Master of Science in Physics

The broad goal of the degree programs in Physics and Astronomy 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. The courses and laboratory/research experiences in the department's master of science program help students to hone their problem solving and analytical skills and thereby become broadly trained critical thinkers. This program more specifically prepares students for Ph.D. programs, for industry, or for work at government laboratories.

Admission to Graduate Studies

Admission Requirements

- All applicants must meet the requirements outlined in the Admission to Graduate Study (https://policy.ku.edu/graduate-studies/admission-to-graduate-study/) policy.
- Bachelor's degree: A copy of official transcripts showing proof of a bachelor's degree (and any post-bachelor's coursework or degrees) from a regionally accredited institution, or a foreign university with equivalent bachelor's degree requirements is required.
- English proficiency: Proof of English proficiency (https://gradapply.ku.edu/english-requirements/) for non-native or non-native-like English speakers is required. There are two bands of English proficiency, including Admission and Full proficiency. For applicants to online programs, Full proficiency is required.

Admission to the Physics and Astronomy Graduate Program

Most admitted students have an undergraduate grade-point average of at least a B (3.0 on a 4.0 scale), overall and in the major. A baccalaureate degree with a major in physics is desirable but not required. Recommended preparation consists of courses in mechanics, electromagnetic theory, thermal physics, introductory quantum mechanics, advanced laboratory, and at least one course in mathematics beyond differential equations. Working knowledge of computers and of an advanced programming language is helpful. A student with less than the recommended preparation may enroll in these courses for graduate credit.

The following materials are required and must be submitted before the application deadline in order for the application to be considered:

- **Transcripts** A scanned version of the transcript from your undergraduate and any post-Bachelor institution(s). If admitted, you will be required to submit official transcripts by the end of your first semester at KU to avoid having a hold placed on your student account. Review the KU Transcript requirement for more information, especially for International Applicants who may need to provide additional documentation.
- **Statement of Purpose** A single document also including: academic interests and professional goals.
- **Resume or Curriculum Vitae**
- **Recommendations**. You will be asked for the names and email addresses of three people who can write a recommendation letter describing your qualifications for graduate school in physics and astronomy. Once you submit the application, an email will be sent to each recommender requesting a letter and electronic survey from each person that you name.

The General and Subject GRE are not required for admission to the Physics and Astronomy graduate program. Submit your graduate application online (https://gradapply.ku.edu/apply/). The deadline to apply for Fall 2025 admission is December 16th, 2024. The deadline to apply for Spring 2026 admission is October 1st, 2025.

The University of Kansas
Department of Physics and Astronomy
Malott Hall
1251 Wescoe Hall Dr., Room 1082
Lawrence, KS 66045

M.S. Degree in Physics

Program requirements:

Within 12 months of entering the program the student must fulfill the requirements of the individualized plan of study (https://physics.ku.edu/graduate-program/additional-requirements/) for all graduate degrees to certify an undergraduate knowledge of Physics. To develop the individualized plan of study, students will be required to attend an advising session with the Departmental Graduate Advisor. This session will include a discussion of the student's transcripts, potential course enrollment, and administration of a diagnostic exam. Results of this exam will help determine a suggested course schedule. Following the development of the individualized plan, the advising process will continue through regular check-ins and reviews of student progress. These reviews will include looking at student grades, research progress, and general progress toward meeting departmental milestones.

The Master of Science in Physics requires a total of 30 hours of coursework and allows for the following two degree completion options:

1. Master's Thesis Defense
2. Final Oral Examination

Course Requirements:

Code	Title	Hours
Core Courses		
PHSX 711	Quantum Mechanics I	3
PHSX 718	Mathematical Methods in Physical Sciences	3
PHSX 821	Classical Mechanics	3
PHSX 831	Electrodynamics I	3
Two additional courses chosen from the following:		**6**
PHSX 721	Chaotic Dynamics	
PHSX 741	Nuclear Physics I	
PHSX 761	Elementary Particles I	
PHSX 781	Solid State Physics I	
PHSX 792	Topics in Advanced Astrophysics	
PHSX 793	Physical Cosmology	
PHSX 795	Space Plasma Physics	
PHSX 815	Computational Methods in Physical Sciences	
Completion Options		

