Department of Physics and Astronomy Guide for Graduate Students

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1 Timeline

• First year, Fall Semester
  
  – O-week - meet with P&A faculty members to discuss undergraduate preparation for Rice’s graduate courses, identifying any needs.
  
  – O-week - meet with P&A faculty member in projected area of thesis research to discuss career and research goals, the most relevant Fall courses, and courses appropriate for a second choice research focus. Obtain a list of colloquium/seminar times for projected research area.
  
  – O-week - attend Departmental orientation to learn P&A policies and practices.
  
  – O-week - meet with Bridgitt Ayers to discuss any issues with housing, health insurance, etc.
  
  – O-week - Receive a copy of the P&A Graduate Student Handbook; read this document from start to finish and keep it for future reference.
  
  – O-week/Friday - register for Fall courses using on-line system.
  
  – Weeks 1-4 - meet with Graduate Student Society (PAGSA) representative to become familiar with their function, and learn about Brown Bag faculty research presentations.
  
  – Mid-semester (October) - meet again with P&A faculty member and Bridgitt Ayers to discern if any problems/issues have arisen, or if things are going smoothly.
  
  – November - start meeting with various faculty members in projected area of thesis research, and also in other P&A disciplines, to ascertain what opportunities are available, and what areas/faculty look like offering a good fit. Continue through December and January. If interested and time permits, starting a small research project can help make an informed decision.
  
  – December - meet with P&A faculty member in projected area of thesis research to identify the most relevant Spring courses. December - register for Spring courses.

• First year, Spring Semester

  – January/February - continue meeting with various faculty members in projected area of thesis research. Goal is to hone in on one or two professors so as to decide with whom to affiliate.
  
  – March/April - finalize affiliation search. This timeframe is optimal for affiliation and establishing first portion of research project. Together with new research advisor, establish the 3-person Departmental committee to oversee your progress throughout your PhD.
  
  – March/April - once affiliated, secure desk/office space convenient to your chosen laboratory or research area.
– May 15 - absolute deadline for research affiliation. University funding of stipend ceases at this point, and you will be unfunded if not affiliated.

• Second Year, Spring Semester
  – April/May - file petition for approval for candidacy for the Master’s degree, lodging it with Bridgitt Ayers. University regulations require this to be completed before the start of your fifth semester.

• Third Year or Fourth Year
  – Defend Master’s Degree before your ninth semester.
2 Introduction

This handbook has been prepared for the purpose of orienting new students and providing information and assistance to all students in the Department of Physics and Astronomy. Please retain this booklet for use while you are in graduate school here. Revisions or additions may be made from time to time, and will be distributed as needed. The official Rice University degree requirements are those described in the General Announcements, available from the Registrar. If academic policies are changed by the faculty, students will be given the option of adhering to the new policy or to the policy as stated in the handbook given to them their first year. Students should keep a personal file containing this handbook and future memos about rule changes and other departmental matters.

3 Academic Regulations and Procedures

3.1 Graduate Committee

The departmental Graduate Committee administers the academic aspects of the program on behalf of the faculty. The committee consists of several faculty members and two graduate students appointed by the chair. Initial course placement is made in consultation with faculty advisors, using information obtained from interviews conducted during orientation week, as described in section 3.3.

If a student desires a special exemption or change from the stated departmental regulations and procedures, he or she should consult with one of the Graduate Committee co-chairs. The co-chair will advise on the drafting of a petition and arrange for a meeting of the committee to resolve the request. Students are strongly urged to submit all petitions as soon as possible.

In the event that non-academic problems or conflicts arise, students are encouraged to consult any member of the Graduate Committee for advice. Particularly serious matters should be discussed with one of the associate chairs, or with the department chair. The university provides more formal grievance procedures if these discussions within the department do not lead to a satisfactory resolution.

3.2 Honor Code

Graduate students are expected to observe the provisions of the Rice University Honor Code, as presented in the booklets received at orientation. Students are responsible for knowing and understanding the principles of the Honor Code. In particular, plagiarism is never acceptable. All written examinations and certain specifically designated assignments are conducted under the Honor Code. The faculty will state the conditions applying to various forms of class work. If in doubt about the conditions for a particular assignment, it is your responsibility to ask the faculty member in charge of the course. In most cases, a single violation of the Honor Code, such as plagiarism or cheating on an exam or assignment, results in failure of the course or expulsion from Rice. The student body at Rice, through its commitment to the Honor Code, accepts responsibility for assuring the validity of all examinations and
assignments conducted under the system. The Honor Council is responsible for investigation of all reported violations and for trial in those cases where the facts warrant.

3.3 Orientation Week

Monday and Tuesday–International student orientation

Wednesday morning–University-wide orientation

Thursday morning–department-wide orientation, including the Chair’s introduction, discussion of the honor code, fellowships, library, career services, and PAGSA.

Assessment of course background and preparation: Thursday after the department-wide meeting, students will meet one-on-one with instructors in the areas of Classical Mechanics, E&M, Thermal Physics/Statistical Mechanics, Quantum Mechanics/Modern Physics, and Computing/Math Methods. The purpose of these interviews is to determine if the student is prepared to take graduate-level courses in these subjects or in areas that rely heavily on the subject material, or if graduate courses in these areas may be waived due to previous course work. In some cases students may be advised to take the corresponding undergraduate course before taking relevant graduate level courses.

