

Hugh O. H. Churchill

CURRICULUM VITAE

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Education

- 2012 Ph.D. in Physics, Harvard University
Dissertation title: “Quantum dots in gated nanowires and nanotubes”
- 2008 A.M. in Physics, Harvard University
- 2006 B.A. in Physics with highest honors and Mathematics, Oberlin College
B.M. in Tuba Performance, Oberlin Conservatory of Music

Employment

- 2021– Associate Professor of Physics, University of Arkansas
- 2015–2021 Assistant Professor of Physics, University of Arkansas
Research interests: quantum materials and devices, quantum transport, optoelectronics
- 2012–2015 Pappalardo Fellow, Massachusetts Institute of Technology Department of Physics
Quantum transport and optoelectronics in dichalcogenides (advisor P. Jarillo-Herrero)
- 2012 Postdoctoral Fellow, Harvard University Department of Physics
Tunneling spectroscopy of superconducting InSb nanowire devices (advisor C. M. Marcus)
- 2006–2012 Research Assistant, Harvard University Department of Physics
Quantum dots in gated nanowires and nanotubes (advisor C. M. Marcus)

Honors

- 2021 Fellow, Arkansas Research Alliance
- 2019 Presidential Early Career Award for Scientists and Engineers
- 2018 NSF CAREER Award
- 2017 ORAU Powe Junior Faculty Award
- 2016 AFOSR Young Investigator
- 2016 Connor Faculty Fellowship, University of Arkansas
- 2012 Pappalardo Postdoctoral Fellowship, MIT

2011	White Prize for Excellence in Teaching, Harvard
2010	IBM Ph.D. Fellow
2006	APS Apker Award for Undergraduate Research
2006	NSF Graduate Research Fellow
2005	Phi Beta Kappa, Sigma Xi, Pi Kappa Lambda

Complete publication list: ([Google Scholar](#))

Research Articles

33. A. Fereidouni, M. H. Doha, K. Pandey, R. Basnet, J. Hu, **H. O. H. Churchill**, “Enhancement of 2D topological semimetal transport properties by current annealing,” *Applied Physics Letters* **121**, 113101 (2022). *Editor’s Pick
32. Z. Jiang, C. Paillard, **H. O. H. Churchill**, M. Xia, S. Zhang, H. Xiang, and L. Bellaiche, “Large linear and nonlinear electro-optic coefficients in two-dimensional materials,” *Physical Review B* **106**, L081404 (2022).
31. K. Welch, M. H. Doha, Z. P. Uttley, A. Fereidouni, A. Omolewu, J. Santos, M. El-Shenawee, **H. O. H. Churchill**, “Comparison of Hall Mobility and Carrier Density of Thin Black Phosphorus Exfoliated from Bulk Crystals Provided by Various Vendors,” *2022 IEEE USNC-URSI Radio Science Meeting*, 31 (2022).
30. X. B. Nguyen, A. Bisht, **H. Churchill**, K. Luu, “Two-dimensional Quantum Material Identification via Self-Attention and Soft-labeling in Deep Learning,” arXiv:2205.15948.
29. M. N. Gikunda, F. Harerimana, J. M. Mangum, S. Rahman, J. P. Thompson, C. T. Harris, **H. O. H. Churchill**, P. Thibado, “Array of Graphene Variable Capacitors on 100 mm Silicon Wafers for Vibration-Based Application,” *Membranes* **12**, 533 (2022).
28. M. R. U. Nabi, A. Wegner, F. Wang, Y. Zhu, Y. Guan, A. Fereidouni, K. Pandey, R. Basnet, G. Acharya, **H. O. H. Churchill**, and J. Hu, “Giant topological Hall effect in centrosymmetric tetragonal $\text{Mn}_{2-x}\text{Zn}_x\text{Sb}$,” *Physical Review B* **104**(17), 174419 (2021).
27. F. Barati, J. P. Thompson, M. C. Dartiailh, K. Sardashti, W. Mayer, J. Yuan, K. Wickramasinghe, K. Watanabe, T. Taniguchi, **H. Churchill**, J. Shabani, “Tuning supercurrent in Josephson field effect transistors using h-BN dielectric,” *Nano Letters* **21**, 1915 (2021).
26. J. S. Batista, **H. O. H. Churchill**, and M. El-Shenawee, “Black phosphorus photoconductive terahertz antenna: 3D modeling and experimental reference comparison,” *Journal of the Optical Society of America B* **38**, 1367 (2021).
25. S. H. Lee, Y. Zhu, H. Yi, D. Graf, R. Basnet, A. Fereidouni, A. Wegner, Y. F. Zhao, L. Min, K. Verlinde, J. He, R. Redwing, **H. O. H. Churchill**, N. Samarth, C.-Z. Chang, J. Hu, and Z. Q. Mao, “Evidence for a magnetic-field induced ideal Weyl state in antiferromagnetic topological insulator MnBi_2Te_3 ,” *Physical Review X* **11**, 031302 (2021).

