

## 4. PhD Program

The following information is for full-time students. Part-time students should refer to Section 6 for modifications to the regulations.

### 4.1 Course Requirements

The university has no requirements except for 12 credits of PhD thesis research (ASTR 899). All other requirements for courses are determined by the department.

During the first two years, full time students will take Radiative Processes and at least five other courses among Instrumentation (required for the observation/instrumentation stream), Computational Astrophysics (required for the theory/computation stream), Galaxies, Planetary Science, ISM & Gas Dynamics, Stellar Structure & Evolution, Cosmology, and High Energy Astrophysics, or show that they have already had equivalent courses. Representative descriptions of the above astronomy courses are given in Appendix A. A research project, taken as ASTR 699, is required during the second year. You are also expected to take a 1-credit seminar, ASTR 695 - Introduction to Research, during both semesters of the first year. This seminar is intended to introduce you to the range of research being carried out in the department and to help you to choose a second-year research project (and subsequently a thesis). Although there is no formal course requirement, all students without suitable observing experience are strongly encouraged to accompany a faculty member on an observing run during their first two years. (The department will provide necessary financial support for one such observing run.)

In the spring semester of the first year, students will normally choose a stream--theory, computation, observation, or instrumentation. All students are required to take an additional five graduate courses (of 3 or four credits each), with the choice of courses varying from one stream to another but typically including physics courses, astronomy courses, and courses from other relevant departments (math, computer science, engineering, etc.). Although it is possible to freely switch from one stream to another, you must satisfy all the requirements for one stream. These stream requirements are summarized in more detail in Appendix B. All students are required to have completed 10 graduate courses (including any that have been accepted from other institutions) by the end of the third year. The University requires that the total GPA in these courses be at least 3.0.

It is expected that a student will have completed no less than 7 (of the required 10) courses before admission to the Ph.D. program. This corresponds to two 3 (or 4) credit courses in three of the four semesters of the first two years and one 3 (or 4) credit course in the other semester. Exceptions may be considered in unusual circumstances, such as illness.

Please note that these 7 (and 10) courses are normal graduate \_ learning \_ courses: courses connected in one way or another with research work (e.g. ASTR 695, ASTR 699, ASTR 799, ASTR 899) or undergraduate level classes do not count to either the 7 or the 10.

### 4.2 Stage 1 - From Admission to Graduate School to Admission to the PhD Program

Admission to the PhD program is a Department of Astronomy decision. It indicates an initial judgement by the faculty that the student is capable of doing independent research and is likely to be able to complete a PhD thesis. Search for a PhD research topic and an advisor does not occur until after admission to the PhD program. The decision is based on the student's course work, the performance on the Qualifying examination and the quality of the research project. The qualifying examination (see next section) is taken during the summer just prior to the start of the third year of graduate studies. The decision on

admission to the PhD program is normally made in September, as soon as feasible after the Qualifier. During the first two years of graduate work, you should expect to concentrate on formal course work (see Section 4.1) and the second-year research project (see Section 4.2.2).

#### 4.2.1 The Qualifier

You are required to take this exam in the summer just prior to the start of your third year of studies. The closed book exam consists of two sections, each of four hours duration and given on successive days.

The exam will cover the material in, or closely related to, the five principal courses listed in Section 4.1. There will only be one try at passing the exam. More specific information on this is circulated several months before the Qualifier. Copies of Qualifiers for the past several years are available in the main Astronomy office.

Shortly after the exam is taken, the Graduate Faculty will meet to discuss the results of the qualifier. Although there is no *a priori* set score for passing the qualifier, scores below 50% are considered poor. Qualifier results will be used by the faculty in their decision on admission to the PhD program (see below). You will be informed of the decisions of the Graduate Faculty as soon as possible.