Students will be assigned an advisor in an area close to the declared intended field of concentration, or one of the fields if more than one is specified. Immediately after the assessment process is finished, the student will meet with the advisor to discuss career and research goals, strategy for affiliation, and course selection for the first year.

Friday–course registration
All graduate students must formally register during the periods specified by the Registrar. The procedure is as follows:

1. Each new student should work out a course plan in consultation with the assigned advisor. For the fall and spring semester, first year students should file an approved course of study with the graduate program coordinator. The course plan of returning graduate students should be approved by the student’s faculty advisor.

2. Use the online registration system, accessible through the Registrar’s web site, to select and register for courses.

3. If local address and telephone numbers are not known at the time of registration, this information should be provided to the department coordinator as soon as it is known.

4. adding or dropping a course must be approved by the advisor and filed with the graduate program coordinator. It is then done through the online system subject to the deadlines published by the Registrar.
3.4 Normal Progress

Students are expected to complete course work, achieve candidacy and complete their research within a reasonable time interval. The department and University rules which define the allowed times are summarized here. Additional information may be found in the University catalog.

3.4.1 Masters Candidacy

All students must file for M.S. candidacy before the first day of their fifth semester in residence. Students who plan to defend a published paper rather than a thesis must also file for M.S. candidacy.

3.4.2 Masters Degree

The M.S. thesis defense must occur early in the eighth semester after enrollment at Rice. The M.S. thesis should be submitted as soon after the examination as possible, but not later than 6 months from the date of the exam. Students defending a published paper rather than a thesis must submit the paper to a journal by the end of the eighth semester at Rice.

3.4.3 Ph.D. Candidacy

The Ph. D. candidacy exam is distinct from the M.S. defense, although these often occur contiguously. Each research area has a list of topics that may come up in the candidacy exam. See the department web pages (http://physics.rice.edu) for a list of topics by research area. Students who have MS degrees from other institutions must still take the Ph. D. candidacy exam.

Students should file for approval of Ph.D. candidacy immediately upon the successful completion of the candidacy examination. Note that it is not necessary to know the exact thesis title, examining committee, or defense date in order to file for candidacy. A student must have been approved for candidacy for the doctoral degree before the beginning of the ninth semester of residency at Rice. After the candidacy papers are accepted by the Graduate School, the student’s stipend will be raised to the “Ph.D. candidate” level.

3.4.4 Ph. D. Degree

The University requires that the thesis defense take place within four years of achieving candidacy and before the end of the 16th semester in residence. The Ph. D. program, including thesis defense, must be completed within ten years of initial enrollment in the degree program. A final version of the thesis must be submitted within 6 months of the defense.

3.5 Course-work and Grades

All degree programs in Physics and Astronomy require students to complete certain courses with satisfactory grades. Since course content changes from time to time, these requirements
are subject to modification and students should be careful to fulfill the requirements in effect for their class. Requests for modification of the course requirements must be addressed to the Graduate Committee. If a petition is necessary, students are strongly encouraged to submit the request before taking a course they wish to substitute for one of the requirements described below.

For students matriculating after 1 August 2002 the requirements are:

1. At least 8 full (3-credit) graduate courses, other than teaching or research, in the Physics and Astronomy Department.

2. At least four of the courses must be chosen from the following list:
   - ASTR 470 Solar System Physics
   - ASTR 551 Sun and Stars
   - ASTR 552 Galaxies and Cosmology
   - PHYS 480 Introduction to Plasma Physics
   - PHYS 515 Classical Mechanics
   - PHYS 521 Quantum Mechanics I
   - PHYS 526 Statistical Physics
   - PHYS 532 Classical Electrodynamics
   - PHYS 541 Radiative Processes

3. At least one of the eight courses must be outside the student’s immediate research area. The courses listed in item 2 above may be counted as an “outside the area” course, but a single course may not be used to fulfill both the requirement of item 2 and the “outside the area” requirement.

4. Teaching: 5 semesters of PHYS 700.

5. The thesis advisor may require additional course work.

   Students should consult the appended list of course recommendations by research area to ensure that their course work provides optimal preparation for thesis research. A list of courses approved to satisfy requirement 3 for each research discipline is also appended. Grades of B or better are considered evidence of satisfactory performance. An average grade of B or better will normally be expected in graduate level physics and astronomy courses, excluding teaching and research. Some research groups may have additional expectations.

### 3.6 Teaching

The department considers teaching experience an essential part of graduate training. Thus, full-time graduate students should expect to assume some teaching duties (e.g., teaching labs, grading papers, grading exams, etc.) for the department in addition to research. The amount of time required for any individual student for such tasks will normally not exceed an average of six hours per week. Assignments will be made for 5 semesters, beginning with the second semester at Rice.
Students involved in teaching register for PHYS 700 (Teaching Practicum), which indicates on their transcript that they have had teaching experience. Questions about teaching assignments should be directed to the associate chair.

Up to two semesters of required teaching may be waived for students who have had significant experience teaching physics or astronomy elsewhere. Service as a graduate TA would generally qualify for exemption, but work as an undergraduate grader would not. Requests for a waiver should be discussed with one of the chairs of the Graduate Committee soon after arrival at Rice.

3.7 Affiliation and Research Advisors

Thesis research is the heart of the doctoral program. Students are therefore encouraged to learn about research opportunities within the department, beginning early in the first year of graduate study.

