Twin Cities Campus

Astrophysics B.S.Astrop.

Astrophysics, Minnesota Institute for

College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2018
- Required credits to graduate with this degree: 120
- Required credits within the major: 84 to 86
- Degree: Bachelor of Science in Astrophysics

The astrophysics program enables students to tackle complex and ill-defined problems within the physical sciences. The program prepares students for careers in professional astronomy, computational astrophysics, secondary education in the physical sciences, ROTC programs in the Air Force or Navy, data analysis, or laboratory science.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

Students must complete 7 courses before admission to the program.

Freshman and transfer students students are usually admitted to pre-major status before admission to this major

For information about University of Minnesota admission requirements, visit the Office of Admissions website.

Required prerequisites
Mathematics Core
Calculus I
MATH 1271 - Calculus I [MATH] (4.0 cr)
or MATH 1371 - CSE Calculus I [MATH] (4.0 cr)
or MATH 1571H - Honors Calculus I [MATH] (4.0 cr)
Calculus II
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - CSE Calculus II (4.0 cr)
or MATH 1572H - Honors Calculus II (4.0 cr)
Linear Algebra and Differential Equations
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - CSE Linear Algebra and Differential Equations (4.0 cr)
or MATH 2574H - Honors Calculus IV (4.0 cr)

Physics Core
Physics I
PHYS 1301W - Introductory Physics for Science and Engineering I [PHYS, WI] (4.0 cr)
or PHYS 1401V - Honors Physics I [PHYS, WI] (4.0 cr)
or PHYS 1501V *{Inactive}*[PHYS, WI] (4.0 cr)
Physics II
PHYS 1302W - Introductory Physics for Science and Engineering II [PHYS, WI] (4.0 cr)
or PHYS 1402V - Honors Physics II [PHYS, WI] (4.0 cr)
or PHYS 1502V *{Inactive}*[PHYS, WI] (4.0 cr)
Physics III
PHYS 2303 - Physics III: Physics of Matter (4.0 cr)
or PHYS 2503H - Honors Physics III (4.0 cr)
or PHYS 2503 - Physics III: Intro to Waves, Optics, and Special Relativity (4.0 cr)
Lower Division Physics Requirement
PHYS 2201 - Introductory Thermodynamics and Statistical Physics (4.0 cr)

General Requirements

All students are required to complete general University and college requirements including writing and liberal education courses. For more information about University-wide requirements, see the liberal education requirements.Required courses for the major or minor in

which a student receives a D grade (with or without plus or minus) do not count toward the major or minor (including transfer courses).

Program Requirements

Core Coursework

Astrophysics Requirements

AST 2001 - Fundamental Astrophysics (4.0 cr)

Take 2 or more course(s) totaling 8 or more credit(s) from the following:

- AST 4001 - Astrophysics I (4.0 cr)
- AST 4002 - Astrophysics II (4.0 cr)
- AST 4031 - Interpretation and Analysis of Astrophysical Data (4.0 cr)
- AST 4041 - Computational Methods in the Physical Sciences (4.0 cr)
- AST 5012 - The Interstellar Medium (4.0 cr)
- AST 5022 - Relativity, Cosmology, and the Universe (4.0 cr)
- AST 5201 - Methods of Experimental Astrophysics (4.0 cr)

Physics Requirements

PHYS 2601 - Quantum Physics (4.0 cr)
PHYS 3041 - Mathematical Methods for Physicists (3.0 cr)
PHYS 3605W - Modern Physics Laboratory [WI] (3.0 cr)
PHYS 4001 - Analytical Mechanics (4.0 cr)
PHYS 4002 - Electricity and Magnetism (4.0 cr)
PHYS 4303 - Electrodynamics and Waves (3.0 cr)

Senior Project

This requirement can be met with directed research in astrophysics or a project tailored to the specific area of interest.

