Physics and Astronomy

Chairperson
Laszlo Mihaly, Physics Building P-110 (631) 632-8100

Graduate Program Director
Jacobus Verbaarschot, Physics Building P-107 (631) 632-8279

Assistant Graduate Program Director
Sara Lutterbie, Physics Building P-110 (631) 632-8759

Degrees Awarded
M.A. in Physics; M.S. in Physics in Scientific Instrumentation; Ph.D. in Physics; Ph.D. in Physics with Concentration in Astronomy; Ph.D. in Physics with Concentration in Physical Biology.

Web Site
http://graduate.physics.sunysb.edu
http://www.physics.sunysb.edu/Physics/

Description of the Physics and Astronomy Department

The Department of Physics and Astronomy in the College of Arts and Sciences offers courses of study and research that normally lead to the Ph.D. degree. The M.A degree is awarded either as a terminal degree, or to students on the way to the Ph.D. degree. The Master of Science in Scientific Instrumentation program is provided for those interested in instrumentation for physical research. A Master of Arts in Teaching program, from the School of Professional Development, is available for students seeking to teach physics in high schools.

Students may find opportunities in various areas of physics not found in the department or in related disciplines at Stony Brook in such programs as Medical Physics, Chemical Physics, Atmospheric and Climate Modeling, Materials Science or Biophysics and at Cold Spring Harbor Laboratory.

The entire faculty participates in teaching a rich curriculum of undergraduate, graduate, and professional development courses, including many courses on special topics of current interest. Graduate students must fulfill one year of teaching. Course requirements are kept at a minimum to allow the student to set up a flexible program. Students are encouraged to participate in research as early as possible and to begin their thesis research no later than the beginning of their third year. The typical length of time to the Ph.D. is four to six years, whereas the Master's in Scientific Instrumentation is a two-year program that involves a thesis project in instrumentation design or development, and the work for an M.A. degree can be completed in two semesters and one Summer.

The Stony Brook Physics and Astronomy Department has been highly ranked in national surveys for the quality of its graduate program, its faculty, and the impact of its published research. It strives to make a graduate education in physics intellectually stimulating and educationally rewarding.

Research Areas

Research areas for the program include, Accelerator Physics and the Center for Accelerator Science and Education; Astronomy, Astrophysics and Cosmology; Atmospheric and Marine Sciences; Brookhaven National Laboratory; Atomic, Molecular and Optical Physics; C.N. Yang Institute for Theoretical Physics; Experimental Condensed Matter and Devices; Experimental High Energy Physics; Experimental Nuclear Physics; Physical Biology at the Laufer Center; Simons Center for Geometry and Physics; Theoretical Condensed Matter and Statistical Physics; and Theoretical Nuclear Physics. For information on this topic, please visit the program website at the link provided below.

http://graduate.physics.sunysb.edu/research/index.shtml

Doctoral Program with Concentration in Astronomy

The Department of Physics and Astronomy offers a Ph.D. degree with concentration in astronomy when the thesis work is carried out in the area of astronomy or astrophysics. The degree requirements are described below.

Doctoral Program with Concentration in Physical Biology

This is an interdisciplinary concentration connected with the Laufer Center for Quantitative Biology. Students usually declare their interest in this concentration not later than the end of the first semester. Postponing this decision will result in a loss of time. There are several differences with the default physics concentration. The number of core courses is reduced by one course while several physical biology courses are required. Instead of the graduate lab students do rotations with faculty associated with the Laufer Center. Also the Graduate Seminar is substituted by the Laufer Center Journal Club.

Doctoral Programs with Concentration in Chemical Physics

The basic degree requirements for a student enrolled in this program are the same as those for other students in physics. Students will usually be advised to take one or more courses in chemical physics. The written part of the preliminary (comprehensive) examination is the same as for other physics students; the oral part will ordinarily be on topics in chemical physics. Subject to the approval of the chairpersons of the two programs involved, the student’s research advisor may be chosen from participating members of the cooperating programs.
Master of Science Program with Concentration in Instrumentation
This is a two year Master of Science Program in which students focus on the study of modern research instrumentation.

Admission requirements of Physics and Astronomy Department

For admission to graduate study in Physics and Astronomy the following, in addition to the minimum Graduate School requirements, are required:

A. A bachelor’s degree in physics or a closely related field from an accredited institution.

B. A minimum grade average of B in all undergraduate coursework, and B or better in the sciences and mathematics.

C. Submission of the Graduate Record Examination (GRE) General Test. Note that the Physics GRE subject test is also recommended.