#### 4.2.2 Second Year Research Project

A research project is required to be done by all PhD-seeking graduate students in their second year. This has the two-fold purpose of introducing the graduate students to the excitement of research and of allowing the faculty to evaluate the student's ability to carry out a research project, particularly including dealing with problems that arise in the course of such work. The seminar ASTR 695 -- Introduction to Research consists of seminars by individual faculty members and postdoctoral researchers describing their research interests. Many presenters will discuss specific second-year projects they would be willing to supervise while others will discuss general areas in which they are working and would supervise projects. By the end of the first year, you should be familiar with what the faculty is doing. Equally important are the weekly Department Colloquia; you should regularly attend these to learn about other areas of research which may be suitable for a second year project. You are also strongly encouraged to discuss potential advisors and research projects with more senior graduate students.

By the end of your first year (May), you should choose a research area under an advisor on the full-time graduate faculty. By the following September you will have chosen a research topic or else your advisor shall have assigned one. You should also have selected a second-year-project committee by this time. This committee should consist of three (or more) people with expertise relevant to the research project (including the advisor), at least two of whom are on the graduate faculty of the department. Most students begin at least the reading for the second-year project during the summer between first and second years and many begin the work for the project at that time. During the Fall semester, you should register for ASTR 699 --Independent Study (normally 3 credits) and start or continue work on the topic. No grade is given for this course -- you should register for the S/U grading option. Most of the research should be done by the end of the Fall semester and the writing should be well under way by late January. A progress report on the status of the project must be submitted in writing to the committee by the end of the Fall semester.

During the Spring semester (again registering for ASTR 699) a first draft must be submitted to the committee by March 1st; it will be returned with written comments in no

more than two weeks. The completed paper should be submitted to the committee by the middle of April. The committee will make any last suggestions.

A second-year examining committee will conduct a brief (typically about one hour) oral examination of all second-year students. This committee must receive copies of the project report by May 1st. The exams will usually be scheduled prior to final exams for the spring semester. Your advisor is expected to be present for the exam. The exam is a miniature version of a thesis defense: you are expected to make a short (15 minutes) presentation summarizing the project and the committee will ask questions about the work done and about its implications. There is no pass or fail decision on the exam but the committee will prepare a written evaluation of your performance on the project itself and on the oral exam. You should typically receive a copy of this report within about two weeks.

The final version of the paper, in a format suitable for publication, shall be submitted by the end of the spring semester. Copies of the final report must go both into your file in the departmental office and into the Uco van Wijk Memorial Library.

Throughout both semesters you should meet with your committee often enough to keep the committee appraised of progress. Table 3 lists the second year project deadlines for both students and committees.

It is important to stress that, while the second year project should be of publishable quality, its primary purpose is not to be published but to allow students to understand the kinds of problems and solutions routinely encountered in doing research, to allow students to think critically about their research, and to allow the faculty to evaluate how well students approach research. Not all research projects will result in a published paper. You are strongly encouraged to also write a cover letter of a few pages both to describe the aspects of the research project which were not appropriate to a journal format but which were nonetheless significant aspects of the learning and to describe your own role *vis* the role of other collaborators in the project.

**Table 3: Second Year Research Project Deadlines**

<b>Date</b>	<b>Year</b>	<b>Description</b>
Sept-May	1st	Attend ASTR 695 and Departmental Colloquia
Sept 1st	2nd	Choose research topic; form advisory committee
Dec 1st	2nd	Progress report to committee before end of semester
March 1st	2nd	First draft of paper to committee
March 15th	2nd	Committee members return first draft with written comments
May 1st	2nd	Final report to Second-Year Examining Committee
May 30th	2nd	Final report to Uco van Wijk Memorial Library and departmental file

#### 4.2.3 Admission to the PhD Program

This is decided by the graduate faculty on the basis of your coursework, your research project and your performance on the qualifier. The decision would normally be made soon after the qualifier, typically by mid-September. The decisions which can be reached are:

1. Admission to the PhD program.
2. Conditional admission. The conditions will be specified but normally consist of revision to the research paper or additional coursework.
3. Rejection from the PhD program. In this case you may petition the faculty for reconsideration.

