ASTRONOMY, PH.D.

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 department has a long-standing reputation as one of the finest graduate astronomy and astrophysics programs in the United States. 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; extrasolar planets; 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.

RESEARCH FACILITIES

Astronomical observations at UW–Madison trace their origin to the 15-inch refractor of Washburn Observatory, founded on the campus in 1878, and still open for public viewing. Wisconsin subsequently pioneered a multi-wavelength approach to astronomical observation. Faculty, research staff, and students are frequent observers on X-ray, ultraviolet, optical, infrared, radio, and submillimeter telescopes around the globe and in space. The department currently participates in the operation of a number of research-class observing facilities and is actively engaged in the development of cutting-edge instrumentation.

The university is a major partner in the WIYN telescope, an advanced technology 3.5m telescope at Kitt Peak, Arizona, optimized for wide-field imaging and spectroscopy, and in the 11m Southern African Large Telescope (SALT), the largest single aperture optical telescope in the Southern Hemisphere. The university is also a partner in the Sloan Digital Sky Survey IV, a massive spectroscopic survey of the distant Universe, nearby galaxies, and stars in the Milky Way. NOEMA, our newest telescope partner, is the most powerful millimeter radio telescope of the Northern Hemisphere and one of the most advanced facilities existing today for radio astronomy. The department is also actively involved in ASKAP and MEERKAT, precursor experiments for an array of radio telescopes one square kilometer in size.

The department has a long history of developing astronomical instrumentation for both ground and space-based facilities. Current efforts center on the development of a near-infrared spectrograph on SALT. UW–Madison scientists are also continuing to develop and operate an innovative and highly successful Star Tracker for sounding rocket and balloon-borne experiments. Technical support is provided by in-house electronics and machine shops.

The theory group uses a variety of facilities to support numerical modeling. The main workhorse comprises 24 dedicated nodes of the campus High Performance Computing (HPC) cluster, each containing 20 CPU cores and 128 GB of RAM, optimized for tightly coupled problems such as magnetohydrodynamical and N-body simulations. A number of smaller clusters within the Astronomy Department are used for development, analysis and three-dimensional visualization.

ADMISSIONS

Please consult the table below for key information about this degree program's admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program's website. Graduate admissions is a two-step process between academic programs and the Graduate School. ***Applicants must meet*** the minimum requirements ***(***https://grad.wisc.edu/apply/requirements/***) of the Graduate School as well as the program(s).*** Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/apply/).

Requirements	Detail
Fall Deadline	December 15
Spring Deadline	The program does not admit in the spring.
Summer Deadline	The program does not admit in the summer.
GRE (Graduate Record Examinations)	Not required.
English Proficiency Test	Every applicant whose native language is not English or whose undergraduate instruction was not in English must provide an English proficiency test score and meet the Graduate School minimum requirements (https://grad.wisc.edu/apply/requirements/#english-proficiency).
Other Test(s) (e.g., GMAT, MCAT)	n/a
Letters of Recommendation Required	3

To enter as a graduate student, an applicant must have undergraduate preparation that includes at least three years of college physics and mathematics through differential equations. Applicants are judged on the basis of previous academic record, letters of recommendation, personal statement, and research experience. 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
- 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 via the online Graduate School Application by December 15.

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding/) is available from the Graduate School. Be sure to check with your program for individual policies and restrictions related to funding.

PROGRAM RESOURCES

FINANCIAL SUPPORT FOR PHD STUDENTS IN ASTRONOMY

University fellowships or departmental assistantships are offered, contingent on satisfactory progress. The length of guaranteed student support is four continuous years for those with no prior graduate work. Three continuous years of funding are guaranteed for those with one year or more of prior graduate work. It is almost always the case that students remain fully funded through their thesis defense.

Teaching Assistants (TA) assist faculty members in the introductory Astronomy courses, generally by teaching discussion and laboratory sections. A graduate student is required to TA at least one semester. Research Assistants (RA) work with a major professor on a mutually agreed research program.

