

# Texas Tech Physics Graduate Booklet

## 2018-2019



*The Andromeda Galaxy. Photo by Jeff Rebarchik, ASTR 2401 student.*

Information presented in this booklet applies to all graduate students entering the Texas Tech Physics Graduate Program in Fall 2018 or later, but much of it is also applicable to students who enrolled earlier.

Department of Physics and Astronomy  
main office: Science 101  
phone: 806.742.3767  
fax: 806.742.1182

<http://www.depts.ttu.edu/phas/>

## Welcome!

Dear Physics Graduate Students,

We are delighted that you chose Texas Tech University for your graduate studies in physics. You made an excellent choice! To assist you, the faculty and staff have prepared this Graduate Booklet that contains the essential information about M.S. and Ph.D. degree requirements, student obligations, courses, research, schedules, milestones, and financial assistance. Please read it carefully and keep it nearby for future reference. The graduate advising team of Prof. Igor Volobouev and Dr. Melanie Ungar will consult with you every semester with the objective of guiding you through your initial coursework and prelim exam so that you can quickly proceed to your research. I suggest that you start thinking about your research direction as early as possible and that you are not shy about visiting with professors and sitting in on group meetings. Our main concern is that you have a productive and satisfying graduate school experience here. We welcome you to our physics family and wish you success!

Nural Akchurin  
Professor and Chair

## 1. Degree Requirements

Students enrolled in graduate programs offered by the Department of Physics and Astronomy must complete the following courses:

### **Core requirements for all programs:**

PHYS 5306: Classical Dynamics

PHYS 5301: Quantum Mechanics I

PHYS 5303: Electromagnetic Theory

PHYS 5305: Statistical Physics

PHYS 5101: Seminar (three of the first four semesters a student is enrolled)

### **Additional core requirements for the doctoral program:**

PHYS 5302: Quantum Mechanics II

PHYS 6306: Advanced Electromagnetic Theory

Students will benefit strongly from taking PHYS 5307 (Methods in Physics I), which is a math methods course, in their first semesters. This course is not formally required, but except for those who enter with an especially strong background in mathematics, it may be difficult for students to complete the core coursework at a satisfactory level without taking it. Many students will also benefit from taking PHYS 5322 (Computational Physics) early in their studies.

**Required course for teaching assistants:** Students on appointment as teaching assistants must complete PHYS 5104 (Instructional Laboratory Techniques in Physics) as soon as this course is offered.

**Electives and optional courses:** Most students will need to take additional coursework beyond the minimum requirements in order to develop the necessary expertise for their thesis research. This coursework should be selected by the student with the help of the student's Research Advisor and thesis committee.

## 1.1 Minimum Requirements for Specific Degree Programs

**M.S. in Physics, thesis option:** 24 credit hours, exclusive of the master's thesis, of which at least 18 must be in the department, as well as 6 credit hours of PHYS 6000 (Master's Thesis) for a total of 30 hours. To be awarded the M.S. degree, students must pass an oral defense of the thesis.

**M.S. in Physics, exam-based option:** 36 credit hours, of which at least 24 must be in the department. Additionally, students must pass a master's comprehensive exam.

**M.S. in Physics, course-based option:** 36 credit hours, of which at least 30 must be formal coursework taken in the department, inclusive of PHYS 5101 (Seminar). Additionally, students must pass a master's oral evaluation.

**Ph.D. in Physics:** 60 credit hours beyond the bachelor's degree, exclusive of the dissertation, as well as at least 12 hours of PHYS 8000 (Doctoral Dissertation) for a total of 72 hours. Only 6 hours of PHYS 5000 (Independent Study) and 12 hours taken outside the department may be counted towards fulfillment of the doctoral degree requirements. To be admitted to candidacy, students must pass the prelim exam and successfully defend their thesis proposal. To be awarded the Ph.D., students must pass a Ph.D. thesis (also called dissertation) defense.

## 1.2 Academic Standing

**GPA requirements:** Students must have an institutional GPA of at least 3.0 both in the core courses and overall in order to earn either a master's or doctoral degree.

