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Research Interests

Interdisciplinary research of condensed matter physics, quantum microwave optics, and quantum bits.

- Quantum materials for quantum sensing and information science, i.e. Josephson junction single photon detectors [*Nature* and *Science*] and 2D-materials qubits [Nano Lett.]
- Kinetic inductance and superfluid stiffness of topological superconductor and twisted superconductivity [arXiv, PRR]
- Quantum-noise-limited amplifier for qubit readout [APL, IEEE] and detection of single-electron spin by coupling to micro-electromechanical systems [PRB].
- Electron hydrodynamic of the massless Dirac and Weyl fermions [in *Science*]
- Detection of dark axion using topological materials and ultra-sensitive photon detectors [PRL]

Professional Preparation

•	Postdoc	California Institute of Technology, advisor: Prof. Keith Schwab	May 2013
		Max Planck Institute for Quantum Optics, advisor: Prof. Emmanuel Bloch	Nov. 2009
•	Ph.D. in Physics	Ohio State University, advisor: Prof. Chris Hammel	Dec. 2008
•	B.S. in Physics	The Chinese University of Hong Kong	June 1998

Appointments

- *Associate Professor*, Northeastern University — 01/2025 – present
- *Research Associate*, Department of Physics, Harvard University — 07/2014 – present
- *Scientist I, II, and Senior*, Raytheon BBN Technologies — 10/2013 – 10/2024

Professional services

- Industrial partner in NSF's Quantum Information Science and Engineering Network (QISE-NET) (2018 – 2023)
- Graphene Week 2023-2024 Scientific Programme Committee
- Lectures in Summer School of Mesoscopic Physics in Asia Pacific Center for Theoretical Physics (APCTP)
- Journal reviewer for Science, Nature Physics, Science Advances, Nano Letters, AIP Advances, Nature Nanotechnol., Phys. Rev. Letters, Nature Comm., Phys. Rev. B, Phys. Rev. X, Carbon, IEEE Sensors
- Quantum seminar organizer at BBN Technologies
- Proposal reviewer for Swiss National Science Foundation, European Research Council, Department of Energy, and Army Research Office

Honors

- Raytheon Intelligence & Space Innovators Award 2020, 2022
- Best Paper Award in IEEE Quantum Week 2022
- Invented Here 2021 by Boston Patent Law Association
- Ohio Eminent Scholar Fellowship in Experimental Materials, 2007/08 academic year.
- Hazel Brown Teaching Award, Ohio State University, 2002.

Patents

- "Tunable Josephson junction oscillator," K. C. Fong, US-20220223780-A1, US-11430937-B2, US-20220393090-A1 (2022).
- "Evaporative-Cooled Solid-State Bolometer and Single-Photon Detector," K. C. Fong and D. R. Englund, US-20220146322-A1 (2022).
- "Microwave detector," K. C. Fong, and L. Ranzani, US-20200363267-A1 (2020), US-11156502-B2 (2021).
- "Josephson parametric amplifier based on superconducting-normal-superconducting junction," K. C. Fong, G. Ribeill, L. C. G. Govia, M. Gustafsson, and T. A. Ohki, US-20200274507-A1 (2020), US-11451204-B2 (2022).
- "Machine Learning for Quantum Material Synthesis," K. C. Fong, M.-H. Siu, Z. Jiang, US-20190362194-A1 (2022).
- "Graphene-based superconducting transistor," K. C. Fong and T. A. Ohki, US-20190288177-A1 (2019), US-10784433-B2 (2020).
- "Number-resolving photon detector with graphene-insulating-superconducting junction," K. C. Fong and T. A. Ohki, US-20180337324-A1 (2018), US-10454016-B2 (2019).
- "Graphene-based bolometer," K. C. Fong, US-20170317220-A1 (2017), US-9869592-B2, US-10024721-B2, US-20180356289-A1 (2018).
- "Graphene-based infrared single photon detector," K. C. Fong and T. A. Ohki, US-20170038260-A1 (2017), US-9945728-B2 (2018).
- "Josephson junction readout for graphene-based single photon detector," K. C. Fong and T. A. Ohki, US-20160372622-A1 (2016), US-9577176-B1, US-20170092834-A1, US-9666743-B2, US-9799817-B2 (2017).
- "Graphene-based infrared bolometer," K. C. Fong, US-20160370232-A1 (2016), US-9933310-B2, US-20180136047-A1 (2018).

