Physics (PHY)

Major and Minor in

Physics

Department of Physics and Astronomy, College of Arts and Sciences

CHAIRPERSON: Paul Grannis DIRECTOR OF UNDERGRADUATE STUDIES: Emilio Mendez ASTRONOMY COORDINATOR: James Lattimer
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Minors of particular interest to students majoring in Physics: Computer Science (CSE), Electrical Engineering (ESE), Materials Science (ESM), Mathematics (MAT), Optics (OPT), Science and Engineering (LSE)

Faculty

Alexander Abanov, *Assistant Professor, Ph.D., University of Chicago:* Theoretical condensed matter physics.

Philip B. Allen, *Professor, Ph.D., University of California, Berkeley:* Theoretical solid-state physics; superconductors and superconductivity.

Ralf Averbeck, *Research Assistant Professor, Ph.D., Universitaet Giessen, Germany*: Experimental nuclear physics.

Dimitri Averin, *Professor, Ph.D., Moscow State University:* Solid-state physics.

Thomas Bergeman, *Research Professor, Ph.D., Harvard University:* Theoretical atomic physics.

Gerald E. Brown, *Distinguished Professor, Ph.D., Yale University; D.Sc., University of Birmingham:* Theoretical nuclear physics. Member, Yang Institute for Theoretical Physics.

Abhay Deshpande, *Assistant Professor, Ph.D., Yale University:* Nucleon spin; heavy ion physics.

Axel Drees, *Professor, Ph.D., University of Heidelberg:* Experimental nuclear physics; relativistic ions.

Adam Durst, *Assistant Professor, Ph.D., Massachusetts Institute of Technology:* Theoretical condensed-matter physics.

Roderich Engelmann, *Professor, Ph.D., University of Heidelberg:* Experimental elementary particle physics.

Aaron Evans, *Assistant Professor, Ph.D., University of Hawaii:* Observational extragalactic astronomy.

Miriam Forman, *Adjunct Professor, Ph.D., Stony Brook University*: Cosmic rays.

Marvin Geller, *Adjunct Professor, Ph.D., Massachusetts Institute of Technology:* Atmospheric dynamics.

Alfred S. Goldhaber, *Professor, Ph.D., Princeton University:* Theoretical physics; nuclear theory; particle physics. Member, Yang Institute for Theoretical Physics.

Vladimir J. Goldman, *Professor, Ph.D., University of Maryland at College Park:* Experimental condensed matter physics.

Maria Concepcion Gonzalez-Garcia, *Associate Professor, Ph.D., Universidad de Valencia:* Particle physics phenomenology; neutrino physics. Member, Yang Institute for Theoretical Physics.

Erlend H. Graf, *Associate Professor, Ph.D., Cornell University:* Experimental low-temperature physics.

Paul D. Grannis, *Distinguished Professor, Ph.D., University of California, Berkeley:* Experimental high-energy physics; elementary particle reactions.

Michael Gurvitch, *Professor, Ph.D., Stony Brook University:* Experimental solid-state physics.

Thomas Hemmick, *Professor, Ph.D., University of Rochester:* Experimental relativistic heavy-ion nuclear physics. Recipient of the State University Chancellor's Award for Excellence in Teaching, 1996.

John Hobbs, *Associate Professor, Ph.D., University of Chicago:* Experimental high-energy physics.

Barbara Jacak, *Professor, Ph.D., Michigan State University:* Experimental nuclear physics; relativistic heavy ions.

Chris Jacobsen, *Professor, Ph.D., Stony Brook University:* X-ray physics.

Chang Kee Jung, *Professor, Ph.D., Indiana University:* Experimental high-energy physics.

Peter B. Kahn, *Professor Emeritus, Ph.D., Northwestern University:* Theoretical physics; nonlinear dynamics.

Janos Kirz, *Distinguished Professor, Ph.D., University of California, Berkeley:* X-ray optics. Recipient of the State University Chancellor's Award for Excellence in Teaching, 1976.

Peter M. Koch, *Professor, Ph.D., Yale University:* Experimental atomic physics; quantum chaos; nonlinear dynamics.

