

Boston University Physics Requirements for the PhD Degree

1. Satisfactory Academic Progress

The Graduate School of Arts and Sciences (GRS) and the Physics Department guarantee five full years (12 months each) of financial support for students who maintain *Satisfactory Academic Progress*. This support will be in the form of Teaching Fellowships, Research Fellowships, or Graduate Fellowships. Funding beyond five years is generally provided (but not guaranteed) to students who are working productively toward the PhD degree. The time limit for completion of the PhD is seven years (exceptions require a petition to GRS).

2. Course requirements

Sixteen 4-credit courses are required with grades of B– or higher. These include the *core courses*: Quantum Mechanics I & II (PY 511-512), Electrodynamics I (PY 521), Mathematical Physics (PY 501), Statistical Physics & Thermodynamics (PY 541), and Advanced Lab (PY 581). Additionally, all first-year students must take the Scholarly Methods course, PY 961, in their first semester. An average grade of B or better must be achieved in the six core courses in order to qualify for the PhD program, with no grade lower than B–.

At least four additional lecture courses (numbered between 500 and 850) must be taken, with at least two *distribution courses* from outside your research specialty. Distribution requirements may be satisfied by taking approved graduate-level courses in other science and engineering departments. You must obtain approval by the DGS prior to taking courses outside of the Physics department to ensure that they will count towards the distribution requirement.

Up to six non-lecture courses may be applied to the 16-course requirement, but no more than two directed study courses (PY909/910) and no more than two seminar courses.

3. Transfer Credits versus Course Waivers

Transfer Credits: Credits may be transferred from other universities to count towards a PhD, as long as they have not been used previously toward any other degree. Only courses that obtained a letter grade (not Pass/Fail) may be considered for a transfer. Courses taken before the senior year of college will not be accepted. Of these, a maximum of eight (8) credits can be used towards a Master's degree, a maximum of sixteen (16) credits can be used towards a Master's and PhD, and a maximum of 32 credits can be used towards a PhD. Transferring credits could have an effect on obtaining a Master's degree during your course of student, so please consult the GRS website guidance. Additional details may be found at <http://www.bu.edu/academics/grs/policies/transfer-of-credits/>. Students who enter the program with a Master's degree from another College or University could also be eligible for transfer credits; decisions are reviewed on a case-by-case basis so please reach out to the Graduate Program Administrator as soon as possible to determine eligibility.

Course Waivers: PY501, 511, 512, 521, 541 and an elective lecture course are normally taken during the first year of graduate study. A student who has either taken an advanced undergraduate lab course or has had significant experimental research experience may petition the faculty member in charge of PY 581 to be excused from this course (i.e.: course waiver). If the petition is approved, PY 581 must be replaced with another 4-credit lecture course. The *Graduate Program Waiver Request form* can be found on the graduate resources website: <https://physics.bu.edu/grad/page/phys-graduate-resources>. Please remember

that course waivers are different than transferring credits. Approved waivers still require students to replace the course with another 4-credit lecture course.

4. Demonstration of Proficiency in Physics

Students are required to demonstrate proficiency through course work by maintaining an average grade of at least B in the five core Physics courses, with no grade lower than B-.

Anyone who fails to achieve the qualification standard during the first year may be asked to re-take the course, for credit or audit, and to re-take the final examination in the second year. Anyone who is unable to achieve the qualification standard at the end of the second year will be terminated from the program.

A student who has failed to achieve the qualification standard may file a petition to the DGS to appeal termination from the program because of exceptional extenuating circumstances. Please contact the DGS directly to determine next steps.

5. Selection of Research Project and Preliminary Oral Examination

You are strongly encouraged to begin research with a faculty member in the Physics department as early as possible. In order to demonstrate Satisfactory Academic Progress, a student should identify a faculty research advisor between their second and third year in the program.

The advisor and student jointly formulate a research project of about one semester in duration. The student presents the results of this project at the Preliminary Oral Exam (POE), which must be held *no later than the end of the third year of graduate study*. A student must meet the course qualification standard and complete PY 581 (or receive a course waiver) to take the POE.

The purposes of the POE are to enable faculty to determine a student's research potential and to test the student's depth and breadth of knowledge. A committee of four faculty members, which includes the student's research advisor, conducts the exam. The committee is proposed by the student and research advisor, and must be approved by the DGS beforehand. The committee includes one member, in addition to the advisor, who is familiar with the subject matter of the research project, one member in the opposite technical discipline (theory or experiment), and one member from outside the student's research field. The committee should be finalized at least *three weeks before* the exam. The student must submit a one-page abstract to the committee at least *two weeks before* the exam.

