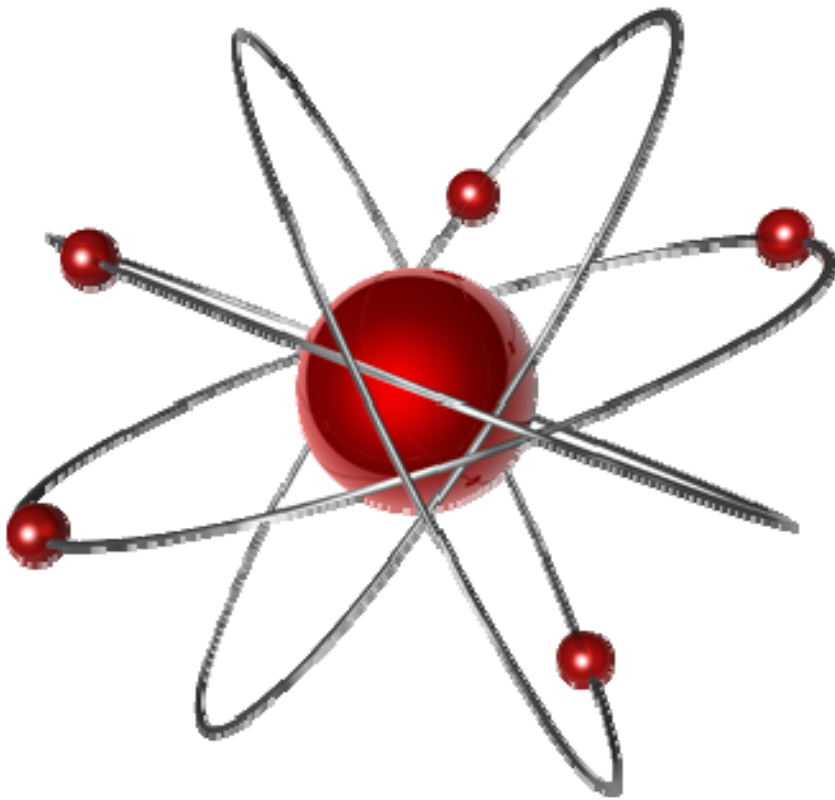


# Graduate Studies Handbook 2020-2021



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Department of Physics  
& Astronomy

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## **A. INTRODUCTION**

This handbook offers guidance to students working toward advanced degrees (doctorate—PhD, master’s—thesis and non-thesis) in physics at Washington State University. As such, it represents the current policies of WSU as a whole, the Graduate School, and the Department of Physics and Astronomy as of the date of issue. Although an attempt has been made to provide all necessary information, it is not possible to cover every possible situation. New student information including advising, office assignments, keys, residency requirements, I-9 forms, W-4 forms, tax information (international students), automated payroll deposit, Social Security Numbers, and teaching assistant duties and various required trainings are typically covered in new student orientation, held the week prior to fall semester. General information about the department office and personnel is also addressed. Students are urged to contact the department’s Administrative Assistant (509-335-1698) for issues and questions not covered in the orientation or in this manual.

Details regarding research programs and course offerings are presented on the departmental website at <https://www.physics.wsu.edu>. General policies regarding graduate enrollment are discussed in detail in the *Graduate School Catalog and the Policies and Procedures Manual*, which is published by the Graduate School: <https://gradschool.wsu.edu/policies-procedures>

Note: In addition to specific requirements set out by the Graduate School, the Department of Physics and Astronomy possesses its own internal requirements. Students are encouraged to discuss relevant issues with the graduate advisor (Appendix C). Another resource is the Graduate Student Council, made up of three graduate student representatives who are appointed by the chair. They serve in important advisory roles and act as liaisons between students and faculty (Appendix C).

## **B. DOCTORAL PROGRAM**

### **B.1. Physics Core Curriculum**

The doctoral core curriculum consists of seven 3-credit-hour courses:

- Phys 521: Classical Mechanics I
- Phys 533: Thermal and Statistical Physics I
- Phys 541: Electromagnetic Theory
- Phys 542: Electrodynamics
- Phys 550: Quantum Theory I
- Phys 551: Quantum Theory II
- Phys 571: Methods of Theoretical Physics

In addition, the student is expected to take *at least one course* from the list below:

- Phys 534: Thermal and Statistical Physics II
- Phys 552: Quantum Theory III
- Phys 563: Solid State Physics

The core is normally taken in the following sequence:

	Fall	Spring
First year	521, 550, 571	533, 541, 551
Second year	PhD Comprehensive Exam, 542, electives	Elective(s)

## B.2. Seminars

All physics graduate students in degree programs are expected to enroll in a total of at least 4 credits of Phys 590 (offered each semester for 1 credit). In addition, all first-year students are required to take Phys 501 in their first semester, in which they will be introduced to research in the department.

## B.3. Additional Graded Courses

The student's doctoral program of study must include a minimum of 72 semester-hours of credit beyond the bachelor's degree, of which 36-semester hours of credit must be for graded course work. ("Graded" means that a letter grade of A - F is assigned for the course.) Appropriate classes must meet the following two criteria to count toward the doctoral program: first, the course cannot be remedial; i.e. the content must not be covered by a standard undergraduate physics core curriculum. Second, the course must contain a significant level of student active participation, measured by some combination of graded homework, graded mid-terms, graded final examination, and graded written research project. Thus, graded seminar courses are not acceptable. *Students may take classes that are not approved for the doctoral program, and grades from such classes will appear on the transcript; however, the credits earned will not count towards the student's doctoral program.*

Please note:

- 500-level courses in the department count toward the doctoral program.
- Courses from other departments may be counted toward the doctoral program (For a list of authorized courses, see appendix A). Students may request courses not listed in appendix A be counted toward the doctoral program if these courses are critical to the student's education, subject to approval by the student's advisor, the graduate advisor and the department chair.

## B.4. Cooperative Program with University of Idaho

The physics departments at WSU and University of Idaho have a cooperative arrangement whereby students have an increased number of options concerning graduate-level courses. No special fees are charged for these courses. In each cooperative class, the regulations of the host institution prevail, but official enrollment and grades are recorded only by the institution in which the student is seeking an advanced degree. The cooperative program is limited to specific courses. More information can be found at: <http://schedules.wsu.edu/Coop>.

## **B.5. Materials Science and Engineering Program**

In addition to the PhD in Physics, Washington State University has a related PhD program in Materials Science and Engineering (MSE). The MSE Program shares faculty and facilities with the Department of Physics and Astronomy, to the benefit of both programs.

## **B.6. Dissertation**

All doctoral programs require that a candidate prepare a dissertation. The student's doctoral committee is responsible for ensuring that the content is acceptable and that the student has followed an appropriate format. See the Graduate School's requirements for final acceptance at:

<https://gradschool.wsu.edu/documents/2014/12/dissertation-and-thesis-submission-guidelines.pdf>

A bound copy of the dissertation should be submitted to the Department of Physics and Astronomy after all other requirements have been satisfied. Details are as follows: Binding is done locally at the Student Book Corporation ("Bookie") or at J & H Printing, 509-332-0782. The department's copy should be on "acid-free" paper and bound with red sturdite. The front cover should have the title, student's name, degree, and year printed in gold lettering as they appear on the front page of the dissertation; the spine should have the student's name, degree, and year in gold lettering.