Vladimir Korepin, *Professor, Ph.D., Leningrad University:* Exactly solvable models in quantum field theory. Member, Yang Institute for Theoretical Physics.

T.T.S. Kuo, *Professor, Ph.D., University of Pittsburgh:* Nuclear theory. Recipient of the State University Chancellor's Award for Excellence in Teaching, 2001.

Kenneth M. Lanzetta, *Professor, Ph.D., University of Pittsburgh:* Observational cosmology.

James Lattimer, *Professor, Ph.D., University of Texas:* Nuclear astrophysics.

Linwood L. Lee, *Jr., Professor Emeritus, Ph.D., Yale University:* Experimental nuclear structure.

Konstantin Likharev, *Distinguished Professor, Ph.D., Moscow State University:* Solid-state physics.

James Lukens, *Professor, Ph.D., University of California, San Diego:* Experimental solid-state physics.

Robert L. McCarthy, *Professor, Ph.D., University of California, Berkeley:* Experimental elementary particle physics.

Barry M. McCoy, *Distinguished Professor, Ph.D., Harvard University:* Statistical mechanics. Member, Yang Institute for Theoretical Physics.

Robert L. McGrath, *Professor, Provost and Vice President of Brookhaven Affairs; Ph.D., University of Iowa:* Experimental physics; nuclear structure.

Clark McGrew, *Assistant Professor, Ph.D., University of California at Irvine:* Experimental particle physics; neutrino physics.

John H. Marburger, *Professor, former President of Stony Brook University and Director, Office of Science and Technology Policy, White House; Ph.D., Stanford University:* Laser theory.

Michael Marx, *Professor, Ph.D., Massachusetts Institute of Technology:* Experimental high-energy and relativistic heavy-ion physics.

Emilio E. Mendez, *Professor, Ph.D., Director of the Institute for Interface Phenomena. Massachusetts Institute of Technology:* Experimental solid-state physics.

Harold J. Metcalf, *Professor, Ph.D., Brown University:* Atomic physics; laser cooling and trapping; atom optics; precision Stark spectroscopy; lasers and optics teaching. Recipient of the State University Chancellor's Award for Excellence in Teaching, 1974.

Laszlo Mihaly, *Professor, Ph.D., University of Budapest:* Experimental solid-state physics. Recipient of the State University Chancellor's Award for Excellence in Teaching, 2003.

Richard A. Mould, *Associate Professor Emeritus, Ph.D., Yale University:* Theoretical physics; general relativity; quantum theory of measurements.

Peter Paul, *Distinguished Service Professor, Ph.D., University of Freiburg:* Experimental nuclear physics.

Stephen G. Peggs, *Adjunct Professor, Ph.D., Cornell University:* Accelerator physics.

Deane M. Peterson, *Associate Professor, Ph.D., Harvard University:* Observational stellar astronomy.

Norbert Pietralla, *Assistant Professor, Ph.D., University of Cologne:* Experimental nuclear-structure physics; gamma-ray spectroscopy.

Madappa Prakash, *Research Professor, Ph.D., University of Bombay, India:* Theoretical nuclear physics.

Michael Rijssenbeek, *Professor, Ph.D., University of Amsterdam:* Experimental high-energy physics.

Martin Rocek, *Professor, Ph.D., Harvard University:* Theoretical physics. Member, Yang Institute for Theoretical Physics.

Dominik Schneble, *Assistant Professor, Ph.D., University of Konstanz:* Experimental atomic physics; ultracold quantum gases.

Vasili Semenov, *Research Professor, Ph.D., Moscow State University:* Experimental condensed matter physics.

Robert Shrock, *Professor, Ph.D., Princeton University:* Theoretical physics; gauge theories, statistical mechanics. Member, Yang Institute for Theoretical Physics.

Edward Shuryak, *Distinguished Professor, Ph.D., Novosibirsk Institute of Nuclear Physics:* Theoretical nuclear physics.