24. Y. Wang, J. Balgley, E. Gerber, M. Gray, N. Kumar, X. Lu, J.-Q. Yan, A. Fereidouni, R. Basnet, S. J. Yun, D. Suri, H. Kitadai, T. Taniguchi, K. Watanabe, X. Ling, J. Moodera, Y. H. Lee, **H. O. H. Churchill**, J. Hu, L. Yang, E.-A. Kim, D. G. Mandrus, E. A. Henriksen, K. S. Burch, “Modulation Doping via a 2D Atomic Crystalline Acceptor,” *Nano Letters* **20**, 8446 (2020).
23. M. H. Doha, J. I. Batista, A. F. Rawwagah, J. P. Thompson, A. Fereidouni, K. Watanabe, T. Taniguchi, M. El-Shenawee, **H. O. H. Churchill**, “Integration of multi-layer black phosphorus into photoconductive antennas for THz emission,” *J. Appl. Phys.* **128**, 063104 (2020).
22. S. Davari, J. Stacy, A. M. Mercado, J. D. Tull, R. Basnet, K. Pandey, K. Watanabe, T. Taniguchi, J. Hu, **H. O. H. Churchill**, “Gate-defined Accumulation-mode Quantum Dots in Monolayer and Bilayer WSe₂,” *Phys. Rev. Appl.* **13**, 054058 (2020).
21. R. Basnet, M. H. Doha, T. Hironaka, K. Pandey, S. Davari, K. M. Welch, **H. O. H. Churchill**, J. Hu, “Growth and Strain Engineering of Trigonal Te for Topological Quantum Phases in Non-Symmorphic Chiral Crystals,” *Crystals* **9**, 486 (2019).
20. D. T. Debu, M. H. Doha, **H. O. H. Churchill**, J. B. Herzog, “Gate voltage and doping effects on near-field radiation heat transfer in plasmonic heterogeneous pairs of graphene and black phosphorene,” *RSC Advances* **9**, 29173 (2019).
19. Josh P. Thompson, M. Hasan Doha, Peter Murphy, Jin Hu, and **Hugh O. H. Churchill**, “Exfoliation and Analysis of Large-area, Air-Sensitive Two-Dimensional Materials,” *J. Vis. Exp.* **143**, e58693 (2019).
18. D. T. Debu, S. J. Bauman, D. French, **H. O. H. Churchill**, and J. B. Herzog, “Tuning Infrared Plasmon Resonance of Black Phosphorene Nanoribbon with a Dielectric Interface,” *Scientific Reports* **8**, 3224 (2018).
17. E. Andharia, T. P. Kaloni, G. J. Salamo, S.-Q. Yu, **H. O. H. Churchill**, and S. Barraza-Lopez, “Exfoliation energy, quasi-particle bandgap, and excitonic properties of selenium and tellurium atomic chains,” *Physical Review B* **98**, 035420 (2018).
16. **H. O. H. Churchill**, S.-Q. Yu, G. J. Salamo, T. Hironaka, X. Hu, J. Stacy, and I. Shih, “Toward Single Atom Chains with Exfoliated Tellurium,” *Nanoscale Research Letters* **12**, 488 (2017).
15. M. Mehboudi, A. M. Dorio, W. Zhu, A. van der Zande, **H. O. H. Churchill**, A. A. Pacheco-Sanjuan, E. O. Harriss, P. Kumar, and S. Barraza-Lopez, “Two-dimensional disorder in black phosphorus and monochalcogenide monolayers,” *Nano Letters* **16**, 1704 (2016).
14. J. I.-J. Wang, Y. Yang, Y.-A. Chen, K. Watanabe, T. Taniguchi, **H. O. H. Churchill**, and P. Jarillo-Herrero, “Electronic Transport of Encapsulated Graphene and WSe₂ Devices Fabricated by Pick-up of Pre-patterned hBN,” *Nano Letters* **15** 1898 (2015).
13. Britton W. H. Baugher*, **Hugh O. H. Churchill***, Yafang Yang, and Pablo Jarillo-Herrero, “Optoelectronic devices based on electrically tunable p-n diodes in a monolayer dichalcogenide,” *Nature Nanotechnology* **9**, 262 (2014).