D. For non-native speakers of English, submission of the Toefl or IELTS test.

E. Admission by the Department of Physics and Astronomy and the Graduate School.

In special cases, a student not meeting requirement A (or, in unusual cases, requirement B) may be admitted on a provisional basis, without financial support. Upon admission, the student will be informed of the requirements that must be satisfied for termination of provisional status.

Retention of students in subsequent years will depend on satisfactory academic progress.

Physics and Astronomy Department

Physics research is conducted in the areas of particle, nuclear, condensed matter, mesoscopic, nanoscale, device, atomic, molecular and optical physics on campus and at research facilities elsewhere.

A number of institutes dedicated to specific fields offer a diverse spectrum of research opportunities. The C. N. Yang Institute for Theoretical Physics focuses on research in fundamental theory such as particle theory, neutrino physics, string theory, supersymmetry, and statistical mechanics. The Nuclear Theory Institute works on non-perturbative quantum chromodynamics, and the properties of hadronic matter under extreme conditions such as those created in the Relativistic Heavy Ion Collider at BNL. The new Simons Center for Geometry and Physics initiated by a significant private donation to the University offers research programs that are built on the historic close interaction between mathematicians and physicists at Stony Brook. It is housed in a new building that was completed in 2010.

Stony Brook co-manages nearby Brookhaven National Laboratory which conducts research in the physical, biomedical, and environmental sciences, as well as in climate and energy technologies. Brookhaven Lab also builds and operates major scientific facilities that include the Relativistic Heavy Ion Collider (RHIC), the Center for Functional Nanomaterials, the National Synchrotron Light Source (NSLS) and its successor now under construction, NSLS II, the Brookhaven Computational Science Center with the IBM BlueGene supercomputer.

In addition to facilities at BNL, faculty and staff make use of many off-campus facilities including the Fermilab Tevatron Collider, the Large Hadron Collider at CERN, Argonne National Laboratory and Lawrence Berkeley National Laboratory.

The Department has a research focus on areas such as particle, nuclear, condensed matter, mesoscopic, nanoscale, device, atomic, molecular and optical physics on campus and at research facilities elsewhere.

Astronomical research is conducted on both theoretical and observational topics. The group uses DOE supercomputing facilities as well as on-site Beowulf clusters for extensive simulations of astronomical objects and nuclear astrophysical processes.

Observational research focuses on topics in galactic and extragalactic star formation, substellar and stellar astrophysics, extrasolar planets, neutron stars, molecular clouds, and galaxy formation and evolution. Faculty and students are also frequent users of the National Optical Astronomy Observatories, the National Radio Astronomy Observatories, the observatories at Mauna Kea and the millimeter wave facilities at CARMA and Nobeyama observatories. They have also received extensive time on space-based observatories, including the Hubble Space Telescope, the Spitzer Space Telescope, the Herschel Space Observatory, and XMM-Newton.

Requirements for the M.A. Degree in Physics
1. Satisfactory performance in a program of studies (30 graduate credits) approved by the department. Normally such a program would include graduate seminars, classical mechanics, electrodynamics, and quantum mechanics.

2. Minimum grade point average of 3.0 in all graduate courses taken at Stony Brook.

3. Either passing the graduate comprehensive examination at the master’s level or completion of a master’s project.

Requirements for the M.S. Degree with Specialization in Scientific Instrumentation (MSI)
A candidate for the master’s degree with concentration in instrumentation will be required to demonstrate a certain level of knowledge of physics (by written and/or oral examination), to take required and elective courses, and to complete both a major and minor project. The curriculum is designed to meet the needs of students learning about the design, construction, and testing of sophisticated instrument systems. The degree holder will not be a super-technician, but a professional scientist trained in both physics and measurement techniques.