Warren Siegel, *Professor, Ph.D., University of California, Berkeley:* Theoretical physics; strings. Member, Yang Institute for Theoretical Physics.

Michal Simon, *Professor, Ph.D., Cornell University:* Observational astronomy.

John Smith, *Professor, Ph.D., University of Edinburgh:* Elementary-particle physics. Member, Yang Institute for Theoretical Physics.

Philip M. Solomon, *Distinguished Professor, Ph.D., University of Wisconsin:* Galactic and extragalactic astronomy.

Gene D. Sprouse, *Professor, Ph.D., Stanford University:* Experimental nuclear structure. Recipient of the State University Chancellor's Award for Excellence in Teaching, 1999.

Peter W. Stephens, *Professor, Ph.D., Massachusetts Institute of Technology:* Experimental solid-state physics.

George Sterman, *Professor and Director, Yang Institute for Theoretical Physics, Ph.D., University of Maryland at College Park:* Theoretical physics; elementary particles. Member, Yang Institute for Theoretical Physics.

Clifford E. Swartz, *Professor Emeritus, Ph.D., University of Rochester:* School curriculum revision.

F. Douglas Swesty, *Research Assistant Professor, Ph.D., Stony Brook University:* Computational nuclear astrophysics.

Sergey Tolpygo, *Adjunct Professor, Ph.D., Russian Academy of Sciences:* Mesocopic physics.

Peter Van Nieuwenhuizen, *Distinguished Professor, Ph.D., Utrecht University:* Theoretical physics. Member, Yang Institute for Theoretical Physics.

Jacobus Verbaarschot, *Professor, Ph.D., University of Utrecht:* Nuclear theory.

Frederick M. Walter, *Professor, Ph.D., University of California, Berkeley:* Observational stellar astronomy.

Thomas Weinacht, *Assistant Professor, Ph.D., University of Michigan:* Ultrafast optical physics; coherent control of molecular dynamics; time-domain spectroscopy.

William I. Weisberger, *Professor, Ph.D., Massachusetts Institute of Technology:* Theoretical physics. Member, Yang Institute for Theoretical Physics.

Amos Yahil, *Professor, Ph.D., California Institute of Technology:* Astronomy.

Chiaki Yanagisawa, *Research Associate Professor, Ph.D., University of Tokyo:* Experimental high energy physics.

Chen Ning Yang, *Einstein Professor Emeritus, D.Sc., Princeton University; Ph.D., University of Chicago:* Theoretical physics; field theory; statistical mechanics; particle physics. Member, Yang Institute for Theoretical Physics.

Ismail Zahed, *Professor, Ph.D., Massachusetts Institute of Technology:* Theoretical nuclear physics.

Teaching Assistants

Estimated number: 46

Physics is the study of the basic physical principles that govern our universe. This study uses the language of mathematics and is applied in all other natural sciences (astronomy, chemistry, biology, geology, etc.) and engineering. The objective of the major in Physics is to teach students those principles, and, in general, how to think scientifically about the physical world.

A basic education in physics is also applicable to many other fields, including astronomy, engineering, computer programming, geology, biophysics, medicine, medical technology, teaching, law, business, etc. Since the basic principles of physics do not go out of style, and will be the basis for many new technologies, the Physics major provides the ability to adapt to new conditions; hence its permanent value. After graduation approximately half of our Physics majors go on to graduate school, either in physics or in a related field (such as those mentioned above). The other half initially take positions in industry, but many of them later return to graduate school.

Astronomy

See the Astronomy entry in the alphabetical listings of Approved Majors, Minors, and Programs for Astronomy courses and major requirements.

Courses Offered in Physics

See the Course Descriptions listing in this *Bulletin* for complete information.

