

# Siyuan Dai

Postdoc Research Fellow  
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## PROFESSIONAL PREPARATION & EDUCATION

- **Postdoc Fellow in ECE**, The University of Texas at Austin, July 2017 - present. **Advisor**: Prof. A. Alù
- **Ph. D. in Physics**, University of California, San Diego, June 2017. **Advisor**: Prof. D. N. Basov
- **B. S. in Applied Physics**, University of Science & Technology of China, June 2011.

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## RESEARCH INTERESTS

Light-matter interactions in quantum and low-dimensional materials; Quantum optics and information; Metamaterials; Biomaterials; Nanophotonics, plasmonics and ultrafast optics; Near-field optics; Nanoscale manufacture; Machine learning.

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## PROFESSIONAL EXPERIENCE

- **Postdoc Research Fellow**, The University of Texas at Austin, 2017-present.  
Topic: Nano-optics and applied nanophotonics in quantum and bio materials.  
**Advisor of graduate research**, The University of Texas at Austin, 2017-present.  
Mykhailo Tymchenko, Ahmed Mekkawy (Senior graduate students): Nano-optics, plasmonics simulation.
- **Research Assistant**, University of California, San Diego, 2011-2017.  
Topic: Infrared nanophotonics, plasmonics and polaritonics of hexagonal boron nitride, graphene and van der Waals heterostructures.  
**Advisor of undergraduate research**, University of California, San Diego, 2014-2015  
Jeremy Rosenfeld (Senior undergraduate): Van der Waals materials fabrication and nano-optics simulation.
- **Undergraduate Research Assistant**, University of Science & Technology of China, Hefei, China, 2009-2011  
Topic: Graphene micro-fabrication and nano-characterization, scanning tunneling microscopy data analysis.  
**Advisor of undergraduate research**, University of Science & Technology of China, Hefei, China, 2010-2011  
Chuntian Cao (now at Stanford University) and Xinzhou Deng (now at USTC): Graphene micro-fabrication.
- **Undergraduate Research Assistant**, Pohang University of Science & Technology, Pohang, Korea, 2010  
Topic: Graphene fabrication and basic transport characterization.

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## AWARDS

- Fritz London Postdoc Fellowship in Physics 2017.
- UCSD Physics Chair's Challenge award 2017.
- Chinese Government Award for Outstanding Self-Financed Student Aboard 2015.
- OTST (Optical Terahertz Science & Technology Conference) Young Scholar Travel Award 2015.
- POSTECH (Pohang University of Science & Technology) Internship Scholarship 2010.
- USTC (University of Science & Technology of China) Outstanding Student Scholarship 2008, 2009, 2010.
- USTC Outstanding Freshman Scholarship 2007.

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## PUBLICATIONS

27 peer-reviewed papers (24 published + 3 under review): **9 first-author** publications: 1 in *Science*, 1 in *Nature Nano.*, 1 in *Nature Comm.*, 1 in *Adv Mater.*, 2 in *Nano Letters* and 3 under review (1 in *arXiv*). **2 corresponding-author** publication. 3 second-author publications (responsible for the experimental part): 1 in *Nature Mater.*, 1 in *Nano Letters*.