**Retaking core courses:** Students who do not earn at least a B- in a required core course may retake that course in order to raise their core course GPA. Each course can be retaken once. For the purpose of calculating the core course GPA, the grade will be replaced. However, retaking a graduate course does not act as a formal grade replacement for the student's cumulative institutional GPA.

**Academic probation:** Students whose cumulative institutional GPA drops below 3.0 will be put on academic probation the following semester. During the first semester of academic probation, the student must achieve a term GPA of at least 3.0. If the student's term GPA is below 3.0, the student will be put on academic suspension for the following semester (fall, spring, or summer). If the student's term GPA is 3.0 or above but their cumulative GPA is still below 3.0, the student will be placed on a second semester of academic probation called additional academic probation. If the student's cumulative GPA is still below 3.0 after two consecutive semesters of academic probation, the student will be placed on academic suspension.

**Academic suspension:** Students who are placed on academic suspension may not enroll in TTU courses the following semester (fall, spring, or summer). If they wish to remain in the program, they must apply for readmission.

## 1.3 The Master's Oral Evaluation

The Master's oral evaluation is performed by a committee of three or more physics faculty members. The evaluation covers topics in the four core graduate courses (Classical Dynamics, Quantum Mechanics I, Electromagnetic Theory, and Statistical Physics) as well as in undergraduate physics courses. The oral evaluation is about one hour long, and the outcome is the pass/fail decision made by the committee. The evaluation is normally conducted in March/April (spring semester) and

October/November (fall semester). A student can attempt to pass the evaluation no more than two times. If the first attempt is unsuccessful, the second one can be made after an interval of at least four months. The requirement for a master's oral evaluation can also be satisfied by passing the oral part of the Ph.D. prelim exam.

#### **1.4 The Master's Comprehensive Exam**

The requirement for a master's comprehensive exam can be satisfied by passing the prelim exam for the Ph.D. program.

#### **1.5 The Ph.D. Prelim Exam**

The purpose of this exam is to assess student's understanding of physics and potential for performing Ph.D. research. The examination spans the topics covered in the four core graduate courses as well as in undergraduate physics courses. Students enrolled in the physics Ph.D. program must pass the prelim exam in order to be admitted to candidacy.

The prelim exam is offered once or twice a year. It is normally conducted in August before the start of the fall semester. It may also be conducted in January, before the start of the spring semester, if sufficient student participation is anticipated. The exam consists of two half-days of written examination and one hour of oral examination for each student. The outcome is the pass/fail decision made by the examination committee.

Students who have a B.S. degree at the time of enrollment in the Ph.D. program must take the prelim exam at the first opportunity available after completing two regular (fall or spring) semesters in the program. Students awarded a thesis-based M.S. degree by the TTU Department of Physics and Astronomy must take the exam at the first opportunity. Students awarded an M.S. degree by another institution must take the exam as soon as they complete the four core courses (by either transferring these courses or taking them at TTU) or at the first opportunity available after completing two regular semesters in the program, whichever comes first. Not showing up for the exam without good reason results in automatic failure.

Students who fail the prelim exam must retake the exam as soon as it is offered again. Failure on the second attempt disqualifies the student from further participation in the TTU Physics Ph.D. program.

Prelim exam date extensions can be granted in exceptional circumstances by the Graduate Advisor. Poor academic standing or student's failure to enroll in a core course are not good reasons to delay the examination. Exam exemptions can be granted to transfer students who have already passed a similar examination (as determined by the Graduate Advisor) in a comparable Ph.D. program offered by another institution.

#### **1.6 Ph.D. Thesis Proposal Defense**

The student must lay out what they plan to do for their Ph.D. thesis in a report of no more than 15 pages. The student must then meet with their thesis committee and demonstrate sufficient background and technical competence to convince the committee that the thesis project is likely to produce substantial scientific results and that the student is capable of completing the work. This meeting will consist of an oral presentation of about 30 minutes followed by questions from the committee. The committee may return a finding that the proposal is acceptable, unacceptable, or

in need of revision. If the proposal is found unacceptable, the student will not be admitted to candidacy. If the proposal is in need of revision, a new proposal defense should be scheduled within 6 months.

