***Twin Cities Campus***

# Physics M.S.

*School of Physics & Astronomy*

**College of Science and Engineering**

Link to a list of faculty for this program.

**Contact Information:**
Director of Graduate Studies in Physics, School of Physics and Astronomy, University of Minnesota, 116 Church St. SE, Minneapolis, MN 55455 (612-626-5982; fax: 612-624-4578)
Email: grad@physics.umn.edu
Website: http://www.physics.umn.edu/grad

- Program Type: Master's
- Requirements for this program are current for Fall 2018
- Length of program in credits: 30
- This program does not require summer semesters for timely completion.
- Degree: Master of Science

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

Note: Students applying for a terminal MS degree are not admitted, unless they arrange for their own financial support. Students admitted to the PhD program are automatically eligible for the MS program.

Physics is the study of the fundamental structure and interactions of matter. Research areas in the program include experimental and theoretical studies in astrophysics and cosmology, biological physics, condensed matter physics, elementary particle physics, nuclear physics, space and planetary physics, and physics education research. Interdisciplinary study is also available with the programs in astrophysics, biological sciences, chemistry, chemical engineering and materials science, electrical and computer engineering, mechanical engineering, and the history of science and technology.

## Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

## Prerequisites for Admission

The preferred undergraduate GPA for admittance to the program is 3.30.

Other requirements to be completed before admission:
Upper division courses in the core areas of classical mechanics, electricity and magnetism, quantum mechanics, and statistical and thermal physics are required. It is advisable to have taken an upper division course in experimental methods in physics.

**Special Application Requirements:**
Students admitted to the Ph.D. program are automatically eligible for the M.S. program. Students applying for a terminal M.S. degree are not admitted unless they arrange for their own financial support.

Applications are accepted for fall admission only. Application by December 15 is strongly encouraged. Additional application information is available at http://www.physics.umn.edu/grad/physics/application.html

International applicants must submit score(s) from one of the following tests:

- TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
  - Internet Based - Reading Score: 19
  - Paper Based - Total Score: 550
- IELTS
  - Total Score: 6.5
- MELAB
  - Final score: 80

Key to test abbreviations(TOEFL, IELTS, MELAB).

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For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

## Program Requirements

**Plan A:** Plan A requires 20 major credits, 0 credits outside the major, and 10 thesis credits.The final exam is oral.

**Plan B:** Plan B requires 30 major credits and 0 credits outside the major.The final exam is oral. A capstone project is required.
**Capstone Project:** The Plan B project is a self-contained research problem performed in conjunction with the student's advisor. Students register for 4 credits of Physics 8500: Plan B project, which count toward the program requirement of 30 credits. The project is described in a written paper. Examples of Plan B projects include carrying out a specific calculation, writing and documenting a computer program, analyzing a set of experimental data, designing and/or constructing experimental instrumentation, and designing and/or constructing an undergraduate laboratory experiment. The alternative to the Plan B project is writing 1-3 Plan B papers. The Plan B papers are related to three courses that the student has taken and do not require original research. It's expected that completion of either the project or the Plan B papers require a nominal three weeks of full-time effort.

**Plan C:** Plan C requires 30 major credits and 0 credits outside the major.The is no final exam.

This program may be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

Physics 4001, 4002, 4101, 4201, and 4303 cannot be used to satisfy degree requirements.

To remain in good academic standing students must maintain a minimum GPA of 3.30.

Students completing the Plan C option must also pass the physics graduate written exam.

**Required Courses**

Plan A and Plan B students must complete either the quantum mechanics sequence or the classical physics sequence. Plan C students must complete both sequences.

**Quantum Mechanics Sequence**

PHYS 5001 - Quantum Mechanics I (4.0 cr)
PHYS 5002 - Quantum Mechanics II (4.0 cr)

**Classical Physics Sequence**

PHYS 5011 - Classical Physics I (4.0 cr)
PHYS 5012 - Classical Physics II (4.0 cr)

**Plan A**

Plan A requires 8 credits in a required sequence and an additional 12 course credits taken in the major or in a related field, including in a minor. Ten thesis credits are also required.
PHYS 8777 - Thesis Credits: Master's (1.0 - 18.0 cr)

**Plan B**

Plan B requires 8 credits in a required sequence and an additional 22 course credits taken in the major or in a related field, including in a minor. Up to 4 credits of PHYS 8500 may be used for the Plan B project.
PHYS 8500 - Plan B Project (4.0 cr)

**Plan C**

Plan C requires the two course sequences listed above (16 credits) and PHYS 5201 (3 credits). The remaining 11 credits may be taken in the major field or in a related field, including in a minor.
PHYS 5201 - Thermal and Statistical Physics (3.0 cr)

**Electives**

Students may choose courses from this list or consult with their advisor for additional options.

