UNIVERSITY of VIRGINIA
DEPARTMENT of PHYSICS

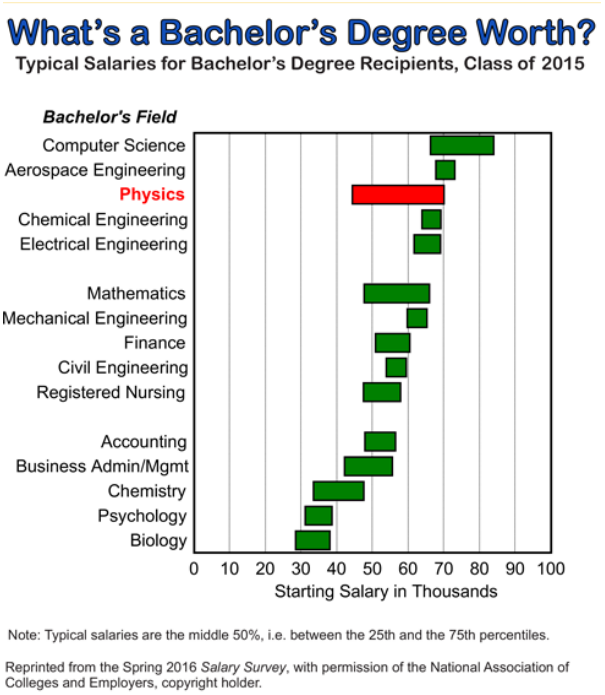
Undergraduate Physics Degree Programs (2024-25)

Physics is concerned with the most basic principles that underlie all phenomena in the universe. Physicists ask, "How does the world work?" They search for the most elementary particles; they seek to understand the emergent behavior of systems ranging from quarks in nuclei to stars in galaxies; they strive for insights into the nature of space, time, matter and energy. On a more human scale, physicists study an enormous range of topics including all the devices of modern electronics, complex biological molecules, the environment and atmosphere, and novel energy resources. Studying physics prepares some students to push back the boundaries of knowledge in this most fundamental of the natural sciences. For others it provides training in the concepts and methods of science for application in a variety of professional areas. All students of physics benefit from excellent problem-solving skills and a deep understanding of technology in modern society.

Physics majors at UVa are an outstanding, enthusiastic and diverse group. Typically, about fifty students graduate each year with bachelor's degrees in Physics. These students have a wide range of interests, and many have double majors. Recent second majors include anthropology, biology, chemistry, economics, English, environmental science, French, German, government, history, mathematics, music, philosophy, psychology, religious studies, Slavic, and studio art, along with all fields of engineering.

Approximately half of our BS Physics and BS Astronomy/Physics majors enter the work force after graduation, where their employment opportunities are excellent. Large companies where our graduates have recently started include KPMG, Epic, NOVA, Exxon Mobile, General Dynamics, GE Lighting, Rolls Royce, McKinsey, and Booz Allen Hamilton. Entry-level salaries for physics majors are similar to those in other technical fields, as illustrated in the graph below. Copious information about careers in physics is available from the American Physical Society, the American Institute for Physics, and the national Society for Physics Students.

The other half of our majors go on to graduate or professional schools, many at top-ranked universities where they are very successful. Recent graduates have attended UC Berkeley, UC Santa Barbara, Cal Tech, Chicago, Cornell, Princeton, Duke, Georgia Tech, Harvard, Toronto, Johns Hopkins, Michigan, MIT, Stanford, and Yale. While the majority of these students continue their physics studies, others go on to professional schools in medicine, education, business and law.



All together, physics offers an unparalleled combination of intellectual satisfaction and career prospects. If this sounds appealing, get in contact with a physics advisor and let us tell you more about it!

If you are curious about how a physics degree may fit your interests, please contact one of the physics undergraduate advisers listed below to learn about the various possibilities and to design a program to fit your specific needs. No prerequisite classes have to be taken before a Physics Major or Minor is declared.

Undergraduate Advisors	**Office**	**Office Phone**	**Email Address**
Gai-Wei Chern	Physics 310C	924-4276	gc6u@virginia.edu
Craig Group	HEP 113	243-5552	rcg6p@virginia.edu
Bob Hirosky	HEP 101	982-5721	rjh2j@virginia.edu
Kent Paschke	Physics 163	924-4543	paschke@virginia.edu
Olivier Pfister	Physics 309	924-7956	op6n@virginia.edu
Jency Sundararajan	Physics 022B	243-8016	zey9gt@virginia.edu
Jongsoo Yoon	Physics 063	982-2197	jy2b@virginia.edu
Cass Sackett	Physics 311	924-6795	cas8m@virginia.edu

REQUIREMENTS: BACHELOR OF ARTS (BA) IN PHYSICS

The Physics BA degree is designed for students interested in physics but planning to enter professional schools in business, education, law, and medicine, and for liberal arts students desiring a strong background in physical science but with career objectives in other areas. It is a highly flexible program that you can customize to support your specific interests, wherever they may lie. Official information regarding the major requirements is available in the Undergraduate Record.