A. A student shall demonstrate proficiency in undergraduate physics at the level of the courses PHY 335 (Junior Laboratory I), 405 (Advanced Quantum Physics). Students need to have demonstrated knowledge in two of the three areas Nuclear and Particle Physics (covered in PHY 431), Condensed Matter Physics (PHY 472) and Laser and Atomic Physics (PHY 452). This can be done (1) by acceptance by the Master’s in Scientific Instrumentation Committee of courses taken as an undergraduate, (2) by written examination, or (3) by passing the courses appropriate to a student’s background;

B. A course about research instrumentation (PHY 514);

C. Two semesters each of graduate lab (PHY 515) and graduate seminar (PHY 598, PHY 599);

D. Students shall works as teaching assistant in an undergraduate laboratory for at least one semester (being a TA in PHY 445 may satisfy the requirement of taking the second semester of graduate lab (PHY 515));

E. Thirty credits (minimum) of graduate courses (500 level or above), including a minor project and a master’s thesis. This thesis must describe a major piece of work in scientific instrumentation and must be in a form acceptable to the Graduate School. It need not be original research in the same sense as a Ph.D. thesis, but it should be the result of an effort consistent with a year of full-time work. The thesis should present an improvement of the state of the art in some area, the development of a sophisticated apparatus, or some other significant laboratory project, and be defended before a committee;

F. Students shall acquire those technical skills deemed necessary by their thesis supervisors. These must include, but are not limited to, machining capability and computer literacy.

Each student will be assigned an advisory committee of three faculty members and will be required to meet frequently with them. It is expected that close communication among all the faculty and students involved will foster spirit, expose problems, and generally contribute to success.

For further information on this program, contact Professor Harold Metcalf.

Requirements for the Professional MSI Track
The only difference with the existing MSI program is that the minor project is replaced by a minimum of 9 credits of “Plus Courses” in Stony Brook’s College of Business, the School of Journalism or similar courses from a different program (subject to approval). The advisory committee will advise the student on which “Plus Courses” to take.

Requirements for the Ph.D. Degree in Physics
A. Completion of the following core courses with a grade of B or better: 501, 505, 511, 512, 540. A student can skip one or more of these courses by sufficiently good performance in the corresponding parts of a placement examination given at the beginning of each fall semester (2nd year and older students need permission from the Graduate Program Director). Students who took similar courses elsewhere can satisfy this requirement by taking advanced graduate courses (subject to approval by an Advising Committee appointed by the Graduate Program Director);

B. Completion of required courses: Each of the courses listed below must be passed with a minimum grade of B:

1. PHY 598 and PHY 599 Graduate Seminars. These courses are normally taken during the first year of graduate study, one per semester, in either order.

2. PHY 515 Methods of Experimental Research. This course must be taken not later than the fourth semester of residence. This requirement can also be satisfied by PHY 517, Laboratory Course in Astronomical Techniques.

3. Two advanced courses, each in an area outside that of the student’s thesis research, chosen from a list of courses approved for this purpose.

C. Passing of the written comprehensive examination. This is offered at the beginning of each semester and has comprehensive problems on astronomy, atomic physics, physical biology, condensed matter physics, nuclear and particle physics, and there will be a balance between more experimentally and more theoretically focused problems. It must be passed in the student’s fourth semester of study at Stony Brook or earlier.

D. Passing an oral examination on a broad range of topics relevant to the student’s intended area of thesis research. The oral examination should be passed before the beginning of the fifth semester of residency.

E. Acceptance of graduate student by an advisor for thesis work;

F. Teaching experience at least equivalent to that obtained in a one-year appointment as a teaching assistant, usually carried out in the first year;

G. Advancement to candidacy for the Ph.D. The department’s recommendation to the Graduate School for advancement to candidacy is based on the satisfactory completion of all requirements listed above;

H. Research, dissertation, and passing the dissertation examination.

I. At least one year of residence.

Stony Brook University Graduate Bulletin: www.stonybrook.edu/gradbulletin
Requirements for the Ph.D. Degree in Physics with Concentration in Astronomy
The requirements are the same except for B3. Instead the student shall take either four astronomy core courses or three astronomy core courses (PHY 521, PHY 522, PHY 523, PHY 524) and one of the advanced courses mentioned under B3. In addition, the thesis work should be in the area of Astronomy or Astrophysics. The thesis proposal will be prepared in a Special Studies Course (PHY 585) with the advisor.