Students are strongly encouraged to attend all the brown bag seminars that are offered during the first semester. These are seminars, presented by the faculty (including research faculty, or Faculty Fellows), to acquaint students with research opportunities. Students should begin in their first semester to explore research opportunities of interest to them, and by the early part of the second semester, to have narrowed down their choices to a few research groups. You are advised to make your interests known to the faculty members in those groups, and to request small projects to enable you to become acquainted with them. The best way to get the information you need to make informed decisions about a group affiliation is to speak with prospective faculty mentors and the current members of that group. You should try to answer questions such as, where are graduates of that group employed? Is funding adequate? What is the typical duration of a Ph.D. in that group? What journals does the group publish in and how often? And most importantly, is the research interesting to you? Students may need to be somewhat flexible in their choice because not all faculty can take additional students in any particular year.

At the end of the first semester, the faculty reviews the performance of all beginning students. Those who are making satisfactory progress will receive written notice that they should make a research affiliation during the second semester. Those showing unsatisfactory or marginal classroom records will be so advised and their eligibility for research affiliation will be considered by the faculty on a case-by-case basis.

You are encouraged to finalize your group affiliation by early March, so that by the end of the semester you are prepared to join the group and quickly become a productive group member.

Students desiring to work with someone who is not a regular faculty member or Faculty Fellow in Physics and Astronomy may do so with the permission of the Graduate Committee. They will be required to submit a brief outline of the proposed work and to obtain the support of a faculty member within the department who will act as departmental advisor. The proposed topic must be appropriate for a degree in physics or astronomy, and the thesis director must be qualified to supervise the project. Approval will initially be granted only for the MS, with an additional petition and review required for the Ph.D.

All research expenses in the department, including most student stipends, are paid by
grants and contracts held by faculty. Thus, a student must make a research affiliation well before May 15 of their first year in order to continue in the program and to receive further support.

3.8 Committees

3.8.1 Graduate Student Advisory Committee

When a student affiliates with a research advisor, the student’s Advisory Committee will be assigned by the Chair of the Graduate Committee. The Advisory Committee is normally composed of three members of the department with the rank of faculty or Faculty Fellow. One member is the thesis advisor, one member is appointed by the Graduate Committee to represent the department, and the third is chosen by mutual agreement of the student and thesis advisor. Each year in the fall semester, the Advisory Committee will meet with the student and assess progress towards the PhD. A progress report will be filed with the Graduate Committee and a copy given to the student. Typically, the Advisory Committee will also serve as the M.S. Committee and Ph.D. Candidacy Committee.

The entire Advisory Committee should serve as a resource for the student. The student should consult the members of the committee for guidance on all aspects of their graduate program and post-graduate planning.

The Advisory Committee continues in its functions and meets annually to assess progress even after a Ph.D. Examination committee has been formed.

3.8.2 Ph.D. Examination Committee

The committee that administers the final oral examination for the Ph.D. is composed of two faculty members or Faculty Fellows from the department, and an additional Rice faculty member from outside the Physics and Astronomy department. Typically the two departmental members are chosen from the student’s Advisory Committee.

3.9 Requirements for Candidacy and Degrees

3.9.1 M.S. Candidacy

The candidate must complete with acceptable grades 30 semester hours of approved advanced courses, including thesis research, or be enrolled at the time of the recommendation for candidacy in a program which will ensure completion of the 30 semester hours by the time that the M.S. degree is awarded.

The candidate must be engaged in a research project involving the candidate’s own independent and original work. The satisfaction of this requirement is to be certified by means of a written statement from the student’s research advisor stating that the progress in research is satisfactory and that the research can reasonably be expected to lead to an acceptable M.S. thesis.
3.9.2  M.S. Degree

The M.S. project is intended only to demonstrate that the student is capable of undertaking research and presenting the results in written form. It is the research advisor’s responsibility to limit the scope of the project in such a way that the student can demonstrate reasonable progress in the time allowed. The formal requirements for the M.S. degree are:

1. The student must complete, with acceptable grades, 30 semester hours of approved advanced courses, including thesis research.

2. The student must complete with acceptable grades, or otherwise satisfy the requirements of, at least four of the basic courses for the doctoral degree, as specified below, plus two other approved courses. An average grade of B or better will normally be expected in the student’s graduate level physics and astronomy courses, excluding research and teaching.

3. As described below, the student must successfully defend the M.S. thesis, or, at the discretion of the examining committee, a research paper of which the student is a principal author.

4. The student must complete a minimum of one year of graduate study at Rice.

3.9.3  M.S. Defense

To obtain an M.S., a student must successfully defend the M.S. thesis, or, at the discretion of the examining committee, a research paper of which the student is a principal author. The M.S. defense, which is public, will consist of a presentation to the M.S. committee about the work and an oral examination conducted by the M.S. committee on the thesis topic and physical principles related to the thesis.

A thesis must be submitted to the Dean of Graduate Studies. A research paper must be submitted to a refereed journal. A detailed list of requirements for the defense and thesis can be found through the Research and Graduate Studies web page.

The degree name, either Physics or Astrophysics, will be specified by the student in consultation with the examining committee.

3.9.4  Ph.D. Candidacy

Achieving candidacy for the PhD implies that a graduate student has (a) completed required coursework, (b) passed required exams to demonstrate his/her comprehensive grasp of the subject area, (c) demonstrated the ability for clear oral and written communication, and (d) shown the ability to carry on scholarly work in his/her subject area.