## **B.7. Advisor, Committee, and Affiliation**

The Graduate Studies Advisor will serve as temporary advisor during the student's first year. The student should *affiliate* with a research group and form a Degree Advisory Committee as early as possible, preferably by the beginning of the second year. The faculty member (principal investigator) of the research group serves as the research advisor and committee chair; the committee must include at least two other graduate faculty members. A majority of committee members (including the chair) must be from Physics & Astronomy. This committee has the responsibility of directing and evaluating the student's progress, supervising the dissertation, and participating in the preliminary and final examinations. It is essential for the student to consult with the committee about coursework, research, and general academic issues. Affiliation and the formation of the Degree Advisory Committee by no later than the end of the third semester of study is an indicator of good standing in the program.

**The Degree Advisory Committee is required to meet in person a minimum of once per year**, prior to submitting the student's Annual Review (see Section D.3), generally due in at the end of the Spring semester. The purpose of the meeting is to assess progress and provide feedback to the student. The guiding question for these meetings should be, "Is there a clear path for the student to obtaining the PhD?" The results of the meeting should be reflected in the written Annual Review.

## **B.8. Program of Study**

As soon as possible after the student affiliates, the Degree Advisory Committee and the student should meet to determine a *Program of Study*, which is then submitted through the department chair to the Graduate School for approval. In addition to the core requirements, the program must show additional coursework and research. A minimum of 20 hours of 800-level (research) course credit is required. It is possible that a student may want or need to change affiliation (see Section E.6), in which case the committee should be reconstituted and the Program of Study revisited by the student and the new committee to see that it is appropriate for the new course of research. The signed Program of Study (on file in the department office) serves as record of the student's affiliation.

## B.9. Transfer Credit

Transfer credit is limited to no more than half of the total graded course credits that are required by the department for the PhD degree. *Students wanting to request a transfer of coursework should talk to the Graduate Studies Advisor immediately upon enrolling at WSU.* The Graduate Studies Advisor, in consultation with other faculty and subject to approval by the chair, shall decide whether transfer credit may be granted department approval, final approval will come from the graduate school upon submission of your Program of study. All transfer work under consideration must have a grade of "A-" or higher. Course content and level of rigor are subject to review by the faculty; the student is required to provide syllabi and transcripts and encouraged to provide sample exams and other course information in support of the request. Graded graduate-level course work must have been taken toward a master's degree or higher at an accredited institution. None of these credits may be applied toward another advanced degree at WSU. Transfer credits are subject to the usual time restrictions and may not be more than ten years old at the time of graduation.

## B.10. Residence

The period of study for doctoral degrees is at least three years (six semesters) beyond the baccalaureate degree, at least two of which, including two consecutive semesters, must be in credit enrollment while in residence at WSU, Pullman. Except where the two consecutive semesters at WSU are concerned, three summer sessions may be counted as a year, and two summer sessions as a semester. (See E.12 for more on residency.)

## B.11. PhD Comprehensive and Preliminary Examinations

Students in the PhD program must pass a departmental comprehensive examination prior to the PhD preliminary examination.

### Comprehensive examination

The comprehensive exam will be given each year in August. Students who have completed their first year will be expected to take the exam at this time. The exam will also be offered to incoming students, should they choose to take it, at no penalty. It consists of written and oral components:

The written exam is designed to test understanding of core physics fundamentals at the advanced undergraduate and first-year graduate level. The exam is prepared by a faculty committee that selects from problems submitted by the entire graduate faculty. There are four 3-hour sections, taken over the course of two days.

1. **Classical Mechanics:** Undergraduate and graduate through the level of Goldstein, Ter Haar, and Fetter & Walecka.
2. **Thermal Physics:** Undergraduate and graduate through the level of Callen, Reichl, & Pathria.
3. **Electromagnetic Theory:** Undergraduate and graduate through the level of Jackson and Landau & Lifshitz.
4. **Quantum Physics:** Undergraduate and graduate through the level of Messiah and Sakurai.

The written examinations are broad in scope and specific topics will be distributed to those signed up to take the exam. Past written examinations are available to students upon request from the department's Administrative Assistant.

The oral exam is about two hours long and is scheduled to take place soon after the written exam component is completed. It is administered by three or more members of the graduate faculty and used to evaluate how students approach problems in front of an audience. This examination by its nature is more subjective.

Students must pass both examination components before scheduling the PhD preliminary examination. Each student's performance will be considered in detail by the graduate faculty, followed by a vote as to whether or not the student has passed the comprehensive exam. A student who does not pass may be allowed to repeat part or all of the examination, depending on the recommendation of the faculty. For a student who fails to pass the comprehensive exam after an allowed number of attempts, the department will notify the Graduate School of its intent regarding his/her future enrollment. If a student fails to pass in a final attempt, he/she may not matriculate to candidacy for the PhD degree; the student's options are to leave the program, find another thesis home outside the department, or finish with a non-thesis MS if the student has the proper credits.

### **PhD preliminary examination**

The student will prepare and present a dissertation research proposal for evaluation by the doctoral committee (see Section B.7). The preliminary exam should be scheduled to take place approximately one year after passing the comprehensive exam.

- The student will prepare a short paper, 4-5 pages, detailing research progress and accomplishments up to that date and outlining a proposal for dissertation research to be carried out. Once the advisor approves of the proposal, the student will schedule a meeting for the preliminary examination through the Graduate School.
- The student will undergo an oral examination with the doctoral committee. Following the examination, doctoral committee members (and other eligible attending faculty) will vote according to Graduate School rules as to whether or not the student has passed the examination, thereby becoming a PhD candidate.
- Should a student change affiliation at any time after successful completion of the preliminary examination, they will not be required to undergo a second preliminary examination.

After passing the preliminary examination, Graduate School rules come into effect that specify a time within which the PhD dissertation defense should be scheduled and passed. The defense should occur no sooner than one year after satisfactory completion of the PhD preliminary exam.

### **B.12. ABD Waiver**

Upon completion of coursework and exams, students may become eligible for an "All But Dissertation" (ABD) tuition waiver. The Graduate School will process, monitor, and approve all students who qualify for ABD waivers.

To qualify for ABD status a student must:

- Be formally appointed to a graduate research assistantship and enrolled in 10-18 credits.
- Have completed all formal coursework in the Program of Study.
- Have completed the preliminary exam by the last day of the semester prior to initiation of the ABD waiver
- Be fully funded from competitive extramural grants via graduate research assistantship

Students will be eligible to receive an ABD tuition waiver for up to five academic semesters. Please see the Administrative Assistant in the Department of Physics and Astronomy for more details on how to apply.

### **B.13. Application for Degree**

A copy of the *Deadlines and Procedures for Doctoral Degree*, which contains the schedule for completing graduation requirements, can be found on the Graduate School's website:

<https://gradschool.wsu.edu/students/>

The *Application for Degree* must be filed with the Graduate School according to the schedule in the *Deadlines and Procedures*; it is suggested that this be done the semester before the student intends to graduate (e.g. in the fall if the student intends to graduate the following spring). Please note that an approved Program of Study must be on file in the Graduate School before the Application for Degree can be filed, and the Application for Degree must be filed before candidates may schedule a Final Examination (see B.13.).