The exam consists of two parts. The first is an oral presentation of the project lasting no longer than 45 minutes. The presentation should be accessible to a non-specialized audience, and interruptions should be made only for clarifications. During the second part of the exam, which includes only the student and the committee, the student will be questioned on details of the presentation, his/her understanding of related areas of physics, the basic physics principles associated with the project, and the broader context of the project. The entire exam will typically last 1.5-2 hours.

Following the exam, the committee privately decides on a grade of Pass or Fail. A Pass grade permits the student to advance to PhD Candidacy and continue research. In the case of a Fail grade, the committee submits its assessment of the student's performance to the DGS. Based on this assessment and the student's other indicators of academic progress, the DGS and the Graduate Committee will decide if the student is allowed an additional attempt at the exam. If an additional attempt is not allowed, the student

will be terminated from the program. A second failure of the Preliminary Oral Exam will result in the student's automatic termination from the program.

Eligible students who are ready to schedule their POE should reach out to the Graduate Program Administrator so that a day/time and location can be reserved. You will need to provide a Title and Abstract for your talk so that the event can be advertised on the Department calendar. You will be given two forms that must be completed and returned to the Department by your research advisor immediately after your exam.

6. Selection of PhD Dissertation Committee

PhD research is normally carried out under the guidance of a faculty member who is a full-time or affiliated member of the Boston University Physics Department. A student may choose to continue his/her association with the faculty advisor for the Preliminary Oral Exam. The student's advisor becomes the First Reader for the PhD dissertation. The PhD Dissertation Committee consists of five members: (1) First Reader, (2) Second Reader, (3) Committee Chair, and (4/5) two other members. The five committee members should include one who works in the opposite technical discipline of the student (theory versus experiment) and one who works in a different field. The Committee Chair is responsible for completing and returning the necessary forms for the student's thesis defense. A student wishing to work with a faculty member outside the Physics Department must first consult with the DGS. GRS policy requires at least two committee members, including the Committee Chair, to be from the Physics Department. By special appointment that is approved by the Dean of GRS, up to two committee members may be from outside Boston University. The membership of the PhD Committee must be approved by the DGS. The selection of the advisor and PhD Committee must be made no later than the end of the Fall semester of the student's fourth year at Boston University.

7. Interim Progress Report

The student must submit an Interim Progress Report to the DGS by the end of Spring semester of the student's fourth year at Boston University. This report is a three- to five-page (single spaced, 12-point font) description of the student's PhD research activities. It should include the anticipated research scope, research accomplishments, and time scale for completion of the PhD. The report should be prepared in consultation with, and approved by, all members of the PhD Dissertation Committee.

8. Dissertation Prospectus

The Dissertation Prospectus is prepared in consultation with the student's PhD Dissertation Committee. It should be submitted to GRS, after approval by the Readers, the DGS and Physics Department Chair, approximately *seven months* before the Final Oral Exam, and *no later than the Fall semester of the student's seventh year*. This document must be four- to six-pages long (single spaced, 12-point font), and must provide a clear statement of the problem being studied and a self-contained discussion of the research techniques. It should also include an outline of the dissertation, with a bullet-style listing of its sections and subsections. These section and subsection headings should be augmented with one or two explanatory sentences.

9. Departmental Seminar

The student is required to give a generally accessible seminar related of the dissertation project as part of a *Graduate Seminar Series*. All five members of the PhD Dissertation Committee must attend the seminar; other faculty and students are encouraged to attend. The seminar should be presented shortly after the Dissertation prospectus is prepared, and no later than *six months before* the Final Oral Exam.

At the conclusion of the seminar, the PhD Dissertation Committee will meet privately with the student to discuss the quality, quantity and schedule of research required for the completion of a satisfactory PhD dissertation.

Eligible students who are ready to schedule their Departmental Seminar should reach out to the Graduate Program Administrator so that a day/time and location can be reserved. You will need to provide a Title and Abstract for your talk so that the event can be advertised on the Department calendar. You will be given one form that must be completed and returned to the Department by your research advisor immediately after your seminar.

