

A Guide for Graduate students in Chemical Physics

The Chemical Physics program allows students to strike a balance between core courses and courses that are better suited to address the student's specific research goals and interests. Students must consult with the chemical physics graduate advisors in their parent departments, either Chemistry and Biochemistry (Eaves) or Physics, (Raschke), to plan their formal course work.

Statistical mechanics and quantum mechanics are core courses of the program. Unless the student receives transfer credit for the equivalent course or can demonstrate competence at the graduate level, a student in the program must take at least one semester of statistical mechanics and one semester of quantum mechanics. Students can demonstrate competence at the graduate level by passing the final exam in these classes with a B or better, or by successfully completing the more advanced version (e.g. PHYS 5260 instead of PHYS 5250). The student plans the rest of their formal coursework with the advice of their Ph.D. and Chemical Physics Graduate Advisor. Students whose home department is Chemistry and Biochemistry should also take their written cumulative exams. After completing an approved curriculum of formal coursework, the student advances to candidacy in Chemical Physics by passing an oral exam.

Choosing a Ph.D. advisor

The student is expected to talk with five or more faculty members whose research interests them. Students should have chosen a Ph.D. advisor must receive an explicit agreement that they have been accepted into the Ph.D. advisor's group by the end of their first semester. Students who have not found a Ph.D. advisor by the end of their second semester may be placed on academic probation. The student must advise the Graduate Secretary and the Chemical Physics Graduate Advisor when a Ph.D. advisor has accepted them into their group. The Ph.D. advisor is not obligated to provide a research assistantship to the student. Students should plan on starting research projects in the spring semester of their first year and plan to devote all of their time during the summer to research.

Selection of formal courses

There are a variety of formal courses that students can choose to meet the degree requirements that complement their research interests. The Chemical Physics program normally requires 15 credit hours of formal coursework. The distinction between formal and graduate courses is made by the chemical physics committee and not by the graduate school. The student may take a 3000 or 4000 level course outside their home department for credit as a formal course, subject to approval by the student's chemical physics graduate and Ph.D. advisor. For instance, a student whose home department is Chemistry may take PHYS 3310 instead of PHYS 7310 with proper consent. Courses below the 5000 level do not satisfy graduate school requirements. When they are approved to satisfy the formal coursework requirements of the Chemical Physics Ph.D. program, additional graduate courses, such as CHEM 6901 or PHYS 5840, must be added to satisfy graduate school requirements.

Courses such as summer courses, seminar courses, group meeting courses, and

independent study courses (for example Chemistry 6901 or Physics 5840, 7840, and 7850) are not considered formal courses. The precise selection of courses depends upon the student's background and research interests, but in general should include at least one semester of graduate level Quantum Mechanics (CHEM 5581 or PHYS 5250), and one semester of graduate level Statistical Mechanics (CHEM 5531 or PHYS 7230).

Students should complete at least four formal courses successfully during their first year. A grade below B- will not count towards your Ph.D. If your grade point average in formal courses falls below 3.0, you will be placed on academic probation. Because Chemical Physics is multidisciplinary, two courses are usually taken outside the student's home department. Some suggested courses are:

Physics

Intermediate Mathematical Physics I and II (PHYS 5030 & PHYS 5040)

Introduction to Quantum Mechanics II (PHYS 5260)

Theory of the Solid State I and II (PHYS 7440 & 7450)

Statistical Mechanics (PHYS 7230)

Advanced Statistical Mechanics (PHYS 7240)

Theoretical Mechanics (PHYS 5210)

Nonlinear Dynamics (PHYS 5220)

Soft Matter Physics (PHYS 7430)

Electromagnetic Theory I and II (PHYS 7310 & 7320)

Atomic and Molecular Spectra (PHYS 7550)

Fundamentals of Optics and Lasers (PHYS 5160)

Optics Laboratory (PHYS 5606)

Quantum Optics (PHYS 7560)

Nonlinear- and nano-optics (PHYS 7650)

Ultrafast Spectroscopy (PHYS 7660)

Chemistry

Advanced Topics in Physical Chemistry (CHEM 5501)

Introduction to Quantum Chemistry (CHEM 5581)

Advanced Molecular Spectroscopy (CHEM 5591)

Chemical Dynamics (CHEM 5541)

Statistical Mechanics (CHEM 5531)

Advances in Molecular Biophysics (CHEM 5561)

Advanced Physical Organic Chemistry (CHEM 5321)

Materials Chemistry and Properties (CHEM 5251)

Chemistry of Solar Energy (CHEM 5271)

