

QUANTUM MATERIALS SCIENCE AND ENGINEERING

Directors

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GRADUATE CERTIFICATE IN QUANTUM MATERIALS SCIENCE AND ENGINEERING

Quantum materials have played a key role in technologies with broad societal impacts (e.g., semiconductors, lasers, LEDs, and medical imaging). Their importance will increase with the growing research on harnessing quantum effects for computation and sensing (e.g., quantum computation and information research programs at leading technology companies). In addition, the role of data science and machine learning methods continue to grow in importance in all fields of science and engineering. The aim of this certificate program is to train Ph.D. students in the multidisciplinary field of quantum materials and associated data science methods to allow them to be at the cutting edge of research and engineering on understanding and using quantum matter that can lead to scientific and engineering breakthroughs.

This certificate program is open to Ph.D. students in several graduate-degree granting programs in the Graduate School of Arts and Sciences, including the Departments of Applied Physics, Chemistry, Computer Science, Mechanical Engineering and Materials Science, and Physics. Students can either choose to participate in the certificate program during the application process to the Graduate School or, if already enrolled in the graduate program of one of the above departments, apply to the certificate program by contacting its directors.

Requirements

In addition to the department-specific requirements for completing a Ph.D., this certificate program has the following requirements. For coursework, each student must successfully complete the six courses below (within the first two years of matriculating at Yale):

1. Quantum Materials Science and Engineering
2. CPSC 553/CB&B 555/GENE 555 Unsupervised Learning for Big Data
3. APHY 448/PHYS 448/ENAS 850/PHYS 548 Solid State Physics I
4. One of three choices for quantum mechanics: APHY 506, Basic Quantum Mechanics; PHYS 508, Quantum Mechanics I; or CHEM 570, Quantum Chemistry
5. An elective course in materials science and engineering, statistical and many-body physics, or machine learning and data science. Examples include PHYS 650, Theory of Solids I; ENAS 787, Forces on the Nanoscale; CPSC 552, Deep Learning Theory and Applications; and ENAS 752, Solidification and Phase Transitions
6. Responsible Conduct of Research course (offered by each home department)

Some exceptions and replacements for these course requirements are permitted with prior approval of the QMSE Directors.

Ph.D. students in the certificate program meet with a mentoring committee convened by the directors at least once each year to monitor progress and provide career guidance for each student. Students also present their research work in a public setting twice: once at Yale (research in progress, chalk talk, or departmental seminar) and once at a non-Yale conference. Students also participate in two QMSE outreach events organized by the directors. Finally, students must complete four of the following professional development activities:

- External Internship of at least ten weeks (fulfills 50 percent of the professional development requirement)
- Attend a workshop on a QMSE-related topic
- Attend a QMSE-hosted professional development event (held at least once per semester)
- Participate in the QMSE hackathon
- Help organize the QMSE symposium or hackathon
- Invite and host an external seminar speaker at Yale to present on QMSE-related research through student's home department
- Meet with Yale alumni working in a QMSE-related field to learn about their career path
- Have a career-advising appointment with the Yale Office of Career Strategy (OCS)

Students receive their certificate upon completion of the above requirements and after admission to candidacy from their home department on a project related to QMSE.