Tuition is remitted for TA and RA appointments. However, all students must still pay the segregated fees, which are about $725 per semester for full-time students, and any additional university fees.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirementstext), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

Face to Face	Evening/ Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students are able to complete a program with minimal disruptions to careers and other commitments.

Evening/Weekend: Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW-Madison Campus.

Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

Requirements	Detail
Minimum Credit Requirement	51 credits
Minimum Residence Credit Requirement	32 credits
Minimum Graduate Coursework Requirement	Half of degree coursework (26 credits out of 51 total credits) must be completed graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university's Course Guide (https://registrar.wisc.edu/course-guide (https://registrar.wisc.edu/course-guide/)/).
Overall Graduate GPA Requirement	3.00 GPA required.
Other Grade Requirements	A GPA of at least 3.0 is required in the core (required) courses and a student may have no more than 3 credits of a C or below. A grade of S must be received in ASTRON 990 Research and Thesis before the preliminary examination can be taken.
Assessments and Examinations	Students take one oral preliminary examination and one written preliminary examination after completing their second academic year. Students who pass are eligible to continue toward their Ph.D. If students do not wish to retake a failed exam, they may complete the requirements for a terminal master's. Doctoral candidates must submit a written dissertation proposal and make an oral presentation to the faculty by the end of their third academic year. A written dissertation must be submitted and successfully defended before a faculty committee.

Language Requirements	No language requirements.
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, 9 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, and one must be completed in physics. Courses with the Graduate Level Coursework attribute are identified and searchable in the university's Course Guide. Courses for the distributed minor or for minors outside of physics should be approved by the student's mentoring committee (or the graduate advisor if the mentoring committee has not yet been formed.)

REQUIRED COURSES

Code	Title	Credits
ASTRON 500	Techniques of Modern Observational Astrophysics	3
ASTRON 700	Basic Astrophysics I	2
ASTRON 702	Basic Astrophysics II	2
ASTRON 715	Stellar Interiors and Evolution	2
ASTRON 720	The Interstellar Medium I: Basic Processes	2
ASTRON 730	Galaxies	2
ASTRON 735	Observational Cosmology	2
ASTRON/ PHYSICS 910	Seminar in Astrophysics [1]	1-4
ASTRON 990	Research and Thesis [2]	1-12
Breadth Requirement		*9*
See PhD policy above on Doctoral Minor/Breadth Requirement for details.		
Total Credits		**51**

1. Barring course conflicts, students are expected to take this course every semester during their first two years for 1 credit each semester. Once students reach dissertator status, they no longer register for this course.
2. Beyond the other required courses listed, students typically take ASTRON 990 Research and Thesis credits to reach the total minimum credit requirement.

POLICIES

GRADUATE SCHOOL POLICIES

The Graduate School's Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy/) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

MAJOR-SPECIFIC POLICIES

PRIOR COURSEWORK

Graduate Work from Other Institutions

With program approval, students may count graduate coursework from other institutions. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

UW–Madison Undergraduate

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

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.

PROBATION

A grade of C or lower in a core course will result in the student being placed on academic probation. This is removed after the next grade of B or better in a core course. Grades of C or lower in two or more core courses will result in dismissal.

A semester GPA below 3.0 will result in the student being placed on academic probation. This will be removed if the student attains a GPA of 3.0 or above in the subsequent semester.

ADVISOR / COMMITTEE

All students will be assigned a mentoring committee consisting of the student's advisor and two other faculty members. Students are strongly encouraged (but not required) to meet with their mentoring committees twice a year in the first two years and annually thereafter.

CREDITS PER TERM ALLOWED

15 credits

TIME CONSTRAINTS

A candidate for a doctoral degree who fails to take the final oral examination and deposit the dissertation within five years after passing the preliminary examination may be required to take another preliminary examination and to be admitted to candidacy a second time.