While it is not required, we recommend that prospective physics majors take PHYS 1930 (Physics in the 21st Century), which introduces many of the 'big ideas' in physics, provides an overview of potential career paths, and helps connect students with research opportunities in the department.

There are three groups of courses that are needed for the BA degree:

(1) MATH 2310[1] and PHYS 1420, 1429, 2410, 2419
(2) MATH 3250 and PHYS 2620, 2720
(3) Four courses chosen from PHYS 2660 and/or 3000-level physics courses

A sample course schedules is shown on page 8.

The classification of the courses into prerequisites and requirements, and into components, reflects the order in which classes are taken. Physics courses are more sequential than courses in some other majors. Each course descriptions in SIS may list other courses that are expected to be taken earlier (pre-requisites), or concurrently (co-requisites).

Students can substitute APMA 2120 (Multivariable Calculus) for MATH 2310 (Calculus III), APMA 2130 (Applied Differential Equations) for MATH 3250 (Ordinary Differential Equations), PHYS1425 (Introductory Physics 1 for Engineers) for PHYS 1420 (Introductory Physics 1), and PHYS 2415 (Introductory Physics 2 for Engineers) for PHYS 2410 (Introductory Physics 2). Electrical and Computer Engineering Students can substitute PHYS 2415 and PHYS 2419 with ECE 3209 (Electromagnetic Fields).

The elective courses PHYS 3110 (Widely Applied Physics), PHYS 3120 (Applied Physics: Energy), and PHYS 3140 (Intermediate Lab) can be used to complete a strong preparation in applied physics. These courses are designed to make use of the concepts learned in the introductory courses to understand some modern applications with a focus on energy production and use. PHYS 3630 (Computational Physics) is another good choice for students interested in computation, or PHYS 3040 (Physics of the Human Body) for students with interest in biology or medicine. Students completing the B.A. program have an outstanding record of success in admission to medical, law, business, and education schools.

All required courses must be passed with a minimum grade of C, and a grade point average of at least 2.000 must be achieved in these courses for graduation. Required courses are those listed as component (2) and (3) above, and their substitutes. The Schools impose other requirements for graduation; e.g. students in the College of Arts and Sciences need to earn a certain number of credits, and, if not Echols scholars, must fulfill General Education requirements.

[1] MATH 2310 is the last of a course sequence that includes MATH 1310 and MATH 1320

3000-level courses that are chosen often as electives and that are offered regularly:

PHYS 3040	Physics of the Human Body	[3]
PHYS 3110	Widely Applied Physics	[3]
PHYS 3120	Applied Physics: Energy	[3]
PHYS 3140	Intermediate Lab	[4]
PHYS 3150	Electronics	[3]
PHYS 3170	Advanced Lab A	[3]
PHYS 3180	Advanced Lab B	[3]
PHYS 3250	Applied Nuclear Physics	[3]
PHYS 3620	Introduction to Condensed Matter Physics	[3]
PHYS 3995	Research	[3]

Classes that are admissible, but directed towards the BS majors, include:

PHYS 3210	Classical Mechanics	[3]
PHYS 3310	Statistical Physics	[3]
PHYS 3420, 3430	Electricity and Magnetism I, II	[3,3]
PHYS 3650, 3660	Quantum Mechanics I, II	[3,3]

REQUIREMENTS: BACHELOR OF SCIENCE (BS) IN PHYSICS

The Physics BS degree is designed for students who are planning graduate study in physics or physics-related areas, or who are planning careers in a scientific or technical field. The program provides intensive preparation in physics and lays a solid foundation for a lifetime of discovery. Official information regarding the major requirements is available in the Undergraduate Record.

While it is not required, we recommend that prospective physics majors take PHYS 1930 (Physics in the 21st Century), which introduces many of the 'big ideas' in physics, provides an overview of potential career paths, and helps connect students with research opportunities in the department.