All students are required to enroll in Research/Thesis hours.		
PHSX 899	Master's Research/Thesis	2
Students select one of the following degree completion options for a total of 10 hours:		10
Master's Thesis: PHSX 899 (Up to 4 additional hours) and advanced elective courses chosen from the list below, up to 10 hours.		
OR		
Final Oral Examination: 1 credit of PHSX 899 and 9 hours of advanced elective credits chosen from the list below, OR 10 hours of advanced elective courses.		
Advanced Elective Courses		
PHSX 511	Introductory Quantum Mechanics	
PHSX 516	Physical Measurements	
PHSX 518	Mathematical Physics	
PHSX 521	Mechanics I	
PHSX 531	Electricity and Magnetism	
PHSX 536	Electronic Circuit Measurement and Design	
PHSX 594	Cosmology and Culture	
PHSX 598	Research Methods	
PHSX 600	Special Topics in Physics and Astrophysics: _____	
PHSX 601	Design of Physical and Electronic Systems	
PHSX 611	Introductory Quantum Mechanics	
PHSX 615	Numerical and Computational Methods in Physics	
PHSX 616	Physical Measurements	
PHSX 621	Mechanics II	
PHSX 631	Electromagnetic Theory	
PHSX 641	Introduction to Nuclear Physics	
PHSX 655	Optics	
PHSX 661	Introduction to Elementary Particle Physics	
PHSX 671	Thermal Physics	
PHSX 681	Introduction to Solid State Physics	
PHSX 691	Astrophysics I	
PHSX 693	Gravitation and Cosmology	
PHSX 721	Chaotic Dynamics	
PHSX 723	Seismology	
PHSX 727	Advanced Geophysics: _____	
PHSX 741	Nuclear Physics I	
PHSX 761	Elementary Particles I	
PHSX 781	Solid State Physics I	
PHSX 792	Topics in Advanced Astrophysics	
PHSX 793	Physical Cosmology	
PHSX 794	Interiors and Atmospheres	
PHSX 795	Space Plasma Physics	
PHSX 796	Radiation and the Interstellar Medium	
PHSX 797	Galaxies	
PHSX 798	High Energy Astrophysics	
PHSX 801	Advanced Topics	
PHSX 811	Quantum Mechanics II	
PHSX 815	Computational Methods in Physical Sciences	
PHSX 841	Nuclear Physics II	
PHSX 855	Advanced Optics	
PHSX 861	Elementary Particles II	
PHSX 871	Statistical Physics I	
PHSX 881	Solid State Physics II	
PHSX 885	Materials Modeling	
PHSX 886	Materials Characterization	
PHSX 895	Plasma Physics	
PHSX 911	Quantum Mechanics III	
PHSX 912	Quantum Field Theory	
PHSX 915	Relativity	
PHSX 931	Electrodynamics II	
PHSX 971	Advanced Statistical Mechanics	
Total Hours		**30**

Advanced lecture courses are those number 500 or above. At least 50% of coursework counted toward the degree must be at the 700 level or above. Credit toward the 30 required hours is not given to students who take courses at a lower level after having completed similar upper level courses (as determined by the department) with a grade of B- or higher.

Oral Presentation Requirement

All graduate students, after their first semester, will deliver at least one oral presentation (https://physics.ku.edu/graduate-program/additional-requirements/) per semester. Presentations must cover a topic in physics or astronomy and typically relate to the student's research.

Completion Options

Thesis Option

A master’s thesis is not required but may be submitted if the candidate and the director of the candidate’s research believe it to be appropriate. Students pursuing this option must complete an oral presentation and defense of a thesis to a faculty committee. A final comprehensive oral examination is given in conjunction with the thesis defense. Potential examination outcomes are Pass with Honors, Satisfactory, and Unsatisfactory.

A minimum of 2 hours of PHSX 899 is required for all M.S. students. No more than 3 hours will be allowed unless directed toward completion of a thesis on original research or a written report. Students must consult with their research advisor before enrolling in more than 3 credit hours of PHSX 899.