You may also go on for a MS degree if the requirements can be fulfilled (See Section 5.) You will be informed in writing of the faculty's decision.

#### 4.3 Stage 2 -- Admission to Candidacy

After admission to the PhD program, you should concentrate on selecting and beginning work on a research project which will eventually become your PhD thesis. A thesis committee should be constituted to reflect your research interests. The University requires that a member of the Graduate Faculty of the University of Maryland must be an advisor for the thesis even if much of the work is done with another scientist (*e.g.*, at a neighboring institution). The Department of Astronomy further requires that a member of the Graduate faculty within Astronomy unofficially look after the student if the primary advisor of the thesis is outside the Department. Once a dissertation topic is selected, the suitability of the topic as a PhD thesis as well as its viability (*i.e.* the likelihood of completing it in a reasonable time period) is discussed at a meeting of the thesis committee. The entire Graduate faculty of the department is to be informed of this meeting and invited to attend. At this meeting, you will give a brief presentation followed by questions. Once the dissertation topic is approved and all other departmental requirements have been met, you may apply to the Graduate School for Admission to Candidacy.

##### 4.3.1 Regulations

University -- Admission to Candidacy must occur within five years of admission to the Graduate School. The official forms for filing for candidacy are available in the Astronomy departmental office. It is the student's responsibility to file these forms in a timely manner.

Department of Astronomy -- All the departmental requirements for admission to the PhD program must, of course, have been fulfilled. In addition, all incompletes must have been removed except for those in research courses where the work is part of the PhD research. All departmental course requirements must have been satisfied.

#### 4.4 Stage 3 -- Candidacy to the PhD

During this period, you should concentrate on completing the PhD research work and on writing the dissertation. The thesis must involve significant, original, and independent research, performed under the supervision of the advisor. The thesis must be of the quality normally required for publication in recognized research journals. It is usual that several drafts are gone through before the final thesis is produced. The Department will normally bear the cost of reproducing the final draft of the thesis. There are University regulations as to the format of the thesis and the mechanics of submitting it to the Graduate School (See the Graduate School's web site at [www.inform.umd.edu/EdRes/Grad Info/](http://www.inform.umd.edu/EdRes/Grad%20Info/)).

Once the dissertation is completed, it is defended in front of a committee consisting of members of the Department of Astronomy, members of the University faculty who are not members of the Department of Astronomy, and external examiners who are not members of the faculty of the University of Maryland. A discussion of the guidelines for the PhD oral can be found in (See the Graduate School's web site at [www.inform.umd.edu/EdRes/GradInfo/](http://www.inform.umd.edu/EdRes/GradInfo/)). Once the committee has approved the dissertation, it can be submitted to the Graduate School.

#### 4.4.1 Regulations

**University** -- A minimum of one and a maximum of four years is allowed between admission to candidacy and completion of the PhD, of which at least one year must be spent at the University of Maryland. During this time you must be continuously registered each semester (not including summer semesters). This is true even if you are not in residence; in this case you must fill out the Continuous Registration Form and pay a nominal fee each semester. When filing for the degree, all Incompletes in the courses being used for the PhD must be completed and a minimum grade point average of 3.0 must be obtained. There are specific deadlines each semester for applying for a degree and for submitting the final dissertation. (See Graduate School's website at [www.inform.umd.edu/EdRes/GradInfo/](http://www.inform.umd.edu/EdRes/GradInfo/)).

**Department** -- A complete draft of the thesis must be submitted to the examining committee two weeks before the final defense. It is your responsibility and that of your advisor to see that the entire Graduate faculty is informed of the examination date and time at least two weeks in advance. You must also have a copy of the thesis available for examination by any other faculty who might wish to attend the defense. You are responsible for seeing that the final thesis reaches the Graduate School.