XINGYU GAO

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ABOUT ME

I am a Ph.D. student at Purdue University, supervised by Prof. Tongcang Li. My research interests focus on solid state spin qubits, quantum optics, optomechanics, and vacuum fluctuations in matter (Casimir physics).

EDUCATION

Ph.D. in Physics Purdue University 2018 - 2024 (Expected)
Advisor: Prof. Tongcang Li

B.S. in Physics University of Science and Technology of China (USTC) 2014 - 2018

RESEARCH EXPERIENCE

Research Assistant in Department of Physics and Astronomy Aug. 2018 - Now
Purdue University

- Spin color centers in hexagonal boron nitride and boron nitride nanotubes.
- Optomechanics with virtual photons and Casimir-based device.
- Thermal spin photonics in the near-field of nonreciprocal media.

Undergraduate Research Assistant at Purdue University June 2017 - Sept. 2017

- Quantum transducer using quantum emitters in 2D materials (theoretical proposal).

Undergraduate Research Assistant at USTC July 2016 - June 2018

- Mesoscopic magnetic resonance based on nitrogen-vacancy (NV) centers in diamond.

REPRESENTATIVE WORK

1. **Gao, X.**, Vaidya, S., Dikshit, S., Ju, P., Shen, K., Jin, Y., and Li, T. Nanotube spin defects for omnidirectional magnetic field sensing. arXiv:2310.02709 (2023).
2. **Gao, X.**, Vaidya, S., Li, K., Ju, P., Jiang, B., Xu, Z., Allcca, A. E., ..., Bhave, S. A., Chen, Y. P., Ping, Y., & Li, T. Nuclear spin polarization and control in hexagonal boron nitride. **Nature Materials**, 21, 1024-1028 (2022).
3. **Gao, X.**, Vaidya, S., Ju, P., Dikshit, S., Shen, K., Chen, Y. P., and Li, T. "Quantum sensing of paramagnetic spins in liquids with spin qubits in hexagonal boron nitride." **ACS Photonics** 10, 8, 2894–2900 (2023).
4. Gong, R., He, G., **Gao, X.**, Ju, P., Liu, Z., Ye, B., Henriksen, E. A., Li, T., & Zu, C. Coherent Dynamics of Strongly Interacting Electronic Spin Defects in Hexagonal Boron Nitride. **Nature Communications** 14, 3299 (2023).
5. Xu, Z., **Gao, X.**, Bang, J., Jacob, Z., & Li, T. Non-reciprocal energy transfer through the Casimir effect. **Nature nanotechnology**, 17, 148-152 (2022).
6. Mathur, N., Mukherjee, A., **Gao, X.**, Luo, J., McCullian, B. A., Li, T., Vamivakas, A. N. & Fuchs, G. D. Excited-state spin-resonance spectroscopy of V_B^- defect centers in hexagonal boron nitride. **Nature Communications**, 13, 3233 (2022).
7. Xu, Z., Ju, P., **Gao, X.**, Shen, K., Jacob, Z., & Li, T. Observation and control of Casimir effects in a sphere-plate-sphere system. **Nature Communications**, 13, 6148 (2022).
8. **Gao, X.**, Jiang, B., ... & Li, T. High-contrast plasmonic-enhanced shallow spin defects in hexagonal boron nitride for quantum sensing. **Nano Letters**, 21, 7708-7714 (2021).

9. **Gao, X.**, Pandey, S., Kianinia, M., Ahn, J., Ju, P., Aharonovich, I., ... & Li, T. Femtosecond laser writing of spin defects in hexagonal boron nitride. **ACS Photonics**, 8, 994-1000 (2021).
10. **Gao, X.**, Khandekar, C., Jacob, Z., & Li, T. Thermal equilibrium spin torque: Near-field radiative angular momentum transfer in magneto-optical media. **Physical Review B**, 103, 125424 (2021).

AWARD

- Bilsland Dissertation Fellowship, Purdue University, 2023
- Dr. Warner L. Black Award, Purdue University, 2023
- Lark-Horovitz Prize in Physics, Purdue University, 2023
- Ross Fellowship, Purdue University, 2018
- Best Bachelor's Thesis Award, USTC, 2018
- Seagate Fellowship, USTC, 2016
- Outstanding Student Award, USTC, 2015,2016,2017

TEACHING AND MENTORING

Teaching Assistant, Department of Physics and Astronomy, Purdue University August 2018- May 2020

SERVICE

- **Quantum open house** 2022, 2023
  Department of Physics and Astronomy, Purdue University
  Introduced the basic idea of quantum physics and related technologies to high school students
- **Physics Inside Out Program** 2019
  Department of Physics and Astronomy, Purdue University
  Introduced scientific research to elementary and middle school students
- **NSIE Birck Nanodays Event** 2019
  Birck Nanotechnology Center, Purdue University
  Volunteered for Nanodays event for K-12 grade students from Indiana schools

PUBULICATIONS

Up to date list is always available on my Google Scholar page [Link] .