## 1.7 Ph.D. Thesis Defense

The oral dissertation defense must be held when school is in session and faculty are on duty. It must be scheduled on or before the defense deadline date (set by the Graduate School) during the semester of graduation. Three weeks before the defense, the graduating student must submit a defense notification form to the Graduate School with the help of the department's Assistant Advisor. Before submitting this form, the student — with the help of their committee chair — must choose a representative from the graduate dean to attend their defense. The graduate dean's representative must be a member of the graduate faculty who does not have an appointment in the Department of Physics and Astronomy. Students should also present copies of their Ph.D. thesis to all committee members and the dean's representative at that time. After a successful defense, the thesis must be submitted to the Graduate School within the time frame allotted for final editing (the thesis submission deadline is usually one week after the defense deadline).

Note: TTU graduate faculty members are typically tenured or tenure-track faculty. In the Texas Tech Department of Physics and Astronomy, those faculty members listed under “faculty” or “joint and adjunct faculty” on the department website are nearly always graduate faculty members. Please see TTU OP 64.10 for detailed information.

## 1.8 Other Requirements and Expectations

**Enrollment requirements:** Full time enrollment as defined by the Graduate School is a minimum of 9 credit hours during a regular (fall or spring) term and 6 hours during the summer term. Summer enrollment is not required of students who do not work for the department during the summer term. During a regular term, enrollment in over 13 hours for doctoral students and in over 16 hours for master's students requires an approval by the Graduate School. Students must be enrolled full time during any regular term in which they receive a Teaching Assistantship (TA) or Research Assistantship (RA). In the summer, students who work for the entire summer term must register for a minimum of 6 credit hours. Students who work for only half the summer (one summer session) must register for a minimum of 3 credit hours.

**Timely registration:** No graduate course can be taught unless at least five graduate students are registered to take it. In order to avoid course cancellations, the Department of Physics and Astronomy strongly encourages graduate students to register for credit hours as early as possible.

**Leveling courses:** Students with insufficient undergraduate preparation or students who earned their undergraduate degrees a substantial length of time before enrolling should consult with the Graduate Advisor about the possibility of taking upper-level undergraduate courses. These courses must be passed with a grade of at least a C, and failure to earn grades of at least C in such courses will result in immediate academic suspension.

**Transfer of coursework:** All transferred coursework must be approved by both the Graduate Advisor and the Graduate School. Only 6 credit hours from another institution may be applied towards a master's degree. Up to 12 transferred credit hours can be applied towards core physics courses by doctoral students. At least 30 credit hours of doctoral coursework and 12 hours of PHYS 8000 must be completed at Texas Tech.

**Core coursework waiver:** The core course requirements can be conditionally waved for an incoming graduate student under the following simultaneous circumstances:

- a) The student is enrolling in the Ph.D. program (not only M.S.).
- b) The student coming or transferring to TTU already knows their Research Advisor, and the Advisor supports the request to waive the course(s).
- c) The waiver request is made either before the student enrolls in their first semester at TTU or at the beginning of the first semester but before the course registration deadline.
- d) The student has already taken similar, graduate-level equivalent courses (as determined by the Graduate Advisor), and the grade earned was at least a B or foreign equivalent. This coursework must be completed not more than seven years prior to admission to the TTU physics Ph.D. program.

The core coursework waiver is granted on the condition that the student takes the Ph.D. Prelim Exam the first time it is offered and passes it on the first attempt. If the first attempt is unsuccessful, the student will be required to take all core courses. The student is still expected to maintain at least 3.0 GPA in the core courses not waived, as well as to satisfy the requirement on the overall number of credit hours taken (the waiver does not reduce this requirement).

**Annual review:** As required by the Graduate School, each student will undergo an annual review in which their Research Advisor or the Graduate Advisor will assess the student's progress in the program and submit a report to the Graduate School. Any student not making satisfactory progress towards the degree will be notified.

**General university-wide requirements:** Graduate students in the department are expected to meet all university requirements for academic integrity and adhere to the guidelines established in the course catalog.