Publications

1. ***"Superfluid stiffness of twisted multilayer graphene superconductors," A. Banerjee, Z. Hao, M. Kreidel, P. Ledwith, I. Phinney, J. M. Park, A. Zimmerman, K. Watanabe, T. Taniguchi, R. M. Westervelt, P. Jarillo-Herrero, P. A. Volkov, A. Vishwanath, K. C. Fong, and P. Kim, arXiv:2406.13742.***
2. *"Observing unconventional superconductivity via kinetic inductance in Weyl semimetal $MoTe_2$," M. Kreidel, J. Balgley, X. Chu, N. Verma, J. Ingham, R. Queiroz, J. Hone, R. M. Westervelt, and K. C. Fong, preprint available.*
3. *"Graphene calorimetric single-photon detector," B. Huang, E. G. Arnault, W. Jung, C. Fried, B. J. Russell, K. Watanabe, T. Taniguchi, E. A. Henriksen, D. Englund, G.-H. Lee, K. C. Fong, arXiv:2410.22433.*
4. "Measuring kinetic inductance and superfluid stiffness of two-dimensional superconductors using high-quality transmission-line resonators," M. Kreidel, X. Chu, J. Balgley, N. Verma, J. Ingham, L. Ranzani, R. Queiroz, R. M. Westervelt, J. Hone, K. C. Fong, Phys. Rev. Research **6**, 043245 (2024).
5. "Infrared single-photon detection with superconducting magic-angle twisted bilayer graphene," G. Di Battista, K. C. Fong, A. Díez-Carlón, K. Watanabe, T. Taniguchi, D. K. Efetov, Sci. Adv. **10**, eadp3725 (2024)
6. "Performance limits to graphene single-photon bolometers by thermal transport," C. Fried, B. J. Russell, E. G. Arnault, B. Huang, G.-H. Lee, D. Englund, E. A. Henriksen, K. C. Fong, Phys. Rev. Applied 21, 014006 (2024).
7. "Graphene amplifier reaches the quantum limit," K. C. Fong, Nat. Nanotechnol. **17**, 1128 (2022).