*equal contribution

→ accompanying *Nature Nanotechnology* News and Views:

- R. Bratschitsch, “Optoelectronic devices: Monolayer diodes light up,” *Nature Nanotechnology* **9**, 247 (2014).
12. R. A. Lai, **H. O. H. Churchill**, and C. M. Marcus, “g-Tensor control in bent carbon nanotube quantum dots,” *Physical Review B* **89**, 121303, Rapid Communication (2014).
 11. Britton W. H. Baugher, **Hugh O. H. Churchill**, Yafang Yang, and Pablo Jarillo-Herrero, “Intrinsic Transport Properties of High Quality Monolayer and Bilayer MoS₂,” *Nano Letters* **13**, 4212 (2013).
 10. **H. O. H. Churchill**, V. Fatemi, K. Grove-Rasmussen, M. T. Deng, P. Caroffe, H. Q. Xu, and C. M. Marcus, “Superconductor-nanowire devices from tunneling to the multichannel regime: Zero-bias oscillations and magnetoconductance crossover,” *Physical Review B* **87**, 241401, Rapid Communication (2013).
→ Editors’ suggestion and PRB Kaleidoscope, June 2013.
 9. G. Yamahata, T. Kodera, **H. O. H. Churchill**, K. Uchida, C. M. Marcus, and S. Oda, “Magnetic field dependence of Pauli spin blockade: a window into the sources of spin relaxation in silicon quantum dots,” *Physical Review B* **86**, 115322 (2012).
 8. S. Weiss, E. I. Rashba, F. Kuemmeth, **H. O. H. Churchill**, and K. Flensberg, “Spin-orbit effects in carbon nanotube double quantum dots,” *Physical Review B* **82**, 165427 (2010).
 7. **H. O. H. Churchill**, F. Kuemmeth, J. W. Harlow, A. J. Bestwick, E. I. Rashba, K. Flensberg, C. H. Stwertka, T. Taychatanapat, S. K. Watson, C. M. Marcus, “Relaxation and dephasing in a two-electron ¹³C nanotube double quantum dot,” *Physical Review Letters* **102**, 166802 (2009).
 6. **H. O. H. Churchill**, A. J. Bestwick, J. W. Harlow, F. Kuemmeth, D. Marcos, C. H. Stwertka, S. K. Watson, C. M. Marcus, “Electron-nuclear interaction in ¹³C nanotube double quantum dots,” *Nature Physics* **5**, 321 (2009).
→ accompanying *Nature Physics* News and Views:
B. Trauzettel and D. Loss, “Carbon surprises again,” *Nature Physics* **5**, 317 (2009).
 5. Yongjie Hu*, **Hugh O. H. Churchill***, David J. Reilly, Jie Xiang, Charles M. Lieber, and Charles M. Marcus, “A Ge/Si heterostructure nanowire-based double quantum dot with integrated charge sensor,” *Nature Nanotechnology* **2**, 622 (2007).
*equal contribution
→ accompanying *Nature Nanotechnology* News and Views:
M. A. Eriksson and M. Friesen, “Nanowires charge towards integration,” *Nature Nanotechnology* **2**, 595 (2007).
 4. S. A. FitzGerald, **H. O. H. Churchill**, P. Korngut, and C. B. Simmons, “Cryogenic apparatus for diffuse reflectance infrared spectroscopy with high-pressure capabilities,” *Review of Scientific Instruments* **77**, 093110 (2006).
 3. S. A. FitzGerald, **H. O. H. Churchill**, P. Korngut, C. B. Simmons, Y. E. Strangas, “Low-temperature rotational-vibrational spectroscopy of H₂ in crystalline C₆₀,” *Physical Review B* **73**, 155409 (2006).
 2. Wang Z. M., **H. Churchill**, C. E. George, and G. J. Salamo, “High anisotropy of lateral alignment in multilayered (In,Ga)As/GaAs(100) quantum dot structures,” *Journal of Applied Physics* **96**, 6908 (2004).

