017).
http://dx.doi.org/10.1038/nphys4284



Synopsis: Sensing Earthly Magnetic Fields

An organic material's resistance changes measurably in weak magnetic fields, with a sensitivity similar to that of migrating birds.

92. S. Jamali, G. Joshi, H. Malissa, J. M. Lupton, C. Boehme
Monolithic OLED-microwire devices for ultrastrong magnetic resonant excitation
Nano Lett. **17** (8), 4648 (2017).
http://dx.doi.org/10.1021/acs.nanolett.7b01135

91. P. Klemm, S. Bange, A. Pöllmann, C. Boehme, and J M. Lupton*
Nanotesla magnetoresistance in π-conjugated polymer devices
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90. H. Kraus, S. Bange, F. Frunder, U. Scherf, C. Boehme, and J. M. Lupton
Visualizing the radical-pair mechanism of molecular magnetic-field effects by magnetic resonance-induced electrofluorescence to electrophosphorescence interconversion
Phys. Rev. B **95**, 241201(R) (2017). (Rapid Communication)
https://doi.org/10.1103/PhysRevB.95.241201

89. M. Kavand, C. Zhang, D. Sun, H. Malissa, Z. V. Vardeny, C. Boehme
Driving field amplitude gauged quantitative inverse spin Hall effect detection
Phys. Rev. B **95**, 161406(R) (2017). (Rapid Communication)
https://doi.org/10.1103/PhysRevB.95.161406
https://arxiv.org/abs/1610.02759

88. C, Boehme, H. Malissa,
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eMagRes **6** (1), 83 (2017).
https://doi.org/10.1002/9780470034590.emrstm1525

87. D. Sun , C. M. Kareis, K. J. van Schooten, W. Jiang, G. Siegel, M. Kavand, R. A. Davidson, W. W. Shum, C. Zhang, H. Liu, A. Tiwari, C. Boehme, F. Liu, P. W. Stephens, J. S. Miller, Z. V. Vardeny*
Spintronic Detection of interfacial magnetic switching in a paramagnetic tris(8-hydroxyquinoline)iron(III)
Phys. Rev. B **95**, 054423 (2017).
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86. K. Ambal, C. C. Williams*, and C. Boehme*,
In-situ absolute magnetometry in a UHV scanning probe microscope based on a spin-dependent current in a conducting polymer-thin film
J. Vac. Sci. Technol. A **35** (2), 021602, (2017).
http://dx.doi.org/10.1116/1.4973920

85. R. Miller, K. J. van Schooten, H. Malissa, G. Joshi, S. Jamali, J. M. Lupton*, and C. Boehme*
Morphology effects on spin-dependent transport and recombination
in polyfluorene thin films
Phys. Rev. B **94**, 214202 (2016).
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84. J. Hao, R. A. Davidson, M. Kavand, K. J. van Schooten, C. Boehme, and J. S. Miller*
Hexacyanobutadienide-based Frustrated and Weak Ferrimagnets: M(HCBD)2•zCH2Cl2 (M = V, Fe)
Inorg. Chem. **55** (18), 9393 (2016).
http://dx.doi.org/10.1021/acs.inorgchem.6b01565

83. G. Joshi, R. Miller, L. Ogden, M. Kavand, S. Jamali, K. Ambal, S. Venkatesh, D. Schurig, H. Malissa, J.M. Lupton*, and C. Boehme*,
Separating hyperfine from spin-orbit interactions in organic semiconductors by multi-octave magnetic resonance using coplanar waveguide microresonators
Appl. Phys. Lett. **109**, 103303 (2016).
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82. M. Kavand, D. L. Baird, K. J. van Schooten, H. Malissa, J. M. Lupton, C. Boehme
Discrimination between spin-dependent charge transport and spin dependent recombination in π-conjugated polymers by correlated current and electroluminescence-detected magnetic resonance
Phys. Rev. B **94**, 075209 (2016).
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Highlighted as "Editors Suggestion" on the front page of *Phys. Rev. B*.

PHYSICAL REVIEW B
covering condensed matter and materials physics

EDITORS' SUGGESTION

Discrimination between spin-dependent charge transport and spin-dependent recombination in π-conjugated polymers by correlated current and electroluminescence-detected magnetic resonance

It has been corroborated in the past that Pauli blockade mechanisms of weakly spin-coupled charge carrier pairs undergoing transitions into doubly occupied singlet states are among the most dominant spin-selection rules influencing room-temperature magnetoresistance and luminescence of organic semiconductors. It has remained unclear though whether these pairs consist of equal or opposite charges, and thus, whether the spin-dependent transitions are recombination or charge transport processes. Here, the authors report on simultaneous transient measurements of electric current and optical emission changes in organic light emitting diodes due to pulsed magnetic resonance induced charge carrier spin manipulation. When a room-temperature steady-state current is changed magnetic resonantly, the electroluminescence changes show identical dynamic and magnetic resonant signatures, indicating that both observables are controlled by the same spin-dependent electronic process. However, a quantitative analysis of the optical emission change reveals that its magnitude significantly exceeds what is expected from the magnitude of the electrical current change, implying that the optical emission change occurs not only because of the device current change but also due to a change of the radiative recombination rate, thereby showing that the observed spin-dependent process is due to recombination, not transport.