PHY 104 Opportunities in Physics

PHY 112-E Light, Color, and Vision

PHY 113-E Physics of Sports

PHY 114-E Electromagnetism, Waves and Radiation for Sports Science

PHY 115 Physics of Sports Laboratory

PHY 116 Electromagnetism, Wave and Radiation for Sports Science Laboratory

PHY 119-E Physics for Environmental Studies

PHY 121-E, 122-E Physics for the Life Sciences I, II

PHY 123, 124 Physics for Life Sciences Laboratory I, II

PHY 125-E Classical Physics A

PHY 126-E Classical Physics B

PHY 127-E Classical Physics C

PHY 131-E, 132-E Classical Physics I, II

PHY 133, 134 Classical Physics Laboratory I, II

PHY 141-E, 142-E Classical Physics I, II: Honors

PHY 191, 192 Transitional Study

PHY 200 Physics Today

PHY 237-H Current Topics in World Climate and Atmosphere

PHY 251 Modern Physics

PHY 252 Modern Physics Laboratory

PHY 277 Computation for Physics and Astronomy

PHY 287 Introduction to Research

PHY 291 Transitional Study

PHY 300 Waves and Optics

PHY 301, 302 Electromagnetic Theory I, II

PHY 303 Mechanics

PHY 306 Thermodynamics, Kinetic Theory, and Statistical Mechanics

PHY 308 Quantum Physics

PHY 310 Probability and Statistics for Experimental Physics

PHY 311 Connections in Science

PHY 313-H Mystery of Matter

PHY 335 Electronics and Instrumentation Laboratory

PHY 390 Special Topics in Physics

PHY 403 Nonlinear Dynamics

PHY 405 Advanced Quantum Physics

PHY 407 Physics of Continuous Media

PHY 408 Relativity

PHY 431 Nuclear and Particle Physics

PHY 445 Senior Laboratory

PHY 447 Tutorial in Advanced Topics

PHY 452 Lasers

PHY 472 Solid-State Physics

PHY 475 Undergraduate Teaching Practicum

PHY 487 Research

Requirements for the Major in Physics (PHY)

The major in Physics leads to the Bachelor of Science degree. All courses must be passed with adequate course grades. (See Notes below.)

Completion of the major requires approximately 67 credits.

A. Courses in Physics

PHY 131/133, 132/134 Classical Physics I, II and Laboratories (See Note 1)

PHY 251/252 Modern Physics and Laboratory

AST/PHY 277 Computation for Physics and Astronomy

PHY 300 Waves and Optics

PHY 301 Electromagnetic Theory

PHY 303 Mechanics

PHY 306 Thermodynamics, Kinetic Theory, and Statistical Mechanics

PHY 308 Quantum Physics

PHY 335 Electronics and Instrumentation Laboratory

PHY 445 Senior Laboratory I

Notes:

1. The sequence PHY 125, 126, 127 or PHY 141, 142 may substitute for PHY 131/133, 132/134.
2. At least four courses numbered 300 or above must be taken at Stony Brook.
3. Each course numbered 300 or above must be completed with a grade of C or higher; a maximum of three courses at the 100 or 200 level passed with a grade of C- may be applied to the major.

B. Courses in Mathematics

1. One of the following sequences:
   MAT 131, 132 Calculus I, II
   or MAT 141, 142 Honors Calculus I, II
   or MAT 125, 126, 127 Calculus A, B, C
2. One of the following:
   MAT 205 Calculus III
   or MAT 203 Calculus III with Applications
   or AMS 261 Applied Calculus III
3. One of the following:
   MAT 305 Calculus IV
   or MAT 303 Calculus IV with Applications
   or AMS 361 Applied Calculus IV: Differential Equations

Note: Equivalency for MAT courses achieved on the Mathematics Placement Examination is accepted as fulfillment of the corresponding requirements, as indicated in the Course Descriptions section of this *Bulletin*.

C. Courses in Related Fields

Twelve credits of acceptable physics-related courses that complement a Physics major's education. A list of acceptable courses is posted in the Physics and Astronomy Undergraduate Office.