There are three groups of courses that are needed for the B.S. degree:

(1) MATH 2310[2] and PHYS 1420, 1429, 2410, 2419
(2) MATH 3250, PHYS 2620, 2720 and either PHYS 1655 or PHYS 3630
(3) MATH 4220, and PHYS 3140, 3170 or 3180, 3210, 3310, 3340, 3420, 3430[3], 3650, 3660, 3995 and one 3000-5000 level Physics elective.

Sample course schedules are shown on pages 9, 10 and 11.

Students can substitute APMA 2120 (Multivariable Calculus) for MATH 2310 (Calculus III), APMA 2130 (Applied Differential Equations) for MATH 3250 (Ordinary Differential Equations), APMA 3140 (Applied Partial Differential Equations) for MATH 4220 (Partial Differential Equations), PHYS1425 (Introductory Physics 1 for Engineers) for PHYS 1420 (Introductory Physics 1), and PHYS 2415 (Introductory Physics 2 for Engineers) for PHYS 2410 (Introductory Physics 2).

Three special concentrations can be pursued by students in either the BA or the BS programs: A Computational Physics Concentration (PHYS 5630, 5640 Computational Physics I, II); an Optics Concentration (PHYS 5310 Optics and PHYS 5320 Fundamentals of Photonics); and an Experimental Physics Concentration (PHYS 3150 Electronics, and both of PHYS 3170 Advanced Laboratory 1, and PHYS 3180 Advanced Laboratory 2).

A grade point average of at least 2.0 for all the required courses with a minimum grade of C must be achieved for graduation. Required courses are the ones listed as components (2) and (3) above, and their substitutes. The School imposes other requirements for graduation; e.g. students in the College of Arts and Sciences need to earn a certain number of credits, and, if not Echols scholars, have to fulfill General Education requirements.

Distinguished Major Program - This program provides recognition of outstanding academic performance in a challenging sequence of Physics courses including a research project. Students who complete the BS requirements with final grade point averages exceeding 3.4, 3.6, or 3.8, are given departmental recommendation to receive their degrees with distinction, high distinction, or highest distinction, respectively.

[2] MATH2310 is the last of a course sequence that includes MATH1310 and MATH1320

[3] Your advisor may allow substituting PHYS 3430 with PHYS 5310 (Optics), in which case PHYS 5310 would not double-count as an elective. Students that plan to continue in graduate school in physics should take PHYS 3430.

REQUIREMENTS: BACHELOR OF SCIENCE IN ASTRONOMY/PHYSICS

The Astronomy/Physics BS is an interdepartmental major administered jointly with the Astronomy Department. The program prepares a student for graduate study in either astronomy or physics, or in related fields. Students in this major have advisors both from Astronomy and Physics. Official information regarding the major requirements is available in the Undergraduate Record.

While it is not required, we recommend that prospective majors take ASTR 1610 (Introduction to Astronomy Research), which introduces many of the 'big ideas' in astronomy and helps connect students with research opportunities in the department.

Students take MATH 1310, 1320, 2310, 3250, 4220; PHYS 1420, 1429, 2410, 2419, 2620, 1655 or 3630, 2720, 3210, 3310, 3420, 3430, 3650; ASTR 2110, 2120, 3130, 4998 (Senior Thesis), and six additional credits of 3000-5000 level astronomy courses. A sample course schedule is shown on page 12.

Students can substitute PHYS1425 (Introductory Physics 1 for Engineers) for PHYS 1420 (Introductory Physics 1), and PHYS 2415 (Introductory Physics 2 for Engineers) for PHYS 2410 (Introductory Physics 2).

Distinguished Astronomy-Physics Major Program - Students must maintain a GPA of 3.400 or better. For the Distinguished Majors Program (DMP), students must meet the requirements of the astronomy-physics major described above, must complete either PHYS 3660 or any PHYS course at the 5000-level, complete a two-semester Senior Thesis (ASTR 4998), and complete at least two ASTR courses at the 4000 or 5000-level (excluding ASTR 4993 and 4998) as part of the six credits of elective astronomy courses. This program leads to the award of degrees with distinction, high distinction, or highest distinction.

REQUIREMENTS: MINOR IN PHYSICS

In addition to a major subject, students may choose a minor in a second subject. The physics minor is an excellent option for students whose primary interests lie elsewhere, but who enjoy physics and want to develop their proficiency with it. Official information regarding the minor requirements is available in the Undergraduate Record.

There are two options leading to a Physics Minor:

Option I

Math 2310[4] (Calculus III) and PHYS 1420, 1429, 2410, 2419 (Introductory Physics I-II for Physics Majors and accompanying workshops), 2620 (Modern Physics), 2720 (Problem Solving), and one 3000-level physics course.

