

Speaker: Prof. Kin Chung Fong, Northeastern University

An interdisciplinary journey from quantum materials to quantum sensors

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Abstract: Quantum science and technology offer unprecedented opportunities to deepen our understanding of nature and enable transformative technologies. Realizing these opportunities, however, requires more than advances within a single discipline. New quantum phenomena must be understood at the level of materials, translated into controllable devices, and ultimately harnessed for increasingly sensitive measurements. This interplay between fundamental physics and device engineering can open pathways that are difficult to envision from any single field of study.

In this talk, I will share my journey across quantum materials, quantum devices, and quantum sensing, illustrating how discoveries in one area can create new opportunities in another. We will begin with the unusual properties of Dirac and topological materials and explore how these quantum phenomena manifest in Josephson junctions. We will then turn to how the unique electronic and thermodynamic properties of these materials can be harnessed to develop novel single-photon detectors. Building on these ideas, we will explore two-dimensional van der Waals materials as platforms for miniaturized quantum devices, including qubits and quantum-noise-limited amplifiers.

Turning this perspective around, we will then apply quantum sensors to investigate fundamental physics. We will focus on studying the pairing symmetry of unconventional superconductors, including magic-angle twisted graphene and topological Weyl superconductors, and explore how these emerging quantum-sensing technologies could enable new scientific frontiers, from planetary science to the search for axion dark-matter.

Together, these examples illustrate how an interdisciplinary approach—connecting materials physics, quantum devices, sensing, and fundamental science—can create new pathways for quantum discovery and technology.

1. B. Huang, et. al., "Thermal detection of single photons using Dirac fermions," Nat. Comm. 17, 3845 (2026).
2. J. Balgley, et. al., "Coherent and compact van der Waals transmon qubits," arXiv:2512.08059 (2025).
3. A. Banerjee, et. al., "Superfluid stiffness of twisted multilayer graphene superconductors," Nature 638, 93 (2025).

BIO: Dr. Kin Chung Fong recently joined Northeastern University and establishes Quantum Wave-Matter group, after a decade-long tenure as a scientist at Raytheon BBN Technologies. He also serves as a Research Associate in the Department of Physics at Harvard University. Dr. Fong's interdisciplinary research focuses on quantum materials and their applications, including the development of high-sensitivity quantum detectors operating in the single-photon regime, quantum-noise-limited amplifiers, and superconducting qubits. His work leverages quantum sensors to explore diverse phenomena, such as hydrodynamic physics in nearly perfect fluids, the pairing symmetry of unconventional superconductors, and the detection of dark matter axions. The experimental platforms for his research include graphene, two-dimensional van der Waals heterostructures, Dirac and Weyl semimetals, and topological materials. Beyond his academic contributions, Dr. Fong holds more than 10 granted patents and has been recognized for his innovations, including the "Invent Here" Award from the Boston Patent Law Association in 2021 and the Raytheon Intelligence & Space Innovators Awards in 2020 and 2022. He earned his PhD from The Ohio State University and completed postdoctoral fellowships at the Max Planck Institute for Quantum Optics and Caltech. Outside of his scientific pursuits, Dr. Fong enjoys outdoor activities with friends and family.