

## CHUNHUI (RITA) DU, Ph.D.

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### RESEARCH INTERESTS

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I am a condensed matter experimentalist with expertise in nanoscale quantum sensing. My work focuses on:

- Single spin magnetometry with nitrogen-vacancy (NV) centers in diamond
- Hybrid quantum devices based on optically active single spin qubit
- Spin transport and dynamics in nanostructured and quantum materials
- Scanning probe based magnetic imaging

### EDUCATION

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**2015 Ph.D. in Physics**, The Ohio State University, Columbus, OH

Advisor: Prof. P. Chris Hammel

Thesis: Probing Spin Dynamics and Transport using Ferromagnetic Resonance based Techniques

**2010 B. S. in Physics**, East China Normal University, Shanghai, China

### RESEARCH EXPERIENCE

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**2019 - Assistant Professor**, Department of Physics, University of California, San Diego

**2015 -2019**

**Postdoctoral Fellow**, Department of Physics, Harvard University

Advisor: Prof. Amir Yacoby

Project: Nanoscale Quantum Sensing of Quantum Materials using NV Centers in Diamond

### HONORS AND AWARDS

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- NSF CAREER Award, 2021-2026.
- Air Force Office of Scientific Research (AFOSR), Young Investigator Award, 2021-2024.
- Harold and Suzy Ticho Endowed Faculty Fellowship in Physics, University of California, San Diego 2019-2024.

### PUBLICATIONS

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(\*equal contribution, google scholar citations > 1800, h-index: 15)

30. E. Lee-Wong, J. Ding, X. Wang, C. Liu, N. J. McLaughlin, H. L. Wang, M. Wu, and **C. H. R. Du**, Quantum Sensing of Spin Fluctuations of Magnetic Insulator Films with Perpendicular Anisotropy, *Phys. Rev. Appl.* **15**, 034031 (2021). [[doi](#)]
29. D. D. Awschalom, **C. H. R. Du**, R. He, F. J. Heremans, A. Hoffmann, J. T. Hou, H. Kurebayashi, Y. Li, L. Liu, V. Novosad, J. Sklenar, S. E. Sullivan, D. Sun, H. Tang, V. Tiberkevich, C. Trevillian, A. W. Tsen, L. R. Weiss, W. Zhang, X. Zhang, L. Zhao, C. W. Zollitsch, Quantum engineering with hybrid magnonics systems and materials, arXiv:2011.03905. [[doi](#)]