The requirements for candidacy in the Physics and Astronomy Department are:

1. The candidate must successfully complete the work required for the M.S. degree at Rice, or demonstrate equivalent accomplishment elsewhere.
2. The student must complete with acceptable grades, the courses required for the student’s matriculating class. An average grade of B or better will normally be expected in the student’s graduate level physics and astronomy courses, excluding research and teaching.

3. The student must be enrolled in Graduate Research (PHYS 800) and be progressing satisfactorily toward completion of the Ph.D. thesis.

4. The student must pass an oral candidacy exam, described below, and the examining committee must certify the student as an acceptable candidate for the Ph.D.

### 3.9.5 Ph.D. Candidacy Examination

The Ph.D. candidacy exam is distinct from the M.S. thesis defense even though the two exams are often conducted sequentially. In the candidacy exam, which is typically not public, committee members ask questions of the student that relate to the underlying physics/astrophysics that is relevant to the proposed thesis area. The lists of important physics topics by specialty (http://physics.rice.edu, then follow the links → Graduate Studies → Degree Programs) as determined by faculty in that sub-field, should serve as a starting point for discussions between the student and the committee on what knowledge and accomplishments a student must demonstrate in order to earn Ph.D. candidacy. Additional topics may be added as appropriate. Topics are openly available and are not to be changed too close to the exam. If a student is seeking Ph.D. candidacy in a research specialty different than the one in which he or she earned the M.S. degree, the examining committee must certify that the student is an acceptable candidate for the Ph.D. in the new specialty.

The departmental delegate on the examining committee should note which of the subfield knowledge topics were addressed during the examination and briefly summarize how the student responded to questions on those topics. This information will be submitted to the department for the purpose of assessing if our graduate program is accomplishing the teaching goals that we have set for it.

### 3.9.6 Ph.D. Degree

To complete the Ph.D. degree a candidate must write a doctoral thesis and publicly defend it in the final oral examination, which is conducted by the Ph.D Examination Committee. The formal requirements for the Ph.D are:

1. The student must complete all course work specified for their matriculating class and any additional courses required by the thesis advisor.

2. The student must satisfactorily complete five semesters of teaching assistance (PHYS 700).

3. The transcript must show at least 90 semester hours credit, including research and teaching, beyond the Bachelor’s Degree. At least 60 semester hours of this study must be done as a full-time student in residence at Rice.
4. The student must successfully complete a research project involving independent and original work. The work must be reported in an approved thesis, and defended in a public oral examination.

The degree name, either Physics or Astrophysics, will be specified by the student in consultation with the examining committee.

3.10 Previous Graduate Work

Certain requirements may be modified for students who have done equivalent graduate work elsewhere. Students should consult with one of the chairs of the Graduate Committee to verify the application of the guidelines described below to their particular case.

Graduate-level courses taken elsewhere will be evaluated by means of an interview with an appropriate faculty member. Courses will be waived in areas where the student has sufficient background.

A research-oriented masters degree, including either a thesis or published paper, may substitute for the thesis portion of the Rice M.S. The faculty, with the advice of the Graduate Committee, will decide if the previous work is equivalent to that expected for a Rice M.S. If so, the student desiring to make such a substitution must affiliate with a research group and find an advisor within the department. After at least one year in residence the student must form an examining committee and give an oral defense of the previous work. These students must also pass the Ph. D. candidacy exam in the area in which they intend to do their Ph. D. research (see section 2.9.5).

It is not necessary for the student to resubmit the thesis to the Graduate School, and the student will not receive a Rice M.S. Similar procedures will apply to students holding an equivalent degree from a non-U. S. institution, regardless of the degree title.

A masters or similar degree based only on course work is not equivalent to the Rice M.S. Students holding such degrees must still demonstrate research ability, defend a thesis or research paper, and pass the Ph. D. candidacy exam to qualify for Ph. D. candidacy.

4 General Information

4.1 Stipend Payments

Research assistantships and special fellowships or traineeships (e.g., NSF fellowship, NASA traineeships) are usually paid on a 12-month basis. Rice fellowships, awarded to incoming students, are paid on a 9-month academic year basis.

Stipends may also be paid during the summer for work on research projects. A student who works for a full summer will receive six paychecks, on the last and 15th days of the summer months.

Students who receive a stipend from any source through Rice University will be paid semi-monthly on the 15th and the last day of each month. (In the event that one of these days falls on a weekend or holiday, payments will be issued the prior working day.) The first academic-year payment will be issued on August 31 and the last (of 18) on the 15th of May. Due to
the break between fall and spring semester, two payments are issued on December 15th and none on December 31. Continuing graduate students will receive their last summer stipend payment on the 15th of August. Checks or deposit notifications are distributed through the department offices.

Upon request, the University will deposit stipend payments directly to your bank account, rather than issuing a check. Department staff can provide you with a form authorizing payroll to make a direct deposit.

4.2 Health Insurance

Rice University requires that all students have health insurance. Students may either provide the Rice Cashier with proof of medical insurance or purchase health insurance from the University. All on-site students are required to pay a Health Center fee, regardless of whether they purchase Rice University medical insurance or are covered by some other agency. Further information can be found at http://studenthealthinsurance.rice.edu/.

