ASTRONOMY, M.S.

The Department of Astronomy offers the doctor of philosophy in astronomy. Although a master's degree is offered, students 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; 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. The department is 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 arm for the Robert Stobie Spectrograph on SALT, and the design and testing of fiber bundle arrays for the Sloan Digital Sky Survey IV. UW scientists are also continuing to develop and operate the Wisconsin H-Alpha Mapper (WHAM), a uniquely powerful instrument dedicated to the study of the warm ionized gas in the Milky Way, and 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 maintains a variety of facilities to support numerical simulations. The main workhorse is a 72-node, 576-core cluster optimized for tightly coupled problems, such as hydrodynamics and magnetohydrodynamics. A number of smaller clusters are used for development, analysis and three-dimensional visualization.

ADMISSIONS

This master's program is offered for work leading to the Ph.D. Students may not apply directly for the master's, and should instead see the admissions information for the Ph.D (http://guide.wisc.edu/graduate/astronomy/astronomy-phd).

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 processes related to funding.

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

<table>
<thead>
<tr>
<th>Face to Face</th>
<th>Evening/Weekend</th>
<th>Online</th>
<th>Hybrid</th>
<th>Accelerated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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</table>

Mode of Instruction Definitions

**Evening/Weekend:** These programs are offered in an evening and/or weekend format to accommodate working schedules. Enjoy the advantages of on-campus courses and personal connections, while keeping your day job. For more information about the meeting schedule of a specific program, contact the program.

**Online:** These programs are offered primarily online. Many available online programs can be completed almost entirely online with all online programs offering at least 50 percent or more of the program work online. Some online programs have an on-campus component that is often designed to accommodate working schedules. Take advantage of the convenience of online learning while participating in a rich, interactive learning environment. For more information about the online nature of a specific program, contact the program.

**Hybrid:** These programs have innovative curricula that combine on-campus and online formats. Most hybrid programs are completed on-campus with a partial or completely online semester. For more information about the hybrid schedule of a specific program, contact the program.

**Accelerated:** These on-campus programs are offered in an accelerated format that allows you to complete your program in a condensed time-frame. Enjoy the

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_Astronomy, M.S._
advantages of on-campus courses with minimal disruption to your career. For more information about the accelerated nature of a specific program, contact the program.

CURRICULAR REQUIREMENTS

<table>
<thead>
<tr>
<th>Minimum Credit Requirement</th>
<th>34 credits</th>
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<tbody>
<tr>
<td>Minimum Residence Credit Requirement</td>
<td>16 credits</td>
</tr>
<tr>
<td>Minimum Graduate Coursework Requirement</td>
<td>Half of degree coursework (17 credits out of 34 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 (<a href="https://registrar.wisc.edu/course-guide/">https://registrar.wisc.edu/course-guide/</a>).</td>
</tr>
<tr>
<td>Overall Graduate GPA Requirement</td>
<td>3.00 GPA required</td>
</tr>
<tr>
<td>Other Grade Requirement</td>
<td>A grade of S must be received in ASTRON 990 Research and Thesis before the preliminary examination may be taken.</td>
</tr>
<tr>
<td>Assessments and Examinations</td>
<td>Students take a preliminary examination after completing their second academic year. Possible scores are &quot;high pass,&quot; &quot;low pass,&quot; and &quot;fail.&quot; Students attaining a high pass or a low pass are eligible for a master's. Students who fail will be dismissed from the program. To receive a terminal master's degree, students must complete a written master's thesis that is approved by their faculty advisor.</td>
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<tr>
<td>Language Requirements</td>
<td>No language requirements</td>
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REQUIRED Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</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>

Breadth Requirement

All M.S. students are required to complete 12 credits of coursework in relevant departments outside of astronomy. The coursework will normal 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 at the 600 level and above. Courses in departments other than physics should be approved by the student's mentoring committee (or the graduate advisor if the mentoring committee has not yet been formed.)

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

GRADUATE PROGRAM HANDBOOK

The Graduate Program Handbook (http://www.astro.wisc.edu/grad-students/phd-program) is the repository for all of the program's policies and requirements.

PRIOR COURSEWORK

Graduate Work from Other Institutions

With program approval, students are allowed to count no more than 17 credits of graduate coursework from other institutions. Coursework earned five or more years prior to admission to a master's 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 five or more years prior to admission to a master's 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.

CREDITS PER TERM ALLOWED

15 credits

TIME CONSTRAINTS

Master's degree students who have been absent for five or more consecutive years will be dismissed from the program.
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.

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. Identify sources and assemble evidence pertaining to questions or challenges in their area of concentration.
3. Synthesize knowledge from disparate sources and evaluate evidence for and against hypotheses.
4. Demonstrate academic mastery in their area of concentration, including an understanding of appropriate research methodologies, current theories, recent findings, and their broader implications.
5. Recognize and apply principles of ethical and professional conduct.

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