28. X. Wang, Y. Xiao, H. Wang, C. Liu, E. Lee-Wong, N. McLaughlin, H. Wang, H. L. Wang, M. Wu, E. Fullerton, **C. H. R. Du**, Electrical Control of Coherent Spin Rotation of a Single-Spin Qubit, *npj Quantum Inf.* **6**, 78 (2020). [[doi](#)]
27. E. Lee-Wong, R. Xue, F. Ye, A. Kreisel, T. van der Sar, A. Yacoby, **C. H. R. Du**, Nanoscale Detection of Magnon Excitations with Variable Wavevectors Through a Quantum Spin Sensor, *Nano Lett.* **20**, 3284 (2020). [[doi](#)]
26. H. L. Wang, S. Zhang, N. J. McLaughlin, B. Flebus, M. Huang, Y. Xiao, E. E. Fullerton, Y. Tserkovnyak, and **C. H. R. Du**, Quantum Sensing of Spin Transport Properties of an Antiferromagnetic Insulator, arXiv:2011.03905. [[doi](#)]
25. N. J. McLaughlin, Y. Kalcheim, A. Suceava, H. L. Wang, I. K. Schuller, and **C. H. R. Du**, Quantum Sensing of Insulator-to-metal Transitions in a Mott Insulator, arXiv:2009.02886. [[doi](#)] (Accepted in *Adv. Quantum Technol.*)
23. T. X. Zhou\*, J. J. Carmiggelt\*, L. M. Gächter\*, I. Esterlis, D. Sels, R. J. Stöhr, **C. H. R. Du**, D. Fernandez, J. F. Rodriguez-Nieva, F. Büttner, E. Demler, and Amir Yacoby, A Magnon Scattering Platform, arXiv:2004.07763. [[doi](#)].
22. H. Zhang\*, M.J.H. Ku\*, F. Casola, **C. H. R. Du**, T. van der Sar, M.C. Onbasli, C.A. Ross, Y. Tserkovnyak, A. Yacoby, R. L. Walsworth, Spin-torque oscillation in a magnetic insulator probed by a single-spin sensor, *Phys. Rev. B* **102**, 024404 (2020). [[doi](#)]
21. **C. H. Du**\*, T. Van der Sar\*, T. X. Zhou\*, P. Upadhyaya, F. Casola, H. Zhang, M. C. Onbasli, C. A. Ross, R. L. Walsworth, Y. Tserkovnyak, and A. Yacoby, Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator, *Science* **357**, 195 (2017). [[doi](#)]
20. H. L. Wang, **C. H. Du**, P. C. Hammel, and F. Y. Yang, Comparative Determination of  $\text{Y}_3\text{Fe}_5\text{O}_{12}/\text{Pt}$  Interfacial Spin Mixing Conductance by Spin-Hall Magnetoresistance and Spin Pumping, *Appl. Phys. Lett.* **110**, 062402 (2017). [[doi](#)]
19. **C. H. Du**\*, I. Lee\*, R. Adur, Y. Obukhov, C. Hamann, B. Buchner, J. McCord, D. V. Pelekhov, and P. C. Hammel, Imaging Interfaces Defined by Abruptly Varying Internal Magnetic Fields by Means of Scanned Nanoscale Spin Wave Modes, *Phys. Rev. B* **92**, 214413 (2015). [[doi](#)]
18. S. A. Manuilov, **C. H. Du**, R. Adur, H. L. Wang, V. P. Bhallamudi, F. Y. Yang, and P. C. Hammel, Spin Pumping from Spin waves in Thin Film YIG, *Appl. Phys. Lett.* **107**, 042405 (2015). [[doi](#)]
17. H. L. Wang\*, **C. H. Du**\*, P. C. Hammel, and F. Y. Yang, Spin Transport in Insulators Mediated by Magnetic Correlations, *Phys. Rev. B* **91**, 220410(R) (2015). [[doi](#)]
16. **C. H. Du**, H. L. Wang, P. C. Hammel, and F. Y. Yang,  $\text{Y}_3\text{Fe}_5\text{O}_{12}$  Spin Pumping for Quantitative Understanding of Pure Spin Transport and Spin Hall Effect in a Broad Range of Materials (invited), *J. Appl. Phys.* **117**, 172603 (2015). [[doi](#)]
15. R. Adur, **C. H. Du**, J. Cardellino, N. Scozzaro, C. S. Wolfe, H. L. Wang, M. R. Herman, V. P. Bhallamudi, D. V. Pelekhov, F. Y. Yang, and P. Chris Hammel, Microscopic Studies of Nonlocal Spin Dynamics and Spin Transport (invited), *J. Appl. Phys.* **117**, 172604 (2015). [[doi](#)]
14. R. Adur, **C. H. Du**, S. A. Manuilov, H. L. Wang, F. Y. Yang, D. V. Pelekhov, and P. C. Hammel, The Magnetic Particle in a Box: Analytic and Micromagnetic Analysis of Probe-Localized Spin Wave Modes, *J. Appl. Phys.* **117**, 17E108 (2015). [[doi](#)]
13. **C. H. Du**, R. Adur, H. L. Wang, S. A. Manuilov, F. Y. Yang, D. V. Pelekhov, and P. C. Hammel, Experimental and Numerical Understanding of Localized Spin Wave Mode Behavior in Broadly Tunable Spatially Complex Magnetic Configurations, *Phys. Rev. B* **90**, 214428 (2014). [[doi](#)]
12. **C. H. Du**\*, H. L. Wang\*, F. Y. Yang, and P. C. Hammel, Systematic Variation of Spin-orbit Coupling with  $d$ -orbital Filling: Large Inverse Spin Hall effect in 3d Transition Metals, *Phys. Rev. B. Rapid Comm.* **90**, 140407(R) (2014). [[doi](#)]
11. R. Adur, **C. H. Du**, H. L. Wang, S. A. Manuilov, V. P. Bhallamudi, C. Zhang, D. V. Pelekhov, F. Y. Yang, and P. C. Hammel, Damping of Confined Modes in a Ferromagnetic Thin Insulating Film: Angular Momentum Transfer Across a Nanoscale Field-defined Interface, *Phys. Rev. Lett.* **113**, 176601 (2014). [[doi](#)]
10. R. Adur, **C. H. Du**, H. L. Wang, S. A. Manuilov, F. Y. Yang, and P. C. Hammel, Dual-Frequency