Final Oral Examination Option

If no thesis is presented, the student must still complete an exam project with an oral component, satisfied by the general oral examination in physics given to all M.S. students. The examination is given shortly before completion of other work for the degree. Potential examination outcomes are Pass with Honors, Satisfactory, and Unsatisfactory.

The master's degree can be completed as a terminal degree, or may be earned in addition to the Ph.D. if requirements for both are completed.

Please visit the departmental web page (https://physics.ku.edu/graduate-program/) for additional information, and to access the graduate student handbook (https://physics.ku.edu/graduate-program/important-information/).

Please visit the Graduate Studies section of the University Policy Library (https://policy.ku.edu/office/Graduate-Studies/) for information on time constraints and other requirements which may apply.

Computational Physics and Astronomy Concentration

This concentration of the M.S. degree is for students with a background in physics, astronomy, computer science, mathematics, or engineering who wish to become familiar with computer-based approaches to problems in these fields. This concentration is intended as a terminal M.S. that can be completed in two years. Minimum preparation expected includes a year's course in general physics, mathematics through differential equations, and a knowledge of python, FORTRAN, C++ or another programming language suited to scientific applications. Students pursuing this degree with an applied mathematics emphasis may wish to consider also earning a Graduate Certificate in Applied Mathematics (https://catalog.ku.edu/liberal-arts-sciences/math/applied-mathematics-gradcert/#text).

All non-coursework M.S. program requirements listed above also apply to this concentration.

Course Requirements:

Code	Title	Hours
Core Courses		
PHSX/ASTR 815	Computational Methods in Physical Sciences	3
PHSX 718	Mathematical Methods in Physical Sciences	3
MATH/EECS 781	Numerical Analysis I	3
or EECS 639	Introduction to Scientific Computing	
EECS Requirement		**3**
Choose one of the following:		
EECS 510	Introduction to the Theory of Computing	
EECS 512	Electronic Circuits III	
EECS 541	Computer Systems Design Laboratory I	
EECS 542	Computer Systems Design Laboratory II	
EECS 545	Electric Energy Production and Storage	
EECS 547	Power System Analysis	
EECS 562	Introduction to Communication Systems	
EECS 563	Introduction to Communication Networks	
EECS 565	Introduction to Information and Computer Security	
EECS 568	Introduction to Data Mining	
EECS 569	Computer Forensics	
EECS 581	Software Engineering II	
EECS 582	Computer Science and Interdisciplinary Computing Capstone	
EECS 592	Cybersecurity Design	
EECS 611	Electromagnetic Compatibility	
EECS 622	Microwave and Radio Transmission Systems	
EECS 623	Interdisciplinary Collaborations	
EECS 628	Fiber Optic Communication Systems	
EECS 630	Advanced Data Structures and Algorithms	
EECS 639	Introduction to Scientific Computing	
EECS 643	Computer Architecture	
EECS 644	Introduction to Digital Signal Processing	
EECS 645	Computer Systems Architecture	
EECS 649	Introduction to Artificial Intelligence	
EECS 658	Introduction to Machine Learning	
EECS 662	Programming Languages	
EECS 664	Introduction to Digital Communication Systems	
EECS 665	Compiler Construction	
EECS 666	Introduction to Network Security	
EECS 670	Introduction to Semiconductor Processing	
EECS 675	Multicore and GPU Programming	
EECS 677	Advanced Software Security Evaluation	
EECS 678	Introduction to Operating Systems	
EECS 683	Introduction to Hardware Security and Trust	
EECS 685	Introduction to IoT Security	
EECS 687	Mobile Security	
EECS 690	Special Topics: _____	
EECS 692	Directed Reading	
EECS 695	Software Reverse Engineering	
EECS 700	Special Topics: _____	
EECS 710	Information Security and Assurance	
EECS 712	Network Security and its Application	
EECS 713	High-Speed Digital Circuit Design	
EECS 721	Antennas	
EECS 723	Microwave Engineering	
EECS 725	Introduction to Radar Systems	
EECS 727	Photonics	
EECS 728	Fiber-optic Measurement and Sensors	
EECS 730	Introduction to Bioinformatics	
EECS 738	Machine Learning	
EECS 739	Parallel Scientific Computing	
EECS 740	Digital Image Processing	
EECS 743	Advanced Computer Architecture	
EECS 744	Digital Signal Processing Implementation in Programmable Logic Devices	
EECS 746	Database Systems	
EECS 750	Advanced Operating Systems	
EECS 752	Modern Computer Organization and Design	
EECS 753	Embedded and Real Time Computer Systems	
EECS 755	Software Modeling and Analysis	
EECS 759	Estimation and Control of Unmanned Autonomous Systems	
EECS 762	Programming Language Foundation I	
EECS 764	Analysis of Algorithms	
EECS 765	Introduction to Cryptography and Computer Security	
EECS 767	Information Retrieval	
EECS 768	Virtual Machines	
EECS 769	Information Theory	
EECS 774	Geometric Modeling	
EECS 776	Functional Programming and Domain Specific Languages	
EECS 777	Advanced Software Security Auditing	
EECS 780	Communication Networks	
EECS 782	Numerical Analysis II	
EECS 783	Hardware Security and Trust	
EECS 785	Internet of Things Security	
EECS 786	Digital Very-Large-Scale-Integration	
EECS 787	Mobile Security	

