INSTITUTE FOR PHYSICAL SCIENCE & TECHNOLOGY

CHEMICAL PHYSICS PROGRAM

GRADUATE STUDIES GUIDE

CONTENTS

I. Requirements

Prerequisites for Advancement to Candidacy

- Two laboratory rotations (**CHPH718I**)
- Quantum and Statistical Physics I (**PHYS612**)
- Quantum and Statistical Physics II (**PHYS613**)
- Chemical Thermodynamics (**CHEM684**)
- Statistical Mechanics and Chemistry (**CHEM687**)
- Two semesters of seminars
- Qualifying Examination passed at the Ph.D. level and normally given at the beginning of the fall and spring semesters
- Advanced courses: (Approval must be given by the directors before registering for these courses and a minimum grade of a B must be earned for credit.)
    - Advanced laboratory course
    - Advanced course outside of the student's main field of study at the 600 level or above
- GPA Requirement: B average
- Scholarly Paper and Presentation

Prerequisites for Graduation:

- 12 credits of **CHPH899**
- Preparation of written doctoral dissertation and oral defense

II. Advising & Mentoring

1st Year Students

Most incoming Chemical Physics PhD students are Teaching Assistants during their first two semesters, while they focus on the core courses and laboratory rotations. During this period, the Directors and Coordinator serve as the primary Academic Advisors and Mentors. The Directors provide principal guidance for general orientation and choosing classes, including the research groups for the laboratory rotations. The Coordinator supports students with administrative details.

Students in Research Groups

Students are strongly encouraged to join a research group in their first summer to gain more extensive research experience. Once a student has joined a research group, the research advisor assumes the primary role as mentor.

After the completion of the first year, all students must complete a **progress survey** each semester. This survey asks students to report their publications, presentations, and research progress. Once completed, the survey will generate an email to the student's Faculty Advisory Committee members outlining his/her progress for the semester.

Faculty Advisory Committee

Once a student joins a research group and passes the qualifying exam, the student is expected to ask at least two, and no more than four, additional faculty members to join the research advisor to form the **Faculty Advisory Committee** ("Committee"). The Committee is responsible for meeting with the student at least once per semester to review the student's progress.

The Committee will provide an annual written progress report to the Directors, pointing out any issues the student may be encountering. The Advisor, who will chair the Committee will also report on progress at the annual Advisors' Meeting in the spring.

Three members from the Faculty Advisory Committee will serve as the three-member "**Scholarly Paper Examining Committee**" responsible for:

- Reviewing and approving the student's scholarly paper, and
- Listening to and approving the oral presentation of the scholarly paper,

both of which are required for the student to advance to candidacy after the completion of required coursework.

Finally, the Committee is expected to form the core of - or be - the five-member PhD Dissertation Defense Examining Committee.

III. Course of Study

First Year

Fall Semester

- **CHPH718I**: Chemical Physics Laboratory Rotation (1 credit) -- **required course**
- **PHYS612**: Quantum and Statistical Physics I (4 credits) -- **required course**
- **CHEM684**: Chemical Thermodynamics (3 credits) -- **required course**
- **Seminar Course** (1 credit) -- **required course** *(to take in your first or second year)*. PHYS728, PHYS838C, PHYS738, PHYS769, CHPH709A, CHPH709B, or CHPH709L. You may take other seminar courses.

Spring Semester

- **CHPH718I**: Chemical Physics Laboratory Rotation (1 credit) -- **required course**
- **PHYS613**: Quantum and Statistical Physics II (4 credits) -- **required course**
- **CHEM687**: Statistical Mechanics and Chemistry (3 credits) -- **required course**
- **Seminar Course** (1 credit) -- **required course** *(to take in your first or second year)*. PHYS728, PHYS838C, PHYS738, PHYS769, CHPH709A, CHPH709B, or CHPH709L. You may take other seminar courses.

Summer Semester

- Join research lab
- Study for Qualifying Examination
- Qualifying Examination (week before the start of Fall classes)

Second Year

- Advanced courses: (Approval must be given by the directors before registering for these courses and a minimum grade of a B must be earned for credit.)
    - Advanced laboratory course -- **required course**
    - Advanced course -- **required course** (outside of the student's main field of study at the 600 level or above)
- Pre-candidacy Research (**CHPH898**)
- Collection of preliminary data and preparation of Scholarly Paper

Third through Fifth Years

- Oral Presentation and Admission to Candidacy
- Ph.D. Research, at least 12 credits of **CHPH899**
- Preparation of written doctoral dissertation
- Dissertation Defense

IV. Research Rotations

Rotations are seven weeks each, with student presentations about two weeks after the end of each rotation period. Students will be evaluated in part based on their presentations. The second rotation is scheduled to start early enough so students have ample time to choose their summer research and possible thesis advisers.