8. “Wideband Josephson Parametric Amplifier with Integrated Transmission Line Transformer,” L. Ranzani, G. Ribeill, B. Hassick, and K. C. Fong, IEEE Int. Conf. on Quantum Computing and Engineering, 314 (2022).
9. “Revealing the ultra-sensitive calorimetric properties of superconducting magic-angle twisted bilayer graphene,” G. Di Battista, P. Seifert, K. Watanabe, T. Taniguchi, K. C. Fong, A. Principi, D. K. Efetov, Nano Lett. 22, 6465 (2022).
10. *“Materials and devices for fundamental quantum science and quantum technologies,” M. Polini, F. Giazotto, K. C. Fong, I. M. Pop, C. Schuck, T. Boccali, G. Signorelli, M. D’Elia, R. H. Hadfield, V. Giovannetti, D. Rossini, A. Tredicucci, D. K. Efetov, F. H. L. Koppens, P. Jarillo-Herrero, A. Grassellino, D. Pisignano, arXiv:2201.09260.*
11. **“Miniaturizing transmon qubits using van der Waals materials,” A. Antony, M. V. Gustafsson, G. Ribeill, M. Ware, A. Rajendran, L. C. G. Govia, T. A. Ohki, T. Taniguchi, K. Watanabe, J. Hone, and K. C. Fong, Nano Lett. 21, 10122 (2021).**
12. “Making high-quality quantum microwave devices with Van der Waals superconductors,” A. Antony, M. V. Gustafsson, A. Rajendran, A. Benyamini, G. Ribeill, T. A. Ohki, T. Taniguchi, K. Watanabe, J. Hone, and K. C. Fong, J. Phys.: Condens. Matter 34, 103001 (2021)
13. “Axion Quasiparticles for Axion Dark Matter Detection,” J. Schütte-Engel, D. J. E. Marsh, A. J. Millar, A. Sekine, F. Chadha-Day, S. Hoof, M. Ali, K. C. Fong, E. Hardy, L. Šmejkal, J. Cosmol. Astropart. Phys. 8, 66 (2021).
14. **“Josephson-junction infrared single-photon detector,” E. D. Walsh, W. Jung, G.-H. Lee, D. K. Efetov, B.-I. Wu, K.-F. Huang, T. A. Ohki, K. Watanabe, T. Taniguchi, P. Kim, D. Englund, and K. C. Fong, Science 372, 409 (2021).**
15. “Ultrasensitive calorimetric measurements of the electronic Heat capacity of graphene,” M. M. Aamir, J. N. Moore, X. Lu, P. Seifert, D. Englund, K. C. Fong, D. K. Efetov, Nano Lett. 21, 5330 (2021).
16. *“Graphene-based bolometer for detecting keV-range superlight dark matter,” D. Kim, J.-C. Park, K. C. Fong, G.-H. Lee, arXiv:2002.07821.*
17. **“Graphene-based Josephson junction microwave bolometer,” G.-H. Lee, D. K. Efetov, W. Jung, L. Ranzani, E. Walsh, T. A. Ohki, K. Watanabe, T. Taniguchi, P. Kim, D. Englund, and K. C. Fong, Nature 586, 42 (2020)**
18. “Evidence of Higher Order Topology in Multilayer WTe2 from Josephson Coupling through Anisotropic Hinge States,” Y.-B. Choi, Y. Xie, C.-Z. Chen, J.-H. Park, S.-B. Song, J. Yoon, B. J. Kim, T. Taniguchi, K. Watanabe, J.-H. Kim, K. C. Fong, M. N. Ali, K. T. Law, G.-H. Lee, Nat. Materials 19, 974 (2020)
19. “Magic-angle bilayer graphene nano-calorimeters – towards broadband, energy-resolving single photon detection,” P. Seifert, X. Lu, P. Stepanov, J. R. Duran, J. N. Moore, K. C. Fong, A. Principi, D. K. Efetov, Nano Lett. 20, 3459 (2020).
20. “Proposal to Detect Dark Matter Using Axionic Topological Antiferromagnets,” D. J. E. Marsh, K. C. Fong, E. W. Lentz, L. Šmejkal, and M. N. Ali, Phys. Rev. Lett. 123, 121601 (2019).
21. “Kinetic Inductance Traveling Wave Amplifiers For Multiplexed Qubit Readout,” L. Ranzani, M. Bal, K. C. Fong, G. Ribeill, X. Wu, J. Long, H. S. Ku, R. P. Erickson, D. Pappas, T. A. Ohki, Appl. Phys. Lett. **113**, 242602 (2018).
22. “Asymmetric Josephson Effect in Inversion Symmetry Breaking Topological Materials,” C.-Z. Chen, J. J. He, M. Ali, G.-H. Lee, K. C. Fong, K. T. Law, Phys. Rev. B **98**, 075430 (2018).
23. *“Impact of contact resistance in Lorenz number measurements,” K. C. Fong, arXiv:1711.04005.*
24. “Fast thermal relaxation in cavity-coupled graphene bolometers with a Johnson noise read-out,” D. K. Efetov, R.-J. Shiue, Y. Gao, B. Skinner, E. Walsh, H. Choi, J. Zheng, C. Tan, G. Grosso, C. Peng, J. Hone, K. C. Fong, and D. Englund, Nat. Nanotechnol. **13**, 797 (2018).
25. “Hydrodynamics of electrons in graphene,” A. Lucas and K. C. Fong, J. Phys.: Condens. Matter **30**, 053001 (2018)
26. “Graphene-based Josephson junction single photon detector,” E. D. Walsh, D. K. Efetov, G.-H. Lee, M. Heuck, J. Crossno, T. A. Ohki, P. Kim, D. Englund, K. C. Fong, Phys. Rev. Applied **8**, 024022 (2017).