A medical insurance subsidy towards purchase of the Rice medical plan is available to full-time doctoral students in their first eight years of doctoral study. The Graduate Student Association maintains a helpful website describing the subsidy.

http://gsa.rice.edu/document/student-health-insurance-and-doctoral-subsidy-08-09

4.3 Building Access

The department coordinator will authorize issuance of door keys to those areas to which access is needed. All keys must be returned when a student leaves permanently. Keys may not be duplicated under any circumstances.

A number of buildings have card-controlled locks. The north door to Herzstein will accept any valid Rice ID, but specific authorization is needed for most other buildings. The graduate coordinator can make arrangements as required.

4.4 Study Areas

The department has a very limited number of desks in Herman Brown Hall for first-year students. The graduate coordinator will assign this space upon request. After the first year, students will be assigned office space convenient to their research groups.

The Heaps Library is located between 210 and 212 Herzstein Hall. The Dessler Reading Room is room 310 Herman Brown. Both contain reference books and journals for the use of department faculty, staff and students. These materials should not be removed except for the purpose of reproduction. Please replace books, journals, periodicals, etc. in their proper place after use, since we have no librarian. The reading rooms can be used for study but should not be considered as a place to leave personal books or belongings.
4.5 Mail and Telephone Service

All first-year graduate students have an assigned mailbox near room 105 Herzstein Hall. This box will be used for official correspondence and any other mail that arrives at the main department office. It should be checked regularly. Continuing students have a mailbox convenient to their research area.

All graduate student offices have access to a campus telephone. Campus calls may be dialed by keying the four-digit extension number. Local off-campus calls may be placed by keying 9 and then the ten-digit area code and number. Toll free numbers may be dialed by 9-1-800- and the number. The phone system has many other interesting features; check with one of the department offices for details.

Long-distance calls may only be placed with a forced authorization code (FAC). After affiliation, the research advisor will authorize charges to one of his or her grants. You will then receive a secret 10-digit FAC number and instructions on its use.

The department maintains FAX machines for general use in the department offices. There is no charge for sending or receiving, but long distance transmissions require a FAC.

4.6 Computing

All new students are assigned a Rice NetID username and password, which gives them access to Rice email and other resources. See the Rice IT web pages http://www.rice.edu/it for more information about computing resources.

Many research groups maintain their own specialized computing facilities. These become available to the student when he/she joins the research group.

4.7 Colloquia and Seminars

Colloquia are regularly scheduled on Wednesday at 4PM in HZ 210 during the academic year, and occasionally at other times. They are intended to expose students and faculty to diverse research areas in physics and astronomy at a level appropriate for non-specialists, and students are strongly encouraged to attend.

Seminars are scheduled at various times by each research group. The presentations will be of particular interest to students working in the pertinent area, and provide an opportunity to interact with distinguished visitors at the forefront of their fields.

The department also supports three named lecture programs each year. The Houston Lecture is a popular presentation by a prominent physicist on a topic of his or her choice. The Marlar Lecture is on a topic in space physics and astronomy. The Rorschach Lecturer is concerned with the interaction of science and society. The lecturers often visit Rice for several days, give an additional technical presentation, and hold discussions with students and faculty.

4.8 Departmental Prizes and Awards

The department awards several prizes to outstanding graduate students. They are:
1. The Tom Bonner Book Prize, given annually to a first year student for outstanding performance in course work.

2. The Robert L. Chuoke Awards, presented to the second and third year graduate students who show the most promise as evidenced by performance in courses and progress in research.

3. The Umland Award, given annually to a graduate student for meritorious service to Physics and Astronomy graduate students.

4. The Marlar Scholar Award in recognition of outstanding achievement in Space Science.

5. The Gordon Fellowship to the astronomy or space physics student who has best demonstrated academic and research achievement.

6. The H. A. Wilson Award for the most outstanding Ph.D. thesis.

There are also several fellowship funds, administered through the department and the university, which provide full or partial support for graduate students.

4.9 External Prizes and Fellowships

While students are most commonly supported during their research via grants or contracts held by their thesis advisor, there are other sources of graduate support. For example, the National Science Foundation, the Department of Defense, and a number of other agencies and foundations have graduate fellowship programs to which you may apply. Likewise, there are graduate training grants of various kinds available in certain areas. There are also numerous small prizes and awards that exist to supplement rather than replace departmental support.

There are three principle incentives from the student perspective for applying to such programs. First, fellowships that include graduate stipend support can potentially pay more than the standard departmental stipend level. Second, external support can partly decouple research advisor affiliation from faculty funding concerns, enabling more flexibility on the part of the student. Third, having won competitive awards will look very good on your resume and help you after you graduate.

A listing of fellowships and discussion of the fellowship application process can be found at http://www.owlnet.rice.edu/killian/assets/fellowships07.pdf. The Center for Student Professional Development (http://cspd.rice.edu/index.php#plan_addl_resources) is also a good resource for this topic.

All students are guaranteed a minimum stipend by the department. In order to motivate students to bring additional resources into a research group and the department, the department has adopted the following guidelines for topping off stipends above this level for students who obtain outside fellowships. In general, they apply to students who receive prizes such as NSF and DOE fellowships, which are external to the department or university and external to grants made to local faculty. They do not apply to situations in which the advisor plays a significant role in bringing the resource to Rice, identifying opportunities for
the student, and formulating a proposal. For example, they do not apply to IGERTs and are often not appropriate for training grants.

