

# Astronomy

Astronomy courses are offered primarily through the Physics department, with subject code PHYSICS (<http://explorecourses.stanford.edu/CourseSearch/search?view=catalog&catalog=&page=0&q=PHYSICS&filter-catalognumber-PHYSICS=on>) on the Stanford Bulletin's ExploreCourses (<http://explorecourses.stanford.edu/CourseSearch/search?view=catalog&catalog=&page=0&q=PHYSICS&filter-catalognumber-PHYSICS=on>) website.

Although Stanford University does not have a degree program in astronomy or astrophysics, teaching and research in various branches of these disciplines are ongoing activities in the departments of Applied Physics, Electrical Engineering, and Physics.

For the convenience of students interested in astronomy, astrophysics, and cosmology, a course program for undergraduate and graduate study is listed in the "Astronomy Cognate Courses (p. 2)" section of this bulletin.

The list includes introductory courses for the student who wishes to be informed about the fields of astronomy without the need for prerequisites beyond high school algebra and physics. Courses in astronomy numbered below 100 are designed to serve this group of students. Astronomy courses numbered 100-199 serve the student interested in an initial scientific study of astronomy. The courses numbered 200 and above are for graduate students and advanced undergraduates, subject to prior approval by the course instructor.

## Undergraduate Programs in Astronomy

The University does not offer a separate undergraduate major in Astronomy. Students who intend to pursue graduate study in astronomy or space science are encouraged to major in physics, following the advanced sequence if possible, or in electrical engineering if the student has a strongly developed interest in radioscience. The course descriptions for these basic studies are listed under the appropriate department sections of this bulletin. Students desiring guidance in developing an astronomy-oriented course of study should contact the chair of the Astronomy Program Committee. The following courses are suitable for undergraduates and are recommended to students considering advanced study in astronomy or astrophysics:

	<b>Units</b>
PHYSICS 100 Introduction to Observational Astrophysics	4
PHYSICS 160 Introduction to Stellar and Galactic Astrophysics	3
PHYSICS 161 Introduction to Cosmology and Extragalactic Astrophysics	3
GS 222 Planetary Systems: Dynamics and Origins	3-4
Students planning study in astronomy beyond the B.S. are urged to take:	
PHYSICS 262 General Relativity	3

The above-mentioned courses are required for physics majors who choose the curriculum with a concentration in astrophysics (see the "Physics (<http://exploreddegrees.stanford.edu/schoolofhumanitiesandsciences/physics>)" section of this bulletin).

## Stanford Student Observatory

The student observatory, located in the hills to the west of the campus, is equipped with a 24-inch and other small reflecting telescopes. It is used for instruction of the observation-oriented courses, PHYSICS 50 Observational Astronomy Laboratory and PHYSICS 100 Introduction to Observational Astrophysics.

The Department of Physics offers a minor in Physics with a concentration in Astronomy.

## Minor in Physics with Concentration in Astronomy

Students wishing to pursue advanced work in astrophysical sciences should major in Physics (<http://exploreddegrees.stanford.edu/schoolofhumanitiesandsciences/physics/#bachelorstext>) and concentrate in astrophysics. However, students outside of Physics with a general interest in astronomy may organize their studies by completing one of the following Physics minor concentration programs.

Students who take the 20, 40, or 60 series at Stanford in support of their major may count those units towards the minor.

An undergraduate Physics minor with a concentration in Astronomy requires the following courses:

### Non-Technical

For students whose majors do not require the PHYSICS 40 or 60 series:

	<b>Units</b>
PHYSICS 21 Mechanics Fluids and Heat	4
PHYSICS 23 Electricity, Magnetism, and Optics	4
PHYSICS 25 Modern Physics	4
& PHYSICS 26 and Modern Physics Laboratory	
PHYSICS 50 Observational Astronomy Laboratory	3-4
or PHYSICS 100 Introduction to Observational Astrophysics	
Select two of the following:	6
PHYSICS 15 Stars and Planets in a Habitable Universe	
PHYSICS 16 The Origin and Development of the Cosmos	
PHYSICS 17 Black Holes and Extreme Astrophysics	
<b>Total Units</b>	<b>21-22</b>

### Technical

For students whose majors require the PHYSICS 40 or 60 series:

	<b>Units</b>
Select one of the following Series:	14-17
Series A	
PHYSICS 41 Mechanics	
PHYSICS 43 Electricity and Magnetism	
PHYSICS 45 Light and Heat	
& PHYSICS 46 and Light and Heat Laboratory	
PHYSICS 70 Foundations of Modern Physics	
Series B	
PHYSICS 61 Mechanics and Special Relativity	
PHYSICS 63 Electricity, Magnetism, and Waves	
PHYSICS 65 Quantum and Thermal Physics	
PHYSICS 67 Introduction to Laboratory Physics	
And take the following three courses:	
PHYSICS 100 Introduction to Observational Astrophysics	4
PHYSICS 160 Introduction to Stellar and Galactic Astrophysics	3
PHYSICS 161 Introduction to Cosmology and Extragalactic Astrophysics	3
<b>Total Units</b>	<b>24-27</b>

Students are also encouraged to take the electricity and magnetism/optics lab of the appropriate PHYSICS series, PHYSICS 24, PHYSICS 44 or PHYSICS 64 for 1 additional unit.