EECS 795	Software Reverse Engineering
EECS 800	Special Topics: _____
EECS 810	Software Engineering and Management
EECS 811	IT Project Management
EECS 812	Software Requirements Engineering
EECS 814	Software Quality Assurance
EECS 818	Software Architecture
EECS 820	Advanced Electromagnetics
EECS 823	Microwave Remote Sensing
EECS 828	Advanced Fiber-Optic Communications
EECS 836	Machine Learning
EECS 839	Mining Special Data
EECS 843	Programming Language Foundation II
EECS 844	Adaptive Signal Processing
EECS 861	Random Signals and Noise
EECS 862	Principles of Digital Communication Systems
EECS 863	Network Analysis, Simulation, and Measurements
EECS 865	Wireless Communication Systems
EECS 866	Network Security
EECS 868	Mathematical Optimization with Applications
EECS 869	Error Control Coding
EECS 891	Graduate Problems
EECS 965	Detection and Estimation Theory
EECS 967	Mathematical Optimization with Communications Applications

EECS or MATH Requirement **3**

Satisfied by one course at the 700 level or above in EECS or MATH. See list above for EECS courses and below for MATH courses.

MATH 717	Nonparametric Statistics
MATH 724	Combinatorial Mathematics
MATH 725	Graph Theory
MATH 727	Probability Theory
MATH 728	Statistical Theory
MATH 750	Stochastic Adaptive Control
MATH 765	Mathematical Analysis I
MATH 766	Mathematical Analysis II
MATH 782	Numerical Analysis II
MATH 783	Applied Numerical Methods for Partial Differential Equations
MATH 790	Linear Algebra II
MATH 791	Modern Algebra
MATH 799	Directed Readings
MATH 800	Complex Analysis I
MATH 802	Set Theory
MATH 810	Real Analysis and Measure Theory I
MATH 820	Introduction to Topology
MATH 821	Algebraic Topology I
MATH 824	Algebraic Combinatorics
MATH 830	Abstract Algebra
MATH 831	Abstract Algebra II
MATH 840	Differentiable Manifolds
MATH 850	Differential Equations and Dynamical Systems
MATH 851	Topics in Dynamical Systems: _____
MATH 865	Stochastic Processes I
MATH 866	Stochastic Processes II
MATH 874	Statistical Decision Theory
MATH 881	Topics in Advanced Numerical Linear Algebra: _____
MATH 882	Topics in Advanced Numerical Differential Equations: _____
MATH 890	Fourier Analysis
MATH 910	Algebraic Curves
MATH 920	Lie Groups and Lie Algebras
MATH 940	Advanced Probability
MATH 950	Partial Differential Equations
MATH 951	Topics in Advanced Partial Differential Equations II: _____
MATH 960	Functional Analysis
MATH 961	Topics in Functional Analysis: _____
MATH 993	Readings in Mathematics

PHSX/ASTR course requirement: 1 additional lecture course within the department at the 500 level or above **3**