Marzieh Kavand et al.
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81. J. Hao, A. L. Rheingold, M. Kavand, K. J. van Schooten, C. Boehme, M. Capdevila, J. J. Novoa, E. Wöß, G. Knör, and J. S. Miller,
The Tetracyanopyridinide Dimer Dianion, σ-[TCNPy]$_2^{2-}$
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80. J. Hao, R. A. Davidson, C. M. Kareis, M. Kavand, K. J. van Schooten, C. Boehme, E. Wöß, G. Knör, and J. S. Miller
Characterization of Tetracyanopyridine (TCNPy)-based Magnets: V[TCNPy]2•z(CH2Cl2) (Tc = 111 K) and V[TCNPy]3•z(CH2Cl2) (Tc = 90 K)
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79. D. Sun, K. J. van Schooten, H. Malissa, M. Kavand, C. Zhang, C. Boehme, and Z. V. Vardeny,
Inverse Spin Hall Effect from pulsed Spin Current in Organic Semiconductors with Tunable Spin-Orbit Coupling,
Nature Materials **15** (5), 863 (2016).
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78. K. Ambal, P. Rahe, A. Payne, J. Slinkman, C. C. Williams, and C. Boehme,

Electrical coupling to individual pairs of phosphorous donor atoms and silicon dangling bonds,
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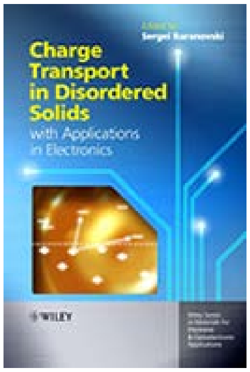

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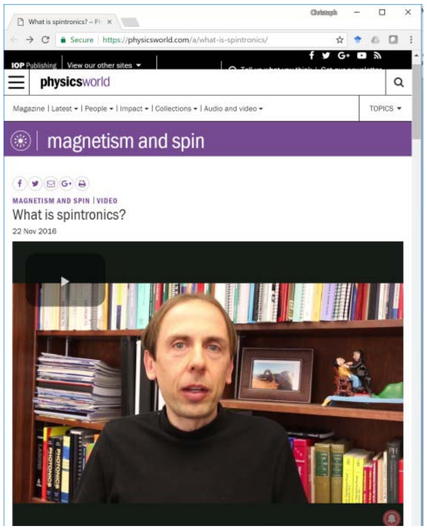

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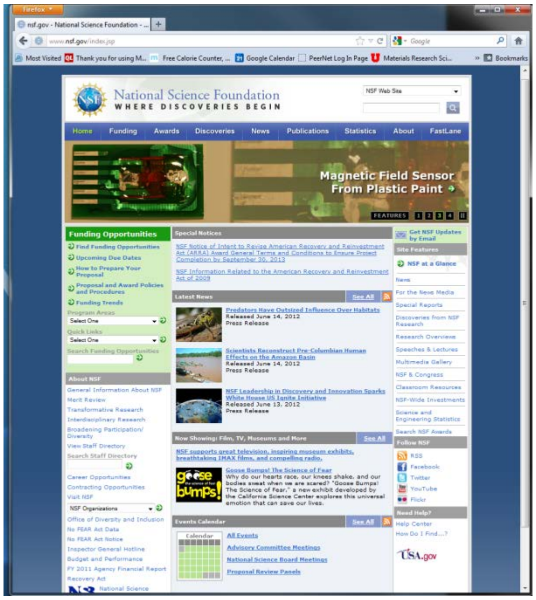
Nuclear spins control electrical currents

Sep 23, 2014

Spin doctor: Christoph Boehme inserts an OLED into a spectrometer



Magnetic Field Sensor From Plastic Paint

NSF Notice of Intent to Revise American Recovery and Reinvestment Act (ARRA) Award General Terms and Conditions to Ensure Project Completion by September 30, 2013

NSF Information Related to the American Recovery and Reinvestment Act of 2009

Predators Have Outsized Influence Over Habitats
Released June 14, 2012
Press Release

Scientists Reconstruct Pre-Columbian Human Effects on the Amazon Basin
Released June 14, 2012
Press Release

NSF Leadership in Discovery and Innovation Sparks White House US Ignite Initiative
Released June 13, 2012
Press Release

NSF supports great television, inspiring museum exhibits, breathtaking IMAX films, and compelling radio.

Goose Bumps! The Science of Fear
Why do our hearts race, our knees shake, and our bodies sweat when we are scared? "Goose Bumps! The Science of Fear," a new exhibit developed by the California Science Center explores this universal emotion that can save our lives.

(Right) The work on electrical detection of nuclear spin motion in organic semiconductor was featured by the DOE Office of Science main website on September 25, 2014.

(left) The work on organic semiconductor based magnetometry was featured by the NSF main website on June 21, 2012.

Nuclear Spins Control Current in Plastic LED

University of Utah physicists are making steps toward quantum computing, spintronic memory, and better displays.

Pursuit of Dark Matter Progresses at AMS

Interface Surprises May Motivate Novel Oxide Electronic Devices