D. Upper-Division Writing Requirement

Students are certified as satisfying the upper-division writing requirement by completing a writing project within their major. Scientific research results in journal publications use a terse language, but physicists and astronomers must also write engagingly in funding applications and in communicating their work to others, and this is what is expected in writing submitted to meet this requirement. Within the first month of the semester in which the student plans to satisfy the requirement, the student should speak with the course instructor or research supervisor about his or her intent to expand upon a course assignment (for example by adding a discussion of the history and significance of a physics experiment) or research project to meet the upper-division writing requirement. If there are questions over the suitability of the proposed writing project, the student should discuss the proposal with the undergraduate program director. Students are encouraged to seek comments on a draft of their text during the course of the semester, and the final text should be submitted to the instructor or research supervisor by the last day of classes for that semester. The course instructor or research supervisor will read the paper for evidence that the student's writing meets the requirement and will forward the paper and their recommendation to the undergraduate program director for consideration. The undergraduate program director makes the final determination. The satisfaction of the writing requirement is certified independently of the course grade, and is best completed in the junior year.

Honors

To receive the Bachelor of Science in Physics with honors, in addition to having completed all the requirements for the B.S. in Physics a student must satisfy the following:

1. PHY 487 Research
2. Two other 400-level physics courses
3. Overall grade point average of at least 3.30 in all physics courses numbered 300 or higher.

The Research Program

A student desiring to prepare for graduate study in physics has considerable flexibility in the choice of courses. The following sample program is suggested:

Freshman Year

PHY 131/133 Classical Physics I and Laboratory
or PHY 141 Classical Physics I: Honors

PHY 132/134 Classical Physics II and Laboratory
or PHY 142 Classical Physics II: Honors

MAT 131 Calculus I

MAT 132 Calculus II

Sophomore Year

PHY 251/252 Modern Physics and Laboratory

PHY 277 Computing for Physics and Astronomy Majors

PHY 300 Waves and Optics

MAT 205 Calculus III

MAT 305 Calculus IV

CHE 131, 132 General Chemistry
or CHE 141, 142 Honors Chemistry

Sample Course Sequence for the Major in Physics

Freshman Fall	Credits
PHY 131/133	4
MAT 131	4
D.E.C.	3
D.E.C.	3
Total	14

Spring	Credits
PHY 132/134	4
MAT 132	4
D.E.C.	3
D.E.C.	3
D.E.C.	3
Total	17

Sophomore Fall	Credits
PHY 251/252	4
PHY/AST 277	3
MAT 205	3
D.E.C.	3
D.E.C.	3
Total	16

Spring	Credits
PHY 300	4
PHY 306	3
MAT 305	3
D.E.C.	3
D.E.C.	3
Total	16

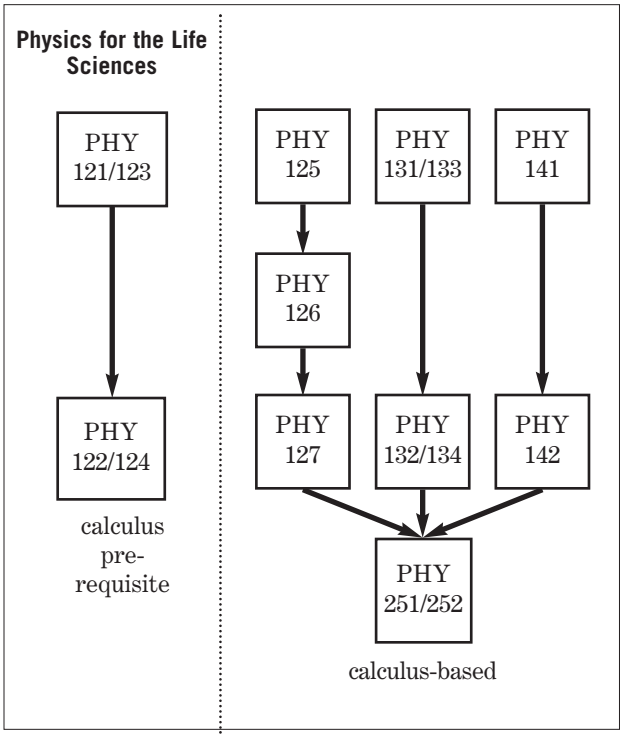
Junior Fall	Credits
PHY 301	3
PHY 303	3
PHY-related elective	3
MAT 341	3
D.E.C.	3
Total	15