- Ferromagnetic Resonance to Measure Spin Current Coupling in Multilayers, *Proc. SPIE* 9167, *Spintronics* VII, 91672J. [[doi](#)]
9. H. L. Wang\*, **C. H. Du\***, P. C. Hammel, and F. Y. Yang, Antiferromagnonic Spin Transport from  $\text{Y}_3\text{Fe}_5\text{O}_{12}$  into NiO, *Phys. Rev. Lett.* **113**, 097202 (2014). [[doi](#)]
  8. H. L. Wang\*, **C. H. Du\***, P. C. Hammel, and F. Y. Yang, Spin Current and Inverse Anomalous Hall Effect in Ferromagnetic Metals Probed by  $\text{Y}_3\text{Fe}_5\text{O}_{12}$ -based Spin Pumping, *Appl. Phys. Lett.* **104**, 202405 (2014). [[doi](#)]
  7. **C. H. Du\***, H. L. Wang\*, F. Y. Yang, and P. C. Hammel, Enhancement of Pure Spin Currents in Spin Pumping  $\text{Y}_3\text{Fe}_5\text{O}_{12}$ /Cu/metal Trilayers through Spin Conductance Matching, *Phys. Rev. Applied* **1**, 044004 (2014). [[doi](#)]
  6. H. L. Wang\*, **C. H. Du\***, Y. Pu, R. Adur, P. C. Hammel, and F. Y. Yang, Scaling of Spin Hall Angle in 3d, 4d and 5d Metals from Epitaxial  $\text{Y}_3\text{Fe}_5\text{O}_{12}$ /metal Spin Pumping, *Phys. Rev. Lett.* **112**, 197201 (2014). [[doi](#)]
  5. H. L. Wang\*, **C. H. Du\***, P. C. Hammel, and F. Y. Yang, Strain-Tunable Magnetocrystalline Anisotropy in Epitaxial  $\text{Y}_3\text{Fe}_5\text{O}_{12}$  Thin Films, *Phys. Rev. B.* **89**, 134404 (2014). [[doi](#)]
  4. C. S. Wolfe\*, V. P. Bhallamudi\*, H. L. Wang, **C. H. Du**, S. A. Manuilov, R. M. Teeling-Smith, A. J. Berger, R. Adur, F. Y. Yang, and P. C. Hammel, Off-Resonant Manipulation of Spins in Diamond via Precessing Magnetization of a Proximal Ferromagnet, *Phys. Rev. B. Rapid Comm.* **89**, 180406(R) (2014). [[doi](#)]
  3. **C. H. Du\***, H. L. Wang\*, Y. Pu, T. L. Meyer, P. M. Woodward, F. Y. Yang, and P. C. Hammel, Probing the Spin Pumping Mechanism: Exchange Coupling with Exponential Decay in  $\text{Y}_3\text{Fe}_5\text{O}_{12}$ /barrier/Pt Heterostructures, *Phys. Rev. Lett.* **111**, 247202 (2013). [[doi](#)]
  2. H. L. Wang\*, **C. H. Du\***, Y. Pu, R. Adur, P. C. Hammel, and F. Y. Yang, Large Spin Pumping from Epitaxial  $\text{Y}_3\text{Fe}_5\text{O}_{12}$  Thin Films to Pt and W Layers, *Phys. Rev. B. Rapid Comm.* **88**, 100406(R) (2013). [[doi](#)]
  1. **C. H. Du**, R. Adur, H. L. Wang, A. J. Hauser, F. Y. Yang, and P. C. Hammel, Control of Magnetocrystalline Anisotropy by Epitaxial Strain in Double Perovskite  $\text{Sr}_2\text{FeMoO}_6$  Films, *Phys. Rev. Lett.* **110**, 147204 (2013). [[doi](#)]

## PRESENTATIONS

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### Talks

13. “Harnessing Nitrogen Vacancy Centers in Diamond for Next-Generation Quantum Science and Technology”, 2021 APS March Meeting, 3/2021. (invited symposium)
12. “Nanoscale Quantum Sensing of Quantum Materials through a Single Spin Magnetometer”, 2021 APS March Meeting, 3/2021. (invited talk)
11. “Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator”, 2019 MMM conference, Las Vegas, NV, 11/2019. (invited talk)
10. “Quantum Sensing of Layered Superconductor at the Nanoscale” presented at 2019 APS March Meeting, Boston, MA, 3/2019.
9. “Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator” presented at Spin Caloritronics IX conference, Columbus, OH, 6/2018. (invited talk)
8. “Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator” presented at 2018 APS March Meeting, Los Angeles, CA, 3/2018. (invited talk)
7. “Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator” presented at 2017 APS March Meeting, New Orleans, LA, 3/2017.
6. “Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator” presented at 1<sup>st</sup> EPiQS Postdoctoral Symposium, Aspen Center for Physics, CO, 2/2017.
5. “Probing Local Spin Dynamics and Transport using Nitrogen Vacancy Centers in Diamond” presented at Rising Star in Physics: An Academic Career Workshop for Women, Massachusetts Institute of Technology, Cambridge, MA, 10/2016.

