

ASTROPHYSICAL AND PLANETARY SCIENCES - BACHELOR OF SCIENCE (BS)

The APS Department is one of the few programs to combine both astrophysics and planetary science. As a result, we provide a unified view of solar and space sciences, planetary systems (our Solar System and others), stellar and galactic astronomy, and cosmology. We also offer hands-on experience with telescopes, optics, instrumentation, computer image processing and computer modeling. These skills are useful for students wishing to pursue graduate degrees or careers in aerospace, technical or computer industries.

The BS in Astrophysical and Planetary Sciences shares the same foundational astronomy, math and physics course sequences as the BA in Astrophysical and Planetary Sciences, but then focuses on more advanced work in these topics. The BS degree is jointly administered with the Department of Physics and requires substantial upper-division work in this field. Upon graduation with a BS in Astrophysical and Planetary Sciences, students will have solid theoretical and applied training for careers or graduate studies in the space sciences. For more detailed information, visit the department website.

The University of Colorado is recognized as a top university in the exploration and study of space. Our faculty members carry out forefront research in a wide range of disciplines, from theoretical cosmology to finding planets around other stars, from observing cosmic microwave background in Antarctica to building space probes to explore Mars' atmosphere. We offer many types of research opportunities for undergraduates including research-based courses, student positions that support research programs and individual research projects with faculty. Students can apply for funding from the Undergraduate Research Opportunities Program. The Honors Program (<https://www.colorado.edu/aps/undergraduate-students/honors-program/>) encourages students to write research theses to qualify for Latin Honors upon graduation.

We encourage all students to explore and share their enthusiasm for science and we support a wide range of extra-curricular activities. These include student groups, the Learning Assistant program, research activities and public outreach. The Sommers-Bausch Observatory (<https://www.colorado.edu/sbo/>) and Fiske Planetarium (<https://www.colorado.edu/fiske/>) offer opportunities for undergraduate students to become involved.

We offer students the ability to graduate with honors. Students must maintain a minimum GPA and write and defend an honors thesis. More information can be obtained from the APS department office and/or the Honors Council Representative. More general information about the honors thesis is on CU Boulder's Honors Program page (<https://www.colorado.edu/honors/>).

Requirements

The Astrophysical and Planetary Sciences - BS physics emphasis option is jointly administered by the APS and Physics Departments. Students in this path are not eligible to pursue a Physics Plan 2 (with Astrophysics focus) major or a physics minor.

For students aiming for a graduate program in astrophysics or planetary sciences. Similar to Physics Plan 2 (Astrophysics focus), with additional astrophysics instrumentation labs and different electives.

Students must complete a minimum of 23 credits in astrophysical and planetary sciences and a minimum of 28 credits in physics (this must include at least 15 upper-division credits in astronomy and 12 in physics).

Through the required coursework for this path of the major, students will fulfill all 12 credits of the Natural Sciences area of the Gen. Ed. Distribution Requirement, including the lab component, and the QRMS component of the Gen. Ed. Skills Requirement.

For more information, view the Physics Emphasis Flowchart (<https://www.colorado.edu/aps/media/253/>).

Required Courses and Credits

Code	Title	Credit Hours
Lower-Division Coursework		
The following courses are required:		
ASTR 1030 & ASTR 1040	Accelerated Introductory Astronomy 1 and Accelerated Introductory Astronomy 2	8
PHYS 1115 & PHYS 1125 & PHYS 1140	General Physics 1 for Majors and General Physics 2 for Majors and Experimental Physics 1 ¹	9
PHYS 2170 & PHYS 2150	Foundations of Modern Physics and Experimental Physics 2	4
PHYS 2210	Classical Mechanics and Mathematical Methods 1	3
Upper-Division Coursework		
The following physics courses are required:		
PHYS 3310	Principles of Electricity and Magnetism 1	3
PHYS 3320	Principles of Electricity and Magnetism 2	3
PHYS 3210	Classical Mechanics and Mathematical Methods 2	3
PHYS 3220	Quantum Mechanics 1	3
Select one of the following two astronomy sequences (6-hour minimum):		6
ASTR 3720 & ASTR 3750	Planets and Their Atmospheres and Planets, Moons, and Rings	9
ASTR 3730 & ASTR 3830	Astrophysics 1 - Stellar and Interstellar and Astrophysics 2 - Galactic and Extragalactic	
Astronomy Electives		
Select three additional courses from the following or from those sequence courses not used above (9-hour minimum):		9
ASTR 3400	Research Methods in Astronomy	
ASTR 3510	Observations and Instrumentation 1	
ASTR 3520	Observations and Instrumentation 2	
ASTR 3560	Astronomical Instrumentation Laboratory	
ASTR 3710	Formation & Dynamics of Planetary Systems	
ASTR 3740	Cosmology and Relativity	
ASTR 3760	Solar and Space Physics	

ASTR 3800	Introduction to Scientific Data Analysis and Computing	
ASTR 4330	Cosmochemistry	
ATOC 4710	Introduction to Atmospheric Physics	
ATOC 4720	Atmospheric Dynamics	
Any ASTR 5000- or 6000-level course with instructor's permission		
Total Credit Hours		51

¹ Or equivalent PHYS 1110, PHYS 1120 & PHYS 1140 sequence.