This policy cannot account for the particulars of every situation, and some training grants fall in a gray zone. For example, the advisor may need to be involved, but the grant may be very competitive and require significant effort on the part of the student, and they may be awarded by agencies largely or completely independent of Rice, such as The Alliance for NanoHealth or NASA. In all cases the department will endeavor to see that the student benefits financially from an external award, but the advisor has some discretion when fellowships fall in this grey zone because he or she must provide the additional resources. Advisors should consider that students demonstrating initiative in finding and applying for certain awards are deserving of some extra compensation. Students should also keep in mind that this policy is contingent upon funding being available for a topoff. Exceptions to these policies may be required to comply with the terms of the fellowship. In all cases, expectations should be discussed with an advisor before applying for a grant or perhaps joining a research group.

Prizes and other awards that are not in the nature of a stipend will go in full to the student, who will continue to receive a normal stipend through the department or research group. When appropriate, students holding external fellowships will receive their fellowship payment plus a supplementary stipend determined as follows: If the standard departmental stipend is $S$ and the annual amount of the external fellowship award is $A$, then the student will receive the fellowship amount plus a supplementary stipend $S'$, where $S'$ is paid by the department or research group. The total amount the student receives is $S_{\text{tot}} = S' + A$ with $S'$ given by

\begin{align*}
S' &= S \quad \text{for } A < 0.2S \\
S' &= 1.2S - A \quad \text{for } 0.2S < A < 1.2S \\
S' &= 0 \quad \text{for } A > 1.2S
\end{align*}

A student’s total income will not exceed 1.2 times the normal stipend unless the award amount is larger than $1.2S$. Exceptions to these policies may be required to comply with the terms of the fellowship. In all cases the department will endeavor to see that the student benefits financially from an external award.

## 5 Purchasing and Expenditures

After affiliation with a research group, you may be asked to make purchases on behalf of your research grant. University accountants are very stringent in their interpretation of federal and university rules that control such expenditures. Please take careful note of the following policies, and consult with a staff member before incurring any expense which might be questioned. Under no circumstances are personal items to be charged to any university or research account.
5.1 Office Supplies

The department stocks and provides supplies for academic and administrative use in both Herzstein and Herman Brown. Please consult the office staff if items you need are not available. To keep costs reasonable, please do not obtain supplies elsewhere. (The campus store, in particular, is much more expensive than our regular suppliers. Research Accounting will generally disallow charges at the campus store.)

Items which could be construed as “office supplies”, such as special paper, plotter pens or printer cartridges, must be charged as laboratory supplies if they are actually used solely for research purposes. Research funds may not be used to pay for general-use office supplies. Please be sure the staff knows the intended usage when asking them to order supply items.

Office supplies purchased by the department or research grants are not for personal use, including course work. All costs of thesis preparation, defense and submission are the responsibility of the candidate. This specifically includes paper, transparencies and printing or copying costs for drafts, defense, and library versions.

5.2 Copying services

Copiers in HZ 105 and in Herman Brown are available for research and departmental use as needed. (Note that government funds cannot be used to prepare an application for a government grant.) Personal use of copiers is not allowed. You may consult Dr. Dodds to obtain a charge code for the appropriate machine.

The department shares in the support of a large-format (36” wide) color printer located in Geology. Department staff can provide information on how to access this unit.

5.3 Mailing/Shipping

All items to be mailed or shipped must be routed through one of the department offices in HZ 105, HB 202 or the Bonner lab. Department staff will help you arrange an appropriate carrier and payment.

The department will pay postage for all university business and for routine research-related correspondence, including grant proposals, journal submissions, paper reviews, and small numbers of preprints. Do not charge single letters to your research grant - Research Accounting will not allow it. Large batches of preprints and other research-related shipping must be charged to the appropriate grant. A valid fund number must be legibly entered in the internal billing reference area of courier tickets such as DHL, UPS, or FedEx. Seek assistance form the department staff for all courier shipments.

5.4 Purchasing

To obtain a purchase order (PO) number, you must submit an approved purchase request form to the purchasing coordinator in HZ 105. Alternatively, you can create a shopping cart on the Rice Marketplace, an online purchasing system between Rice and many common vendors. Access to the Rice Marketplace requires training. When merchandise is received,
bring the packing slips and all other supporting documentation to the purchasing coordinator promptly so that payment can be processed. Slow payment on purchase orders is a major vendor complaint. Individuals or research groups who do not complete transactions promptly will not be issued further purchase order numbers.

Small items may be purchased with personal funds and reimbursed up to $50.00 from petty cash, or by check request for larger amounts. This should not become routine. You will not be reimbursed for payment of Texas sales tax, so be sure the vendor understands that the sale is exempt from state sales tax. If needed, documentation of tax-exempt status can be found here:

http://professor.rice.edu/images/professor/controllers/forms/Tax_Exempt_Cert

Research purchases can also be made with Rice purchasing cards issued to the PI. Users of these cards are reminded that they are responsible for record keeping in accord with university regulations. In particular, the card is to be used for allowable expenses on the designated fund so that transfers are performed only rarely. Monthly statements must be reconciled with original receipts and/or packing slips promptly, and all documents must be retained for at least 5 years. These conditions are particularly important for Federal funds, and violation will lead to withdrawal of the card, at the least.

5.5 Travel

Student travel must be authorized by the department chairman or the principal investigator of the project to which the travel will be charged.