### **B.14. Final Examination**

Doctoral candidates must pass a final oral examination that shall be primarily a defense of the dissertation, but may cover the general fields of knowledge pertinent to the degree. The final examination normally lasts approximately two hours. It must follow the preliminary examination by at least 3 months and at most 3 years. Before the final examination may be scheduled, the student must submit appropriate forms found at <https://gradschool.wsu.edu/facultystaff-resources/18-2/> at least 10 working days in advance of the examination date.

The examining committee consists of the doctoral committee (and, in some cases, a representative of the University Graduate Studies Committee) and any other members of the graduate faculty in attendance. The student's doctoral advisory committee will conduct this examination. *NOTE: Scheduling of the final oral examination is the responsibility of the student. Students must confer with the dissertation committee before scheduling the examination. If you wish to use the Band Room (Webster 1243), it must be reserved through the department's support staff in Webster 1245.*

## **C. MASTER'S PROGRAM**

### **C.1. Master's of Science, Physics – non-thesis (time to completion: about two years)**

- A minimum of 30 semester-hours of approved graded 500-level course work in physics or related fields
  - 18 credits must be in the physics core curriculum (see B.1., 6 of the 7 courses listed)
  - Minimum of one (1) credits of Phys 501 seminar (taken in the first semester)
  - Minimum of four (4) credits of Phys 590 seminar (offered each semester for 1 credit)
  - Minimum of four (4) credits of 702
  - 500-level courses in the department count toward the master's program
  - 500-level courses from other departments may be counted toward the master's program, subject to approval by the advisor and the department chair



## C.2. Master's of Science, Physics - thesis (includes a substantial thesis project; time to completion, about three years)

- A minimum of 30 semester-hours of approved graduate credit, including 21 hours of graded 500-level course work in physics or related fields
  - 18 credits must be in the physics core curriculum (see B.1., 6 of the 7 courses listed)
  - Minimum of one (1) credits of Phys 501 seminar (taken in the first semester)
  - Minimum of four (4) credits of Phys 590 seminar (offered each semester for 1 credit)
  - Minimum of four (4) credits of Phys 700
  - 500-level courses in the department count toward the master's program
  - 500-level courses from other departments may be counted toward the master's program, subject to approval by the advisor and the department chair.

A bound copy of the thesis should be submitted to the Department of Physics and Astronomy after all other requirements have been satisfied. (See B.6. for details).

## C.3. Advisor, Committee, and Affiliation

The Graduate Studies Advisor will serve as temporary advisor during the student's first year. The student should *affiliate* with a research group and form a Degree Advisory Committee as early as possible, preferably by the beginning of the second year. The faculty member (principal investigator) of the research group serves as the research advisor and committee chair; the committee must include at least two other graduate faculty members. This committee has the responsibility of directing and evaluating the student's progress, supervising the dissertation (for a thesis master's), and participating in the final examination. It is essential for the student to consult with the committee about coursework, research, and general academic issues. Affiliation and the formation of the Degree Advisory Committee by no later than the end of the third semester of study is an indicator of good standing in the program.

**The Degree Advisory Committee is required to meet in person a minimum of once per year**, prior to submitting the student's Annual Review (see Section D.3), generally due in March. The purpose of the meeting is to assess progress and provide feedback to the student. The guiding question for these meetings should be, "Is there a clear path for the student to obtaining the MS?" The results of the meeting should be reflected in the written Annual Review.

## C.4. Program of Study

As soon as possible after the student affiliates, the Degree Advisory Committee and the student should meet to determine a *Program of Study*, which is then submitted through the department chair to the Graduate School for approval. In addition to the core requirements, the program must show additional coursework and either research (thesis master's) or directed-study (non-thesis master's) credits. It is possible that a student may want or need to change affiliation (see Section E.6), in which case the committee should be reconstituted and the Program of Study revisited by the student and the new committee to see that it is appropriate for the new course of research or directed study. The signed Program of Study (on file in the department office) serves as record of the student's affiliation and must be submitted no later than the beginning of the semester preceding the semester of graduation.

## C.5. Transfer Credit

Transfer credit is limited to no more than half of the total graded course credits that are required by the department for the PhD degree. *Students wanting to request a transfer of coursework should talk to the*

*Graduate Studies Advisor immediately upon enrolling at WSU.* The Graduate Studies Advisor, in consultation with other faculty and subject to approval by the chair, shall decide whether transfer credit may be granted department approval, final approval will come from the graduate school upon submission of your Program of study. All transfer work under consideration must have a grade of "A-" or higher and must be obtained while seeking a higher degree. Course content and level of rigor are subject to review by the faculty; the student is required to provide syllabi and transcripts and encouraged to provide sample exams and other course information in support of the request. Graded graduate-level course work must have been taken toward a master's degree or higher at an accredited institution. None of these credits may be applied toward another advanced degree at WSU. Transfer credits are subject to the usual time restrictions and may not be more than ten years old at the time of graduation.

## **C.6. Residence**

The residence requirement for the master's degree is one academic year: (a) two semesters, (b) one semester and two summer sessions, or (c) three summer sessions (See E.12 for more on residency)

## **C.7. Application for Degree**

A copy of the *Deadlines and Procedures for Doctoral Degree*, which contains the schedule for completing graduation requirements, can be found on the Graduate School's website:

<https://gradschool.wsu.edu/students/>

The *Application for Degree* must be filed with the Graduate School according to the schedule in the *Deadlines and Procedures*; it is suggested that this be done the semester before the student intends to graduate (e.g. in the fall if the student intends to graduate the following spring). Please note that an approved Program of Study must be on file in the Graduate School before the Application for Degree can be filed, and the Application for Degree must be filed before candidates may schedule a Final Examination (see below, section C.8). For additional details, please contact the Administrative Assistant.

## **C.8. Final Examination**

A final oral examination is required of all master's candidates. This examination is intended to test the candidate's ability to integrate and interpret material in the major and supporting fields with emphasis on the work presented in the thesis or special problem. This examination may be scheduled when all requirements of the department and Graduate School have been satisfied (or are expected to be satisfied by the end of the current semester). The scheduling form must be submitted to the Graduate School at least *10 working days in advance of the examination date*. A student's advisory committee will conduct this examination.

***NOTE: Scheduling of the final oral examination is the responsibility of the student. Students must confer with their thesis committee before scheduling the examination. A form is available from the Graduate School's website. If you wish to use the Band Room (Webster 1243) it should be reserved through the support staff in Webster 1245.***

## **D. ASSISTANTSHIPS AND FELLOWSHIPS**

### **D.1. Assistantships**

Research and teaching assistantships serve the following purposes:

- To provide the student holding the assistantship with financial support

- To give the student opportunities for training in research and teaching
- To augment the research and teaching program of the department

### Terms

The normal appointment to a research assistantship (RA) or teaching assistantship (TA) is half-time. Academic-year appointments normally begin August 16 and conclude May 15. Summer appointments can vary in duration depending on the nature of the duties. Paydays are twice a month.

