

## ASTRONOMY

### Astronomy

College of Science, Engineering and Technology  
Department of Physics and Astronomy  
141 Trafton Science Center N • 507-389-5743  
Web site: [cset.mnsu.edu/pa/](http://cset.mnsu.edu/pa/)

Chair: Mark A. Pickar  
Paul Eskridge, Steven Kipp, Russell Palma, James Pierce

The astronomy program serves the needs of a wide range of students, from those with only a casual interest in the subject to those students planning careers in the field. The 100-level courses (which include general education offerings) are designed to introduce astronomy to the student with a minimal background in mathematics and the physical sciences. The courses taken by astronomy majors and minors cover a variety of topics in modern astronomy and astrophysics and require significant preparation in mathematics and physics.

The astronomy major serves as the first step toward a career in teaching or research in astronomy. Students majoring in astronomy are strongly encouraged to consider a double major with mathematics or physics.

**Admission to Major** is granted by the department. Minimum university admission requirements are

- a minimum of 32 earned semester credit hours.
- a minimum cumulative GPA of 2.00 ("C").

Contact the department for application procedures.

Many courses in the astronomy program require prerequisites. Students should consult the COURSE DESCRIPTIONS section of this bulletin to determine these courses.

#### POLICIES/INFORMATION

**GPA Policy.** Astronomy majors or minors must maintain a minimum 2.5 GPA in all coursework for their astronomy program, and in addition must earn a "C" or better for a course to apply to their major or minor. These standards apply to the courses required for the degree and their prerequisites. A minimum cumulative GPA of 2.0 is required for graduation. There are no prerequisite GPA requirements for internships.

Refer to the College regarding required advising for students on academic probation.

**P/N Grading Policy.** No more than one-fourth of the total undergraduate degree requirements may be earned in P/NC courses.

**Residency and Transfer Credit.** At least 30 hours of undergraduate credit must be earned at Minnesota State Mankato during the last two academic years.

Students majoring in astronomy have an advisor from their area of interest assigned to them. Questions and concerns pertaining to advising and the assignment of advisors can be answered by Angie B. Bomier, student relations coordinator, TR125 Trafton Science Center, telephone 389-1521.

The astronomers operate two observatories on the southern edge of the campus. The Standeford Observatory contains a 14-inch Schmidt-Cassegrain telescope, used for visual observations by general education students and other observatory visitors. Several other 10- to 13-inch telescopes are also available for instructional use by students in Astronomy 125. Andreas Observatory houses a 0.5-meter computer-controlled Cassegrain telescope. This instrument, which is equipped with photographic and electronic cameras and photometers, is used primarily for advanced instruction and faculty research. Standeford Observatory is open regularly for students and other visitors during the spring and the fall. Public viewing nights at Andreas Observatory are held occasionally during the year as weather permits.

### ASTRONOMY BS

Most professional astronomers hold a doctorate in astronomy or astrophysics; this major is designed to prepare students for graduate studies in these areas.

#### Required General Education

|      |     |                       |
|------|-----|-----------------------|
| MATH | 121 | Calculus I (4)        |
| PHYS | 221 | General Physics I (4) |

#### Required Support Courses

|      |     |                                     |
|------|-----|-------------------------------------|
| MATH | 122 | Calculus II (4)                     |
| MATH | 223 | Calculus III (4)                    |
| MATH | 321 | Ordinary Differential Equations (4) |
| PHYS | 222 | General Physics II (3)              |
| PHYS | 223 | General Physics III (3)             |
| PHYS | 232 | General Physics II Lab (1)          |
| PHYS | 233 | General Physics III Lab (1)         |
| PHYS | 335 | Modern Physics I (3)                |

#### Required for Major

|      |     |                                      |
|------|-----|--------------------------------------|
| AST  | 201 | Spherical Astronomy (2)              |
| AST  | 215 | Astronomy and Astrophysics I (4)     |
| AST  | 225 | Astronomy and Astrophysics II (4)    |
| AST  | 353 | Photometry I (2)                     |
| AST  | 354 | Photometry II (2)                    |
| AST  | 355 | Astrometry (2)                       |
| AST  | 357 | Spectroscopy (2)                     |
| AST  | 420 | Stellar Astrophysics (3)             |
| AST  | 421 | Stellar Structure (3)                |
| AST  | 430 | Galactic Structure (3)               |
| AST  | 431 | Extragalactic Astronomy (3)          |
| PHYS | 441 | Mechanics (4)                        |
| PHYS | 447 | Electricity and Magnetism I (3)      |
| PHYS | 448 | Electricity and Magnetism II (3)     |
| PHYS | 461 | Quantum Mechanics (4)                |
| PHYS | 465 | Computer Applications in Physics (3) |

**Required Minor: None.**

### ASTRONOMY MINOR

#### Required General Education

|      |     |                       |
|------|-----|-----------------------|
| MATH | 121 | Calculus I (4)        |
| PHYS | 221 | General Physics I (4) |

#### Required Support Courses

|      |     |                         |
|------|-----|-------------------------|
| MATH | 122 | Calculus II (4)         |
| PHYS | 222 | General Physics II (3)  |
| PHYS | 223 | General Physics III (3) |

#### Required for Minor

|     |     |                                   |
|-----|-----|-----------------------------------|
| AST | 125 | Observational Astronomy (3)       |
| AST | 201 | Spherical Astronomy (2)           |
| AST | 215 | Astronomy and Astrophysics I (4)  |
| AST | 225 | Astronomy and Astrophysics II (4) |

#### COURSE DESCRIPTIONS

##### AST 101 (3) Introduction to Astronomy

Broad survey of astronomy: the night sky, seasons, moon phases, eclipses, light, telescopes, stars, stellar evolution, galaxies, cosmology, the solar system.