27. "Frictional magneto-Coulomb drag in graphene double-layer heterostructure," X. Liu, L. Wang, K. C. Fong, Y. Gao, P. Maher, K. Watanabe, T. Taniguchi, J. Hone, C. Dean, P. Kim, Phys. Rev. Lett. **119**, 056802 (2017).
28. "Active 2D materials for on-chip nanophotonics and quantum optics," R.-J. Shiue, D. K. Efetov, G. Grosso, C. Peng, K. C. Fong, and D. Englund, Nanophotonics **6**, 1329 (2017).
29. **"Observation of the Dirac fluid and the breakdown of the Wiedemann-Franz law in graphene," J. Crossno, J. K. Shi, K. Wang, X. Liu, A. Harzheim, A. Lucas, S. Sachdev, P. Kim, T. Taniguchi, K. Watanabe, T. A. Ohki, and K. C. Fong, Science 351, 1058 (2016).**
30. "Transport in inhomogeneous quantum critical fluids and in the Dirac fluid in graphene," A. Lucas, J. Crossno, K. C. Fong, P. Kim, and S. Sachdev, Phys. Rev. B **93**, 075426 (2016).
31. "Development of high frequency and wide bandwidth Johnson noise thermometry," J. Crossno, X. Liu, T. A. Ohki, P. Kim, and K. C. Fong, Appl. Phys. Lett. **106**, 023121 (2015).
32. "The effect of spin transport on spin lifetime in nanoscale systems," J. Cardellino, N. Scozzaro, M. R. Herman, A. J. Berger, C. Zhang, K. C. Fong, C. Jayaprakash, D. V. Pelekhov, and P. C. Hammel, Nat. Nanotechnol. **9**, 343 (2014).
33. "Measurement of the Electronic Thermal Conductance Channels and Heat Capacity of Graphene at Low Temperature," K. C. Fong, E. E. Wollman, H. Ravi, W. Chen, A. A. Clerk, M. D. Shaw, H. G. Leduc, and K. C. Schwab, Phys. Rev. X **3**, 041008 (2013).
34. **"Ultra-sensitive and wide bandwidth thermal measurements of graphene at low temperature," K. C. Fong and K. C. Schwab, Phys. Rev. X 2, 031006 (2012).**
35. "Spin lifetime in small electron spin ensembles measured by magnetic resonance force microscopy," K. C. Fong, M. R. Herman, P. Banerjee, D. V. Pelekhov and P. C. Hammel, Phys. Rev. B **84**, 220405(R) (2011).
36. "Magnetization reversal in an individual 25 nm iron-filled carbon nanotube ," P. Banerjee, F. Wolny, D. V. Pelekhov, M. R. Herman, K. C. Fong, U. Weissker, T. Mühl, Yu. Obukhov, A. Leonhardt, B. Büchner, and P. C. Hammel, Appl. Phys. Lett. **96**, 252505 (2010).
37. "Manipulating spins by cantilever synchronized frequency modulation: a variable resolution magnetic resonance force microscope," K. C. Fong, P. Banerjee, Yu. Obukhov, D. V. Pelekhov and P. C. Hammel, Appl. Phys. Lett. **93**, 012506 (2008).
38. "Detection of higher order modulation harmonics in magnetic resonance force microscopy," T. Mewes, C. K. A. Mewes, E. Nazaretski, J. Kim, K. C. Fong, Y. Obukhov, D. V. Pelekhov, P. E. Wigen and P. C. Hammel, J. Appl. Phys. **102**, 33911 (2007).
39. "Real time cantilever signal frequency determination using digital signal processing", Yu. Obukhov, K. C. Fong, D. Daughton and P. C. Hammel, J. Appl. Phys. **101**, 034315 (2007).
40. "Light-free magnetic resonance force microscopy for studies of electron spin polarized systems", D. V. Pelekhov, C. Selcu, P. Banerjee, K. C. Fong, P. C. Hammel, H. Bhaskaran and K. Schwab, J. Magn. Mag. Matls. **286**, 324 (2005).