Advanced Quantum Chemistry (TBA)

Examples of formal coursework

A student who is specializing in condensed matter theory may choose to take the following formal courses:

Quantum mechanics (CHEM 5581 OR PHYS 5250)

Electromagnetic Theory (PHYS 7310 OR PHYS 3310)

Statistical Mechanics (CHEM 5531 OR PHYS 7230)
Mathematical Physics (PHYS 5030 AND/OR PHYS 5040)
Advanced Statistical Mechanics (PHYS 7240)
Theory of the Solid State (PHYS 7440 & 7450)
Chemical Dynamics (CHEM 5541)
Nonlinear Dynamics (PHYS 5220)
Soft Matter Physics (PHYS 7430)

An experimental student in spectroscopy may decide to take:

Quantum Mechanics (CHEM 5581 OR PHYS 5250)
Spectroscopy (CHEM 5591 OR PHYS 7550)
Statistical Mechanics (CHEM 5531 OR PHYS 7230)
Chemical Dynamics (CHEM 5541)
Optics (PHYS 4510)
Theoretical Mechanics (PHYS 5210)

A typical trajectory for a student studying molecular, solid-state, or ultrafast spectroscopy could be:

Introduction to Quantum Mechanics (CHEM 5581)
Classical Mechanics (PHYS 5210)
Electromagnetic Theory I and II (PHYS 7310 & 7320)
Advanced Molecular Spectroscopy (CHEM 5591)
Statistical Mechanics (CHEM 5531)
Chemical Dynamics (CHEM 5541)
Optics (PHYS 4510) or Optics Laboratory (PHYS 5606)
Fundamentals of Optics and Lasers (PHYS 5160)
Nonlinear- and nano-optics (PHYS 7650)
Ultrafast Spectroscopy (PHYS 7660)

A typical trajectory for a student studying soft matter systems might be:

Quantum Mechanics (CHEM 5581 OR PHYS 5250)
Statistical Mechanics (PHYS 7230)
Electromagnetic Theory I and II (PHYS 7310 & 7320)
Solid State Physics (PHYS 4340)
Introduction to Soft Matter (PHYS 4810-003 - new course # TBA)
Advanced Physical Chemistry (CHEM 5501)
Materials Chemistry & Properties (CHEM 5251)
Theory of the Solid State I (PHYS 7440)
Advanced Soft Matter Physics (PHYS 7430)
Liquid Crystal and Polymer Physics (TBA)

A student studying biophysics might take:

Quantum Mechanics (CHEM 5581 OR PHYS 5250)
Statistical Mechanics (PHYS 7230)

Electromagnetic Theory I (PHYS 7310)
Biochemistry I and II (CHEM 5711 & 5731)
Advances in Molecular Biophysics (CHEM 5561)
Advanced Soft Matter Physics (PHYS 7430)
Cellular and Molecular Motion, a Biophysical Approach (MCDB 5550)

A student specializing in cold atoms or molecules might take:
Introduction to Quantum Mechanics I and II (PHYS 5250 & PHYS 5260)
Electromagnetic Theory I and II (PHYS 7310 & 7320)
Classical Mechanics (PHYS 5210)
Statistical Mechanics (PHYS 7230)
Fundamentals of Optics and Lasers (PHYS 5160)
Atomic and Molecular Spectra (PHYS 7550)
Quantum Optics (PHYS 7560)
Chemical Dynamics (CHEM 5541)
Advanced Molecular Spectroscopy (CHEM 5591)
Optics (PHYS 4510) or Optics Laboratory (PHYS 5606)

The Oral Exam

After applying for candidacy in Chemical Physics and choosing a Ph.D. advisor, the student is required to schedule an oral exam. The oral examination usually lasts about one hour and should be completed by the end of the student's fourth semester. The student should give about 15 minutes of a "chalk talk" about their proposed Ph.D. research. At the oral exam, a student is expected to exhibit competence in elementary physics and chemistry; electricity and magnetism; chemical kinetics, thermodynamics and statistical mechanics; atomic and molecular structure at the advanced undergraduate level. The oral exam committee will judge whether or not the student is making satisfactory progress in their research, the student understands the main issues within their field of research, and is proposing a feasible research plan. After passing the oral exam, the student is required to write and defend a Ph.D. thesis and complete annual progress reviews (see F3 through F5 of the Chemical physics rules).

Academic probation

Students placed on academic probation must schedule a meeting with the Chemical Physics Graduate advisor and submit a plan for removal of probationary status immediately.