PHSX 511	Introductory Quantum Mechanics
PHSX 516	Physical Measurements
PHSX 518	Mathematical Physics
PHSX 521	Mechanics I
PHSX 531	Electricity and Magnetism
PHSX 536	Electronic Circuit Measurement and Design
PHSX 594	Cosmology and Culture
PHSX 598	Research Methods
PHSX 600	Special Topics in Physics and Astrophysics: _____
PHSX 601	Design of Physical and Electronic Systems
PHSX 611	Introductory Quantum Mechanics
PHSX 615	Numerical and Computational Methods in Physics
PHSX 616	Physical Measurements
PHSX 621	Mechanics II
PHSX 631	Electromagnetic Theory
PHSX 641	Introduction to Nuclear Physics
PHSX 655	Optics
PHSX 661	Introduction to Elementary Particle Physics
PHSX 671	Thermal Physics
PHSX 681	Introduction to Solid State Physics
PHSX 691	Astrophysics I
PHSX 693	Gravitation and Cosmology
PHSX 711	Quantum Mechanics I
PHSX 721	Chaotic Dynamics
PHSX 723	Seismology
PHSX 727	Advanced Geophysics: _____
PHSX 741	Nuclear Physics I
PHSX 761	Elementary Particles I
PHSX 781	Solid State Physics I
PHSX 792	Topics in Advanced Astrophysics
PHSX 793	Physical Cosmology
PHSX 794	Interiors and Atmospheres
PHSX 795	Space Plasma Physics
PHSX 796	Radiation and the Interstellar Medium

PHSX 797	Galaxies	
PHSX 798	High Energy Astrophysics	
PHSX 801	Advanced Topics	
PHSX 811	Quantum Mechanics II	
PHSX 821	Classical Mechanics	
PHSX 831	Electrodynamics I	
PHSX 841	Nuclear Physics II	
PHSX 855	Advanced Optics	
PHSX 861	Elementary Particles II	
PHSX 871	Statistical Physics I	
PHSX 881	Solid State Physics II	
PHSX 885	Materials Modeling	
PHSX 886	Materials Characterization	
PHSX 895	Plasma Physics	
PHSX 911	Quantum Mechanics III	
PHSX 912	Quantum Field Theory	
PHSX 915	Relativity	
PHSX 931	Electrodynamics II	
PHSX 971	Advanced Statistical Mechanics	
Additional Electives: Nine or more credits from at least 3 lecture or lab courses from the following list:		**9**
Students may also choose any PHSX/ASTR courses numbered 500 and above to fulfill this requirement. Please see above for full list.		
EECS 739	Parallel Scientific Computing	
EECS 836	Machine Learning	
EECS 868	Mathematical Optimization with Applications	
MATH 611	Time Series Analysis	
MATH 647	Applied Partial Differential Equations	
MATH 650	Nonlinear Dynamical Systems (Cannot be counted along with PHSX 721)	
MATH 727	Probability Theory	
or MATH 627	Probability	
MATH 728	Statistical Theory	
or MATH 628	Mathematical Theory of Statistics	
MATH/EECS 782	Numerical Analysis II	
MATH 783	Applied Numerical Methods for Partial Differential Equations	
Thesis Hours		
PHSX 899	Master's Research/Thesis	6
Total Hours		**33**

*Note: Double counting of courses is not allowed, e.g. a course cannot be used to fulfill two requirements simultaneously.

Courses numbered 500 or above count for graduate credit, but at least 50% of credit hours must be at the 700 level or above.

Thesis

An important component of this concentration is the completion and documentation of a successful computer project. A thesis must be presented that describes the basic physics involved in the project, the method of implementing the project, and a discussion of the results. An oral defense of the thesis is required before a committee of at least 3 members of the graduate faculty. Potential examination outcomes are Pass with Honors, Satisfactory, and Unsatisfactory.

Please visit the departmental web page (https://physics.ku.edu/graduate-program/) for additional information, and to access the graduate student handbook (https://physics.ku.edu/graduate-program/important-information/). Please visit the Graduate Studies policy library (https://policy.ku.edu/office/Graduate-Studies/) for other requirements which may apply.

At the completion of this program, students will be able to:

- Display knowledge of graduate level physics and astronomy.
- Display successful (oral and written) communication of scientific results.
- Display acquisition of discipline specific research skill.
- Display ability of independent research in physics and astronomy.