Assistantships are offered on the basis of academic merit, with preference given to students making satisfactory progress in the physics graduate academic program. Re-appointment to an assistantship will be approved if recommended by the department, and if the student has a cumulative grade point average no lower than 3.00 since the initial appointment. Graduate School regulations specify that the time that a student may hold an appointment is ordinarily limited as follows:

- Master's candidates: two years.
- Doctoral candidates with a master's degree: four years.
- Doctoral candidates without a master's degree: six years.

If a student is making satisfactory progress toward the completion of a program, the student's advisor may petition the Graduate School for an extension.

Students who receive any waiver of tuition (operating fee waiver for TAs, qualified tuition reduction for RAs, All But Dissertation (ABD) waivers for RAs, or nonresident tuition waiver for TAs/RAs) *must reside within the state of Washington. Additionally, students on TA appointments are required to live in the state of Washington.* The award of an assistantship for a one-time period does not guarantee a similar offer at a later time. First- and second-year graduate students supported on a TA should be aware that if they deviate from the program plan approved by their advisor in such a way that their progress towards a physics graduate degree is impeded, the Physics and Astronomy Department may cease financial support regardless of a good academic standing.

Graduate students initially offered assistantships with admission are not guaranteed funding after the first two years, even if they are making normal progress through the physics core curriculum. It is the student's responsibility to find and join a funded research program. It is neither a right nor standard practice to be a TA for the duration of one's graduate studies. (See Appendix F for details regarding the different types of assistantships and their pay rates.)

### Duties of Teaching Assistants

Duties will be assigned by the Lab Director in conformity with accepted departmental policies and practices. It is the TA's responsibility to obtain permission from the Lab Director before making any deviations or changes in his/her teaching schedule. This includes a family emergency or unscheduled leave of absence. Issues related to classroom disruptions such as disruptive behavior is covered in the weekly physics laboratory meetings conducted by the instructional supervisor. Consult your current copy of the department's TA training manual for more information.

### Duties of Research Assistants

Duties will be assigned by the student's research supervisor as deemed appropriate for conducting the research project(s).

## D.2. Other Awards

Fellowships, traineeships, and other kinds of support for graduate students are also available. These are provided by state, federal, and private agencies. Graduate students at WSU are automatically considered for those administered by WSU as they become available. Information about fellowships offered by the department is available at the department website. Applying for awards not administered by WSU is the responsibility of the student. Information about external fellowships and traineeships may be available from the Office of Research Support and Operations (ORSO) <https://orso.wsu.edu/>

## D.3. Annual Review – Graduate Students

In accordance with Graduate School policy, an annual review is carried out for all graduate students (the form is shown in Appendix D). For unaffiliated students, this review is conducted by the Graduate Studies Advisor and consists of an examination of course grades and efforts to find and affiliate with a research group. Teaching assistants are also evaluated by the Lab Director on the basis of the director's and student evaluations. Affiliated students are evaluated by their PhD committees, which are required to meet with the student prior to submitting the review (see Section B.7). A current annual review, submitted by the spring deadline, with an overall average rating of 3.0 or better, is indicative of good standing in the program.

## E. POLICIES AND REGULATIONS

### E.1. Enrollment

Graduate students must maintain continuous enrollment until all requirements for the degree are completed. Enrollment may be in one of the following categories: (a) full-time enrollment of 10 credits or more; (b) part-time enrollment of fewer than 10 credits; (c) summer session enrollment for credit; or (d) graduate leave status for credit. Students wishing to schedule a preliminary or final examination *must be enrolled for two (2) examination credits* (Phys 700, 702, or 800) during the term in which the examination is taken.

### E.2. Time to Completion and Leave Status

#### Time Limits for Completion of Doctoral Degree

The time limit for use of graduate credit toward a doctoral degree is 10 years from the beginning date of the earliest course applied toward the degree. In addition, the doctoral degree must be completed within 3 years of the date of the satisfactory completion of the preliminary examination. The Graduate School recognizes that part-time students may require a longer completion period. As appropriate, departments may request an extension of this time limit.

**1. One-year Extension.** Each program for a doctoral degree is considered individually. According to Graduate School policy, in most cases, the requirements for the degree should be completed within three years of the date of satisfactory completion of the Preliminary Examination. A one-year extension as an exception to Graduate School policy may be requested by the student and advisor. The first extension is normally submitted by the department chair to an associate dean in the Graduate School.

See full treatise on extensions in GS Policies and Procedure, Chapter Six, F. 1-3.  
<https://gradschool.wsu.edu/chapter-six-f/>

**2. Second Extension.** The Graduate School regards a second extension as a "serious matter [that] should be considered a final stage of the process to complete the degree." A second extension requires a memorandum of justification, including an estimated time to completion of degree from the student's advisor via the department chair. Prior to submission, a departmental faculty meeting must be held in which the student's case is made and discussed by the entire faculty. The department chair must ballot the graduate faculty for their support of the request. The results of the ballot must be reported to the Graduate School as part of the memorandum request. If the extension is granted, a letter will be sent to the student (copied to the department chair, the chair of the thesis/dissertation committee, and the dean of the Graduate School) outlining the conditions of the approval.

**3. Third Extension.** According to Graduate School policy, "[it] is possible to obtain a 3rd extension under exceptional circumstances (personal and/or family medical issues, etc.). The 3rd extension is absolutely final. Because of this, the process for requesting it is more formal and involves a wider segment of the university community." Faculty advisors should consult with the department chair regarding special circumstances.

#### Time Limits for Completion of Master's Degree

The time limit for use of graduate credit toward a master's degree is six years from the beginning date of the earliest course applied toward the degree. As necessary, departments may request an extension for up to one year.

#### Graduate Leave Status

Graduate students are considered to be actively pursuing a degree from the time of first enrollment in the Graduate School until graduation or until the limits described below have expired. Students who find they cannot enroll can be considered for *Graduate Leave Status*.

- **Exceptions to Continuous Enrollment.** Typically, degree-seeking graduate students enroll in credits every semester until degree completion, however, sometimes circumstances are such that degree-seeking students are unable to enroll for credits. Such circumstances may include illness, family issues, financial need, work, or other obligations. The exceptions to continuous enrollment discussed in this section address circumstances in which a degree-seeking student must be away from campus and cannot enroll for credits. These students must complete the appropriate graduate leave or internship leave paperwork, obtain approval from their faculty advisor and program chair, and submit the paperwork to the Graduate School in advance of the semester they will be away. *Official leaves of absence, internships leave status, and absences not approved under this policy are included in the time to complete a degree.*
- **Graduate Leave of Absence.** Degree-seeking students in active status who must be away from campus for reasons such as medical issues (EFML), family obligations, job obligations, military service, and Peace Corps service, and who cannot maintain continuous enrollment in any given semester, may apply for an official graduate leave of absence. For additional information, see Chapter 5, Section A.6: <https://gradschool.wsu.edu/chapter-five-a6-7/>
- **Reenrollment for a Degree-Seeking Student (This reenrollment policy does not apply to doctoral students in continuous doctoral status).** A degree-seeking graduate student (who is not in continuous doctoral status) who does not maintain continuous enrollment or who is not on approved graduate leave or internship leave status, and who is absent for one semester or two consecutive semesters (excluding the summer) must complete the reenrollment form **before** the student can register for classes. Reenrollment requires a nonrefundable processing fee because the student is returning from an **unapproved** absence. Reenrollment also requires departmental approval and is not

guaranteed. Students enrolling after being in **continuous doctoral status**, or on approved graduate leave or internship leave, **do not** have to complete the reenrollment form or pay the reenrollment fee.