## 2. Other Student Obligations

**Advising appointments:** Students who have not fulfilled their core course requirements must meet with the Graduate Advisor at least once per regular (fall or spring) semester for a scheduled appointment. Students will have registration holds placed on their accounts that will not be lifted until after their appointment.

**Research reports:** Students enrolled in more than 3 credit hours of Research and/or Dissertation (combination of PHYS 7000 and/or PHYS 8000) courses in a single regular semester must write a one-page report on their research progress during that semester and email it to their Research Advisor, the Graduate Advisor, and the Assistant Advisor. Students will have registration holds placed on their accounts that will not be lifted until after the student submits a report.

**Paperwork:** Students are expected to contact the Graduate Advisor and the Assistant Advisor about filing all required paperwork with the Graduate School, including degree plans, add/change program forms, qualifying exam reports, and defense notification forms. Forms, dates, and deadlines should be obtained from the Graduate School's website.

### 3. Graduate Courses in Physics

Students can find descriptions of all graduate courses in physics in the TTU Undergraduate and Graduate Catalog:

<https://catalog.ttu.edu/>

To learn which courses are being offered in current and upcoming semesters, students should ask the Assistant Advisor or consult the section search tool:

<https://sections.app.texastech.edu/>

### 4. Research, Thesis, and Independent Study Courses

Students will often end up taking a large fraction of their credit hours in unstructured courses. A few guidelines are thus helpful for students and for faculty in terms of expectations for these courses. It is expected in all cases that students will consult with faculty mentors before signing up for independent study courses.

**Independent study:** Independent study should normally be used for cases in which a student wishes to develop an understanding of the type of material that might make up a scheduled course during a semester when the course in question is not being offered. Students in independent study courses should expect to do a substantial amount of reading and homework-type problems and perhaps take a test on the course material. Only under exceptional circumstances should independent study courses take the place of the standard core courses. According to the Graduate School rules, only 6 hours of PHYS 5000 (Independent Study) may be applied towards fulfillment of the doctoral degree requirements. Students must obtain the instructor's permission as well as a registration permit from the Assistant Advisor to enroll in a section of PHYS 5000.

**Research courses:** Research courses should be taken with the student's Research Advisor, who should be selected by the end of the student's first year in the graduate program. Per the Graduate School, only 6 hours of PHYS 5000 (Independent Study) and PHYS 7000 (Research) total may be applied towards fulfillment of the master's degree requirements.

**Master's Thesis (PHYS 6000):** Thesis-option master's students must enroll in at least 6 hours of PHYS 6000 (Master's Thesis) in order to earn their degree. Once a student begins enrolling in PHYS 6000, the student must enroll in at least 1 hour of PHYS 6000 every semester (fall, spring, and summer) until the graduation semester. During the student's graduation semester, the student must be enrolled in at least 3 hours of PHYS 6000. The student must earn a grade of B or better in thesis work to qualify for graduation. The thesis is assigned a letter grade in the final semester of thesis hours only; previous term thesis hours should receive a grade of CR (credit).

**Doctoral Dissertation (PHYS 8000):** Doctoral students should not enroll in PHYS 8000 (Doctoral Dissertation) until after they have successfully defended their Ph.D. thesis proposal and have been admitted to candidacy. Once a student begins enrolling in PHYS 8000, the student must enroll in at least one hour of PHYS 8000 every semester (fall, spring, and summer) until the graduation semester. During the student's graduation semester, the student must be enrolled in at least 3 hours of PHYS 8000. The student must earn a grade of B or better in dissertation work to qualify for graduation. The thesis is assigned a letter grade in the final semester of thesis hours only; previous term thesis hours should receive a grade of CR (credit).

## 5. Thesis Committees

**Master's thesis committee:** A master's thesis committee must consist of the student's Research Advisor and at least one other TTU graduate faculty member. The Research Advisor, who will serve as the committee chair, must be either a faculty member or an adjunct faculty member in the Department of Physics and Astronomy.

**Ph.D. advisory committee:** A doctoral advisory committee must consist of at least four members. The advisory committee is chaired by the student's Research Advisor who must be either a faculty member or an adjunct faculty member in the Department of Physics and Astronomy. At least one other committee member must be a graduate faculty from the Department of Physics and Astronomy. Only one committee member may be a Ph.D. scientist from outside the university or an emeritus TTU faculty. The external committee member must be approved by the graduate dean (contact the Assistant Advisor about filing this paperwork).