**Atomic Physics and Optics**

PHYS 8161 - Atomic and Molecular Structure (3.0 cr)

**Biophysics and Medical Physics**

PHYS 5081 - Introduction to Biopolymer Physics (3.0 cr)
PHYS 5401 *{Inactive}*(4.0 cr)
PHYS 5402 *{Inactive}*(4.0 cr)
PHYS 8311 - Biological Physics of Single Molecules (3.0 cr)

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PHYS 8312 - Biological Physics of Macroscopic Systems (3.0 cr)
PHYS 8300 - Seminar: Biological and Medical Physics. (1.0 cr)

**Condensed Matter Physics**

PHYS 4211 - Introduction to Solid-State Physics (3.0 cr)
PHYS 5701 - Solid-State Physics for Engineers and Scientists (4.0 cr)
PHYS 8702 - Statistical Mechanics and Transport Theory (3.0 cr)
PHYS 8711 - Solid-State Physics I (3.0 cr)
PHYS 8712 - Solid-State Physics II (3.0 cr)
PHYS 8750 - Advanced Topics in Condensed Matter Physics (3.0 cr)
PHYS 8700 - Seminar: Condensed Matter Physics (1.0 cr)

**Elementary Particle Physics**

PHYS 4511 - Introduction to Nuclear and Particle Physics (3.0 cr)
PHYS 8011 - Quantum Field Theory I (3.0 cr)
PHYS 8012 - Quantum Field Theory II (3.0 cr)
PHYS 8013 - Special Topics in Quantum Field Theory (3.0 cr)
PHYS 8901 - Elementary Particle Physics I (3.0 cr)
PHYS 8902 - Elementary Particle Physics II (3.0 cr)
PHYS 8911 - Introduction to Supersymmetry (3.0 cr)
PHYS 8950 *{Inactive}*(3.0 cr)
PHYS 8900 - Seminar: Elementary Particle Physics (1.0 cr)

**Mathematical, Advanced Quantum, and Computational Physics**

PHYS 5041 - Mathematical Methods for Physics (4.0 cr)
PHYS 8001 - Advanced Quantum Mechanics (3.0 cr)
PHYS 8301 - Symmetry and Its Application to Physical Problems (3.0 cr)

**Nuclear Physics**

PHYS 8800 - Seminar: Nuclear Physics (1.0 cr)
PHYS 8801 - Nuclear Physics I (3.0 cr)
PHYS 8802 - Nuclear Physics II (3.0 cr)
PHYS 8850 - Advanced Topics in Nuclear Physics (3.0 cr)

**Plasma and Space Physics**

PHYS 4611 - Introduction to Space Physics (3.0 cr)
PHYS 4621 - Introduction to Plasma Physics (3.0 cr)
PHYS 8601 - Plasma Physics I (3.0 cr)
PHYS 8602 - Plasma Physics II (3.0 cr)
PHYS 8611 - Cosmic Rays and Plasma Astrophysics (3.0 cr)
PHYS 8650 - Advanced Topics in Space and Plasma Physics (3.0 cr)
PHYS 8600 - Seminar: Space Physics (1.0 cr)

**Relativity and Cosmology**

PHYS 5022 - Relativity, Cosmology, and the Universe (4.0 cr)
PHYS 8501 - General Relativity and Cosmology I (3.0 cr)
PHYS 8502 - General Relativity and Cosmology II (3.0 cr)
PHYS 8200 - Seminar: Cosmology and High Energy Astrophysics (1.0 cr)

**Physics Education**

PHYS 5072 - Best Practices in College Physics Teaching (1.0 - 3.0 cr)
PHYS 8100 - Seminar: Problems of Physics Teaching and Higher Education (1.0 cr)

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