Spring	Credits
PHY 302	3
PHY 308	3
PHY 335	3
MAT 342	3
Elective	3
Total	15

Senior Fall	Credits
PHY 487	3
PHY elective	3
PHY-related elective	3
D.E.C.	3
D.E.C.	3
Total	15

Spring	Credits
PHY 445	3
PHY elective	3
PHY-related elective	3
PHY-related elective	3
D.E.C.	3
Total	15

Introductory Physics Sequences



CHE 133, 134 General Chemistry Laboratory
or CHE 143, 144 Honors Chemistry Laboratory

Junior Year

PHY 301, 302 Electromagnetic Theory

PHY 303 Mechanics

PHY 306 Thermodynamics, Kinetic Theory, and Statistical Mechanics

PHY 308 Quantum Physics

PHY 335 Electronics and Instrumentation Laboratory

MAT 341 Applied Real Analysis

MAT 342 Applied Complex Analysis

Senior Year

PHY 405 Advanced Quantum Physics

PHY 445 Senior Laboratory I

At least two courses selected from:

PHY 403 Nonlinear Dynamics

PHY 408 Relativity

PHY 431 Nuclear and Particle Physics

PHY 447 Tutorial in Advanced Topics

PHY 472 Solid-State Physics

PHY 487 Research

Note: Of the courses mentioned above, MAT 341, MAT 342, PHY 302, and PHY 487 are not required for the B.S. in Physics.

Physics Secondary Teacher Education Program

See the Education and Teacher Certification entry in alphabetical listings of Approved Majors, Minors, and Programs.

Introductory Physics Sequences

The Department of Physics offers four Introductory Physics Sequences. The PHY 121/123, 122/124 sequence is designed specifically for students majoring in biological sciences or pre-clinical programs. Any of the other three sequences (PHY 131/133, 132/134; PHY 141, 142; PHY 125, 126, 127) together with PHY 251/252 constitute an intensive introduction to classical and modern physics for those who may major in Physics, other physical sciences, or engineering. These three Introductory Physics Sequences cover the same material, although the pace is different. The two-semester sequence (PHY 131/133, 132/134 or PHY 141, 142) should be taken only by students who are prepared for a pace considerably faster than that of the PHY 125, 126, 127 three-semester sequence. The PHY 141, 142 sequence is designed for students with the strongest interest and preparation in physics and mathematics. The flow chart shows the four basic Introductory Physics Sequences available. (In the PHY 125, 126, 127 sequence, 126 and 127 may be taken in either order.)

The Minor in Physics (PHY)

The minor in Physics is available for those who want their formal University records to emphasize a serious amount of upper-division work in physics.

All courses offered for the minor must be passed with a letter grade of C or higher. Completion of the minor requires 20 physics credits beyond the Introductory Physics Sequence.

Requirements for the Minor in Physics for students with majors in the College of Arts and Sciences:

1. PHY 251/252 Modern Physics
2. PHY 300 Waves and Optics
3. PHY 301 Electromagnetic Theory
4. PHY 303 Mechanics
5. PHY 335 Electronics and Instrumentation Laboratory
6. One of the following:

   PHY 306 Thermodynamics, Kinetic Theory, and Statistical Mechanics

   CHE 302 Physical Chemistry II

Requirements for the Minor in Physics for students with majors in the College of Engineering and Applied Sciences:

1. PHY 251 Modern Physics
2. One of the following:

   PHY 300 Waves and Optics

   ESE 321 Electromagnetic Waves and Wireless Communication

   ESG 281 An Engineering Introduction to the Solid State
3. One of the following:

   PHY 301 Electromagnetic Theory

   ESE 319 Introduction to Electromagnetic Fields and Waves
4. PHY 303 Mechanics
5. One of the following:

   PHY 306 Thermodynamics, Kinetic Theory, and Statistical Mechanics

   ESM 309 Thermodynamics of Solids

   MEC 398 Thermodynamics II
6. One of the following:

   PHY 335 Electronics and Instrumentation Laboratory

   ESE 314 Electronics Laboratory B