Required Ancillary Calculus Coursework

Code	Title	Credit Hours
Select one of the following sequence of courses:		16-19
APPM 1350 & APPM 1360 & APPM 2350 & APPM 2360	Calculus 1 for Engineers and Calculus 2 for Engineers and Calculus 3 for Engineers and Introduction to Differential Equations with Linear Algebra	
MATH 1300 & MATH 2300 & MATH 2400 & APPM 2360	Calculus 1 and Calculus 2 and Calculus 3 and Introduction to Differential Equations with Linear Algebra	
Total Credit Hours		16-19

Recommended Physics Electives

Code	Title	Credit Hours
PHYS 4150	Plasma Physics	
PHYS 4230	Thermodynamics and Statistical Mechanics	
PHYS 4410	Quantum Mechanics 2	
PHYS 4420	Nuclear and Particle Physics	
PHYS 4510	Optics	

Plan(s) of Study

Physics Emphasis

Year One

Fall Semester		Credit Hours
ASTR 1030	Accelerated Introductory Astronomy 1	4
PHYS 1115	General Physics 1 for Majors	4
APPM 1350 or MATH 1300	Calculus 1 for Engineers or Calculus 1	4-5
Gen Ed Skills course / FYSM		3
Credit Hours		15-16

Spring Semester

ASTR 1040	Accelerated Introductory Astronomy 2	4
APPM 1360 or MATH 2300	Calculus 2 for Engineers or Calculus 2	4-5
PHYS 1125	General Physics 2 for Majors	4
PHYS 1140	Experimental Physics 1	1

Gen Ed Distribution/Diversity course	3
Credit Hours	16-17

Year Two

Fall Semester

APPM 2350	Calculus 3 for Engineers	4
PHYS 2170	Foundations of Modern Physics	3
PHYS 2150	Experimental Physics 2	1
Gen Ed Distribution course (example: Social Sciences)		3
Elective		3

Credit Hours **14**

Spring Semester

PHYS 2210	Classical Mechanics and Mathematical Methods 1	3
ASTR 2600	Introduction to Scientific Programming (recommended, not required)	3
APPM 2360	Introduction to Differential Equations with Linear Algebra	4
Gen Ed Distribution/Diversity course (example: Social Sciences/US Perspective)		3
Elective		3

Credit Hours **16**

Year Three

Fall Semester

ASTR 3730 or ASTR 3710	Astrophysics 1 - Stellar and Interstellar (part one of required sequence) or Formation & Dynamics of Planetary Systems	3
ASTR 3400	Research Methods in Astronomy (Or Upper Division ASTR-Elective)	3
PHYS 3210	Classical Mechanics and Mathematical Methods 2	3
PHYS 3310	Principles of Electricity and Magnetism 1	3
Gen Ed Distribution course		3

Credit Hours **15**

Spring Semester

ASTR 3830 or ASTR 3720	Astrophysics 2 - Galactic and Extragalactic (part two of required sequence) or Planets and Their Atmospheres	3
PHYS 3220	Quantum Mechanics 1	3
PHYS 3320	Principles of Electricity and Magnetism 2	3
Gen Ed Skills Course (Upper Division Writing)		3
Gen Ed Upper Division course / Elective		3

Credit Hours **15**

Year Four

Fall Semester

ASTR Upper-division Elective		3
PHYS 4230	Thermodynamics and Statistical Mechanics (recommended, not required)	3
Gen Ed Course or Upper Division Elective		3
Upper-Division Elective or ASTR Independent Study or Research (would not count for ASTR Upper Division Credit)		3
Upper-Division Elective or ASTR Upper-Division Elective		3

Credit Hours **15**

Spring Semester

PHYS 4410	Quantum Mechanics 2 (recommended, not required)	3
ASTR Upper-division Elective or ASTR Independent Study or Research (would not count for ASTR Upper Division Credit)		3
ASTR Upper-division Elective		3
Upper-Division Elective		3
Gen Ed Distribution course		3
Credit Hours		15
Total Credit Hours		121-123

Learning Outcomes

By the completion of the program, students will be able to:

- Solve quantitative or conceptual problems across the core areas of astrophysics planetary sciences by applying relevant models, theories, and technical approaches.
- Analyze and evaluate scientific information in order to describe a question at the frontier of an astronomical discipline.
- Follow scientific practices to conduct experiments, collect and analyze data, report findings in a scientific manner.
- Present a scientific concept to a variety of audiences including experts and/or the general public
- Use computational programming to perform quantitative analysis and/or produce data visualizations.