Selected Talks in Conferences and Presentations

1. *"Listening to the music of superfluid", New York University, Jan. 30, 2025.*
2. "Graphene-based calorimetric single-photon detection", invited talk, MRS Boston, Dec. 4, 2024.
3. "An interdisciplinary approach to advance quantum science and technology", Florida State Univ., Nov. 13, 2024.
4. "Hybrid superconductors for quantum devices", Cornell Center for Materials Research Symposium, Apr. 23, 2024.
5. "Listening to the music of superfluid", UC Irvine, Apr. 23, 2024.
6. "Kinetic inductance sensing and single-photon calorimeter for future THz spectroscopy", NASA Goddard Space Flight Center, Jan. 10, 2024.
7. "Superconductor-based quantum devices: Physics and applications", Summer School, ITRC School for quantum information device, Pohang, S. Korea, Aug. 23, 2023.

8. “Advancing single-photon detector using graphene”, invited, SPIE Photonics West 2D Photonic Materials and Devices VI, San Francisco, Jan. 31, 2023.
9. “Advancing single-photon detector using graphene”, invited, IEEE Photonics Conference, Vancouver, Nov. 14, 2022.
10. “Two-dimensional materials for quantum sensors and qubits”, contributed talk, Applied Superconductivity Conference, Oct. 25, 2022.
11. “Quantum research in R&D company”, MRSEC at Ohio State University, Oct. 13, 2022.
12. “Enabling quantum technologies by 2D materials”, keynote, Graphene Week 2022, Munich, Sept. 7, 2022.
13. “Advancing single-photon detector using graphene”, invited talk, SiC workshop, Cleveland, Aug. 10, 2022.
14. “Superconductor-based quantum sensors: basic principles and applications”, lecture, The 11th School of Mesoscopic Physics: Quantum Control and Sensing, Pohang, May 20, 2022.
15. “What can van der Waals materials bring to quantum technologies?”, seminars, UMass Amherst, National University of Singapore, Nanyang Technological University, POSTECH, STEP Graphene workshop, March-May 2022.
16. “Quantum research in R&D company”, MRSEC at Columbia University and Center for Quantum Network at U. of Arizona, Jan. 8, 2022 and July 28 2021, respectively.
17. “Fundamental limit of bolometry”, condensed matter seminar, Ohio State University, MIT, Jan., 2021.
18. “Graphene-based Josephson junction single photon detector”, ICAMD in S. Korea, Dec. 11, 2019.
19. “Graphene-based detectors for quantum information and astrophysics”, Washington University in St. Louis, Nov. 18, 2019.
20. “Quantum materials for quantum information science”, IBM TJ Watson Research Center, Oct. 11, 2019.
21. “Dirac fluid, quantum sensor, and dark matter”, *Workshop on Hydrodynamics Across the Scales*, Apr. 26, 2019.
22. “Searching dark matter using graphene-based detectors”, seminar, Fermi National Accelerator Lab., Feb. 24, 2019.
23. “Quantum materials for quantum information”, invited talk, Korean Physical Society Meeting , Oct. 24, 2018.
24. “Graphene-based single photon detector”, invited talk, SPIE Defense and Commercial Sensing, Apr. 18 2018.
25. “Putting hydrodynamic into solid state”, colloquium, Ohio State University, Jan. 9 2018.
26. “Listening to hydrodynamics noise in solid state systems”, seminar, University of Chicago, Oct. 31, 2017.
27. “Listening to the hydrodynamic noise of Dirac fluid in graphene”, invited talk in *Fluid flows: from graphene to planet atmospheres*, Simon Center for Geometry and Physics, Mar. 20, 2017.
28. “Observation of the Dirac fluid and the breakdown of the Wiedemann-Franz law in graphene”, invited talk in *Low Energy Challenges for High Energy Physicists II*, Perimeter Institute, Waterloo, Ontario, August 23, 2016.
29. “Strongly interacting physics in Dirac fluid”, invited talk, Young Research Leaders Group Workshop, Mainz, Germany, June 15, 2016.
30. “Observation of the Dirac fluid and the breakdown of the Wiedemann-Franz law in graphene”, invited talk, APS March Meeting, Baltimore, Maryland, Mar. 14, 2016.
31. “Toward Graphene-Based Microwave Photon Counter” invited talk, APS March Meeting, Baltimore, Maryland, Mar. 19, 2013.
32. “Can graphene detect single microwave photon?” Submillimeter-Wave Advanced Technology seminar, NASA Jet Propulsion Laboratory, Apr. 12, 2012.