

Physics, M.S.

COLLEGE OF SCIENCE AND TECHNOLOGY

Learn more about the Master of Science in Physics.

About the Program

The objective of the M.S. degree program in Physics is to provide advanced training in Physics sufficiently broad to permit the graduate to pursue a range of technical careers. Students choose to pursue the Coursework Track or Thesis Track to complete the M.S. degree.

Time Limit for Degree Completion: 3 years

Campus Location: Main

Full-Time/Part-Time Status: The degree program can be completed on a full- or part-time basis.

Job Prospects: The program is dedicated to producing well-trained scientists prepared for careers as high school science teachers, technical writers, or members of a technical support staff.

Non-Matriculated Student Policy: Non-matriculated students are restricted to taking the following courses:

Code	Title	Credit Hours
PHYS 5101	Analytical Mechanics	
PHYS 5301	Electromagnetic Theory	
PHYS 5501	Mathematical Physics	

If the student applies to and is accepted into the program, the courses taken, up to 9 credits, may be applied toward the degree requirements.

Financing Opportunities: Financial aid in the form of Teaching Assistantships, Research Assistantships, and Temple University Fellowships is reserved largely for Ph.D. students. Applicants with a bachelor's degree who wish to earn a doctorate should apply to the Ph.D. program, not the M.S. program. Students in the Ph.D. program normally complete all of the requirements for the M.S. in their first two years and may request the M.S. degree at that time while continuing in the Ph.D. program.

Admission Requirements and Deadlines

Application Deadline:

Fall: January 15; December 15 international

Spring: September 15; August 15 international

For full consideration, applications must be submitted by the deadline. Late applications may be considered in exceptional cases.

APPLY ONLINE to this graduate program.

Letters of Reference:

Number Required: 2

From Whom: Letters of recommendation should be obtained from college/university faculty members or scientists familiar with the applicant's academic and scientific capabilities.

Coursework Required for Admission Consideration: Applicants should have successfully completed coursework typically required for a bachelor's degree in Physics.

Bachelor's Degree in Discipline/Related Discipline: A baccalaureate degree in Physics is typically required. A certified transcript is required from each institution previously attended by the applicant.

Statement of Goals: In one to two pages, address your specific interest in Temple's program, research and career goals, and academic and research achievements.

Standardized Test Scores:

GRE: General Test required. Subject Test in Physics strongly recommended, but not required.

Applicants who earned their baccalaureate degree from an institution where the language of instruction was other than English, with the exception of those who subsequently earned a master's degree at a U.S. institution, must report scores for a standardized test of English that meet these minimums:

- TOEFL iBT: 79
- IELTS Academic: 6.5
- PTE Academic: 53

Transfer Credit: Graduate credits from an accredited institution may be transferred into the program. The credits must be equivalent to coursework offered at Temple, and the grade must be a "B" or better in order to transfer. The Graduate Program Committee must approve all requests for transfer credit. The maximum number of credits a student may transfer is 6.

Program Requirements

General Program Requirements:

Number of Credits Required Beyond the Baccalaureate: 30

Required Courses:

Thesis Track

Code	Title	Credit Hours
Core Courses		
PHYS 5101	Analytical Mechanics	3
PHYS 5301	Electromagnetic Theory	3
PHYS 5501	Mathematical Physics	3
PHYS 5701	Quantum Mechanics I	3
PHYS 5702	Quantum Mechanics II	3
PHYS 8102	Statistical Mechanics	3
PHYS 8702	Solid State Physics	3
PHYS 8703	Nuclear and Elementary Particle Physics	3
Research Courses		
PHYS 9996	Master's Thesis Research	3
Select 3 credits of additional coursework from the following:		3
PHYS 8004	Problems in Experimental Physics	
PHYS 8005	Problems in Theoretical Physics	
PHYS 9996	Master's Thesis Research	
Total Credit Hours		30

Coursework Track

Code	Title	Credit Hours
Core Courses		
PHYS 5101	Analytical Mechanics	3
PHYS 5301	Electromagnetic Theory	3
PHYS 5501	Mathematical Physics	3
PHYS 5701	Quantum Mechanics I	3
PHYS 5702	Quantum Mechanics II	3
PHYS 8102	Statistical Mechanics	3
PHYS 8702	Solid State Physics	3
PHYS 8703	Nuclear and Elementary Particle Physics	3
Additional Coursework ¹		6
Total Credit Hours		30

¹ The balance of coursework is identified in consultation with the graduate advisor and subject to the approval of the Graduate Program Committee. No more than 3 credits may be taken in these independent study courses: PHYS 8004 Problems in Experimental Physics; PHYS 8005 Problems in Theoretical Physics; or PHYS 9998 Pre-Dissertation Research / Elevation to Candidacy.