## Graduate Programs in Astronomy

Graduate programs in astronomy and astrophysics and related topics are carried out primarily in the Department of Physics but also the departments of Applied Physics and Electrical Engineering. Students should consult the course listings, degree requirements, and research programs of these departments for more detailed information.

Graduate research opportunities are available in many areas of theoretical and observational astronomy. For further information, see the Kavli Institute of Particle Astrophysics and Cosmology (<http://kipac.stanford.edu>) website.

### Students planning to conduct research in astronomy and astrophysics should take:

Select one of the following:	Units
PHYSICS 361 Cosmology	3
PHYSICS 362 Advanced Extragalactic Astrophysics and Cosmology	

### Students lacking a background in astrophysics, gravitation, and plasma physics should take:

PHYSICS 260 Introduction to Stellar and Galactic Astrophysics	3
PHYSICS 261 Introduction to Cosmology and Extragalactic Astrophysics	3
PHYSICS 262 General Relativity	3
PHYSICS 312 Basic Plasma Physics (Not offered 2015-16)	3

### Students with special interests in gravitation should take:

PHYSICS 364 Advanced Gravitation (Not offered 2014-15)	3
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Each year a number of "special topics" course are offered. Refer to courses in the PHYSICS 360 range for more details. Students interested in research programs in space physics involving spacecraft studies of the planets, their satellites, and their near-space environments should see the "Center for Space Science and Astrophysics (<http://exploreddegrees.stanford.edu/centerslaboratoriesandinstitutes/#spacesciencetext>)" section of this bulletin.

*Emeriti: (Professors)* Von R. Eshleman, Peter A. Sturrock, G. Leonard Tyler, Robert V. Wagoner

*Professors:* Roger Blandford (Physics, SLAC), Pat Burchat (Physics), Blas Cabrera (Physics), Sarah Church (Physics), Kent Irwin (Physics, SLAC), Steven Kahn (Physics, SLAC), Chao-Lin Kuo (Physics, SLAC), Bruce Macintosh (Physics), Peter Michelson (Physics), Vahé Petrosian (Physics, Applied Physics), Roger W. Romani (Physics)

*Associate Professors:* Steve Allen (Physics, SLAC), Tom Abel (Physics, SLAC), Chao-Lin Kuo (Physics, SLAC), Risa Wechsler (Physics, SLAC)

*Professor (Research):* Philip H. Scherrer (Physics)

## Astronomy Cognate Courses

### Elementary Lectures

The following courses provide a descriptive knowledge of astronomical objects and astrophysics. PHYSICS 15, PHYSICS 16, and PHYSICS 17 are for students not majoring in the sciences and are taught in different quarters by different instructors, and may be taken individually or in any order.

	Units
PHYSICS 15 Stars and Planets in a Habitable Universe	3

PHYSICS 16 The Origin and Development of the Cosmos	3
PHYSICS 17 Black Holes and Extreme Astrophysics	3

## Observatory

The following courses allow students to use the on-campus Stanford Student Observatory, and are intended to familiarize students with observational methods and analysis of astronomical data. PHYSICS 50 is for general students, while PHYSICS 100 involves more advanced observations and is intended for students with a college level background in physics.

	Units
PHYSICS 50 Observational Astronomy Laboratory	3
PHYSICS 100 Introduction to Observational Astrophysics	4

## Advanced Undergraduate

The following courses are for students with a more advanced knowledge of basic physics and mathematics, and form the core courses for a concentration in astrophysics for Physics majors.

	Units
PHYSICS 160 Introduction to Stellar and Galactic Astrophysics	3
PHYSICS 161 Introduction to Cosmology and Extragalactic Astrophysics	3

## Graduate

	Units
GES 222	3-4
PHYSICS 260 Introduction to Stellar and Galactic Astrophysics	3
PHYSICS 261 Introduction to Cosmology and Extragalactic Astrophysics	3
PHYSICS 262 General Relativity	3
PHYSICS 301 Astrophysics Laboratory (Not offered 2014-15)	3
PHYSICS 312 Basic Plasma Physics (Not offered 2014-15)	3
PHYSICS 361 Cosmology (Not offered 2014-15)	3
PHYSICS 362 Advanced Extragalactic Astrophysics and Cosmology (Not offered 2014-15)	3