AST 4994W - Directed Research [WI] (2.0 - 5.0 cr)

Multivariable Calculus

MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2573H - Honors Calculus III (4.0 cr)
or MATH 2374 - CSE Multivariable Calculus and Vector Analysis (4.0 cr)

Upper Division Writing Intensive within the Major

Students are required to take one upper division writing intensive course within the major. If that requirement has not been satisfied within the core major requirements, students must choose one course from the following list. Some of these courses may also fulfill other major requirements.

Take 0 - 1 course(s) from the following:

- AST 4994W - Directed Research [WI] (2.0 - 5.0 cr)
- PHIL 3601W - Scientific Thought [WI] (4.0 cr)
- PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)
- HSCI 4121W - History of 20th-Century Physics [WI] (3.0 cr)
  or PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)

Technical Electives

All students must select at least 16 credits from the following (in consultation with your advisor). Some courses have been clustered into areas of interest to help with the selection of technical electives.

Take 16 or more credit(s) from the following:

- AST 4001 - Astrophysics I (4.0 cr)
- AST 4002 - Astrophysics II (4.0 cr)
- AST 4031 - Interpretation and Analysis of Astrophysical Data (4.0 cr)
- AST 4041 - Computational Methods in the Physical Sciences (4.0 cr)
- AST 5012 - The Interstellar Medium (4.0 cr)
- AST 5022 - Relativity, Cosmology, and the Universe (4.0 cr)
- AST 5201 - Methods of Experimental Astrophysics (4.0 cr)
- PHYS 4041 - Computational Methods in the Physical Sciences (4.0 cr)
- PHYS 4051 - Methods of Experimental Physics I (5.0 cr)
- PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)
- PHYS 4101 - Quantum Mechanics (4.0 cr)
- PHYS 4201 - Statistical and Thermal Physics (3.0 cr)
- PHYS 4611 - Introduction to Space Physics (3.0 cr)
- PHYS 4621 - Introduction to Plasma Physics (3.0 cr)
- MATH 2283 *{Inactive}*(3.0 cr)
- MATH 4512 - Differential Equations with Applications (3.0 cr)
- MATH 4567 - Applied Fourier Analysis (4.0 cr)
- MATH 5485 - Introduction to Numerical Methods I (4.0 cr)
- MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
- ESCI 3006 - Rocks and Stars: Introduction to Planetary Science (3.0 cr)
- EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)

- EE 3006 - Fundamentals of Electrical Engineering Laboratory (1.0 cr)

- **Data Analysis Specialist**

  Students interested in careers with corporate and government labs and research divisions, such as programming, image processing, laboratory instrumentation, and general data analysis are suggested to take elective credits from the following:

  Take 0 or more course(s) from the following:

  - AST 5201 - Methods of Experimental Astrophysics (4.0 cr)
  - CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
  - EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)
  - PHYS 4051 - Methods of Experimental Physics I (5.0 cr)
  - PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)

- **Professional Astronomer**

  Students interested in graduate school in astronomy are recommended to take elective credits including the following:

  Take 0 or more course(s) from the following:

  - PHYS 4101 - Quantum Mechanics (4.0 cr)
  - PHYS 4201 - Statistical and Thermal Physics (3.0 cr)

- **Secondary Education**

  Students interested in entry to a master's program for secondary education are recommended to take elective credits including the following, as well as complete 100 hours of in-class experience across at least two semesters:

  Take 0 or more course(s) from the following:

  - PSY 1001 - Introduction to Psychology [SOCS] (4.0 cr)
  - HSCI 1814 - Revolutions in Science: The Babylonians to Newton [HIS, GP] (3.0 - 4.0 cr)

    or HSCI 4121W - History of 20th-Century Physics [WI] (3.0 cr)
  - PHIL 1005 - Scientific Reasoning (4.0 cr)

    or PHIL 3601W - Scientific Thought [WI] (4.0 cr)
  - AST 5201 - Methods of Experimental Astrophysics (4.0 cr)

    or PHYS 3994 - Directed Research (1.0 - 5.0 cr)

    or PHYS 4994 - Directed Research (1.0 - 5.0 cr)
  - This course pair replaces AST 4994 in the student's program:
    - PHYS 4051 - Methods of Experimental Physics I (5.0 cr)

      PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)