1. **Hugh Churchill**, Henry Teng, and Robert M. Hazen, “Correlation of pH-dependent surface interaction forces to amino acid adsorption: Implications for the origin of life,” *American Mineralogist* **89**, 1048 (2004).

Invited Publications

3. **H. Churchill**, “Growth and Exfoliation of Selenium and Tellurium for Quantum Chains of Atoms,” *Microscopy and Microanalysis* **24**, 1672 (2018).
2. **Hugh O. H. Churchill** and Pablo Jarillo-Herrero, “Two-dimensional crystals: Phosphorus joins the family,” *Nature Nanotechnology*, **9**, 330 (2014). (News and Views)
1. F. Kuemmeth, **H. O. H. Churchill**, P. K. Herring, C. M. Marcus, “Carbon nanotubes for coherent spintronic devices,” *Materials Today* **13**, 18 (2010).

Patent Application

1. Shui-Qing Yu, **Hugh Churchill**, and Gregory Salamo, “Growth of Single Atom Chains for Nano-Electronics and Quantum Circuits,” U.S. Patent Application Serial Number 15/910,789. Filed March 2, 2018.

Invited Presentations

37. Panelist, Arkansas Business Leaders CHIPS Summit (November 2022)
36. Arkansas Academy of Computing Annual Meeting (October 2022)
35. Project Scope webinar, Arkansas Research Alliance (June 2022)
34. Quantum Circuits in 2D Materials, University of Ottawa (May 2022)
33. South Carolina Quantum Technology Forum, Clemson University (April 2022)
32. Condensed Matter seminar, University of Connecticut (December 2021)
31. Pappalardo seminar, Massachusetts Institute of Technology (December 2021)
30. 2D Crystal Consortium seminar, Penn State University (December 2021)
29. Physics Department Colloquium, University of Ottawa (September 2021)
28. Nanoscale and Quantum Phenomena Institute Colloquium, Ohio University (November 2020)
27. Colloquium, University of Wyoming (October 2020)