Requirements for the Ph.D. Degree in Physics with Concentration in Physical Biology
A. Four Physics core course: Electrodynamics (PHY 505), Quantum Mechanics I (PHY 511), Statistical Mechanics (PHY 540) and either Classical Mechanics (PHY 501) or Quantum Mechanics II (PHY 512). Students can be exempted from these courses in the same way as in A above.
B. Two Core Courses in Physical Biology: Physical Biology (PHY 558) and Biological Dynamics and Network (PHY 559)
C. Biology For Physical Scientists (PHY 561)
D. Two semesters of Teaching (PHY 600)
E. Two semesters of Lab Rotations (PHY 584)
F. Two semester of the Laufer Center Journal Club (PHY 665)
G. Two Life Science courses form an approved list. Currently, the following courses have been approved: Biomolecular Structure and Analysis (CHE 541), Molecular Genetics (MCB 503), Structural Biology and Spectroscopy (MCB 512), Graduate Biochemistry I (MCB 520) and Cell Biology (MCB 656)
H. Passing of the Comprehensive Exam. The exam will have 4 questions in Physical Biology and students have the option to pass this exam based on these problems.
I. An oral exam on a topic in Physical Biology. The oral examination should be passed before the beginning of the fifth semester of residency
J. Acceptance of the graduate student by an advisor working on the topic of Physical Biology.
K. A Advancement to candidacy for the Ph.D. The department’s recommendation to the Graduate School for advancement to candidacy is based on the satisfactory completion of all requirements listed above.
L. Research, dissertation, and passing the dissertation examination.
M. At least one year of residence.

Faculty of the Department of Physics and Astronomy

Einstein Professor
Yang, Chen Ning\(^1\), Emeritus. Ph.D., 1948, University of Chicago: Theoretical physics; field theory; statistical mechanics; particle physics.

Distinguished Professors
Dill, Ken, Ph.D., 1978, UCSD, La Jolla: Physical Biology.
Brown, Gerald E\(^1\), Emeritus, Ph.D., 1950, Yale University: Theoretical physics; the many-body problem.
Grannis, Paul D., Emeritus, Ph.D., 1965, University of California, Berkeley: Experimental high-energy physics.
Jacak, Barbara, Ph.D., 1984, Michigan State University: Experimental nuclear physics; relativistic heavy ions.
Kirz, Janos, Emeritus, Ph.D., 1963, University of California, Berkeley: X-ray optics and microscopy; synchrotron radiation.
Lattimer, James M., Ph.D., 1976, University of Texas: Nuclear, neutrino and high-energy astrophysics; supernovae, neutron stars, dense matter; grain formation; isotopic anomalies in meteorites.
Likharev, Konstantin K., Ph.D., 1979, Moscow State University, Russia: Mesoscopic physics.
McCoy, Barry M.\(^1\), Ph.D., 1967, Harvard University: Theoretical physics; statistical mechanics.
Shuryak, Edward, Ph.D., 1974, Institute of Nuclear Physics, Novosibirsk, Russia: Theoretical nuclear physics.
Sterman, George\(^1\), Director of Yang Institute for Theoretical Physics. Ph.D., 1974, University of Maryland: Theoretical physics.
Van Nieuwenhuizen, Peter\(^1\), Ph.D., 1971, University of Utrecht, Netherlands: Theoretical physics; quantum field theory.

Distinguished Service Professor

Stony Brook University Graduate Bulletin: www.stonybrook.edu/gradbulletin
Paul, Peter, Emeritus, Ph.D., 1959, University of Freiburg, Germany: Experimental nuclear physics.

Distinguished Teaching Professors

Hemmick, Thomas, Ph.D., 1989, University of Rochester: Experimental nuclear physics; relativistic heavy ions.

