Graduate Teaching Experience

Although teaching is not a general Graduate College requirement, experience in teaching is considered an important part of the graduate experience in this program.

Faculty Research Interests

Research activity in the Department of Astronomy includes observational and theoretical investigations of a wide array of astronomical objects:

- Early-universe cosmology (inflation, particle dark matter, cosmic nucleosynthesis)
- Large-scale structure of the universe (cosmic microwave background, galaxy clusters)
- Extragalactic systems (galaxy structure and evolution, interacting galaxies, active galaxies, jets, and quasars)
- Interstellar medium (multiple phases, molecular clouds, HII regions, bubbles and superbubbles, planetary nebulae, supernova remnants, magnetic fields, and galactic structure)
- Stars (formation, structure and evolution, atmospheres, nucleosynthesis, novae, supernovae, pulsars, and stellar statistics)
- Compact objects (black holes, neutron stars, white dwarfs)

Theoretical astrophysics is also a strong research interest among many faculty members in the Department of Astronomy and the Department of Physics. Current activity centers on:

- Astrophysical fluid dynamics, magnetohydrodynamics and radiation hydrodynamics
- Physics of dense stellar matter
- Accretion phenomena
- High energy and relativistic astrophysics
- Cosmic inflation and structure formation
- Nuclear and particle processes in cosmology and astrophysics
- Black hole physics and astrophysics
- Gravitational lensing
- Gravitational wave phenomena

Facilities and Resources

- The Dark Energy Survey
- The Large Synoptic Survey Telescope
- The South Pole Telescope
- Astronomy students and faculty successfully compete for time on many space-based telescopes, including the Hubble, Planck, Spitzer, Herschel, Chandra, and Fermi.

A number of projects in the Department of Astronomy partner with the National Center for Supercomputing Applications (NCSA) at Illinois. These include development and application of astrophysical simulations such as the FLASH package and general relativistic magnetohydrodynamic codes that provide insight into the nature of structure formation and the physics of black holes. Astronomy faculty also leverage NCSA’s pioneering development of
cyberinfrastructure environments to facilitate data transport for the Sloan Digital Sky Survey (SDSS), the Dark Energy Survey, the Square Kilometer Array, and the Large Synoptic Survey Telescope. NCSA and the Astronomy Department also jointly founded the Laboratory for Cosmological Data Mining to apply novel algorithms to the rich datasets now available for cosmological analysis, including those from the SDSS and Wilkinson Microwave Anisotropy Probe.

- Illinois is the home of the Blue Waters National Petascale Computing Facility, one of the most powerful supercomputers in the world, and the most powerful on a university campus. A portion of Blue Waters time is dedicated to Illinois faculty, and Astronomy students and faculty use Blue Waters for their research.

**Financial Aid**

University fellowships are available and may be combined with part-time teaching assistantships. Most resident students are supported for their first two or three years by half-time teaching assistantships. The typical teaching assistant takes two or three graduate courses per semester and spends twenty hours per week handling quiz sections in elementary astronomy courses. Teaching assistantships are responsible positions, and the concomitant duties are considered to be a valuable part of the student’s educational experience. Advanced students may compete for research assistantships offered by faculty members whose research is partially supported by federal grants.

**Master of Science in Astronomy**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 501</td>
<td>Radiative Processes</td>
<td>4</td>
</tr>
<tr>
<td>ASTR 502</td>
<td>Astrophysical Dynamics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Additional formal coursework (excluding thesis research, non-thesis research, and independent study credit hours, e.g., ASTR 599, ASTR 590)</td>
<td>16</td>
</tr>
</tbody>
</table>

Research/Project/Independent Study Hours (e.g. ASTR 590; 4-8 min/max applied toward degree): 1

Based on Placement Exam results, students may be required to complete ASTR 404, ASTR 405, ASTR 406, and/or ASTR 414 during their first year. A maximum of 8 hours of these courses may be applied to the degree. 2

Total Hours: 32

**Other Requirements**

Other requirements may overlap

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of the additional formal coursework, the minimum number of hours in the unit (excluding thesis research, non-thesis research, and independent study credit hours)</td>
<td>8</td>
</tr>
<tr>
<td>Of the additional formal coursework, the minimum number of 500-level hours (excluding thesis research, non-thesis research, and independent study credit hours)</td>
<td>4</td>
</tr>
</tbody>
</table>

1 Research Project (minimum 4 hours)

- The student will complete a research project with an Astronomy Department faculty member (i.e. ASTR 590). A paper reporting the results is required, which must be prepared in scientific journal style and approved by the faculty member.

2 Demonstrated Proficiency in Astronomy

(1) ASTR 404, ASTR 405, ASTR 406 and ASTR 414

Students must show proficiency in the four courses by one of the following options:

- Pass the appropriate section of the placement exam (four sections aligned to the four courses), which is offered at the start of every Fall semester. A student can petition to take the exam once more the following year. The decision on petition approval by the graduate advisor will depend on the student’s background and proficiency plan.