26. TNano20 International Workshop on Nanotechnology, Tblisi, Republic of Georgia (October 2020)
25. Solid State and Quantum Physics seminar, Laboratory for Physical Sciences (February 2020)
24. Center for Complex Quantum Systems seminar, UT Austin (February 2019)
23. Center for Quantum Phenomena seminar, New York University (February 2019)
22. Microscopy and Microanalysis, Baltimore, MD (July 2018)
21. Condensed Matter Physics Seminar, Texas A&M University (March 2017)
20. Physics Colloquium, University of Tulsa (December 2016)
19. Colloquium, Center for Nanophysics and Advanced Materials, University of Maryland (November 2016)
18. Physics Colloquium, Missouri State University (November 2016)
17. Condensed matter physics seminar, University of Oklahoma (October 2016)
16. Keynote speaker, Arkansas Junior Science and Humanities Symposium, Arkansas Tech University (March 2016).
15. Arkansas INBRE Conference, Fayetteville, AR (November 2015).
14. Quantum Innovators Workshop, Institute for Quantum Computing, Waterloo, Ontario, Canada (October 2014).
13. IEEE Summer Topicals Meeting Series, Montreal, Quebec, Canada (July 2014).
12. 1st Muju International Winter School Series, South Korea (February 2014).
11. Boston Area Carbon Nanoscience Plus (BACON+) meeting, Harvard University (October 2013).
10. Workshop on Interferometry and Interactions in Non-equilibrium Meso- and Nano-systems, International Center for Theoretical Physics, Trieste, Italy (April 2013).
9. Winter Conference on Topological States of Matter, Aspen Center for Physics, Aspen, CO (January 2013).
8. Majorana Fermion Zero Modes in Solid-State Systems, Kavli Institute for Theoretical Physics, Santa Barbara, CA (December 2012).
7. Boston Area Carbon Nanoscience (BACON) meeting, Massachusetts Institute of Technology (February 2011).
6. International Winterschool on Electronic Properties of Novel Materials, Kirchberg, Austria (March 2010).
5. Seminar at National Research Council of Canada, Ottawa (March 2009).
4. Boston Area Carbon Nanoscience (BACON) meeting, Harvard University (December 2008).

3. Workshop on Quantum Phenomena and Information, International Center for Theoretical Physics, Trieste, Italy (June 2008).
2. Nanoscale Science and Engineering Center Research Exchange Seminar, Harvard University (January 2008).
1. APS March Meeting (March 2007).

Teaching

Courses taught:

- | | |
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| Fall 2015 | PHYS 2074, University Physics II
(191 students, 4.00/4.31 student evaluation of course/instructor, 5-point scale) |
| Fall 2016 | PHYS 502V, The Physics of 2D Materials
(6 students, 4.75/4.75 student evaluation) |
| Spring 2017 | PHYS 3923H, Honors Colloquium: The Science of Music and Sound
(20 students, 4.07/4.47 student evaluation) |
| Fall 2017 | PHYS 3613, Modern Physics
(44 students, 4.25/4.50 student evaluation) |
| | PHYS 502V, The Physics of 2D Materials
(5 students, 4.75/4.75 student evaluation) |
| Spring 2018 | PHYS 3613, Modern Physics
(54 students, 4.46/4.63 student evaluation) |
| Fall 2018 | PHYS 5413, Quantum Mechanics I
(10 students, 4.44/4.67 student evaluation) |
| Spring 2020 | PHYS 6713, Condensed Matter Physics II
(8 students, 4.29/4.57 student evaluation) |
| Fall 2020 | PHYS 3613, Modern Physics
(43 students, 4.96/4.96 student evaluation) |
| Spring 2021 | PHYS 2074/2074H, University Physics II
(270 students, 4.39/4.79 student evaluation) |
| Fall 2021 | PHYS 3613, Modern Physics
(48 students, 4.67/4.79 student evaluation) |
| Fall 2021 | PHYS 2074/2074H, University Physics II
(131 students, 4.10/4.38 student evaluation) |

Mentoring:

High School students (5): Ian Garcia (Springdale High School, Springdale, AR), Ahmad Rawwagah* (Fayetteville High School, Fayetteville, AR) Jason Harmon (Bentonville High School, Bentonville, AR) Abhinav Komanduri (Bentonville High School, Bentonville, AR) Aryan Mahajan (Bentonville High School, Bentonville, AR) Bryan Williams (Bentonville High School, Bentonville, AR)
* coauthor

Undergraduate students (24): Grace Woods (UC Santa Cruz), Hamilton Johnson[†] (Ouachita Baptist), Joseph Matson[†] (Hendrix), Alejandro Mercado ^{*,**,†,‡} (Arkansas), William Johnson (Arkansas), Reza Teghavi (Arkansas), Keenan Staggs (Arkansas), Peter Murphy* (SUNY Geneseo), William Shattuck^{**,†,‡} (Arkansas), Brett Glenn^{**,‡} (Arkansas), Jeremy Tull^{*,**†} (Arkansas), Noshin Nawar (Arkansas), Peter Gea (Cornell), Clay Wright[†] (Presbyterian), Michael Mastalish[‡] (Marquette), Katie Welch[†] (Hendrix), Cory Stephenson (Arkansas), Alex Siebenmorgen (Arkansas), Garrett Kitterman (Arkansas), Hunter Lindemann (Arkansas), Nathaniel Sawyers (Arkansas), Casper McPherson (Oklahoma State), Jeremy Choh (Hendrix), Bryan Williams (Arkansas), Lance Yarbrough (Arkansas)

*coauthor

**Honors student

[†]recipient of Honors College Research Grant

[‡]pursuing or completed graduate degree in Physics or related field

Graduate theses in progress (7): Shiva Davari (Ph.D., Physics), Michael Mastalish[†] (Ph.D., Physics), Katie Welch (M.S., Materials Science and Engineering), Sumaya Rahman (Ph.D., Materials Science and Engineering), Katlin Reynolds (Ph.D., Physics), Brycelynn Bailey[†] (Ph.D., Physics), Mariam Afrose (Ph.D., Materials Science and Engineering).

*admitted to NSF/DOE Quantum Science Summer School, Cornell University (2018)

[†]admitted to LPS Qubit Collaboratory Summer of Quantum, Laboratory for Physical Sciences (2021)

Graduate theses completed (7): Takayuki Hironaka (M.S., Electrical Engineering) William Shattuck (M.S., Physics) Abayomi Omolewu (M.S., Physics) Mahmudul Hasan Doha (Ph.D., Physics) Joshua Thompson (Ph.D., Physics) Arash Fereidouni (Ph.D., Physics) Jeb Stacy (Ph.D., Physics)

Service

- 2015-2022 UA Physics Department Undergraduate Advisor
- 2015-2019 UA Physics Department Undergraduate Affairs Committee
- 2015-2017 UA Physics Department Research Services Committee
- 2016-2017 UA Physics Department Faculty Search Committee (Chair)
- 2018-2019 UA Physics Department Faculty Search Committee (Chair)
- 2020- UA Physics Department Graduate Affairs Committee (Chair, 2021-)
- 2016- UA Toxic Substances Committee
- 2021- Honors Council, Fulbright College of Arts and Sciences
- 2016-2020 Arkansas INBRE Workshop (10-15 students each year)
- 2017- NSF panelist, proposal reviewer for AFOSR, DOE, M. J. Murdock Charitable Trust
- 2019 Organizer of APS March Meeting tutorial on layered materials, 100+ attendees

Journal reviewer for ACS Nano, Advanced Materials, Applied Physics Letters, Nano Letters, Nature Communications, Nature Materials, Nature Nanotechnology, Nature Electronics, IEEE Electron Device Letters, Applied Science, Matter, Micromachines

Outreach: lab tours for local FIRST robotics team (group of eight 6th grade girls), group of 15 Fayetteville High School students, group of 20 Marshallese high school students from Springdale, AR

DIY Laboratory Electronics: openDACs.com

Co-creator, CleanARAir cleanARAir.com