**Assembling a committee:** Students should consult their Research Advisor about assembling advisory committees. These committees should be formed well in advance of the milestones for which they are necessary. For example, a student who plans to defend a master's thesis in the spring semester should assemble their committee in the preceding fall.

## 6. Expected Timescales for Reaching Key Milestones

1. Students are expected to enroll in two core courses, the seminar, and at least one other course of their choice (with at least 9 credit hours total) in each of their first two regular (fall or spring) semesters at Texas Tech. Exceptions are made for students with transfer work on a case-by-case basis.
2. All doctoral and exam-based master's students who have completed two regular semesters of coursework are expected to take the prelim exam. For most students, this means after their first academic year. Students who wish to continue on in the Ph.D. program after completing a thesis-option M.S. degree must take the prelim as soon as possible after formally adding the Ph.D. program. Students who fail the prelim on the first try must take the exam again the next time it is offered. Students with enrollment in leveling courses may delay taking the prelim, but this is not the norm and will be decided on a case-by-case basis by the Graduate Advisor.
3. For all degrees, a Research Advisor should be selected by the student by the end of the first academic year. The advisor must be a faculty member or an adjunct faculty member in the Department of Physics and Astronomy. Students who wish to change their Research Advisor must consult with the Graduate Advisor.
4. Master's degrees should ordinarily be completed within two years. A third year may be allowed for students who need to take leveling courses or as permitted by the Graduate Advisor.
5. The Ph.D. thesis proposal (also called the dissertation proposal) should be defended within one year of passing the prelim or completing sufficient coursework to qualify for a master's degree, whichever is later. The Graduate Advisor may authorize an extension on this timescale where appropriate.
6. Per the Graduate School, all requirements for the doctoral degree must be completed within a period of eight consecutive years from matriculation or four years from admission to candidacy (i.e., four years after passing the Ph.D. thesis proposal defense), whichever comes first.



## **7. Financial Assistance**

### **7.1. Teaching Assistant Support**

The letter detailing the offer of admission to a student will indicate the duration and form of financial support for the student. For most incoming graduate students, there will be guaranteed support for a minimum of two semesters as a teaching assistant, contingent upon satisfactory performance both as a teaching assistant and in academic coursework. Continued support can normally be expected contingent on satisfactory performance as a teaching assistant and satisfactory progress towards the student's degree.

Students needing teaching assistant support are expected to notify the Director of Teaching Laboratories by the deadline each semester or they will risk not being funded.

Students who do not meet expected timescales for completing the master's degree requirements (normally within two years of entry), passing the prelim exam (normally within two years of entry), presenting the dissertation proposal (normally within three years of entry) or completing the dissertation (normally within four years of defending the proposal) will be placed at low priority for teaching assistant positions unless there are extenuating circumstances which are clearly laid out.

International graduate students may be funded as graders for two semesters if they fail to pass the international TA workshops prior to starting teaching. Only in exceptional circumstances will students who continue not to pass the TA workshop be funded as graders.

### **7.2. Research Assistant Support**

Research assistantships may be provided on a case-by-case basis by the student's Research Advisor. This type of funding normally comes from research grants, and stipends are comparable to those of a TA.

### **7.3. University Scholarships and Fellowships**

Texas Tech University and the Department of Physics and Astronomy provide a substantial number of fellowships and scholarships to graduate students. Some of these fellowships are merit-based (competitive) and some are need-based. You can apply for these fellowships at the Graduate School website:

<https://www.depts.ttu.edu/gradschool/financial/FellowshipsScholarships.php>

See the website for important deadlines. Apply early and allow your reference letter writers at least several weeks to prepare and upload their letters.

Note that the Graduate School general fellowship application also serves as an application for all departmental fellowships and scholarships. If you miss the general fellowship application deadline, you can still ask your Research Advisor or some other faculty member to nominate you for a departmental scholarship. These nominations are usually solicited by the departmental scholarship committee in March of each year.

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