10. Dissertation and Final Oral Exam

The PhD Dissertation must contain an account of original research and results conducted by the candidate. It should contain a critical evaluation of prior research, place the results of the PhD research in perspective, and discuss future research directions. It must be a cohesive document, rather than a compilation of reports or publications. The writing of the dissertation should begin no later than the time of the Departmental Seminar. The First and Second readers should be informed of progress and provide feedback as required. The student should provide a first draft of the dissertation to the First and Second Readers no later than *two months before* the Final Oral Exam. A properly formatted draft of the thesis must be submitted to the Readers and GRS at least *three weeks* prior to the Final Oral Exam.

The student must write and obtain approval of a Dissertation Abstract prior to scheduling the Final Oral Exam. The abstract cannot exceed 350 words, and must describe the research project, methods, results, and dissertation contents. It must be approved by the Readers, the DGS, and the Physics Chair, and must be submitted to GRS *at least three weeks before* the Final Oral Exam. The scheduling and approval form for the Final Oral Exam can be found through the GRS website:

<http://www.bu.edu/cas/files/2018/07/Schedule-and-Abstract.pdf>.

Students are required by GRS to undergo a Final Oral Examination in which they defend their dissertations as valuable contributions to knowledge in their fields and demonstrate a mastery of their fields of specialization in relation to their dissertations. The Final Examining Committee is composed of five or more professorial faculty members including members of the PhD Dissertation Committee. The Final Oral Exam, which must be attended by all five members of the PhD Examining Committee, is formally scheduled by the Physics Department Office, which notifies GRS. The exam consists of two parts. The first is open to the public and consists of a presentation of the research that should last no more than 45 minutes. The talk should be accessible to a non-specialized audience, with emphasis on clarity of presentation. Interruptions should occur only for minor clarifications. The audience is excused for the second part, in which the PhD Examining Committee asks the candidate to defend the dissertation, including the background, scope, limitations of the work, completeness of data or calculations, and the validity of the conclusions. At the end of the second part, the PhD Examining Committee privately decides on a Pass or a Fail grade. In the case of a Pass grade, the title page of the PhD Dissertation is signed by the Readers and is submitted to GRS. In the case of a Fail grade, the PhD Examining Committee and the candidate formulate a plan for revisions, corrections, and/or additional work that will lead to an acceptable dissertation.

Eligible students who are ready to begin the process of completing their PhD, should submit their Intent to Graduate through the GRS website: <http://www.bu.edu/cas/current-students/phd-mfa->

[students/graduation-information/intent-to-graduate-form-for-phd-students/](http://www.bu.edu/cas/current-students/phd-mfa-students/graduation-information/intent-to-graduate-form-for-phd-students/). Please notify the Graduate Program Administrator prior to doing so in order to ensure that all required information is up-to-date. Students should also closely review the Graduation Checklists posted on the GRS website to better understand deadlines and criteria prior to and following your defense. Information can be found on the GRS Graduation Checklists website: <http://www.bu.edu/cas/current-students/phd-mfa-students/graduation-information/>. When you are ready to schedule your Final Oral Exam, please coordinate immediately with the Graduate Program administrator so that a day/time and location can be reserved. You will need to provide a Title and Abstract for your talk so that the event can be advertised on the Department calendar. You will be given two forms that must be completed and returned to the Department by your Committee Chair immediately after your exam.

11. PhD Timetable

Generally at the End of First Year

- Completion of the *core courses* PY501, PY511, PY512, PY521, and PY541, with an average of B with no single course grade lower than B-.
- Students who have completed the equivalent of these graduate level courses can satisfy the core course requirement by filing a petition immediately upon entering the graduate program, choosing one of three alternatives:
 - (i) retake one or more core physics courses at Boston University;
 - (ii) present evidence of prior satisfactory performance equivalent core course(s) to waive the requirement(s); or
 - (iii) opt for an oral proficiency examination to be administered by a faculty committee appointed by the DGS. Additional details are listed in Section 3.

The *Graduate Program Waiver Request form* can be found on the graduate resources website:
<https://physics.bu.edu/grad/page/phys-graduate-resources>.

No Later than End of Second Year

- Show evidence of competence by achieving at least an **average grade** of B in the core courses with no grade lower than B-.

No Later than End of Third Year

- Completion or waiver of the *Advanced Lab* requirement (PY581).
- Passing grade on the *Preliminary Oral Exam*.

No Later than End of Fourth Year

- Selection of the *PhD Dissertation Committee* by the end of the Fall semester.
- *Interim Progress Report* submitted to the Director of Graduate Studies (DGS) by the end of the Spring semester, to be prepared in consultation with, and approved by the members of the PhD Dissertation Committee.