1. **S. Dai**, J. Quan, G. Hu, C. Qiu, T. H. Tao, X. Li & A. Alù. "Hyperbolic phonon polaritons in suspended hexagonal boron nitride". under review (2018).
2. **S. Dai\***, J. Zhang, Q. Ma, K. Kittiwatanakul, A. S. McLeod, X. Chen, S. N. Gilbert Corder, K. Watanabe, T. Taniguchi, J. Lu, Q. Dai, P. Jarillo-Herrero, M. K. Liu & D. N. Basov. "Phase change materials for nanopolaritonics: a case study of hBN/VO<sub>2</sub> heterostructures". *arXiv* 1809.09652 (2018), under review.  
\*corresponding author
3. **S. Dai**, W. Fang, Y. Stehle, R. Y. Tay, Q. Ma, D. Rodan, P. Jarillo-Herrero, M. M. Fogler, E. H. T. Teo, J. Kong & D. N. Basov. "Surface phonon polaritons in monolayer and bilayer hexagonal boron nitride". under review (2018).
4. **S. Dai**, M. Tymchenko, Z. Xu, T. Tran, Y. Yang, Q. Ma, K. Watanabe, T. Taniguchi, P. Jarillo-Herrero, I. Aharonovich, D. N. Basov, T. H. Tao & A. Alù. "Internal nanostructure diagnosis with hyperbolic phonon polaritons in hexagonal boron nitride". *Nano Lett.* 18, 5205 (2018).
5. **S. Dai**, M. Tymchenko, Y. Yang, Q. Ma, M. Pita-Vidal, K. Watanabe, T. Taniguchi, P. Jarillo-Herrero, M. M. Fogler, A. Alù, D. N. Basov. "Manipulation and steering of hyperbolic surface polaritons in hexagonal boron nitride". *Adv Mater.* 30, 1706358 (2018).
6. A. J. Giles, **S. Dai**, I. Vurgaftman, T. Hoffman, S. Liu, L. Lindsay, C. T. Ellis, N. Assefa, I. Chatzakis, T. L. Reinecke, J. G. Tischler, M. M. Fogler, J. H. Edgar, D. N. Basov & J. D. Caldwell. "Ultra-low-loss Polaritons in Isotopically Pure Materials: A New Approach". *Nature Materials* 17, 134 (2018).
7. J. Lopez, A. Ambrosio, **S. Dai**, C. Huynh, D. Bell, X. Lin, N. Rivera, S. Huang, Q. Ma, S. Eyhusen, I. Kaminer, K. Watanabe, T. Taniguchi, J. Kong, D. N. Basov, P. Jarillo-Herrero & M. Soljacic. "Large Photothermal Effect in Sub-40 nm h-BN Nanostructures Patterned Via High-Resolution Ion Beam". *Small* 14, 1800072 (2018).
8. D. Wang, X. Fan, X. Li, **S. Dai**, L. Wei, W. Qin, F. Wu, H. Zhang, Z. Qi, C. Zeng, Z. Zhang & J. Hou. "Quantum Control of Graphene Plasmon Excitation and Propagation at Heaviside Potential Steps". *Nano Lett.* 18 (2), 1373-1378 (2018).
9. G. Cheng, D. Wang, **S. Dai**, X. Fan, F. Wu, X. Li & C. Zeng. "Nano-imaging of an edge-excited plasmon mode in graphene". *Nanoscale* 10, 16314 (2018).
10. **S. Dai**, Q. Ma, Y. Yang, J. Rosenfeld, M. D. Goldflam, A. S. McLeod, Z. Sun, T. Andersen, Z. Fei, M. K. Liu, K. Watanabe, T. Taniguchi, M. Thiemens, F. Keilmann, P. Jarillo-Herrero, M. M. Fogler & D. N. Basov. "Efficiency of Launching Highly Confined Polaritons by Infrared Light Incident on a Hyperbolic Material". *Nano Lett.* 17, 5285 (2017).
11. X. Sun, **S. Dai**, S. S. Sunku, L. Le, D. N. Basov & J. W. Fleischer. "Subdiffractive Field Retrieval in Hyperbolic Materials". *Applied Industrial Optics: Spectroscopy, Imaging and Metrology* JTU5A. 10 (2017).
12. L. Cheng, D. Wang, **S. Dai\***, Y. Yan, X. Fan, L. Wei, C. Zeng\*. "Near-field imaging of the LaAlO<sub>3</sub>/SrTiO<sub>3</sub> interfacial conductivity". *J. Infrared Millim. Waves* 36, 534 (2017). \*corresponding author
13. A. Ambrosio, L. A. Jauregui, **S. Dai**, K. Chaudhary, M. Tamagnone, M. M. Fogler, D. N. Basov, F. Capasso, P. Kim & W. L. Wilson. "Mechanical Detection and Imaging of Hyperbolic Phonon Polaritons in Hexagonal Boron Nitride". *ACS Nano* 11, 8741 (2017).
14. Y. Shao, K. W. Post, J. Wu, **S. Dai**, A. J. Frenzel, A. R. Richardella, J. Lee, N. Samarth, M. M. Fogler, A. V. Balatsky, D. Kharzeev, D. N. Basov. "Faraday rotation due to surface states in the topological insulator (Bi<sub>1-x</sub>Sb<sub>x</sub>)<sub>2</sub>Te<sub>3</sub>". *Nano Lett.* 17(2), 980-984 (2017).
15. F. Hu, Y. Luan, Z. Fei, I. Palubski, M. Goldflam, **S. Dai**, J. Wu, K. Post, G. C. A. M. Janssen, M. M. Fogler & D. N. Basov. "Imaging the localized plasmon resonance modes in graphene nanoribbons". *Nano Lett.* 17, 5423 (2017).
16. F. J. Bezares, A. Sanctis, J. Saavedra, A. Woessner, P. Alonso-González, I. Amenabar, J. Chen, T. Bointon, **S. Dai**, M. M. Fogler, D. N. Basov, R. Hillenbrand, M. Craciun, F. Javier Garcia de Abajo, S. Russo, F. Koppens. "Intrinsic plasmon-phonon interactions in highly-doped graphene: A near-field imaging study".