- Pass the course with a B grade or better.

- Students who have had an equivalent course at another institution (B grade or better) may petition for those courses to count as proficiency.

3 For additional details and requirements refer to the department’s Graduate Programs (http://www.astro.illinois.edu/academics/graduate/programs) and the Graduate College Handbook (http://www.grad.illinois.edu/gradhandbook).

**Doctor of Philosophy in Astronomy**

**Entering with approved M.A./M.S. degree**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 501</td>
<td>Radiative Processes</td>
<td>8</td>
</tr>
<tr>
<td>&amp; ASTR 502</td>
<td>Astrophysical Dynamics</td>
<td>1</td>
</tr>
<tr>
<td>Based on Placement Exam results, students may be required to complete ASTR 404, ASTR 405, ASTR 406, and/or ASTR 414 during their first year. A maximum of 8 hours of these courses may be applied to the degree. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research/Project/Independent Study Hours (e.g. ASTR 590; 4-24 min/max applied toward degree)</td>
<td>32-52</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours: 64

**Other Requirements**

Other requirements may overlap

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students may add a graduate concentration in Astrochemistry.</td>
<td>1</td>
</tr>
<tr>
<td>Qualifying Exam Required</td>
<td>No</td>
</tr>
<tr>
<td>Preliminary Exam Required</td>
<td>Yes</td>
</tr>
<tr>
<td>Final Exam/Dissertation Defense Required</td>
<td>Yes</td>
</tr>
<tr>
<td>Dissertation Deposit Required</td>
<td>Yes</td>
</tr>
<tr>
<td>Minimum GPA:</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Doctor of Philosophy in Astronomy**

**Entering with approved B.A./B.S. degree**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 501</td>
<td>Radiative Processes</td>
<td>8</td>
</tr>
<tr>
<td>&amp; ASTR 502</td>
<td>Astrophysical Dynamics</td>
<td>1</td>
</tr>
<tr>
<td>Additional formal coursework (excluding thesis research, non-thesis research and independent study credit hours, e.g., ASTR 599, ASTR 590)</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Based on Placement Exam results, students may be required to complete ASTR 404, ASTR 405, ASTR 406, and/or ASTR 414 during their first year. A maximum of 8 hours of these courses may be applied to the degree. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research/Project/Independent Study Hours (e.g. ASTR 590; 4-32 min/max applied toward degree)</td>
<td>32-52</td>
<td></td>
</tr>
</tbody>
</table>

**Information listed in this catalog is current as of 06/2016**
<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 599</td>
<td>Thesis Research (min/max applied toward degree)</td>
<td>32-60</td>
</tr>
</tbody>
</table>

Total Hours 96

### Other Requirements

Other requirements may overlap

Students may add a graduate concentration in Astrochemistry.

#### First Summer Research Project (4 hours)

During the first summer in residence, each student will enroll in ASTR 590 (Independent Study) and will complete a research project with an Astronomy Department faculty member. A paper reporting the results is required, which must be prepared in scientific journal style and approved by the faculty member.

#### Master's Degree Required Before Admission to PhD?

No

#### Qualifying Exam Required

No

#### Preliminary Exam Required

Ph.D. Preliminary Examination consists of a written preliminary paper on the Ph.D. research topic and an oral examination. It must be passed by the end of the third year of study.

#### Final Exam/Dissertation Defense Required

Completion of an original research project culminating in a dissertation thesis publishable in whole or in part is required. The final examination is a defense of the doctoral dissertation.

#### Dissertation Deposit Required

Yes

#### Minimum GPA:

3.0

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1. Students entering with an approved M.A. or M.S. degree may proficiency out of ASTR 501 and ASTR 502 with departmental approval. Other 500-level ASTR graduate courses must be taken in the unit for substitute credit hours.

2. **Demonstrated Proficiency in Astronomy**
   (ASTR 404, ASTR 405, ASTR 406 and ASTR 414)

   Students must show proficiency in the four courses by one of the following options:
   - Pass the appropriate section of the placement exam (four sections aligned to the four courses), which is offered at the start of every Fall semester. A student can petition to take the exam once more the following year. The decision on petition approval by the graduate advisor will depend on the student's background and proficiency plan.
   - Pass the course with a B grade or better.
   - Students who have had an equivalent course at another institution (B grade or better) may petition for those courses to count as proficiency.

3. For additional details and requirements refer to the department's Graduate Programs (http://www.astro.illinois.edu/academics/graduate/programs) and the Graduate College Handbook (http://www.grad.illinois.edu/gradhandbook).

4. Of the additional formal coursework, 8 (with 4 in the unit) is the minimum number of hours in the unit (excluding thesis research, non-thesis research, and independent study credit hours).