The aims of the two rotations are to get to know the research topic and tools used in various labs, to develop laboratory skills, and to find a thesis mentor. Rotations require a minimum 8 hours per week presence in a lab/office. One of the rotations can be with a faculty/adjunct faculty outside the program. Incoming students will have the month of September to research and choose their first rotation.

The length of the presentations should be 10 - 15 minutes.

Rotation 1: Suggested time: September 12 - November 18 -- Fall semester grade.
Rotation 2: Suggested time: January 30 - April 7 -- Spring semester grade.

V. Candidacy Requirements

A student must be admitted to candidacy for the doctorate within five years after admission to the doctoral program and at least six months before the date on which the degree will be conferred. It is the responsibility of the student to submit an application for admission to candidacy when all the requirements for candidacy have been fulfilled. Applications for admission to candidacy are made in duplicate by the student and submitted to the graduate program for further action and transmission to the Graduate School.

The Application for Admission to Candidacy must be received by the Office of the Registrar prior to the 25th of the month in order for the advancement to be effective the first day of the following month.

In order to advance to Ph.D. candidacy, the student must pass the written Qualifying Examination, submit a Scholarly Paper, and make an oral presentation.

Qualifying Exam

The Qualifying Exam is given in four parts, generally taken immediately before the start of a student's third and fourth semesters (second year).

Before the start of the Fall semester:

- Part A1 corresponds to the material in **CHEM684** (Thermodynamics).
- Part A2 corresponds to the material in **PHYS612** (Quantum and Statistical Physics I).

*Students can petition to waive either or both Physics parts (Part A2, Part B2) of the Qualifying Exam if they earn a grade of **B** or better in PHYS612 and PHYS613.*

Before the start of the Spring semester:

- Part B1 corresponds to the material in **CHEM687** (Statistical Mechanics with a Chemistry Focus).
- Part B2 corresponds to the material in **PHYS613** (Quantum and Statistical Physics II).

*Students can petition to waive either or both Chemistry parts (Part A1, Part B1) of the Qualifying Exam if they earn a grade of **B+** or better in CHEM684 and CHEM687.*

Students have a maximum of two attempts to pass the Qualifying Exam requirement.

Scholarly Paper & Oral Presentation

The Scholarly Paper is a requirement for Ph.D. candidacy and the non-thesis M.S. Degree.

Scholarly Paper

The paper should provide an informative review of the research topic selected by the candidate in consultation with his/her academic and research advisors. The bibliography is a particularly important part of the paper and should include the most significant references to the topic.

Students with a well-developed thesis topic and research results are expected to include these results together with further research plans in their paper and presentation.

Students less far along with research will present background material and summaries of the research areas in which they will be working. A concise review of the literature is expected, along with a bibliography of the most important literature.

The length of the paper is expected to be approximately 20 double space pages (12-point font) with 1-inch margins. The paper is not to be a collaborative effort. It is to be the work of the student alone.

Oral Presentation

This public presentation is to last approximately one hour and can be part of a regularly scheduled seminar series such as the *Informal Statistical Mechanics Seminar* or the *Nonlinear Dynamics Seminar*. At least two members of the Scholarly Paper Examining Committee* must be present and there should be sufficient time for questions and discussion. The paper must be submitted to the Examining Committee **at least two weeks before the date of the oral presentation**.

The oral presentation follows a seminar format and is open to questions from the audience. The Examining Committee is free to request revisions of the written document and to have discussions with the student one-on-one before approving the document and presentation.

* The **Scholarly Paper Examining Committee** consists of **at least 3 faculty members, including the advisor**, who will read the scholarly paper and attend the oral presentation. These faculty must hold appointments at the University of Maryland, College Park, but there are no requirements on faculty home. At least one member should be tenured or tenure-track (i.e., a Full Member of the Graduate Faculty). The other members can be Associate Members of the Graduate Faculty.

VI. Dissertation Defense

Within 12 to 18 months after beginning Ph.D. research the candidate is to select a Ph.D. Thesis Examination Committee. To complete the Ph.D. candidates must earn 12 credits of BIPH899 (Ph.D. dissertation research, only available after advancement to Ph.D. candidacy) and prepare a written Ph.D. dissertation, the format of which (font, margins, etc.) must follow the University of Maryland Thesis and Dissertation Style Guide.

The policies and procedures for the oral dissertation examination are set by the Graduate School.