*Nano Lett.* 17(10), 5908 (2017).

17. A. J. Giles, **S. Dai**, O. J. Glembocki, A. V. Kretinin, Z. Sun, C. T. Ellis, J. G. Tischler, T. Taniguchi, K. Watanabe, M. M. Fogler, K. S. Novoselov, D. N. Basov & J. D. Caldwell. "Imaging of anomalous internal reflections of hyperbolic phonon-polaritons in hexagonal boron nitride". *Nano Lett.* 16(6), 3858 (2016).
18. Z. Fei, J. Foley, W. Gannett, M. Liu, **S. Dai**, G. Ni, A. Zettl, M. M. Fogler, G. Wiederrecht, S. K. Gray, D. N. Basov. "Ultraconfined Plasmonic Hotspots inside Graphene Nanobubbles". *Nano Lett.* 16(12), 7842-7848 (2016).
19. **S. Dai**, Q. Ma, M. K. Liu, T. Andersen, Z. Fei, M. D. Goldflam, M. Wagner, K. Watanabe, T. Taniguchi, M. Thiemens, F. Keilmann, G. C. A. M. Janssen, S-E. Zhu, P. Jarillo-Herrero, M. M. Fogler & D. N. Basov. "Graphene on hexagonal boron nitride as a tunable hyperbolic metamaterial". *Nature Nanotech.* 10, 682-686 (2015).
20. **S. Dai**, Q. Ma, T. Andersen, A. S. McLeod, Z. Fei, M. K. Liu, M. Wagner, K. Watanabe, T. Taniguchi, M. Thiemens, F. Keilmann, P. Jarillo-Herrero, M. M. Fogler & D. N. Basov. "Subdiffractive focusing and guiding of polaritonic rays in a natural hyperbolic material". *Nature Comm.* 6, 6963 (2015).
21. Z. Fei, M. Goldflam, J. Wu, **S. Dai**, M. Wagner, A. McLeod, M. K. Liu, S-E. Zhu, G. C. A. M. Janssen, M. M. Fogler & D. N. Basov. "Edge plasmons and plane plasmons in graphene nanoribbons". *Nano Lett.* 15(12), 8271-8276 (2015).
22. Z. Fei, E. G. Iwinski, G-X. Ni, L. M. Zhang, W. Bao, A. S. Rodin, Y. Lee, M. Wagner, M. K. Liu, **S. Dai**, M. Goldflam, M. Thiemens, F. Keilmann, C. N. Lau, A. H. Castro-Neto, M. M. Fogler & D. N. Basov. "Tunneling Plasmonics in Bilayer Graphene". *Nano Lett.* 15(8), 4973-4978, (2015).
23. M. K. Liu, A. J. Sternbach, M. Wagner, T. V. Slusar, T. Kong, S. L. Bud'ko, S. Kittiwatanakul, M. M. Qazilbash, A. McLeod, Z. Fei, E. Abreu, J. Zhang, M. Goldflam, **S. Dai**, G-X. Ni, J. Lu, H. A. Bechtel, M. C. Martin, M. B. Raschke, R. D. Averitt, S. A. Wolf, H-T. Kim, P. C. Canfield & D. N. Basov. "Phase transition in bulk single crystals and thin films of VO<sub>2</sub> by nanoscale infrared spectroscopy and imaging". *Phys. Rev. B* 91, 245155 (2015).
24. **S. Dai**, Z. Fei, Q. Ma, A. S. Rodin, M. Wagner, A. S. McLeod, M. K. Liu, W. Gannett, W. Regan, K. Watanabe, T. Taniguchi, M. Thiemens, G. Dominguez, A. H. Castro-Neto, A. Zettl, F. Keilmann, P. Jarillo-Herrero, M. M. Fogler & D. N. Basov. "Tunable Phonon Polaritons in Atomically Thin van der Waals Crystals of Boron Nitride". *Science* 343, 1125-1129 (2014).
25. M. K. Liu, M. Wagner, J. Zhang, A. S. McLeod, S. Kittiwatanakul, Z. Fei, E. Abreu, M. Goldflam, A. Sternbach, **S. Dai**, K. West, J. Lu, S. A. Wolf, R. D. Averitt & D. N. Basov. "Symmetry breaking and geometric confinement in VO<sub>2</sub>: Results from a three-dimensional infrared nano-imaging". *Appl. Phys. Lett.* 104, 121905 (2014).
26. Z. Fei, A. S. Rodin, W. Gannett, **S. Dai**, W. Regan, M. Wagner, M. K. Liu, A. S. McLeod, G. Dominguez, M. Thiemens, M. M. Fogler, A. H. Castro-Neto, F. Keilmann, A. Zettl, R. Hillenbrand, M. M. Fogler & D. N. Basov. "Electronic and plasmonic phenomena at grain boundaries in chemical vapor deposited graphene" *Nature Nanotech.* 8, 821-825 (2013).
27. M. K. Liu, M. Wagner, E. Abreu, S. Kittiwatanakul, A. S. McLeod, Z. Fei, M. Goldflam, **S. Dai**, M. Fogler, J. Lu, S. A. Wolf, R. D. Averitt, D. N. Basov. "Anisotropic electronic state via spontaneous phase separation in strained Vanadium dioxide films". *Phys. Rev. Lett.* 111, 096602 (2013).