Culminating Events:*Thesis:*

A master's thesis is required for students in the [Thesis Track](#), but not for students in the Coursework Track. The thesis is based on the student's research and approved in accordance with the policies of the Department of Physics and the Graduate School.

Comprehensive Examination:

The M.S. comprehensive examination is required for students in the [Coursework Track](#), but not for students in the Thesis Track. The exam, which tests the student's mastery of undergraduate and beginning graduate physics, consists of a three-part written exam and an oral exam. General subject areas covered by the examination include classical electromagnetic theory, classical mechanics, mathematical physics, modern physics, quantum mechanics, statistical mechanics, and thermodynamics.

M.S. students in the Coursework Track are required to take the comprehensive examination in the summer at the end of their first year of full-time graduate study. They are tested on the subject matter in six core courses: PHYS 5101, PHYS 5301, PHYS 5501, PHYS 5701, PHYS 5702, and PHYS 8102. In the event of failure, the exam may be retaken once. If the student fails a second time, s/he is dropped from the graduate program.

Contacts**Department Web Address:**

<https://www.temple.edu/academics/degree-programs/physics-ms-st-phys-ms>

Department Information:

Dept. of Physics
406 Science and Education Research Center
1925 N. 12th Street
Philadelphia, PA 19122-1801
physgrad@temple.edu
215-204-7634

Submission Address for Application Materials:

<https://cst.temple.edu/academics/graduate-programs/apply-now>

Department Contacts:*Admissions Chair:*

Xifan Wu
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215-204-7627

Graduate Chair:

Andreas Metz
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215-204-7668

Chair:

James Napolitano
napolj@temple.edu
215-204-7827

Courses**PHYS 5000. Topical Seminar. 3 Credit Hours.**

This course considers special topics in Physics, not considered in our other courses. The level of this course is graduate, but the content could be accessible to upper-level undergraduate Physics majors.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 5001. Introduction to Quantum Computing. 3 Credit Hours.

This course will give an elementary introduction to some basics of quantum information and quantum computing that are accessible to not only physicists but also people with a variety of backgrounds. It will introduce the students to the latest scientific and technological advancement, and prepare for further study and/or initiating research if one wishes to pursue in this field.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PHYS 5002. Physics Research and Ethics. 1 Credit Hour.

This course will introduce new graduate students to the diverse faculty research programs in physics at Temple, and help them to make an informed choice of research advisor and topic. It will also make sure that all students are aware of the ethical code for physicists. The course will meet for one hour per week. In the first 3 to 5 weeks, the instructor will lecture on the ethical and etiquette responsibilities of students, teachers, and researchers in physics. In each of the next 10 to 12 weeks, a faculty volunteer will explain his or her research program and opportunities for student participation in it. A faculty member may also nominate a graduate student to speak to the class. Former graduate students who hold physics research positions could also be invited to speak. Students will have ample opportunity to ask questions. They will be required to turn in one-page summaries of the lectures for grading by the lecturers; this should measure the students' understanding and improve their writing skills. A possible text for the ethics lectures would be the National Academy of Sciences booklet "On Being a Scientist".

Field of Study Restrictions: Must be enrolled in one of the following Majors: Physics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PHYS 5101. Analytical Mechanics. 3 Credit Hours.

Variational principles, Lagrange's and Hamilton's equations; canonical transformations; small oscillations; dynamics of particles, rigid bodies, strings and membranes; hydrodynamics; chaos in deterministic systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PHYS 5301. Electromagnetic Theory. 3 Credit Hours.

Boundary value problems of the electrostatic and magnetostatic fields; Maxwell's equations; plane waves at boundaries in dielectric and conducting media; potentials in the Lorentz gauge; Green's functions for wave and Helmholtz equations; multipole radiation; material dispersion; diffraction.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PHYS 5302. Advanced Electromagnetic Theory. 3 Credit Hours.

Maxwell stress tensor; relativistic dynamics; Lagrangian formulation of electrodynamics; Noether's theorem; laser resonant cavities and optics of Gaussian beams; Eikonal and geometrical optics limit; synchrotron radiation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

PHYS 5301|Minimum Grade of B-|May not be taken concurrently.