Schedule Guidelines for Completion of PhD

- *Dissertation Prospectus* submitted to the DGS and GRS approximately *seven months* before the Final Oral Exam. Year-specific deadlines are available from GRS.
- *Departmental Seminar*, a presentation of PhD research to the PhD dissertation committee and an audience of departmental students and faculty. It must be held no later than *six months* before the Final Oral Exam.
- *Dissertation Abstract*, approved by the DGS and Physics chair, and submitted to GRS *three weeks* prior to Final Oral Exam.
- *Properly formatted draft of thesis* submitted to readers and GRS *three weeks* before Final Oral Exam.
- *Final Oral Exam*. Deadlines for specific graduation dates and detailed rules are available from GRS.
- For the most up-to-date deadlines and criteria, please review the GRS Graduation Checklists website at: <http://www.bu.edu/cas/current-students/phd-mfa-students/graduation-information/>.

APPENDIX 1: PhD Distribution Requirements

A student with a research specialty in Category A subjects must take two (2) distribution courses in Category B, and vice versa. Only one starred (*) item may count toward the distribution requirement. A student may also, *with prior permission from the DGS*, be allowed to satisfy the Distribution requirements by taking approved graduate courses in other science and engineering departments. Course listings and descriptions can be found in Appendix 2 (below). For the most accurate listing of course offerings, please review the Graduate Resources page at <https://physics.bu.edu/grad/page/phys-graduate-resources>.

APPENDIX 2: Course Offerings

Category	Description
A	Courses in high energy (theory and experiment) , nuclear, etc.
B	Courses in condensed matter (theory and experiment), statistical physics, biophysics, etc.
C	Core Course
W	Waiver
*	Indicates a course that can be counted towards a distribution requirements, but cannot be combined with another asterisked course to complete the distribution requirements of the PhD degree.
^	Course will be offered upon sufficient demand.

Class	Name	Category
PY 501	Mathematical Physics	C
PY 502*	Computational Physics	A/B
PY 511	Quantum Mechanics I	C
PY 512	Quantum Mechanics II	C
PY 521	Electromagnetic Theory I	C
PY 522*	Electromagnetic Theory II	A/B
PY 536	Quantum Computing	A/B
PY 538	Econophysics	A/B
PY 541	Statistical Mechanics I	C
PY 542	Statistical Mechanics II	B
PY 543	Introduction to Solid State Physics	B
PY 551	Introduction to Particle Physics	A
PY 555	Cosmological Physics	A
PY 561^	Introduction to Nuclear Physics	A
PY 571	Introduction to Biophysics	B
PY 581	Advanced Laboratory	C/W
PY 621*	Advanced Scientific Computing in Physics	A/B
PY 677	An Introduction to Evidence-Based Undergraduate STEM Teaching	A/B
PY 681	Electronics for Scientists	A/B
PY 701^	Advanced Mathematical Physics I	A/B
PY 702^	Advanced Mathematical Physics II	A/B
PY 713	Quantum Field Theory I	A
PY 714^	Quantum Field Theory II	A

Class	Name	Category
PY 731^	Theory of Relativity	A
PY 741	Solid-State Physics I	B
PY 742	Solid-State Physics II	B
PY 743	Low-Temperature Physics	B
PY 744	Polymer Physics	B
PY 745	Experimental Surface Physics and Chemistry	B
PY 747	Advanced Statistical Mechanics	B
PY 751	High-Energy Physics I	A
PY 752	High-Energy Physics II	A
PY 761^	Nuclear and Intermediate Energy Physics I	A
PY 762^	Nuclear and Intermediate Energy Physics II	A
PY 771	Systems Biology	B
PY 782	Advanced Materials Characterization	B
PY 811^	Advanced Quantum Field Theory	A
PY 841^	Symmetry in Condensed Matter Physics	B
PY 842^	Many-Body Topics in Solid State Physics	B
PY 895	Special Topics in Theoretical Physics	A/B
PY 896	Special Topics in Theoretical Physics	A/B
PY 897	Special Topics in Experimental Physics	A/B
PY 901	Research in Physics	n/a
PY 902	Research in Physics	n/a
PY 909	Directed Study in Physics	A/B
PY 910	Directed Study in Physics	A/B
PY 961	Scholarly Methods in Physics	C