## PRESENTATIONS

**19 first-author** conference/seminar presentations: **9 invited presentations: 1** at **APS march meeting**, **8** in national lab and department seminars. 10 presentations in science and engineering conferences.

1. **Invited speaker** at academic seminar in Wuhan National High Magnetic Field Center, HUST, Wuhan, China, 2018.
2. SPIE Optics + Photonics, San Diego, 2018.

3. **Invited speaker** at academic seminar in National Center for Nanoscience and Technology, Beijing, China, 2017.
4. **Invited speaker** at academic seminar in Hefei National Laboratory for Physical Sciences at the Microscale & USTC, Hefei, China, 2017.
5. MRS Spring Meeting & Exhibit, Phoenix, 2017.
6. **Invited speaker** at academic seminar in University of Texas, Austin, Austin, 2016.
7. **Invited speaker** at academic seminar in Duke University, Durham, 2016.
8. SPIE Optics + Photonics, San Diego, 2016.
9. APS March meeting, “Emission and propagation of hyperbolic phonon polaritons in hexagonal boron nitride”, Baltimore, 2016.
10. **Invited speaker** at academic colloquium in US Naval Research Laboratory, Washington DC, 2016.
11. **Invited speaker** at APS March meeting, “Hyperbolic phonon polaritons in hexagonal boron nitride”, San Antonio, 2015.
12. APS March meeting, “Tunable polaritons from plasmon-phonon coupling in hyperbolic media”, San Antonio, 2015.
13. **Invited speaker** at academic seminar in Hefei National Laboratory for Physical Sciences at the Microscale & USTC, Hefei, China, 2015.
14. Metamaterials Science & Technology Workshop, San Diego, 2015.
15. **Invited speaker** at academic seminar in Fudan University, Shanghai, China, 2015.
16. Optical Terahertz Science & Technology Conference, San Diego, 2015.
17. SPIE Optics + Photonics, San Diego, 2014.
18. Gordon Research Conference: Plasmonics, Newry, 2014.
19. APS March meeting, “Nano-imaging and nano-spectroscopy of tunable surface phonon polaritons in hexagonal boron nitride”, Denver, 2014.

### **SYNERGISTIC ACTIVITIES**

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- **Reviewer** for Nano Letters, Scientific Reports, ACS Photonics, Nanophotonics, Optics Letters, Optics Express, Applied Physics Letters, Journal of Optics, Applied Optics, JOSA B, Photonics and Nanostructures etc.
- **Session Chair** for MRS Spring Meeting & Exhibit, Phoenix, 2017