Chemical Physics M.S. (Non-Thesis)

Requirements

- Two laboratory rotations (**CHPH718I**)
- Written Qualifying Examination passed at the M.S. level
- GPA Requirement: B average
- Scholarly Paper and Presentation
- 30 graduate credits of which 24 must be course credits including:
    - Advanced laboratory course
    - Two credits of seminar
    - Advanced course at the 600 level or above

Chemical Physics M.S. (Thesis)

Requirements

- Two laboratory rotations (**CHPH718I**)
- Written Qualifying Examination passed at the M.S. level
- Written Masters Thesis (Paper and Presentation)
- GPA Requirement: B average
- 30 graduate credits of which 24 must be course credits including:
    - Six credits of **CHPH799** - (M.S. thesis research)
    - Two credits of seminar
    - Advanced laboratory course
    - Advanced course at the 600 level or above

Thesis & Oral Presentation

The Thesis Examining Committee is to consist of at least three faculty members including the research advisor. The Examination Committee will review the M.S. thesis and attend and participate in the defense of the thesis.

The thesis is to consist of an introduction to the field of research with which the student is engaged, a clear statement of the problem under study, the objectives of the research, the approach taken, original results, interpretation, discussion, and conclusions. A concise review of the literature, and a bibliography of the most important literature should also be included.

The M.S. thesis has no set length, but is typically 30 to 40 pages. The format of the thesis (font, margins, etc.) must follow the University of Maryland Thesis and Dissertation Style Guide.

Appendix

List of Advanced Laboratory Courses

- CHPH718F – Special Topics in Chemical Physics
- **ENEE648D** (3 credits) - Advanced Topics in Electrical Engineering; Optoelectronics Lab
- **ENMA600** (3 credits) - Advanced Atomistic Modeling in Materials
- ENMA683 (1 credit) – Structural Determination Laboratory
- **PHYS685** (3 credits) - Research Electronics
- ENME432 (3 credits) - Reactor and Radiation Measurements Laboratory
- **ENME744** (3 credits) - Additive Manufacturing

List of Advanced Courses

Physics (PHYS)

- **PHYS624** - Advanced Quantum Mechanics
- **PHYS625** - Non-relativistic Quantum Mechanics
- **PHYS703** - Introduction to Nonequilibrium Statistical Physics
- **PHYS715** - Chaotic Dynamics
- PHYS720 - Quantum Technology
- PHYS721 - Atomic and Optical Physics I
- PHYS733 - Topological Quantum Phases of Matter
- PHYS752 - Elementary Particle Physics II: Theory
- **PHYS761** - Plasma Physics I
- PHYS786 - Machine Learning for Physicists
- PHYS798Z - Computational and Mathematical Analysis for Networks Across Scales
- PHYS830 - Theoretical Condensed Matter Physics
- PHYS851 - Advanced Quantum Field Theory

Chemistry (CHEM)

- **CHEM601** - Structure and Bonding of Molecules and Materials
- CHEM602 - Advanced Inorganic Chemistry II
- CHEM608B -
- CHEM608E - Crystallography in the Solid State
- CHEM608V - Organotransition Metal Chemistry and Catalysis
- **CHEM623** - Optical Methods of Quantitative Analysis
- CHEM624 - Electrical Methods of Quantitative Analysis

- CHEM633 - Atmospheric Chemistry and Climate
- CHEM641 - Organic Reaction Mechanisms
- CHEM647 - Organic Synthesis
- CHEM648P - Chemical Biology
- CHEM689L - Interfacing with Instrumentation using LabVIEW
- CHEM690 - Quantum Chemistry I
- **CHEM703** / **CHPH703** / **PHYS703** - Introduction to Nonequilibrium Statistical Physics (Chris Jarzynski)
- **CHEM705** - Nuclear Chemistry
- CHEM718B -

Engineering (ENEE, ENMA, ENCH)

- ENEE691 -
- **ENEE692** - Introduction to Photonics
- **ENEE790** - Quantum Electronics I
- **ENEE791** - Quantum Electronics II
- ENMA650
- **ENMA664** - Advanced Environmental Effects on Engineering Materials
- **ENCH648C** - Special Problems in Chemical Engineering; Control of Air Pollution Sources
- ENPM650

MATH & AMSC

- **AMSC661** - Scientific Computing II
- **AMSC664** - Advanced Scientific Computing II
- **MATH858T** - Stochastic Methods and Applications (Maria Cameron)
- **MATH858M** - Asymptotic Methods with Applications (Dio Margetis)

Astronomy (ASTR)

- **ASTR601** - Radiative Processes
- **ASTR622** - Cosmology

Atmospheric and Oceanic Science (AOSC)

- **AOSC610** - Dynamics of the Atmosphere and Ocean I
- **AOSC620** - Physics and Chemistry of the Atmosphere I

OTHER COURSES OF INTEREST:
https://ipst.umd.edu/graduate-programs/chemical-physics/prospective-students/other-courses