PHYS 5501. Mathematical Physics. 3 Credit Hours.

Tensor analysis; group theory; complex variable theory; partial differential equations; Sturm-Liouville systems; integral transforms; integral equations and Green's function methods.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PHYS 5502. Computational and Mathematical Physics. 3 Credit Hours.

Preliminaries; numerical applicability, survey of algorithms, computer modeling, programming considerations; basic numerical methods; numerical linear algebra; numerical solution to ordinary and partial differential equations; molecular dynamics; Monte Carlo simulations; nonlinear methods.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

PHYS 5501|Minimum Grade of B-|May not be taken concurrently.

PHYS 5701. Quantum Mechanics I. 3 Credit Hours.

Fundamental principles of quantum mechanics; relation to classical mechanics; Schroedinger and operator formulations; path integrals; Aharonov-Bohm effect; examples of exact solutions; central forces and angular momentum; scattering theory; Bell's theorem.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PHYS 5702. Quantum Mechanics II. 3 Credit Hours.

Matrix mechanics; theory of electron spin; Hilbert space formulation of quantum mechanics; transformation theory; theory of rotations; spin and statistics; stationary approximation methods with application to atomic systems; time-dependent perturbation theory; exponential decay.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

PHYS 5701|Minimum Grade of B-|May not be taken concurrently.

PHYS 8001. Practicum Teaching of Physics. 1 Credit Hour.

Required of all graduate teaching assistants in their first semester. Consists of supervised instruction in undergraduate laboratories and a weekly two-hour class.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PHYS 8004. Problems in Experimental Physics. 1 to 6 Credit Hour.

Special problems in the field of experimental physics. The course is designed to acquaint the student with the research techniques employed in experimental physics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 8005. Problems in Theoretical Physics. 1 to 6 Credit Hour.

Special problems in the field of theoretical physics. The course is designed to acquaint the student with the research techniques employed in theoretical physics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 8020. Topical Seminar I. 3 Credit Hours.

This course considers special topics in Physics, not considered in depth in our other courses.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 8030. Topical Seminar II. 3 Credit Hours.

This course considers special topics in Physics, not considered in depth in our other courses.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 8050. Physics Seminar. 0 Credit Hours.

This course provides the graduate students with the state of the field knowledge about Physics. Students attend 10 to 12 Colloquium/Seminars per semester given by the experts, mostly drawn from national and international authorities in the field. The students are graded on the basis of their attendance in these seminars, and are encouraged to discuss their research with these visiting experts. Last year's colloquium included among other experts, a Nobel Laureate, Sir Anthony Leggett, 2003.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 8102. Statistical Mechanics. 3 Credit Hours.

Review of thermodynamics; kinetic theory; statistical definition of entropy; microcanonical, canonical, and grand canonical ensembles; applications to gases, diatomic molecules, magnetic systems, phase transitions; quantum statistics; ideal boson and fermion systems; Bose-Einstein condensation; black body radiation; models of solids; properties of liquid helium.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(PHYS 5501|Minimum Grade of B-|May not be taken concurrently
AND PHYS 5701|Minimum Grade of B-|May not be taken concurrently)

PHYS 8701. Quantum Field Theory. 3 Credit Hours.

Properties of quantized radiation field; emission, absorption and scattering of photons by atoms; nonrelativistic Lamb shift; Dirac equation: nonrelativistic limit, Lorentz covariance, exact solutions; hole theory; Lagrangian field theory; field quantization; S-matrix; covariant perturbation theory; Feynman rules for QED with application to various processes.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

PHYS 5702|Minimum Grade of B-|May not be taken concurrently.

PHYS 8702. Solid State Physics. 3 Credit Hours.

Crystal and x-ray diffraction; lattice vibrations and thermal properties; energy bands and electronic properties; semiconductors; optical and dielectric properties; para-, ferro-, and antiferromagnetism; introduction to superconductivity and superfluidity.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(PHYS 5701|Minimum Grade of B-|May not be taken concurrently)
AND (PHYS 5702|Minimum Grade of B-|May not be taken concurrently)

PHYS 8703. Nuclear and Elementary Particle Physics. 3 Credit Hours.

The Standard Model (SM); gauge invariance, non-Abelian gauge theories, SM Lagrangian, electroweak theory and QCD, Higgs mechanism, confinement; experimental considerations: accelerators and detectors, elastic scattering and form factors, deep inelastic scattering and structure functions; advanced topics in the SM: grand unification, neutrino mass, big bang cosmology, dark matter.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(PHYS 5701|Minimum Grade of B-|May not be taken concurrently)
AND (PHYS 5702|Minimum Grade of B-|May not be taken concurrently)

PHYS 8704. Many Electron Theory. 3 Credit Hours.

