The goal of the graduate program is to prepare capable and creative astronomers for careers in research and education. The granting of the Ph.D. degree indicates that the recipient has a mastery of the knowledge and techniques of modern astrophysics. A Ph.D. candidate is expected to be both knowledgeable of problems at the frontiers of astrophysical research and able to carry out independent forefront research in a specialized area. Candidates are required to gain experience as teaching assistants and are encouraged to work with a variety of faculty and research staff members during the first two years of study.

The Department of Astronomy offers the doctor of philosophy in astronomy. Although a master's degree is offered, students generally are not admitted for a terminal master's degree.

The program provides each student with a broad knowledge of modern observational and theoretical astrophysics, while emphasizing the development of independent research skills. Beginning with the first year in the program, graduate students play an active role in the department's research programs and have access to all research facilities. As teaching assistants, they also acquire experience as astronomy educators.

The faculty are engaged in a broad range of observational and theoretical research. Topics of study include dynamical phenomena of massive stars; binary star evolution; dynamics of star clusters and star forming regions; compact objects; the interstellar and intergalactic medium; star formation; plasma astrophysics; computational fluid mechanics; magnetic fields; turbulence; the structure, kinematics, and stellar populations of nearby galaxies; active galactic nuclei; galactic winds and chemical evolution; galaxy clusters; galaxy formation and evolution; the star formation and black hole accretion history of the universe; and the development of innovative astronomical instrumentation. More information is available on the department website.

**Funding**

Prospective students should see the program website for funding information.

**Requirements**

**Minimum Degree Requirements and Satisfactory Progress**

To make progress toward a graduate degree, students must meet the Graduate School Minimum Degree Requirements and Satisfactory Progress (http://guide.wisc.edu/graduate/#policiesandrequirementstext) in addition to the requirements of the program.

**Doctoral Degrees**

Ph.D.

**Minimum Graduate Degree Credit Requirement**

51 credits

**Minimum Graduate Residence Credit Requirement**

32 credits

**Minimum Graduate Coursework (50%) Requirement**

Half of the degree coursework (26 of 51 credits) must be completed in graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university’s Course Guide (http://my.wisc.edu/CourseGuideRedirect/BrowseByTitle).

**Prior Coursework Requirements: Graduate Work from Other Institutions**

With program approval, students are allowed to count no more than 34 credits of graduate coursework from other institutions. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

**Prior Coursework Requirements: UW–Madison Undergraduate**

Up to 700 credits numbered 7 or above from a UW–Madison undergraduate degree are allowed to count toward the degree.

**Prior Coursework Requirement: UW–Madison University Special**

With program approval, students are allowed to count no more than 15 credits of coursework numbered 400 or above taken as a UW–Madison Special student. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

**Credits Per Term Allowed**

15 credits

**Program-Specific Courses Required**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTRON 500</td>
<td>Techniques of Modern Observational Astrophysics</td>
<td>3</td>
</tr>
<tr>
<td>ASTRON 700</td>
<td>Basic Astrophysics I</td>
<td>2</td>
</tr>
<tr>
<td>ASTRON 702</td>
<td>Basic Astrophysics II</td>
<td>2</td>
</tr>
<tr>
<td>ASTRON 715</td>
<td>Stellar Interiors and Evolution</td>
<td>2</td>
</tr>
<tr>
<td>ASTRON 720</td>
<td>The Interstellar Medium I: Basic Processes</td>
<td>2</td>
</tr>
<tr>
<td>ASTRON 730</td>
<td>Galaxies</td>
<td>2</td>
</tr>
<tr>
<td>ASTRON 735</td>
<td>Observational Cosmology</td>
<td>2</td>
</tr>
<tr>
<td>ASTRON 990</td>
<td>Research and Thesis</td>
<td>1-12</td>
</tr>
</tbody>
</table>

**Doctoral Minor/Breadth Requirements**

All doctoral students are required to complete a minor. They may either meet the minor requirements set by an external department (typically physics), or they may choose a distributed minor. In the latter case 12 credits must be taken from two or more relevant departments outside of astronomy. The coursework will normally be at the 400 level and above although special exceptions may be made in the case where 300-level courses are needed to satisfy prerequisites. At least two courses must be completed in graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university’s Course Guide (http://my.wisc.edu/
Mathematics through differential equations. Applicants are judged on the basis of previous academic record, letters of recommendation, personal statement, research experience, and Graduate Record Exam (GRE) scores. Admission is competitive and is for the fall only.

Applicants for admission must submit the following via the Graduate School online application:

- Transcripts of all undergraduate work
- Statement on reasons for graduate study in astronomy
- Three letters of recommendation from people well acquainted with past academic work
- Graduate Record Exam (GRE) scores (general test and subject test in physics)
- International students must submit scores from the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS)

Financial support is provided through university fellowships (incoming graduate students only) or department assistantships. To compete for fellowships awarded by the university, students must submit all application materials (including the GRE scores) via the online Graduate School Application by December 31.

### Learning Outcomes

#### Knowledge and Skills

- Demonstrate a broad understanding of core astrophysical topics including gravitational dynamics; radiative processes; the interstellar medium; the formation, structure, and evolution of stars and galaxies; cosmology; and observational and numerical techniques.
- Demonstrate academic mastery in their area of concentration, including a deep understanding of current theories, recent findings, and their broader implications.
- Use their core knowledge and critical thinking skills to assess the work of others. They will examine the scientific literature, evaluate evidence for and against hypotheses, synthesize knowledge from disparate sources, and develop conclusions.
- Evaluate scientific literature and use it to construct theoretical frameworks and testable predictions for their own research projects.
- Participate in writing competitive proposals to use research facilities and to obtain research support.

#### Professional Conduct

- Students will foster ethical and professional conduct.

### Additional Learning Goals

**Research**

Students will develop and complete original research that substantively advances a specific field of study. In so doing, they will cultivate their critical thinking skills, creativity, and independence. They will:

- Utilize modern instrumental, observational, or theoretical research techniques in their analysis.
- Formulate ideas, designs, or techniques that advance the boundaries of knowledge within their field.
- Critically evaluate the robustness and limits of conclusions drawn from their research and the potential for future studies.
• Write clear and concise research articles for publication in refereed journals.
• Deliver articulate oral presentations on their research to diverse audiences ranging from academic departments to the general public.
• Work productively in a collaborative environment.

TEACHING

• Students will serve as teaching assistants for at least one semester. They will: communicate scientific ideas in a clear and understandable manner, employ techniques that enhance student engagement, and develop and carry out assessments of student progress.

PEOPLE

Faculty: Professors Zweibel (chair), Barger, Bershady, Gallagher, Heinz, Lazarian, Mathieu, Stanimirovic, Wilcots; Associate Professor Townsend; Assistant Professors D'Onghia, Tremonti