The Dean and the Department can sometimes provide supplemental funds for students presenting papers at meetings. Contact the graduate coordinator to request this assistance.

When preparing for a trip, please give the graduate coordinator your itinerary and account number(s) to be charged. The graduate coordinator will provide guidance for making air and hotel reservations. Note that most grants require the use of US carriers.

Travel expense documentation must be submitted within three days after returning from a trip. The following original receipts must be supplied: Airline ticket stub; Hotel receipt; Car rental receipts (these must show amount charged); Miscellaneous items such as taxi, bus, and registration.

A Course Recommendations By Research Specialty

A.1 Astronomy and High-Energy Astrophysics

Course requirements by research area are in addition to the departmental requirements described in section 3.5.

A wide variety of research topics are available within these two groups. Hence, the best
Courses for each student will vary on a case by case basis, taking into account the background of the student and the recommendations of the adviser. In many astronomy departments it is not unusual for students to take as many as 12 graduate courses in physics and astronomy.

Courses required for all research in astrophysics:
ASTR 551 Sun and Stars and
ASTR 552 Galaxies and Cosmology.

Most research projects require
PHYS 541 Radiative Processes.

Students also must participate in the AU (ASTR 500), a weekly astronomy seminar given by faculty, students, and outside speakers in order to gain experience presenting talks.

In addition, students typically take several of the following:
PHYS 521 Quantum Mechanics I
ASTR 542 Nebular Astrophysics
ASTR 555 Protostars and Planets
ASTR 565 Compact Objects
PHYS 480 Introduction to Plasmas
PHYS 561 General Relativity
ASTR 600 Special Topics
ASTR 470 Solar System Physics.

Other useful courses include PHYS 522 (Quantum Mechanics II), PHYS 526 (Statistical Physics), PHYS 532 (E&M), and PHYS 515 (Classical Dynamics) for theorists. Useful courses for observers and experimentalists include ASTR 450 (Experimental Space Science) and ASTR 554 (Astrophysics of the Sun). Students who want to specialize in numerical simulations will probably want to take PHYS 516 (Mathematical Methods) and advanced computation courses in the Computational and Applied Mathematics Department.

### A.2 Atomic, Molecular and Optical (AMO) Physics

Course requirements by research area are in addition to the departmental requirements described in section 3.5.

Atomic, Molecular and Optical (AMO) Physics AMO physics studies simple systems that reveal the behavior of matter and light at a fundamental level. While the phenomena can be complex, physical intuition stems from a strong grounding in the classical areas. Further study introduces students to the terminology, concepts, and techniques of the field.

The courses required for research in AMO physics:
PHYS 521 Quantum Mechanics I  
PHYS 526 Statistical Physics  
PHYS 532 Classical Electrodynamics  
PHYS 515 Classical Dynamics  

Students also typically take:  
PHYS 522 Quantum Mechanics II  
PHYS 571 Modern Atomic Physics  
Phys 572 Fundamentals of Quantum Optics  

Other valuable courses are:  
PHYS 537/538 Methods of Experimental Physics I and II  
PHYS 516 Mathematical Methods  
PHYS 600 Advanced Topics in Physics: Cold Atoms in Atomic Physics  
CHEM 630 Molecular Spectroscopy and Group Theory  

During the first year, interested students are encouraged to discuss course selection with professors doing research in AMO physics.  

A.3 Biophysics  

Course requirements by research area are in addition to the departmental requirements described in section 3.5.  

Biophysicists study the physical principles underlying the complex processes of living systems at all levels. Experimental and theoretical approaches to biophysical research require a strong background in fundamental physics. Due to the highly multidisciplinary nature of biophysics, additional coursework is determined by the area of specialization. Current research in the department focuses on molecular biophysics.  

The courses required for Biophysics:  
PHYS 521 Quantum Mechanics I  
PHYS 526 Statistical Physics  
PHYS 532 Classical Electrodynamics  
PHYS 515 Classical Dynamics  

Students also typically take:  
PHYS 522 Quantum Mechanics II  
PHYS 563 Solid State I
Other valuable courses are:
PHYS 537/538 Methods of Experimental Physics I and II
PHYS 533/534 Nanostructures and Nanotechnology I and II
PHYS 600 Advanced Topics in Physics: Molecular Biophysics
PHYS 610 Biological and Molecular Simulation

During the first year, interested students are encouraged to discuss course selection with professors doing research in Biophysics.

A.4 Condensed Matter and Nanoscale Physics

Course requirements by research area are in addition to the departmental requirements described in section 3.5.

Condensed matter physics concerns systems with many degrees of freedom (e.g. metals) where many-body phenomena play an important role (e.g. superconductivity and magnetism). Nanoscale physics examines the evolution of these properties as the system size approaches the atomic scale. Graduate level proficiency in the fundamental concepts is an essential prerequisite, while further coursework focuses on specific phenomena and techniques of the field. The department sponsors both theoretical and experimental research in these areas.