Fall, Spring  
GE-3

##### AST 102 (3) Introduction to the Planets

Survey of our solar system: the sun, planets, moons, asteroids, comets, and meteoroids; history of the discovery and exploration of the solar system.

Fall, Spring  
GE-3

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## ASTRONOMY

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### **AST 104 (2) Introduction to Experimental Astronomy**

Experiments in astronomy; astronomical observations; measurement, interpretation, and analysis of various types of astronomical data.

Pre or Co-req: AST 101 or AST 102

Variable

GE-3

### **AST 115 (2) Life in the Universe**

The probability of extraterrestrial intelligent life; the chemical basis of life; planetary environments; habitable zones; the Drake equation; UFOs; space travel; interstellar communication; limits on technical civilizations.

Fall, Spring

GE-2, GE-3

### **AST 125 (3) Observational Astronomy**

Techniques for observing with naked eye, binoculars and small telescopes; constellation and star identification; use of star atlases and handbooks; observations of stars, binaries, clusters, nebulae, etc. Evening observing sessions required.

Pre: AST 101 or consent

Fall

### **AST 201 (2) Spherical Astronomy**

The celestial sphere; coordinate systems; sidereal and solar time; diurnal motion; precession; proper motion; refraction; aberration; parallax. Requires a background in trigonometry.

Spring

### **AST 215 (4) Astronomy and Astrophysics I**

Celestial mechanics; gravitational and tidal forces; stellar motions and parallax; radiation and matter; magnitudes and stellar spectra; binary stars and stellar masses; stellar structure and evolution.

Pre: MATH 121 and PHYS 221

Fall

### **AST 225 (4) Astronomy and Astrophysics II**

Stellar endpoints; close binary systems; variable stars; the Milky Way; normal galaxies; galactic evolution; active galaxies and quasars; cosmology.

Pre: AST 215, MATH 122, PHYS 222

Spring

### **AST 294 (1-6) Workshop**

A short course devoted to a specific astronomical topic. May be repeated for credit on each new topic.

Variable

### **AST 351 (1) Telescope Operations**

Telescope optics; operating the 0.5-meter telescope; pointing and guiding; preparation of observing lists and finder charts; operation of the telescope's ancillary equipment.

Pre: AST 201 and AST 215, Consent

Variable

### **AST 353 (2) Photometry I**

Photometric systems; observational techniques of point-source photometry; methods of data reduction; interpretation of data.

Pre: AST 215

ALT-Fall

### **AST 354 (2) Photometry II**

Observations of extended sources; photometric calibration of extended sources; use of secondary standard stars.

Pre: AST 353

ALT-Spring

### **AST 355 (2) Astrometry**

Reduction of digital images to determine positions, proper motions, and parallaxes of stars; analysis of errors.

Pre: AST 201 and AST 215

ALT-Spring

### **AST 357 (2) Spectroscopy**

Line identification; radial velocity determinations; spectral classification.

Pre: AST 225

ALT-Fall

### **AST 420 (3) Stellar Astrophysics**

Blackbody radiation; radiative transfer; atomic structure; spectroscopic notation; excitation; ionization; absorption and emission coefficients; line profiles; analysis of stellar spectra.

Pre: AST 225 and PHYS 223

ALT-Fall

### **AST 421 (3) Stellar Structure**

The gaseous state; degenerate matter; equations of stellar structure; polytropes; models of stellar interiors and atmospheres; stellar evolution; nucleosynthesis; stellar endpoints.

Pre: AST 420

ALT-Spring

### **AST 430 (3) Galactic Structure**

Structure, kinematics, and dynamics of our galaxy.

Pre: AST 225, PHYS 222, MATH 223

ALT-Fall

### **AST 431 (3) Extragalactic Astronomy**

Normal galaxies; groups and clusters of galaxies; galaxy interactions and mergers; active galactic nuclei; large-scale structure; galaxy formation and evolution; cosmology.

Pre: AST 430

ALT-Spring

### **AST 488 (1-4) Seminar**

May be repeated for credit on each new topic.

Pre: Consent

Variable

### **AST 491 (1-6) In-Service**

A course designed to upgrade the qualifications of persons on-the-job.

Variable

### **AST 493 (1-6) Undergraduate Research**

Students will conduct supervised research in astronomy.

Pre: Consent

Variable

### **AST 494 (1-6) Workshop**

A short course devoted to a specific astronomical topic. May be repeated for credit on each new topic.

Variable

### **AST 495 (1-4) Selected Topics**

A course in a particular area of astronomy not regularly offered. May be repeated for credit on each new topic.

Pre: Consent

Variable

### **AST 497 (1-16) Internship**

Provides a student the opportunity to gain expertise and experience in a special field under the supervision of a qualified person.

Pre: Consent

Variable

### **AST 499 (1-8) Individual Study**

Individual study under the guidance of an astronomy faculty member.

Pre: Consent

Fall, Spring