

CHEMICAL PHYSICS GRADUATE PROGRAM

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The Graduate Program in Chemical Physics may be selected by students who wish to satisfy their degree requirement by a thesis in chemical physics combined with interdisciplinary course work. The program has 26 faculty members in 5 different Departments, including 13 in Chemistry, 4 in Physics, 7 in Chemical Engineering and Materials Science, 1 in Biochemistry, and 1 in Medicinal Chemistry. Their research programs are described in on the Web at <http://www.chem.umn.edu/chemphys/>.

I. Prerequisites for entering the Chemical Physics Graduate Program

The prerequisites are:

- A. Adequate preparation in mathematics, intermediate physics, and physical chemistry
- B. Acceptance by the Graduate School
- C. Approval by the Chemical Physics Program's Director of Graduate Studies (**DGS**). This approval will be granted only to those who demonstrate the ability to obtain support. For beginning graduate students, this financial support usually consists of a fellowship or a teaching assistantship from one of the departments represented on our graduate faculty. In this regard, note that the Chemistry and Physics Departments consider entering Chemical Physics students for support with the same priority as students majoring in Chemistry and Physics, respectively.

Current graduate students with a teaching assistantship, research assistantship, or fellowship who wish to switch to Chemical Physics may do so upon obtaining the approval of the DGS.

II. Proficiency examination

After the student's admission into the Chemical Physics Program, he or she must pass a proficiency exam in physical chemistry, which presupposes knowledge equivalent to a full year study of physical chemistry at the undergraduate upper division level.

III. Course program

Each student will choose a program of study in consultation with his or her TMC. Ordinarily course programs for Ph.D. students will include at least 24 graduate credits, which must include either:

- (a) at least 5 credits in chemistry and at least 5 credits in physics, or
- (b) at least 16 credits in chemistry and/or physics combined, including at least 5 credits of quantum mechanics and at least 5 credits chosen from among the areas of thermodynamics, statistical mechanics, statistical physics, and chemical dynamics.

There is no minor or supporting field requirement, and no foreign language requirement.

IV. Ethics training

Every student in the Chemical Physics Program must become acquainted with basic concepts of professional and research ethics as part of new student orientation and also receive subsequent training in the responsible conduct of research/professional ethics. Both the Chemistry Department and the Physics Department have programs in place to provide this training. Each student in the Chemical Physics Program should choose whether he or she wishes to receive this training in the Chemistry Department or the Physics Department and will be responsible for completing the requirements of the department chosen. The student should inform the Chemical Physics secretary of which of the two plans has been selected by the end of the first semester in residence.

V. Seminar

Seminars by leading researchers from other universities and from government and industrial laboratories are given in the Chemistry Department approximately weekly throughout the academic year. Physical chemistry students also frequently find the research seminars held in Physics, Chemical Engineering and Material Science, and other departments to be of interest. Student are expected to attend at least one seminar each week. In addition, "Waves and Beams" is a weekly lunchtime workshop at which physical chemistry students volunteer to present their ongoing research to other members (faculty, postdoctoral associates, and students) of the physical chemistry group (see <http://www.chem.umn.edu/pchem/seminar/wavesbeams>). At the end of their third year, all graduate students also present a seminar on their research at the Chemistry Department Research Symposium.

VI. Choice of research adviser

The deadline for chemical physics students to choose a permanent research adviser to remain in good academic standing is the end of February for student who begin in Fall Semester. However, chemical physics students who require financial support (e.g., in the form of a teaching assistantship) from the Chemistry Department during the summer following their first year (as is the case for most students) must meet the Chemistry Department's earlier deadline for choosing an adviser, which is the first Monday on or following January 15th. *Chemical physics students must report their choice of advisor to 115 Smith Hall by this date to ensure summer support from the Chemistry Department.* This is the case unless the decision to delay choosing an adviser has been approved in writing by the student's TMC; such signed approval should be handed in to the Graduate Operations Office, when appropriate. Students are expected to interview at least four faculty members regarding their research. Students should submit their choice, along with signatures of the interviewed faculty, to the Graduate Operations office using the form attached at the end of this *Bulletin*.