Option II

Math 2310[6] (Calculus III) and PHYS 2010, 2020, 2030, 2040 (the Introductory Physics Courses that satisfy pre-health requirements), 2620 (Modern Physics), 2720 (Problem solving), and one 3000-level physics course.

*Option II is intended for exceptional students only. Modern Physics, and most electives, require calculus-based physics, and mathematics preparation as it is taught in MATH 2310 (Multivariable Calculus). It is strongly recommended to see a physics major advisor, or the course instructor, before taking Modern Physics.

Students can substitute APMA 2120 (Multivariable Calculus) for MATH 2310 (Calculus III), PHYS1425 (Introductory Physics 1 for Engineers) for PHYS 1420 (Introductory Physics 1), and PHYS 2415 (Introductory Physics 2 for Engineers) for PHYS 2410 (Introductory Physics 2).

A grade point average of at least 2.0 for all the required courses for the minor with a minimum grade of C must be achieved.

The college does not allow for double counting of courses between minor and major(s) for college students. A physics advisor can grant exceptions to this if the course which is to be double counted is an introductory physics course that is a required component in the major.

[4] MATH 2310 is the last of a course sequence that includes MATH 1310 and MATH 1320

TYPICAL COURSE SEQUENCES

Example Course Sequence for BA Physics

Shown is a typical schedule for a student who intends to major with a BA in physics. The course sequence shown covers only the courses that are relevant for the major. A Physics BA can easily be started in the second year.

Fall			Spring		
First Year					
MATH 1310	Calculus I	[4]	MATH 1320	Calculus II	[4]
PHYS 1930	Phys. 21st century*	[2]	PHYS 1420	Intro. Physics 1	[3]
PHYS 1660	Practical Computing*	[1]	PHYS 1420	Intro. Phys. 1 Workshop	[1]
Second Year					
MATH 2310	Calculus III	[4]	MATH 3250	Differential Eqn.	[4]
PHYS 2410	Intro. Physics 2	[3]	PHYS 2620	Modern Physics	[4]
PHYS 2419	Intro. Phys. 2 Workshop	[1]	PHYS 2720	Problem solving	[2]
Third Year					
PHYS 2660	Fund. Sci. Comp.	[3]	PHYS 3140	Intermediate Lab	[4]
Fourth Year					
PHYS 3110	Widely Applied Physics	[3]	PHYS 3120	Applied Physics: Energy	[3]

* These courses are not required

First Example Course Sequence for BS in Physics

The standard schedule shown here assumes no AP credit or summer classes, and it is suitable for a student who does not need to prepare for the Physics GRE in fall of the fourth year. The course sequence shown covers only the courses that are relevant for the major.

Fall			Spring		
		First Year			
MATH 1310	Calculus I	[4]	MATH 1320	Calculus II	[4]
PHYS 1930	Phys. 21st century*	[2]	PHYS 1420	Intro. Physics 1	[3]
PHYS 1660	Practical Computing*	[1]	PHYS 1420	Intro. Phys. 1 Workshop	[1]
		Second Year			
MATH 2310	Calculus III	[4]	MATH 3250	Differential Eqn.	[4]
PHYS 2410	Intro. Physics 2	[3]	PHYS 2620	Modern Physics	[4]
PHYS 2419	Intro. Phys. 2 Workshop	[1]	PHYS 2720	Problem solving	[2]
PHYS 1655	Python	[3]			
		Third Year			
MATH 4220	Part. Diff. Eq.	[3]	MATH 4210	Mathematics for Physics	[3]
PHYS 3210	Class. Mech.	[3]	PHYS 3420	Electricity & Magn. I	[3]
PHYS 3310	Statistical Physics	[3]	PHYS 3140	Intermediate Lab	[4]
		Fourth Year			
PHYS 3430	Electricity & Magn. II	[3]	PHYS 3660	Quantum Physics II	[3]
PHYS 3650	Quantum Physics I	[3]	PHYS 3180	Advanced Lab B	[3]
PHYS 3995	Research	[3]	PHYS 3xxx	Elective	[3]

* These courses are not required.

Second Example Course Sequence for BS in Physics

Students applying to graduate school typically take the physics GRE exam in fall of the fourth year. The course sequence shown covers only the courses that are relevant for the major.