- **Readmission for a Degree-Seeking Student.** A degree-seeking graduate student who fails to maintain continuous enrollment or approved graduate leave or internship leave, and who is absent for three or more consecutive semesters (excluding the summer) is required to reapply and pay a nonrefundable application fee to the Graduate School if he/she wishes to be considered for readmission to a program.
- Readmission is not guaranteed. Doctoral students who drop out of **continuous doctoral status** are also required to reapply and pay a nonrefundable application fee to the Graduate School for readmission to a program.
- Students may not take graduate examinations (preliminary or final) during Graduate Leave Status terms.
- For a full treatise on graduate leave, see GS Policies and Procedures, Chapter Five, A.3 <https://gradschool.wsu.edu/chapter-five-a2/>

### E.3. Courseload

The following indicates the number of credits that constitutes a required course load for a graduate student.

- Students on a research assistantship or teaching assistantship must enroll in at least 10 credit-hours (1 credit = 3 hours of effort), not to exceed 18 credits.
- For all students, at least one credit must be a research credit (Phys 700, 702, or 800 for affiliated students; Phys 600 for unaffiliated students) of their total credit load.
- Students not on an appointment, and enrolling solely for the purpose of completing theses or dissertations and taking preliminary or final examinations, must register for a minimum of two semester-hours of Phys 700, 702, or 800 during that semester or summer session.
- All master's and doctoral degree students not on appointment are required to enroll for a minimum of 2 credits every fall and spring semester until they complete all of their degree requirements. Doctoral students who have taken their preliminary exams, have met all of their program requirements except completion of their dissertation, and do not have the funding to register for two or more research credits will be placed into Continuous Doctoral Status for a limited number of semesters. Students in Continuous Doctoral Status will be charged a \$50/semester administrative fee and will have limited access to University resources.
- International students holding valid visas should consult with the International Programs - Global Services for additional enrollment requirements.

### E.4. University Policy: Sexual Harassment and Academic Ethics

#### Sexual Harassment

Teaching Assistants are expected to provide a positive learning environment. The following is WSU's policy on sexual harassment:

WSU's discrimination policy explicitly prohibits sexual harassment as a form of unlawful sex discrimination. Sexual harassment is defined as follows: Unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitutes sexual harassment when (1) submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment or education, (2) submission to or rejection of such conduct by an individual is used as the basis for employment or educational decisions affecting such individual, or (3) such conduct has the purpose or

effect of unreasonably interfering with an individual's work or educational performance or creating an intimidating, hostile or offensive environment. *WAC 504-26-227*.

The department will offer on-site training during the week of new student orientation. Students on assistantship are also required to take the online training at: <https://hrs.wsu.edu/dshp>. Questions regarding this training may be directed to HRS at 509-335-4521 or e-mail at [hrs@wsu.edu](mailto:hrs@wsu.edu).

### Academic Ethics

General standards for the conduct of graduate students at Washington State University are given in sections of the Washington Administrative Code (WAC) reproduced in the *Washington State University Student Handbook*. The current handbook excerpt can be found at: <http://conduct.wsu.edu/policies/>

The following excerpts from the Code are particularly relevant to academic ethics:

Washington State University, as a community dedicated to the advancement of knowledge, expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Under the terms of admission to Washington State University, students accept its regulations and acknowledge the right of the University to take disciplinary action, including expulsion, for conduct judged unsatisfactory or disruptive to the educational process. *Academic dishonesty, including all forms of cheating, plagiarism (which includes copying sections from another source without referencing, or submitting the same work for two different classes), and fabrication, is prohibited. Knowingly facilitating academic dishonesty is also prohibited. The expectation of WSU is that students will accept these standards and conduct themselves as responsible members of the academic community. These standards should be interpreted by students as general notice of prohibited conduct. They should be read broadly, and are not designed to define misconduct in exhaustive forms. WAC 504-26-202.*

Professors may sometimes amplify these guidelines by mandating specific procedures applicable to particular courses or examinations. For example, there might be restrictions concerning collaboration on homework, rules delimiting items that may be brought into exam rooms, etc. However, the general principle applicable in all cases may be stated quite simply: *Students must refrain from activities that have even the appearance of academic dishonesty.* The consequences of academic dishonesty may include any or all of the following: a failing grade for an examination or for the course; dismissal from or denial of an assistantship; and expulsion from the graduate program.

### Graduate Student "Responsible Conduct of Research" Training

Mandatory training on the Responsible Conduct of Research is required of all graduate students. This is a web-based training located at: <https://myresearch.wsu.edu/>

Students must take this training as soon as possible. The training will need to be repeated after a five-year period. *U.S. legal residents will not be eligible for an assistantship until after the training is completed.* However, a grace period of one semester will be allowed for international non-resident students to complete it.

Should a student complete the training late in the semester, and the assistantship is processed late, the student will be responsible for paying all late fees applied to the student's account before the waiver(s) is/are applied to the student account. If you have questions about this training, please contact the Graduate School (335-3535).

## E.5. Grades

In the grading system used at WSU, numerical equivalents of letter grades are:

A	4.0
A–	3.7
B+	3.3
B	3.0
B–	2.7
C+	2.3
C	2.0
C–	1.7
D+	1.3
D	1.0
F	0.0

The Program of Study is the list of specific courses required for the advanced degree, defined in this handbook, as approved by the Department of Physics and Astronomy and the Graduate School. **To earn any physics degree, a student must have a cumulative grade point average of at least 3.0 in all graded courses listed in the Program of Study.** In addition, to be in good standing in the program, the cumulative grade point average since admission must be at least 3.0. No course for which the student has received a grade below "B" may be dropped from a degree program. *Courses in the Program of Study for which a "C–" or below has been received must be repeated.* An admitted student whose cumulative grade point average in all course work falls below 3.0 will be placed on academic probation and may be dropped from WSU. **Enrollment will be terminated if a student has earned a U (Unsatisfactory) grade for research credits (700, 701, 702, 800) OR an F for Independent Study (600) for two semesters (including the summer term).** Reinstatement requires written consent of the department chair and the associate dean of the Graduate School. Unaffiliated students must take at least one credit of Independent Study each semester with the goal of affiliating; progress toward affiliation will be assessed by the Graduate Studies Advisor.

See GS Policies and Procedure, Chapter Six,C for additional information:

<https://gradschool.wsu.edu/chapter-six-c/>

## E.6. Committee Changes

Should a student find it necessary to switch to a new advisor, changes may be requested on forms available through the Administrative Assistant. The request may be initiated either by the student or by the committee chair. All program and/or committee changes require approval from the department chair *before* submission to the Graduate School.

## E.7. Times for Examinations

Final examinations for degrees and preliminary examinations are ordinarily scheduled for times when classes are in session.