GRIEVANCES AND APPEALS

These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (https://doso.students.wisc.edu/bias-or-hate-reporting/)
- Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/#grievance-procedure)
- Hostile and Intimidating Behavior Policies and Procedures (https://hr.wisc.edu/hib/)
  - Office of the Provost for Faculty and Staff Affairs (https://facstaff.provost.wisc.edu/)
- Dean of Students Office (https://doso.students.wisc.edu/) (for all students to seek grievance assistance and support)
- Employee Assistance (http://www.eao.wisc.edu/) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)

- Employee Disability Resource Office (https://employeedisabilities.wisc.edu/) (for qualified employees or applicants with disabilities to have equal employment opportunities)
- Graduate School (https://grad.wisc.edu/) (for informal advice at any level of review and for official appeals of program/departmental or school/college grievance decisions)
- Office of Compliance (https://compliance.wisc.edu/) (for class harassment and discrimination, including sexual harassment and sexual violence)
- Office of Student Conduct and Community Standards (https://conduct.students.wisc.edu/) (for conflicts involving students)
- Ombuds Office for Faculty and Staff (http://www.ombuds.wisc.edu/) (for employed graduate students and post-docs, as well as faculty and staff)
- Title IX (https://compliance.wisc.edu/titleix/) (for concerns about discrimination)

Students should contact the department chair or program director with questions about grievances. They may also contact the L&S Academic Divisional Associate Deans, the L&S Associate Dean for Teaching and Learning Administration, or the L&S Director of Human Resources.

OTHER

University fellowships or departmental assistantships are offered, contingent on satisfactory progress. The length of guaranteed student support is four continuous years for those with no prior graduate work. Three continuous years of funding are guaranteed for those with one year or more of prior graduate work. It is almost always the case that students remain fully funded through their thesis defense.

PROFESSIONAL DEVELOPMENT

GRADUATE SCHOOL RESOURCES

Take advantage of the Graduate School's professional development resources (https://grad.wisc.edu/pd/) to build skills, thrive academically, and launch your career.

PROGRAM RESOURCES

The goal of the graduate program is to prepare capable and creative astronomers for careers in research and education. Each student will have both a graduate student mentor and a set of three faculty mentors, called a “Committee of Three” (or Co3 for short). The Co3’s are expected to evolve into a Thesis Committee as the student progress towards their degree. The Committee of Three fosters more departmental collaborations and provides students with a broader advising perspective and regular feedback on their progress.

LEARNING OUTCOMES

1. 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.
2. Demonstrate academic mastery in their area of concentration, including a deep understanding of current theories, recent findings, and their broader implications.
3. Evaluate scientific literature and use it to construct theoretical frameworks and testable predictions for their own research projects.
4. Foster ethical and professional conduct.
5. 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.
6. Utilize modern instrumental, observational, or theoretical research techniques in their analysis.
7. Formulate ideas, designs, or techniques that advance the boundaries of knowledge within their field.
8. Critically evaluate the robustness and limits of conclusions drawn from their research and the potential for future studies.
9. Write clear and concise research articles for publication in refereed journals.
10. Critically evaluate the robustness and limits of conclusions drawn from their research and the potential for future studies.
11. Write clear and concise research articles for publication in refereed journals.
12. Deliver articulate oral presentations on their research to diverse audiences ranging from academic departments to the general public.
13. Serve as teaching assistants for at least one semester. 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 Richard Townsend (chair), Amy Barger, Matt Bershady, Sebastian Heinz, Alex Lazarian, Bob Mathieu, Snezana Stanimirovic, Christy Tremonti, Susanna Widicus Weaver, Eric Wilcots, and Ellen Zweibel

Associate Professor Elena D'Onghia

Assistant Professor Ke Zhang

Staff:
Department Administrator: Steve Anderson
Student Coordinator: Heather Sauer