The course is at an intermediate level and is appropriate for students of experimental and theoretical condensed matter and AMO physics. The course familiarizes students with the theory of correlated electrons and states with broken electron symmetry, it also provides a framework for the description of experimental properties in materials with electron correlations. Topics include: Phenomenology of cohesion in molecules and solids, Many-electron wavefunctions, Functionals and their extrema, Wavefunction variational principles, Hellmann-Feynman theorem, One- and two-particle density matrices, and the electron density Wavefunction vs. density functional methods, Hohenberg-Kohn theorem, Functional derivatives, Uniform electron gas Kohn-Sham spin-density functional theory, Approximate functionals, Linear Response Theory and Stability, Collective Excitations, Superconducting Instability, Magnetic Instabilities, Charge Density Wave Instabilities in low-dimensional systems, Ferromagnetic, Spin and Orbital density wave phases, Instabilities of the Half-Filled Band, BCS Theory of Superconductivity, s, p and d wave pairing, the Integer and Fractional Quantum Hall States, Collective Excitations and Goldstone Modes.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Science & Technology.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

PHYS 8702|Minimum Grade of B-|May not be taken concurrently.

PHYS 8705. Advanced Topics in Nuclear and Particle Physics. 3 Credit Hours.

The course is at an intermediate level and is appropriate for students of experimental and theoretical nuclear and particle physics. Topics include: Accelerators, Detectors, Essential elements of data analysis and statistics, Selected advanced topics in QFT, Hard scattering processes and the parton structure of hadrons, Breaking of global and local symmetries (Higgs mechanism), Effective field theory, Neutrino physics, Physics beyond the SM, Nuclear matter under extreme conditions, Overview of nuclear structure and reactions.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Science & Technology.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

PHYS 8703|Minimum Grade of B-|May not be taken concurrently.

PHYS 8985. Teach in Higher Ed: Phys. 2 Credit Hours.

Teaching in Higher Ed: Physics. This course focuses on learning theory and the best teaching practices, with the aim of preparing students for effective higher education teaching.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PHYS 9991. Master's Research Projects. 1 to 6 Credit Hour.

Short-term, limited research project or laboratory project in the field. This course is not the capstone project course, nor can it be used for thesis based research. The course is for master's students only, including PSM, MA or MS. This class will not confer full-time program status unless nine credits are taken.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Degree Restrictions: Must be enrolled in one of the following Degrees: Master of Arts, Master of Science, Prof Science Masters.

Repeatability: This course may be repeated for additional credit.

PHYS 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.

This course is required for students who are preparing for the preliminary or candidacy examination. Students should enroll after coursework is completed or when preparing for the candidacy exam until the time that the preliminary or candidacy examination is completed. This course will confer full-time status at the minimum credit hour registration limit of one credit. All students must complete a minimum of one credit of this course. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 9995. Capstone Project. 1 to 6 Credit Hour.

Capstone project for master's students including students in PSM, MA or MS. This class will provide full-time status. Students in PSM programs need to register for at least one credit of this course to fulfill program requirements. Additional credits may be required for specific programs. This course will confer full-time status at the minimum credit hour registration limit of one credit.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Degree Restrictions: Must be enrolled in one of the following Degrees: Master of Arts, Master of Science, Prof Science Masters.

Repeatability: This course may be repeated for additional credit.

PHYS 9996. Master's Thesis Research. 1 to 6 Credit Hour.

Course for master's thesis research. Only intended for students in thesis bearing master's programs. A minimum of one credit is required. This course will confer full-time status at the minimum credit hour registration limit of one credit.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 9998. Pre-Dissertation Research / Elevation to Candidacy. 1 to 6 Credit Hour.

This course is intended for students who are performing research prior to candidacy. Students can register for this course after required courses are completed. This course will confer full-time status at the minimum credit hour registration limit of one credit. Students must be registered for this course during the semester that they are to be elevated to candidacy examination. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PHYS 9999. Dissertation Research. 1 to 6 Credit Hour.

The course is for Ph.D. students who have been elevated to candidacy. During the course of their candidacy students must complete a minimum of two credits of dissertation research. This course will confer full-time status at the minimum credit hour registration limit of one credit. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Student Attribute Restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student.

Repeatability: This course may be repeated for additional credit.