## E.8. Exceptions to Requirements and Regulations

Exceptions to policy must have the approval of the department chair.



## E.9. Summer Program

Graduate courses other than Phys 600, 700, 702, and 800 are not usually offered in the summer. It is not necessary for a student to be enrolled in the summer session. All first-year graduate students are strongly encouraged to approach faculty members with similar research interests concerning summer research opportunities, including financial support; it is recommended that students begin this process early in the spring semester. A summer research experience is an excellent way for a student to learn about research activities without making long-term commitments.

## E.10. Final Procedures for Obtaining Graduate Degrees

There are several final formalities listed in the Deadlines and Procedures that need attention from the Graduate School during the semester in which the student plans to complete a graduate degree. Failure to attend to these may postpone the granting of the degree. As a safeguard, follow this rule of thumb: *Any student who plans to receive a graduate degree at the end of a given semester should contact the Administrative Assistant or the Graduate School at the beginning of that semester to determine appropriate requirements and procedures.* See *Deadlines and Procedures for Graduation* at: <http://gradschool.wsu.edu/deadlines/>

## E.11. English Examination for Foreign Teaching Assistants

Graduate student teaching assistants are an integral part of the Department of Physics and Astronomy's teaching mission. A good grasp of both written and spoken English is required to retain a teaching assistantship. Good communication skills are crucial to the student's educational experience in his or her own graduate classes. Before being assigned TA duties, international students are required to pass an oral exam. These exams are scored on a scale of 1 through 5 with 1 being the highest level and 5 being the lowest. **Students receiving a score of 4 or 5** are required to take intensive English and accent-remediation courses, as well as retake the exam until they get a score of at least 3 (or better). **Students receiving a score of 5** will be advised to take a reduced physics course load to allow them extra time to work on their English comprehension and speaking skills, and will be assigned to work with an experienced TA as a mentor. The director of undergraduate laboratories supervises the mentoring process and is responsible for assigning duties and monitoring student progress. All second-year students will be retested and are expected to have a score of 3 or better, or their teaching assistantships may be in jeopardy.

## E.12. Establish residency!

It is very important that those who are able to qualify seek residency status. United States citizens and permanent residents of the United States can become residents of the state of Washington by completing the *Residency Questionnaire* and submitting all required documentation by the relevant deadline. See: <https://gradschool.wsu.edu/establishing-residency/>

**Please note that most of these documents must be obtained at least 12 months prior to the beginning of the semester (e.g. voter's registration card), or cover that period of time (e.g. rent receipts).**

- Copies of lease, rental agreement, letter from landlord, rent receipts, canceled rent checks or home purchase agreement verifying domicile in Washington **for the 12 months prior to the beginning of the semester.**
- Voter's registration card for Washington State, if registered to vote (must have obtained 12 months prior to the beginning of the semester).

- Copy of State of Washington vehicle registration, if you own or use a vehicle (all vehicles that you use must be registered in the state of Washington). Additionally, provide a copy of your driver's license or, if you do not drive, your State of Washington identification card.
- Documents with dates showing that you have established a "home" in Washington (e.g. bank account documents).
- Copy of your most recent federal tax return (or W-2 forms if you did not file last year), if financially dependent (see questionnaire instructions online for more information if you are 24 or younger).
- If not a U.S. citizen, provide documentation of residency status with the U.S. Citizenship and Immigration Service (USCIS) (see questionnaire instructions for more information).
- Evidence of financial independence if 24 or younger (see questionnaire instructions). If you are financially dependent (supported by a parent/guardian), all of the above documentation should be provided by your parent or guardian, verifying his/her status as a Washington State resident.

A year after taking these steps, please download the Residency Questionnaire at the above link and submit it, along with documentation, to the Graduate School in Room 324, French Administration Building. You can actually submit the application even if you "became a resident" 11 months ago and it will be processed once the final month has elapsed. Otherwise, keep the application and submit it when you are at least 11 months past completing the above steps (the sooner, the better!)

### **E.13: Students Leaving for Break: Seeking Permission**

Students who wish to leave for a break must receive permission from their advisor (or if a TA, also from the Lab Director). It is recommended to obtain this permission prior to arranging airfare. If you are not able to return to Pullman by the agreed upon date, your salary may be adjusted accordingly. If you are not in town by August 16 or January 2 (or the first working day thereafter), you may lose your tuition waiver as well as having your salary adjusted.

Unless prior arrangements have been made, TAs must be in Pullman and report to the Lab Director on August 16 or January 2 (or the first working day thereafter). This allows for required TA meetings and other planning sessions to occur prior to the first day of classes.

### **E.14: Official Travel**

Any official student travel which is undertaken for the purpose of:

- Any WSU class listed in the Schedules of Classes or any Center for Distance and Professional Education class
- Off-campus activities of recognized University student groups or University organizations
- University administrative or departmental activities fall under the Travel Authority outlined in the Business Policies and Procedures Manual (TRAVEL 95.05, revised 10-14).

Students must obtain a prior authorization from the Department of Physics and Astronomy for any travel:

- When a travel advance is requested
- When conference registration is to be paid in advance
- When the traveler will be going out of state or out of the country
- When official WSU travel is partially or entirely supported by funds not administered by the WSU Controller's Office, e.g., from a third party (another educational institution, a private organizations) or the traveler's personal funds
- When seeking authorization for applicant, student, speaker or other nonemployee travel
- When required by the administrative unit.

For questions on travel, contact the Department of Physics and Astronomy.

## APPENDICES

### Appendix A: Courses Approved for Graduate Programs

The following courses have been approved for physics MS or PhD programs.

<u>Course Number</u>	<u>Course Name</u>
Astronom 435	Astronomy and Astrophysics
Astronom 450	Life in the Universe
CHEM 480	Solid State Chemistry
CHEM 509	Chemical Group Theory
CHEM 534	Chemical Statistical Mechanics
CHEM 535	Computational Quantum Chemistry
CHEM 536	Quantum Chemistry
CHEM 564	Molecular Phenomena
CPT 530)	Numerical Analysis (cross listed with Math 548)
CPT 580	Parallel CPT
EE 496	Introduction to Semiconductor Device Theory
EE 504	Modern Optics
EE 507	Random Processing Engineering
EE 520	Plasma Engineering
EE 521	Analysis of Power Systems
EE 528	Special Topics in Electromagnetics
EE 535	Numerical Solutions to EM Problems I
EE 536	Numerical Solutions to EM Problems II
EE 574	Optoelectronics
EE 596	Advanced Analog Integrated Circuits
English 545	Graduate Student Writing Workshop
GEOL 545	Astrobiology
Math 501	Real Analysis
Math 502	Intro. to Functional Analysis
Math 507	Adv. Theory of Numbers
Math 511	Adv. Linear Algebra
Math 540	Applied Math I
Math 541	Applied Math II
Math 544	Advanced Matrix Computation
Math 545	Numerical Analysis of Parabolic and Hyperbolic PDEs
Math 546	Numerical Analysis of Elliptic PDEs
Math 548	Numerical Analysis (cross listed CPT 530)
Math 570	Mathematical Foundations of Continuum Mechanics I
Mat S 571	Microscopic Analysis of Solid Surfaces
Math 586	Mathematical Modeling in the Natural Sciences.
ME 461	Introduction to Nuclear Engineering
ME 501	Continuum Mechanics
ME 509	MEMS Engineering
ME 530	Elasticity
MSE/505	(cross listed with Mat Sci 505)
MAT SCI 505	Adv. Mat. Science (MSE and MAT SCI both offer this course)
MSE 402	Polymeric Materials
MSE 461	Intro. Nuclear Engineering
MSE 515	Electronic Properties of Materials
Phys 410	Electronics
Phys 463	Solid State
Phys 465	Intro to Nuclear Physics
Stat 512	Analysis of Variance in Designed Experiments
Stat 544	Applied Stochastic processes