4. "Spin Transport in Insulators Mediated by Magnetic Correlations Probed by  $\text{Y}_3\text{Fe}_5\text{O}_{12}$ -based Spin Pumping" presented at 2015 APS March Meeting, San Antonio, TX, 3/2015.
3. "Broadly Tunable Approach to Localizing Ferromagnetic Resonance Modes Controlled by Field Orientation" presented at 59<sup>th</sup> Annual Magnetism and Magnetic Materials (MMM) Conference, Honolulu, HA, 11/2014.
2. "Probing the Spin Pumping Mechanism and Efficiency using YIG-based Structure" presented at Institute for Materials Research Week, Columbus, OH, 5/2014 (invited talk).
1. "Probing the Spin Pumping Mechanism: Exchange Coupling with Exponential Decay in  $\text{Y}_3\text{Fe}_5\text{O}_{12}$ /Barrier/Pt Heterostructures" presented at 58<sup>th</sup> Annual Magnetism and Magnetic Materials (MMM) Conference, Denver, CO, 11/2013.

### Seminars and Colloquiums

30. "Harnessing Nitrogen Vacancy Centers in Diamond for Next-Generation Quantum Science and Technology", Physics Colloquium, California State University, 2/2021.
29. "Harnessing Nitrogen Vacancy Centers in Diamond for Next-Generation Quantum Science and Technology", Department of Physics, Case Western Reserve University, 10/2020.
28. "Harnessing Nitrogen Vacancy Centers in Diamond for Next-Generation Quantum Science and Technology", Department of Physics, The University of Arizona, 9/2020.
27. "Nanoscale Quantum Sensing of Quasi-Two-Dimensional Materials", Department of Physics, University of California, Davis, Davis, CA, 6/2019.
26. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, University of California, Irvine, Irvine, CA, 3/2018.
25. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, University of California, San Diego, La Jolla, CA, 2/2018.
24. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, Caltech, Pasadena CA, 2/2018.
23. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, Columbia University, New York, NY, 2/2018.
22. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics and Astronomy, University of Rochester, Rochester, NY, 2/2018.
21. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, University of Illinois at Urbana-Champaign, Champaign, IL, 2/2018.
20. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics and Astronomy, Purdue University, West Lafayette, IN, 2/2018.
19. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, Carnegie Mellon University, Pittsburgh, PA, 2/2018.
18. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, The University of Texas at Austin, Austin, TX, 2/2018.
17. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, University of Florida, Gainesville, FL, 2/2018.
16. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, New York University, New York, NY, 1/2018.
15. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, University of Notre Dame, Notre Dame, IN, 1/2018.
14. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, Massachusetts Institute of Technology, Cambridge, MA, 1/2018.
13. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, Brown University, Providence, RI, 1/2018.
12. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, Boston College, Chestnut Hill, MA, 1/2018.
11. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department

- of Physics, Pennsylvania State University, State College, PA, 1/2018.
10. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Institute for Molecular Engineering, University of Chicago. Chicago, IL, 12/2017.
  9. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, University of Wyoming, Laramie, WY, 11/2017.
  8. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator," Department of Physics, Oklahoma State University, Stillwater, OK, 10/2017.
  7. "Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator" presented at Center for Nanoscale Systems Seminar, Harvard University, Cambridge, MA, 10/2017.
  6. "Spin Dynamics and Transport studied by Ferromagnetic Resonance (FMR) based Techniques," Department of Physics, Princeton University, Princeton, NJ, 4/2015.
  5. "Spin Dynamics and Transport studied by Ferromagnetic Resonance (FMR) based Techniques," Department of Applied Physics, Stanford University, Stanford, CA, 3/2015.
  4. "Spin Dynamics and Transport studied by Ferromagnetic Resonance (FMR) based Techniques," Department of Physics, The University of Chicago, Chicago, IL, 3/2015.
  3. "Spin Dynamics and Transport studied by Ferromagnetic Resonance (FMR) based Techniques," Department of Physics, Massachusetts Institute of Technology, Cambridge, MA, 3/2015.
  2. "Spin Dynamics and Transport studied by Ferromagnetic Resonance (FMR) based Techniques," Department of Physics, Harvard University, Cambridge, MA, 2/2015.
  1. "Spin Dynamics and Transport studied by Ferromagnetic Resonance (FMR) based Techniques," Department of Physics and Applied Physics, Yale University, New Haven, CT, 2/2015.

### **SYNERGISTIC ACTIVITIES**

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- A faculty mentor of Cal-Bridge program to create pathway for students in the underrepresented groups to enter the Ph.D. programs in physics and astronomy.
- A faculty host for Tech Trek program at UCSD. Coordinate the demo activities on electricity, magnetism, sound, and optics. June, 2019, San Diego, CA.
- A Guest speaker of Young Physicists Program at UCSD. Deliver a public lecture about "Introduction to superconductivity" to local high school students. April, 2019, San Diego, CA.
- Session chair of APS March meeting (2017-2019) and Magnetism & Magnetic Materials Conference (2019).
- Frequent journal reviewer for Nature Physics, Physical Review Letters, Physical Review B, Nature Communications, Applied Physics Letters, Scientific Reports.