1. **Gao, X.**, Vaidya, S., Dikshit, S., Ju, P., Shen, K., Jin, Y., and Li, T. Nanotube spin defects for omnidirectional magnetic field sensing. arXiv:2310.02709 (2023).
2. **Gao, X.**, Vaidya, S., Ju, P., Dikshit, S., Shen, K., Chen, Y. P., and Li, T. "Quantum sensing of paramagnetic spins in liquids with spin qubits in hexagonal boron nitride." **ACS Photonics** 10, 8, 2894–2900 (2023).
3. Vaidya, S., **Gao, X.**, Dikshit, S., Aharonovich, I., and Li, T. "Quantum sensing and imaging with spin defects in hexagonal boron nitride." **Advances in Physics: X** 8:1, 2206049 (2023).
4. Gong, R., He, G., **Gao, X.**, Ju, P., Liu, Z., Ye, B., Henriksen, E. A., Li, T., & Zu, C. Coherent Dynamics of Strongly Interacting Electronic Spin Defects in Hexagonal Boron Nitride. **Nature Communications** 14, 3299 (2023).
5. Jin, Y., Shen, K., Ju, P., **Gao, X.**, Zu, C., Grine, A. J., and Li, T. Quantum control and fast rotation of levitated diamonds in high vacuum. arXiv:2309.05821 (2023).
6. Li, J., **Gao, X.**., Sajjan, M., Su, J. H., Li, Z. K., and Kais, S. "Møller-Plesset Perturbation Theory Calculations on Quantum Devices." arXiv:2308.01559 (2023).

7. Ju, P., Jin, Y., Shen, K., Duan, Y., Xu, Z., **Gao, X.**, and Li, T. Near-field GHz rotation and sensing with an optically levitated nanodumbbell. arXiv:2301.10868 (2023).

8. **Gao, X.**, Vaidya, S., Li, K., Ju, P., Jiang, B., Xu, Z., Allcca, A. E., ..., Bhave, S. A., Chen, Y. P., Ping, Y., & Li, T. Nuclear spin polarization and control in hexagonal boron nitride. **Nature Materials**, 21, 1024-1028 (2022).

9. Xu, X., Solanki, A. B., Sychev, D., **Gao, X.**, ..., Chen, Y. P., Taniguchi, T., Watanabe, K., Rodionov, I. A., Kildishev, A. V., Li, T., Upadhyaya, P., & Shalaev, V. M. Greatly Enhanced Emission from Spin Defects in Hexagonal Boron Nitride Enabled by a Low-Loss Plasmonic Nanocavity. **Nano Letters** 23, 25–33 (2022).

10. Xu, Z., Ju, P., **Gao, X.**, Shen, K., Jacob, Z., & Li, T. Observation and control of Casimir effects in a sphere-plate-sphere system. **Nature Communications**, 13, 6148 (2022).

11. Mathur, N., Mukherjee, A., **Gao, X.**, Luo, J., McCullian, B. A., Li, T., Vamivakas, A. N. & Fuchs, G. D. Excited-state spin-resonance spectroscopy of V_B^- defect centers in hexagonal boron nitride. **Nature Communications**, 13, 3233 (2022).

12. Xu, Z., **Gao, X.**, Bang, J., Jacob, Z., & Li, T. Non-reciprocal energy transfer through the Casimir effect. **Nature nanotechnology**, 17, 148-152 (2022).

13. Hu, Z., **Gao, X.**, & Li, T. Stability of the discrete time-crystalline order in spin-optomechanical and open cavity QED systems. **Photonics** (Vol. 9, No. 2, p. 61). MDPI (2022).

14. **Gao, X.**, Jiang, B., ... & Li, T. High-contrast plasmonic-enhanced shallow spin defects in hexagonal boron nitride for quantum sensing. **Nano Letters**, 21, 7708-7714 (2021).

15. **Gao, X.**, Pandey, S., Kianinia, M., Ahn, J., Ju, P., Aharonovich, I., ... & Li, T. Femtosecond laser writing of spin defects in hexagonal boron nitride. **ACS Photonics**, 8, 994-1000 (2021).

16. **Gao, X.**, Khandekar, C., Jacob, Z., & Li, T. Thermal equilibrium spin torque: Near-field radiative angular momentum transfer in magneto-optical media. **Physical Review B**, 103, 125424 (2021).

17. Wang, Y., Khandekar, C., **Gao, X.**, Li, T., Jiao, D., & Jacob, Z. Broadband circularly polarized thermal radiation from magnetic Weyl semimetals. **Optical Materials Express**, 11, 3880-3895 (2021).

18. **Gao, X.**, Yin, Z. Q., & Li, T. High-Speed Quantum Transducer with a Single-Photon Emitter in a 2D Resonator. **Annalen der Physik**, 532, 2000233 (2020).

19. Bang, J., Seberson, T., Ju, P., Ahn, J., Xu, Z., **Gao, X.**, Robicheaux, F., & Li, T. Five-dimensional cooling and nonlinear dynamics of an optically levitated nanodumbbell. **Physical Review Research**, 2, 043054 (2020).

20. Ahn, J., Xu, Z., Bang, J., Ju, P., **Gao, X.**, & Li, T. (2020). Ultrasensitive torque detection with an optically levitated nanorotor. **Nature Nanotechnology**, 15, 89-93.

21. Xie, T., Shi, F., Chen, S., Guo, M., Chen, Y., Zhang, Y., Yang, Y., **Gao, X.**, Kong, X., Wang, P. and Tateishi, K., 2018. Mesoscopic magnetic resonance spectroscopy with a remote spin sensor. Physical Review Applied, 9(6), p.064003 (2018).