## Appendix B: Physics and Astronomy Faculty at WSU

<b>Name</b>	<b>Email Address</b>	<b>Office*</b>	<b>Phone</b>
Allen, Michael	mlfa@wsu.edu	1246	335-1279
Baldassare, Vivienne	vivienne.baldassare@wsu.edu	947H	335-9179
Bose, Sukanta	sukanta@wsu.edu	948B	334-3698
Cerruti, Nicholas	ncerruti@wsu.edu	1252	335-2711
Collins, Brian	brian.collins@wsu.edu	523	335-4671
Collins, Gary S.	collins@wsu.edu	554	335-1354
Dexheimer, Susan	dexheimer@wsu.edu	627	335-6389
Duez, Matthew	m.duez@wsu.edu	947E	335-2396
Engels, Peter	engels@wsu.edu	654	335-3698
Forbes, Michael	michael.forbes@wsu.edu	947F	335-6125
Gittes, Fred	gittes@wsu.edu	1254	335-7380
Gu, Yi	yigu@wsu.edu	544A	335-7208
Gupta, Yogendra M.	ymgupta@wsu.edu	ISP 202	335-7217
Kuzyk, Mark G.	kuz@wsu.edu	746A	335-4672
Marston, Philip L.	marston@wsu.edu	738A	335-5343
McCluskey, Matthew	mattmcc@wsu.edu	646	335-5356
McMahon, Jeffrey	jeffrey.mcmahon@wsu.edu	947D	335-7219
Rasmussen, Anya	anya.rasmussen@wsu.edu	1248	
Saam, Brian	brian.saam@wsu.edu	1245	335-9532
Tomsovic, Steven	tomsovic@wsu.edu	929	335-7207
Worthey, Guy	gworthey@wsu.edu	948C	335-4994

**\*Offices are in the Webster Physical Sciences Building unless otherwise specified.**

**Note: all telephone area codes are (509)**

## Appendix C: Departmental Information

**Department Chair:** Brian Saam

**Graduate Studies Advisor:** Brian Collins

### **Graduate Studies Committee**

Gary Collins, chair

Matthew Duez

Yi Gu

Robin Stratton

### **Graduate OSA-SPIE Chapter Officers 2020-2021**

Robbie Robinson, President

TBD, Vice President

TBD, Treasurer

TBD, Secretary

### **Physicists for Inclusion in Science (PHIS)**

Officers TBD

**Mailing address:** Department of Physics & Astronomy  
Washington State University  
PO Box 642814  
Pullman, WA 99164-2814

**Web:** physics.wsu.edu

**E-mail:** physics@wsu.edu

**Phone:** (509) 335-1698

**Fax:** (509) 335-7816

### **Whom to contact for various issues:**

- TA or laboratory matters: Jacob Turner
- Payroll and tuition: Robin Stratton
- Office space, keys: Robin Stratton or Laura Krueger
- Academic questions: Robin Stratton
- Schedule appointment to meet with department chair: Robin Stratton
- Ordering supplies or making travel arrangements: Laura Krueger or Tom Busch

### **Support staff:**

<b>Name</b>	<b>Email Address</b>	<b>Office*</b>	<b>Phone</b>
Busch, Tom	tjbusch@wsu.edu	1245	335-2414
Johnson, Tom	johnstm@wsu.edu	B7	335-5097
Krueger, Laura	lkrueger@wsu.edu	1245	335-9533
Stratton, Robin	rstratton@wsu.edu	1245	335-9532
Jacob Turner	jacob.turner@wsu.edu	1248/347	335-3398

*\*Offices are in the Webster Physical Sciences Building unless otherwise specified.*

Appendix D: Annual Review

*Department of Physics and Astronomy*  
Graduate Student Annual Review

Evaluation of: \_\_\_\_\_  
For the academic year: \_\_\_\_\_

Part I: To be filled out by all students

Your cumulative GPA: \_\_\_\_\_

**Certification of Assistantship Duties (if applicable):**

*If you have served in an assistantship position during the past year, please review and sign below, along with your faculty advisor or supervisor.*

The graduate assistantship position that you have held during this past year and the related tuition waivers were contingent upon factors as outlined in your offer letter. By signing below you certify you have met the following contingent factors for the preceding semester(s) during which you held an assistantship (circle all that apply: fall / spring / summer / year: \_\_\_\_\_):

- I remained enrolled full time (at least 10 credits as defined in Graduate School policy manual, chapter 9) during the period of the appointment.
- I maintained a 3.0 cumulative GPA during the period of the appointment.
- I met the service requirement of an average of 20 hours per week for 0.5 FTE as scheduled by my department/supervisor (or based on hours required for partial FTE appointment).

\_\_\_\_\_  
Student Sign/Date

\_\_\_\_\_  
Faculty Advisor/Supervisor Sign/Date

**Are you part of a research group? If so, please give your advisor's name. If not, list all steps that you have taken to date to get involved in research.**

**List all scientific meetings you attended and all talks, posters and publications you have authored or co-authored during the review period. Provide a full citation for each, including a complete list of authors, title, venue/journal, and date of presentation/submission/publication. Also identify your personal presentations, as opposed to presentations by others. Attach an extra sheet if more space is needed.**

## Part II: To be filled out by advisor

**Instructions:** Rate on scale of 1 (lowest) to 5 (highest) with 3 representing average expectations. Supplement rating with comments and suggestions for overcoming deficiencies. Add additional evaluative comments at bottom of form if desired. Meet with student to discuss evaluation and sign.

Progress in acquiring knowledge of field (e.g., scientific literature) 1 2 3 4 5

Comprehension of the aims of the research project 1 2 3 4 5

Progress in developing research skills 1 2 3 4 5

Time spent working 1 2 3 4 5

Efficiency (e.g., use of time) 1 2 3 4 5

Anticipated date of finishing: \_\_\_\_\_

Other comments:

Signature \_\_\_\_\_ Date: \_\_\_\_\_  
Advisor/Graduate Coordinator

Signature \_\_\_\_\_ Date: \_\_\_\_\_  
Committee Member

Signature \_\_\_\_\_ Date: \_\_\_\_\_  
Committee Member

Signature \_\_\_\_\_ Date: \_\_\_\_\_  
Graduate Student

## **Appendix E: Graduate Courses and Descriptions**

**501 Grad Seminar Physics** (1) Seminar introduces new physics graduate students to research within the department as well as interdisciplinary research related to Department of Physics and Astronomy.

