

# Bachelor of Science in Physics

## Why study physics and astronomy?

Our goal is to understand the physical universe. The questions addressed by our department's research and education missions range from the applied, such as an improved understanding of the materials that can be used for solar cell energy production, to foundational questions about the nature of mass and space and how the Universe was formed and subsequently evolved, and how astrophysical phenomena affected the Earth and its evolution. We study the properties of systems ranging in size from smaller than an atom to larger than a galaxy on timescales ranging from billionths of a second to the age of the universe. Our courses and laboratory/research experiences help students hone their problem solving and analytical skills and thereby become broadly trained critical thinkers. While about half of our majors move on to graduate studies in STEM, many find employment in the private sector in diverse situations ranging from financial analysts to physicians. Graduates of all our degree programs can be found in key positions regionally, nationally, and internationally. In this way, our department is at the forefront of telling the academic story of the University of Kansas to people around the state and around the world.

## Undergraduate program in physics and astronomy

We welcome all students curious about the universe around them. This includes not only students planning on graduate study in STEM, but also students from other disciplines where a background in foundational physical science and critical thinking can be useful – teaching, medicine, e.g. – and anyone seeking to include astronomy and physics as part of their general education. The department offers BA degrees in astronomy and physics and BS degrees in astronomy, physics, and engineering physics; degrees in astronomy and physics are granted through the College of Liberal Arts and Sciences whereas engineering physics degrees are granted through the School of Engineering. The BS physics degree includes an interdisciplinary track that allows students to take elective courses in other STEM disciplines and a pre-medicine emphasis for students interested in health professions. We also offer minors in astronomy and physics and a certificate in astrophysics of origins. We involve our undergraduate majors in cutting-edge research practically from the day they join the department; research is a requirement of both the BS Astronomy and BS Physics degrees. The breadth of our research program affords our students exposure to a number of different fields and we are justifiably proud of our undergraduate researchers who routinely publish papers, attend conferences, and/or conduct research abroad (in Antarctica, Chile, CERN, e.g.).

## Undergraduate Admission

### Admission to KU

All students applying for admission must send high school and college transcripts to the Office of Admissions. Unless they are college transfer students with at least 24 hours of credit, prospective students must send ACT or SAT scores to the Office of Admissions. Prospective first-year students should be aware that KU has qualified admission requirements that all new first-year students must meet to be admitted. Consult the

Office of Admissions (<http://admissions.ku.edu>) for application deadlines and specific admission requirements.

Visit the International Support Services (<http://www.iss.ku.edu>) for information about international admissions.

Students considering transferring to KU may see how their college-level course work will transfer on the Office of Admissions (<http://credittransfer.ku.edu>) website.

## Admission to the College of Liberal Arts and Sciences

Admission to the College is a different process from admission to a major field. Some CLAS departments have admission requirements. See individual department/program sections for departmental admission requirements.

## Requirements for the B.S. Degree in Physics

Physics Bachelor of Science (B.S.) General Education Requirements

All students pursuing the Bachelor of Science in Physics must complete the KU Core requirements in addition to the degree and major requirements. For details regarding the KU Core requirements, please see the KU Core section of the catalog.

Code	Title	Hours
<b>Foundational Physics and Mathematics</b>		
Majors must complete courses as specified in each of the following areas. Majors are advised to take honors courses when eligible. All honors equivalents are also acceptable to fulfill PHSX major requirements. These hours do not contribute to the minimum number of hours required for the major.		
Calculus I. Satisfied by:		
MATH 125	Calculus I	4
or MATH 145	Calculus I, Honors	
Calculus II. Satisfied by:		
MATH 126	Calculus II	4
or MATH 146	Calculus II, Honors	
Seminar in Physics, Astronomy, & Engineering Physics. Satisfied by:		
PHSX 150	Seminar in Physics, Astronomy and Engineering Physics	0.5
General Physics I. Satisfied by:		
PHSX 211	General Physics I	5
& PHSX 216	and General Physics I Laboratory	
or PHSX 217	General Physics I Honors	
General Physics II. Satisfied by:		
PHSX 212	General Physics II	4
& PHSX 236	and General Physics II Laboratory	
or PHSX 217	General Physics II Honors	
<b>General Science Requirements</b>		
Foundations of Chemistry I. Satisfied by:		
CHEM 130	General Chemistry I	5
or CHEM 150	Chemistry for Engineers	
or CHEM 170	Chemistry for the Chemical Sciences I	

or CHEM 190 Foundations of Chemistry I, Honors  
& CHEM 191 and Foundations of Chemistry I Laboratory, Honors

**Advanced Mathematics**

Vector Calculus. Satisfied by:

MATH 127 Calculus III 4  
or MATH 147 Calculus III, Honors

Elementary Linear Algebra. Satisfied by:

MATH 290 Elementary Linear Algebra 2-3  
or MATH 291 Elementary Linear Algebra, Honors  
or MATH 590 Linear Algebra

Differential Equations. Satisfied by:

MATH 320 Elementary Differential Equations 3

**Advanced Physics**

Majors must complete a course in each of the following areas:

General Physics III. Satisfied by:

PHSX 313 General Physics III 3

Intermediate Physics Lab. Satisfied by:

PHSX 316 Intermediate Physics Laboratory I 1

Introductory Quantum Mechanics. Satisfied by:

PHSX 511 Introductory Quantum Mechanics 3

Mechanics I. Satisfied by:

PHSX 521 Mechanics I 3

Electricity and Magnetism. Satisfied by:

PHSX 531 Electricity and Magnetism 3

Thermal Physics. Satisfied by:

PHSX 671 Thermal Physics 3

Undergraduate Research or Honors Research. Satisfied by:

PHSX 503 Undergraduate Research 1-4  
or PHSX 501 Honors Research

Required Electives (Majors must complete one of the following options, Preprofessional, Interdisciplinary, or Pre-Medicine) 25-45

**Preprofessional Option** 26-27

Computing and Programming. Satisfied by:

EECS 138 Introduction to Computing: \_\_\_\_\_  
or EECS 166 Programming I  
or EECS 166 Programming I: Honors

Mechanics II. Satisfied by:

PHSX 621 Mechanics II

Electromagnetic Theory. Satisfied by:

PHSX 631 Electromagnetic Theory

Quantum Mechanics. Satisfied by:

PHSX 711 Quantum Mechanics I

Advanced Physics Labs. Satisfied by both of the following:

PHSX 516 Physical Measurements

PHSX 536 Electronic Circuit Measurement and Design

Physics Elective. Satisfied by any PHSX lecture or laboratory course numbered 500 or higher and not part of the other specific requirements for the major.

Math Elective. Satisfied by one of the following:

PHSX 518 Mathematical Physics

PHSX 718 Mathematical Methods in Physical Sciences

MATH 526 Applied Mathematical Statistics I

MATH 530 Mathematical Models

MATH 558 Introductory Modern Algebra

MATH 581 Numerical Methods

MATH 590 Linear Algebra

MATH 628 Mathematical Theory of Statistics

MATH 646 Complex Variable and Applications

MATH 647 Applied Partial Differential Equations

MATH 648 Calculus of Variations and Integral Equations

MATH 660 Geometry I

MATH 661 Geometry II

any 700-level MATH lecture course except MATH 701 and MATH 715

**Interdisciplinary Option** 25-30

Computing and Programming. Satisfied by:

EECS 138 Introduction to Computing: \_\_\_\_\_  
or EECS 166 Programming I  
or EECS 166 Programming I: Honors

Advanced Physics Labs. Satisfied by one of the following:

PHSX 516 Physical Measurements

PHSX 536 Electronic Circuit Measurement and Design

Advanced Physics. Satisfied by two of the following:

PHSX 621 Mechanics II

PHSX 631 Electromagnetic Theory

PHSX 711 Quantum Mechanics I

PHSX 516 Physical Measurements <sup>1</sup>

PHSX 536 Electronic Circuit Measurement and Design <sup>1</sup>

Physics Elective. Satisfied by any PHSX lecture or laboratory course numbered 500 or higher and not part of the other specific requirements for the major.

Math Elective. Satisfied by one of the following:

PHSX 518 Mathematical Physics

PHSX 718 Mathematical Methods in Physical Sciences

MATH 526 Applied Mathematical Statistics I

MATH 530 Mathematical Models

MATH 558 Introductory Modern Algebra

MATH 581 Numerical Methods

MATH 590 Linear Algebra

MATH 628 Mathematical Theory of Statistics

MATH 646 Complex Variable and Applications

MATH 647 Applied Partial Differential Equations

MATH 648 Calculus of Variations and Integral Equations

MATH 660 Geometry I

MATH 661 Geometry II

any 700-level MATH lecture course except MATH 701 and MATH 715

Allied Science Fields. Satisfied by the completion of 2 advanced courses in 1 allied science field chosen from the following:

Biology. Satisfied by two of the following:

BIOL 400 Fundamentals of Microbiology

BIOL 412 Evolutionary Biology

BIOL 416 Cell Structure and Function

BIOL 595 Human Genetics

BIOL 600 Introductory Biochemistry, Lectures

BIOL 636 Biochemistry I

BIOL 638	Biochemistry II
BIOL 546	Mammalian Physiology
Chemistry. Satisfied by two of the following:	
CHEM 598	Research Methods (UKanTeach students only)
CHEM 310	Fundamentals of Organic Chemistry
CHEM 330	Organic Chemistry I
CHEM 335	Organic Chemistry II
CHEM 530	Physical Chemistry I
CHEM 535	Physical Chemistry II
Geology. Satisfied by two of the following:	
GEOL 360	Field Investigation
GEOL 562	Structural Geology
GEOL 575	Seismic Exploration
GEOL 576	Potential Fields Exploration
Electrical Engineering and Computer Science. Satisfied by two of the following:	
EECS 622	Microwave and Radio Transmission Systems
EECS 628	Fiber Optic Communication Systems
EECS 670	Introduction to Semiconductor Processing
EECS 713	High-Speed Digital Circuit Design
EECS 721	Antennas
EECS 728	Fiber-optic Measurement and Sensors
<b>Pre-Medicine Option</b>	56-60
Advanced Physics Labs. Satisfied by one of the following:	
PHSX 516	Physical Measurements
PHSX 536	Electronic Circuit Measurement and Design
Introductory Biology. Satisfied by the following:	
BIOL 150	Principles of Molecular and Cellular Biology
BIOL 152	Principles of Organismal Biology
Genetics. Satisfied by the following:	
BIOL 350	Principles of Genetics
BIOL 595	Human Genetics
Advanced Biology. Satisfied by:	
BIOL 400	Fundamentals of Microbiology
BIOL 503	Immunology
BIOL 546	Mammalian Physiology
Biochemistry. Satisfied by the following:	
BIOL 600	Introductory Biochemistry, Lectures or BIOL 636 Biochemistry I
BIOL 601	Principles of Biochemistry Laboratory or BIOL 637 Introductory Biochemistry Laboratory
General Chemistry II. Satisfied by:	
CHEM 135	General Chemistry II or CHEM 175 Chemistry for the Chemical Sciences II or CHEM 195 Foundations of Chemistry II, Honors & CHEM 196 Foundations of Chemistry II Laboratory, Honors
Organic Chemistry. Satisfied by:	
CHEM 330	Organic Chemistry I
CHEM 331	Organic Chemistry I Laboratory
CHEM 335	Organic Chemistry II
CHEM 336	Organic Chemistry II Laboratory
Physical Chemistry. Satisfied by:	

CHEM 520 Biological Physical Chemistry with Laboratory  
or CHEM 53 Physical Chemistry I  
& CHEM 537 and Physical Chemistry Laboratory

BIOL, MATH, or PHSX Elective (above 400 level)

Social Science Courses (recommended but not required):<sup>Both</sup>  
courses satisfy KU Core Goal 3S.

SOC 104 Elements of Sociology

or SOC 105 Elements of Sociology, Honors

PSYC 104 General Psychology<sup>Also satisfies KU Core Goal 4.1</sup>

or PSYC 105 General Psychology, Honors

<sup>1</sup> This course will not count as one of the two Advanced Physics Courses if it has already counted toward the one required Advanced Physics Lab.

## Physics Major Hours & Major GPA

While completing all required courses, majors must also meet each of the following hour and grade-point average minimum standards:

### Major Hours

Satisfied by 30 hours of major courses.

### Major Hours in Residence

Satisfied by a minimum of 15 hours of KU resident credit in the major.

### Major Junior/Senior (300+) Hours

Satisfied by a minimum of 12 hours from junior/senior courses (300+) in the major.

### Major Junior/Senior (300+) Graduation GPA

Satisfied by a minimum of a 2.0 KU GPA in junior/senior courses (300+) in the major. GPA calculations include all junior/senior courses in the field of study including F's and repeated courses. See the Semester/Cumulative GPA Calculator (<http://clas.ku.edu/undergrad/tools/gpa>).

## Departmental Honors in Physics and Astronomy

Qualified students earning either a B.A. or a B.S. degree in the College of Liberal Arts and Sciences with a major in astronomy or physics may graduate with Honors in Physics & Astronomy by fulfilling the following requirements: (1) By the end of the candidate's final semester, achieve a minimum GPA of 3.25 overall and 3.5 in the major, in all courses taken in residence and elsewhere; and (2) Complete at least 24 semester hours of astronomy and physics courses numbered 500 or above, including undergraduate research represented by two hours of credit in ASTR 597, ASTR 503, PHSX 501 or PHSX 503. A grade of B or better must be earned in one of the following: ASTR 597, ASTR 503, PHSX 501 or PHSX 503. In addition, all our all of our department's honors requirements include student research, for which results shall be presented in at least one of the following forms: (1) a written research summary, read by 3 faculty members in physics and astronomy or related fields or authorship on a peer-reviewed manuscript; (2) a research-based oral presentation at an appropriate venue (e.g., Undergraduate Research symposium, a presentation in an advanced department seminar class, a discipline specific meeting); or (3) presentation of a poster at an appropriate venue. A student who plans to graduate with honors in physics and astronomy must file a Declaration of Intent Form with the Departmental Honors Coordinator, preferably during his/her junior

year but in any case no later than enrollment for the final undergraduate semester.