The courses required for research in CM and nanoscale physics are:
PHYS 521 Quantum Mechanics I
PHYS 526 Statistical Physics
PHYS 532 Classical Electrodynamics
PHYS 515 Classical Dynamics

Most students also take:
PHYS 563 Solid State I
PHYS 564 Solid State II

Courses with an emphasis on theory include:
PHYS 663 Condensed Matter Theory: Applications
PHYS 664 Condensed Matter Theory: Many-body Formalism

Other valuable courses are:
PHYS 533/534 Nanostructures and Nanotechnology I and II
PHYS 539 Characterization and Fabrication at the nm Scale
PHYS 566 Surface Physics
PHYS 600 Advanced Topics in Physics: Nanoscale Science and Technology
PHYS 516 Mathematical Methods  
PHYS 537/538 Methods of Experimental Physics I and II

During the first year, interested students are encouraged to discuss course selection with professors doing research in CM and nanoscale physics.

A.5 Nuclear and Particle Physics

Course requirements by research area are in addition to the departmental requirements described in section 3.5.

The courses required for research in particle physics are:
PHYS 521 Quantum Mechanics I  
PHYS 522 Quantum Mechanics II  
PHYS 532 Classical Electrodynamics  
PHYS 542 Introduction to Nuclear and Particle Physics  
PHYS 543 Quarks and Leptons  
and one of  
PHYS 515 Classical Dynamics  
PHYS 516 Mathematical Methods

Depending on their interests, most students are also advised to take some of the following courses:
PHYS 526 Statistical Physics  
PHYS 544 Special Topics in Nuclear and Particle Physics  
PHYS 561 General Relativity  
PHYS 622 Quantum Field Theory

A.6 Space Plasma Physics

Course requirements by research area are in addition to the departmental requirements described in section 3.5.

Courses from the basic group that are essential to space plasma physics:
ASTR 470 Solar System Physics  
PHYS 480 Introduction to Plasma Physics  
PHYS 532 Classical Electrodynamics

Additional courses from the basic group that most space physics faculty advise their students to take:
Relevant Math Courses: PHYS 516 (Mathematical Methods) deals mostly with the classic theoretical methods of physics and is recommended for people who wish to use a lot of analytic theory in their research or who need some brushing up in that type of work. People who wish to do computer simulations in their research should take PHYS 416 (Computational Physics) and may wish to take a course in numerical methods or programming from another department. Possibilities include CAAM 420 (High-level languages), CAAM 421 (Vector and parallel computing), MECH 525 (Parallel computing), and MECH 676 (Finite difference methods).

Some advanced courses in space plasma physics are offered every two or three years. A graduate student specializing in space plasma physics will probably be advised to take some of these courses, depending on the situation.

PHYS 510 Magnetospheric Physics
PHYS 512 Ionospheric Physics
PHYS 519 Plasma Kinetic Theory
PHYS 520 Nonlinear Plasma Dynamics
ASTR 554 Astrophysics of the Sun

B Graduate Courses by Research Area

General

Note that these courses may not be used to satisfy the “outside the area” requirement described in section 3.5.

PHYS 515 Classical Dynamics
PHYS 516 Mathematical Methods
PHYS 521 Quantum Mechanics I
PHYS 522 Quantum Mechanics II
PHYS 526 Statistical Physics
PHYS 532 Classical Electrodynamics
PHYS 537/538 Methods of Experimental Physics I and II

Astronomy/Astrophysics

ASTR 470 Solar System Physics
ASTR 505 Processes in Cosmic Plasmas
ASTR 542 Nebular Astrophysics
ASTR 551 Astrophysics I
ASTR 552 Astrophysics II
ASTR 554 Astrophysics of the Sun
ASTR 555 Protostars and Planets
ASTR 565 Compact Objects
PHYS 541 Radiative Processes
PHYS 561 General Relativity

**Space Plasma Physics**
ASTR 470 Solar System Physics
ASTR 554 Astrophysics of the Sun
PHYS 480 Introduction to Plasma Physics
PHYS 510 Magnetospheric Physics
PHYS 519 Plasma Kinetic Theory

**Condensed Matter**
PHYS 533 Nanostructure/Nanotechnology I
PHYS 534 Nanostructure/Nanotechnology II
PHYS 535 Crystallography and Diffraction
PHYS 539 Characterization and Fabrication
PHYS 563 Intro to Solid State I
PHYS 564 Intro to Solid State II
PHYS 566 Surface Physics
PHYS 568 Quantum Phase Transitions
PHYS 605 Computational Electrodynamics
PHYS 663 Condensed Matter Theory: Applications
PHYS 664 Condensed Matter Theory: Many-Body Formalism

**Biophysics**
PHYS 551 Biological Physics
PHYS 552 Topics in Biological Physics
PHYS 610 Biological and Molecular Simulation
PHYS 643 Mechanical and Thermodynamic Properties of Biomembranes

**Nuclear and Particle**
PHYS 542 Intro to Nuclear and Particle Physics
PHYS 543 Physics of Quarks and Leptons
PHYS 544 Special Topics in Nuclear and Particle Physics
PHYS 622 Quantum Field Theory

**AMO Physics**
PHYS 569 Ultrafast Optical Phenomena
C Candidacy Topics by Research Area

Each specialty subfield has assembled a list of topics that are important for a student in order to complete a Ph.D. and have a successful career in that subfield. These lists also serve as good starting points for discussions with research advisors and departmental committees about topics and the format of the Ph.D. Candidacy Exam. As these lists of topics change from time to time, it is best to refer to the department website for the most up-to-date list:

http://physics.rice.edu/Content.aspx?id=57#PHD%20Candidacy

or http://physics.rice.edu
follow the links → Graduate Study → Degree Programs

The lists of topics is under the section “Ph. D. Candidacy Exam”