**514 Optoelectronics Lab I** V 1 (0-3) to 3 (0-9) May be repeated for credit; cumulative maximum 3 hours. Prereq graduate standing. Experiments with optical systems: Imaging, interference, coherence, information storage/processing, gas and solid state lasers, optical fibers, and communications systems.

**521 Classical Mechanics I** 3 Prereq Phys 320; 571 or cc:// Laws of motion as developed by Newton, d'Alembert, Lagrange, and Hamilton; dynamics of particles and rigid bodies. Cooperative course taught jointly by WSU and UI (Phys 521).

**522 Classical Mechanics II** 3 Prereq Phys 521. Continuation of Phys 521. Classical mechanics of liquids and deformable solids; stress, deformation and strain, flow, oscillations and waves.

**533 Thermal and Statistical Physics I** 3 Prereq Math 440; Phys 330. Thermodynamic laws and potentials, kinetic theory, hydrodynamics and transport coefficients; introduction to statistical mechanics, ensembles, partition functions. Cooperative course taught jointly by WSU and UI (Phys 533).

**534 Thermal and Statistical Physics II** 3 Prereq Chem 531, 535; or Phys 533, 551. Phase transitions and critical phenomena, Ginzburg-Landau theory, Bose-Einstein condensation, superfluids, Fermi systems, low-temperature expansions. Cooperative course taught jointly by WSU and UI (Phys 531).

**541 Electromagnetic Theory** 3 Prereq Phys 342, 571 or c//. Special relativity and the classical electromagnetic field; emission, propagation, and absorption of electromagnetic waves. Cooperative course taught jointly by WSU and UI (Phys 541).

**542 Electrodynamics** 3 Prereq Phys 541. Interaction of matter and electromagnetic radiation; classical and quantum electrodynamics. Cooperative course taught jointly by WSU and UI (Phys 542).

**545 Nonlinear Optics** 3 Prereq Phys 534, 542, 551. Nonlinear wave propagation theory applied to several nonlinear-optical phenomena; experimental techniques that probe a material's nonlinearity.

**546 Quantum Electronics** 3 Prereq Phys 541, 551 or c//. The physics of lasers and of coherent optical radiation generation and propagation.

**550 Quantum Theory I** 3 Prereq Math 440, 441; Phys 450. Introduction to quantum theory; physical and mathematical foundations; application to atomic systems. Cooperative course taught jointly by WSU and UI (Phys 550).

**551 Quantum Theory II** 3 Prereq Phys 550, 571. Symmetry and invariance; angular momentum theory; approximation methods. Cooperative course taught jointly by WSU and UI (Phys 551).

**552 Quantum Theory III** 3 Prereq Phys 551. Scattering theory; relativistic wave mechanics; quantum field theory. Cooperative course taught jointly by WSU and UI (Phys 552).

**561 Atomic and Molecular Physics** 3 Prereq Phys 550. Physics of atoms and molecules using quantum theory. Cooperative course taught jointly by WSU and UI (Phys 561).

**563 Physics of the Solid State** 3 Prereq Phys 534, 551. Lattice vibrations and defects; ionic and electronic conductivities; band theory; magnetic properties; luminescence. Cooperative course taught jointly by WSU and UI (Phys 563).

**565 Nuclear Physics** 3 Prereq Phys 465, 551. Nuclei and nuclear interactions from theoretical and experimental viewpoint, properties of nuclei, two-body problems, complex nuclei, nuclear spectroscopy, reactions, models. Cooperative course taught jointly by WSU and UI (Phys 566).

**571 Methods of Theoretical Physics** 3 Prereq Math 440, 441. Mathematical methods for theoretical physics; linear algebra, tensor analysis, complex variables, differential equations, integral equations, variational calculus, and group theory. Cooperative course taught jointly by WSU and UI (Phys 571).



**573 Physical Applications of Group Theory** 3 Prereq Phys 551. Introduction to group theory with application to atoms, molecules, solids, and elementary particles; no previous knowledge of group theory assumed. Cooperative course taught by UI (Phys 573), open to WSU students.

**575 Advanced Solid State Physics** 3 Prereq Phys 534, 542, 552 or c//, 563, 571. Quantum theory of solids; Green's functions, correlation functions and other field-theoretic methods; magnetism, superconductivity and transport properties.

**581 Advanced Topics** 3 May be repeated for credit; cumulative maximum 12 hours. Topics of current interest in advanced physics. Cooperative course taught jointly by WSU and UI (Phys 581).

**590 Seminar** 1 May be repeated for credit. S, F grading.

**592 Wave Propagation Seminar** 2 Prereq Math 440, 441. May be repeated for credit; cumulative maximum 4 hours. Waves in the continuum; elastic, plastic, and hydrodynamic waves; shock waves. S, F grading.

**600 Special Projects or Independent Study** Variable credit. S, F grading.

**700 Master's Research, Thesis, and/or Examination** Variable credit. S, U grading.

**702 Master's Special Problems, Directed Study and/or Examination** Variable credit. S, U grading.

**800 Doctoral Research, Dissertation, and/or Examination** Variable credit. S, U grading.

### Astrophysics

**581 Topics in Modern Astrophysics** 3 May be repeated for credit; cumulative maximum 9 hours. Prereq Math 315; Phys 202. Problems of current astrophysical interest in the areas of stellar atmospheres, stellar interiors, gaseous nebulae, the interstellar medium and galaxies, gravitation and cosmology (formerly 538)

*Note: For the Graduate School's Deadlines and Procedures for Graduation please visit: <http://www.gradschool.wsu.edu/Forms/>*

## **Appendix F: Graduate Assistantships**

Physics graduate students who hold teaching assistantships are paid at a rate of Step 42 when they are admitted with a bachelor's (BS) (Fall 2020 \$1,909.00 per month) and Step 47 when they already have a master's (MS) or have passed the prelims (Fall 2020 \$2,009.00 per month).

Graduate students who hold research assistantships (RA) are paid at a rate of Step 44 when they are admitted with a BS (Fall 2020 \$1,949.00 per month) and Step 49 when they already have an MS or have passed the prelims (Fall 2020 \$2,048.50 per month).

Students are encouraged to become associated with faculty in areas of a research specialty that they would like to work in as early as possible.

## **Appendix G: Program Student Learning Outcomes**

Our graduates are expected to achieve the following five learning outcomes based on academic coursework, research and participation in departmental activities:

- I. Learn to use scientific reasoning and independent thinking to form and test hypotheses.
- II. Learn how to apply important concepts in each of four core areas of physics: mechanics, electricity and magnetism, quantum mechanics, and thermal and statistical physics.
- III. Design and conduct one or more original significant scientific research projects with publication-quality results.
- IV. Be able to present scientific results clearly, both orally and in writing, to the larger scientific community through publications, conference presentations, research proposals, or in other meaningful ways.
- V. Prepare for a career in physics or careers that exploit the skills gained during graduate studies.

**Department of Physics and Astronomy**

**Graduate Studies Handbook**

**Academic Year 2020-2021**

The preceding information pertains to all graduate students in the Department of Physics and Astronomy, but particularly applies to the incoming class of 2020-2021. For more information on the physics and astronomy program at Washington State University, please email the chair's assistant at [physics@wsu.edu](mailto:physics@wsu.edu)