Fall			Spring		
		First Year			
MATH 1310	Calculus I	[4]	MATH 1320	Calculus II	[4]
PHYS 1930	Phys. 21st century*	[2]	PHYS 1420	Intro. Physics 1	[3]
PHYS 1660	Practical Computing*	[1]	PHYS 1420	Intro. Phys. 1 Workshop	[1]
		Second Year			
MATH 2310	Calculus III	[4]	MATH 3250	Differential Eqn.	[4]
PHYS 2410	Intro. Physics 2	[3]	PHYS 2620	Modern Physics	[4]
PHYS 2419	Intro. Phys. 2 Workshop	[1]	PHYS 2720	Problem solving	[2]
PHYS 1655	Python	[3]	MATH 4210	Mathematics for Physics	[3]
		Third Year			
MATH 4220	Part. Diff. Eq.	[3]	PHYS 3660	Quantum Physics II	[3]
PHYS 3210	Class. Mech.	[3]	PHYS 3420	Electricity & Magn. I	[3]
PHYS 3650	Quantum Physics I	[3]	PHYS 3140	Intermediate Lab	[4]
		Fourth Year			
PHYS 3430	Electricity & Magn. II	[3]	PHYS 3180	Advanced Lab B	[3]
PHYS 3310	Statistical Physics	[3]	PHYS 3xxx	Elective	[3]
PHYS 3995	Research	[3]			

* These courses are not required.

Third Example Course Sequence for BS in Physics

This course sequence assumes AP credit (or similar) for Calculus I, Calculus II, and Introductory Physics 1. The course sequence shown covers only the courses that are relevant for the major.

Fall			Spring		
		First Year			
MATH 2310	Calculus III	[4]	PHYS 2419	Intro. Phys. 2 Workshop	[1]
PHYS 2410	Intro. Physics 2	[3]	MATH 3250	Differential Eqn.	[4]
PHYS 1429	Intro. Phys. 1 Workshop	[1]	PHYS 2620	Modern Physics	[4]
----------			PHYS 2720	Problem solving	[2]
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		Second Year			
MATH 4220	Part. Diff. Eq.	[3]	PHYS 3420	Electricity & Magn. I	[3]
PHYS 3210	Class. Mech.	[3]	PHYS 3140	Intermediate Lab	[4]
PHYS 3310	Statistical Physics	[3]	MATH 4210	Mathematics for Physics	[3]
PHYS 1655	Python	[3]	----------		
----------			----------		
		Third Year			
PHYS 3430	Electricity & Magn. II	[3]	PHYS 3660	Quantum Physics II	[3]
PHYS 3650	Quantum Physics I	[3]	PHYS 3180	Advanced Lab B	[3]
PHYS 3995	Research	[3]	PHYS 3xxx	Elective	[3]
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The schedule ends after 3 years. Some students take more advanced courses in physics, and some concentrate on a second major in their fourth year. Some students graduate early.

Example Course Sequence for BS Astronomy/Physics

This schedule is for students who intend to major with a BS in Astronomy / Physics. The course sequence shown covers only the courses that are relevant for the major. Students in the Distinguished Astronomy-Physics Major Program are required to take more courses, mostly in their fourth year.

This schedule assumes one semester of calculus experience from high school, either via dual enrollment or AP Calculus AB. The major is still readily accessible to students with no calculus background, consult with an advisor about developing a schedule suitable to your situation.

Fall			Spring		
First Year					
MATH 1320	Calculus II	[4]	MATH 2310	Calculus III	[4]
PHYS 1660	Practical Computing*	[1]	PHYS 1420	Intro. Physics 1	[3]
----------			PHYS 1420	Intro. Phys. 1 Workshop	[1]
----------			ASTR 1610*	Intro. Astr. Research	[1]
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Second Year					
ASTR 2110	Intro Astrophys. I	[3]	ASTR 2120	Intro Astrophys. II	[3]
MATH 3250	Differential Equations	[4]	PHYS 2620	Modern Physics	[4]
PHYS 2410	Intro. Physics 2	[3]	PHYS 2720	Problem solving	[2]
PHYS 2419	Intro. Phys. 2 Workshop	[1]	PHYS 3340	Math for Physics	[3]
PHYS 1655	Python	[3]	----------		
Third Year					
MATH 4220	Part. Diff. Eq.	[3]	PHYS 3420	Electricity & Magn. I	[3]
PHYS 3210	Class. Mech.	[3]	ASTR 3130	Observational Lab	[3]
PHYS 3650	Quantum Physics I	[3]	ASTR 3/4xxx	Astronomy elective	[3]
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Fourth Year					
PHYS 3430	Electricity & Magn. II	[3]	ASTR 3/4xxx	Astronomy elective	[3]
PHYS 3310	Statistical Physics	[3]	ASTR 4998	Thesis	[3]
ASTR 4810	Astrophysics*	[3]	----------		
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* These courses are not required.