VII. Written preliminary examination

For the written preliminary exam, a student may select one of the three options:

- (i) Chemical Physics format, as described further below.
- (ii) Physical Chemistry format, as described in the "Physical Chemistry" section of this Bulletin.
- (iii) Physics format, which consists of a seven hour long written exam, three hours in the morning and four hours in the afternoon, which tests the student's knowledge of advanced undergraduate physics. Interested students should contact the Physics Department for additional information.

*Students should inform the Chemical Physics secretary of which of the three options has been selected by the end of Spring Semester.

The Chemical Physics format for the written preliminary exam consists of two parts:

- I. A thesis-project proposal
- II. A research proposal or critique based on a paper from the chemical physics literature, published within the last 3 years, not in the student's primary thesis research area.

The literature paper upon which Paper II is based must be selected by the second Monday of September of the second year, and both papers must be submitted to the student's Written Preliminary Examination Committee by the fourth Monday of November of the second year. Each paper should be 8-16 pages long. The writing style and quality should be that of a journal article or a proposal to a funding agency. Background and motivation should be given in an introductory section; the student's

own contributions should be clearly identified as such. Proposals should be specific concerning the measurements or calculations to be made, the apparatus or methods to be employed, and the possible significance of the results.

VIII. Oral preliminary examination

To remain in good standing, students who have begun their graduate studies in chemical physics during Fall semester of their first year must take their oral preliminary examination by the end of the third week in March of their second year, and must have passed the exam by the end of spring semester of that year. Those who do not meet these deadlines will no longer be in good standing in the Ph.D. Program and will be reclassified into the M.S. program in Chemical Physics. The form for requesting assignment of the oral exam committee should be submitted by November 1 of the second year. For students beginning in Spring Semester or entering the program as advanced graduate students, an alternative schedule should be established by the Chemical Physics TMC at the first meeting.

The oral exam usually lasts between 1 and 2 hours. Typically, for students who pass the written preliminary exam by the chemical physics or the physical chemistry format, the oral exam begins with a 20-minute long presentation of the written preliminary papers (about 10 minutes each). The presentation is followed by questions based primarily on these papers and on the underlying fundamentals of chemical physics. The student will be expected to answer fairly specialized questions on areas that are close to the proposed research topics, written preliminary papers, and courses taken, but the further the questioning is from these areas, the less knowledge will be expected. For students passing the written preliminary exam by the physics format, the exam usually begins with a brief research presentation and is followed by questions on the presentation, the research, the fundamentals underlying the research, and general chemical physics.

IX. Checklist of normal progress and deadlines for the Ph.D. in Chemical Physics

- On entering (Fall semester, first year):* Pass the proficiency examination in physical chemistry (if not, pass by the end of spring semester). Plan a course program in consultation with the TMC.
- First Monday on or following January 15, first year* (for students requiring summer support from the Chemistry Department): Choose a permanent research adviser and submit "Choice Form: Research Adviser and Type of Written Preliminary Examination".
- End of first year:* Should have a GPA of 3.0 and have completed at least 14 credits of graduate courses (excluding research credits) with a grade of B or better.

- Second Monday of September, second year:* Hand in "Selection of Paper for Part 2 of Written Preliminary Exam", if chemical physics format was chosen.
- Fourth Monday of November, second year:* Hand in written preliminary examination papers, if chemical physics format was chosen
- Second Monday in January, second year:* Hand in revised written preliminary examination papers (if necessary), if chemical physics format was chosen.
- End of January, second year:* Written preliminary examination passed.
- November 1, second year:* Submit "Request for Approval of a Graduate Program", "Degree Program Form", and "Preliminary Oral Examination Prospective Committee Request Form".
- Third week of March, second year:* Oral preliminary exam taken.
- Last day of May intersession, second year:* Oral preliminary exam passed.
- Fall semester, third year:* (or the first semester after passing the oral preliminary exam): Submit "Thesis Proposal Form" and "Ph.D. Final Examination Committee Form". Start registering for the maximum number of doctoral thesis credits (ChPh 8888) each semester (14 cr/semester if not registering for other credits), until 24 credits have been accrued (thereafter, register for 1 thesis or graded credit per semester).
- Third or fourth year:* Chemical Physics Seminar given (register for ChPh 8101, 1 cr., this semester).