Professors
Allen, Philip B., Ph.D., 1969, University of California, Berkeley: Theoretical condensed matter physics.
Aronson, Meigan, Ph.D., 1988, University of Illinois: Experimental condensed matter.
Averin, Dmitrii V., Ph.D., 1987, Moscow State University, Russia: Theoretical condensed matter physics.
Courant, Ernest D., Emeritus, Ph.D. 1943, University of Rochester: Theoretical physics; high-energy accelerator design.
DeZafra, Robert L., Emeritus, Ph.D., 1958, University of Maryland: Atmospheric sciences; remote sensing, stratospheric dynamics, and trace constituent measurements; millimeter-wave spectroscopy.
Douglas, Michael, Ph.D., 1988, California Institute of Technology: String Theory.
Drees, Klaus Axel, Ph.D., 1989, University of Heidelberg, Germany: Experimental nuclear physics; relativistic heavy ions.
Engelmann, Roderich, Ph.D., 1966, University of Heidelberg, Germany: Experimental high-energy physics.
Goldman, Vladimir J., Ph.D., 1985, University of Maryland: Experimental condensed matter physics.
Gurvitch, Michael, Ph.D., 1978, University at Stony Brook: Experimental condensed matter physics.
Jacobson, Chris, Undergraduate Program Director. Ph.D., 1988, University at Stony Brook: X-ray microscopy and holography.
Jung, Chang Kee, Ph.D., 1986, Indiana University: Experimental high-energy physics.
Kahn, Peter B., Emeritus, Ph.D., 1960, Northwestern University: Theoretical physics; nonlinear dynamics.
Kharzeev, Ph.D., 1990, Moscow State University: Heavy ion physics and particle theory.
Koch, Peter M., Ph.D., 1974, Yale University: Experimental atomic physics; quantum chaos; nonlinear dynamics.
Korepin, Vladimir, Ph.D., 1977, Leningrad University, Russia: Theoretical physics.
Kuo, Thomas T.S., Ph.D., 1964, University of Pittsburgh: Nuclear theory.
Lanzetta, Kenneth M., Ph.D., 1988, University of Pittsburgh: Formation and evolution of galaxies; evolution of the intergalactic medium.
Lukens, James, Emeritus, Ph.D., 1968, University of California, San Diego: Experimental condensed matter physics.
McCarthy, Robert L., Ph.D., 1971, University of California, Berkeley: Experimental high-energy physics.
McGrath, Robert L., Emeritus, Ph.D., 1965, University of Iowa: Experimental nuclear physics.
Mendez, Emilio E., Director, Center for Functional Nanomaterials, BNL. Ph.D., 1979, Massachusetts Institute of Technology: Experimental condensed matter physics.
Mihaly, Laszlo, Chair of the Department, Ph.D., 1977, Eotvos Lorand University, Budapest, Hungary: Experimental condensed matter physics.
Rijssenbeek, Michael, Ph.D., 1979, University of Amsterdam, Netherlands: Experimental high-energy physics.
Rocek, Martin, Ph.D., 1979, Harvard University: Theoretical physics: supersymmetry and supergravity.
Shrock, Robert 1, Ph.D., 1975, Princeton University: Theoretical physics; gauge theories; statistical mechanics.

Siegel, Warren 1, Ph.D., 1977, University of California, Berkeley: Theoretical physics; strings.

Simon, Michal, Emeritus, and Research Professor, Ph.D., 1967, Cornell University: Infrared astronomy; physics of the interstellar medium; star formation; solar astronomy.

Smith, John 1, Emeritus, Ph.D., 1963, University of Edinburgh, Scotland: Theoretical physics; elementary particle physics.


Verbaarschot, Jacobus J.M., Graduate Program Director, Ph.D., 1982, University of Utrecht, Netherlands: Theoretical physics.

Walter, Fredrick M., Ph.D., 1981, University of California, Berkeley: Stellar astrophysics, including X-ray optical and infrared photometry and spectroscopy; RS CV objects; pre-main sequence objects.

Weisberger, William 1, Emeritus, Ph.D., 1961, MIT: Theoretical physics.

Yahil, Amos, Emeritus, Ph.D., 1970, California Institute of Technology: Galaxies; clusters of galaxies; physical cosmology; accretion processes; stellar collapse; supernovae; nuclear astrophysics.

Zahed, Ismail, Ph.D., 1983, Massachusetts Institute of Technology: Theoretical nuclear physics.
Sehgal, Neelima, Ph.D., 2008, Rutgers University: Galaxies and cosmology.
Teaney, Derek, Ph.D., 2001 Stony Brook University: Nuclear theory.
Tsybychev, Dmitri, Ph.D., 2004 University of Florida: Experimental high-energy physics.
Wei, Tzu-Chieh, Ph.D., 2005, University of Illinois, Urbana: Theoretical Particle physics.

Research Faculty
Patel, Vijay, Ph.D., 2001 Stony Brook University: Experimental condensed matter physics.
Schamberger, Robert Dean, Ph.D., 1977, State University of New York at Stony Brook: Experimental high-energy physics.
Semenov, Vasili, Ph.D., 1975, Moscow State University, Russia: Experimental condensed matter physics.
Swesty, Douglas F., Ph.D., 1993 University at Stony Brook: Computational and nuclear astrophysics.
Yanagisawa, Chiaki, Ph.D. 1981, University of Tokyo, Japan: Experimental high energy physics.

Adjunct Faculty
Aronson, Samuel, Director of Brookhaven National Laboratory, Ph.D. 1968, Princeton University: Experimental nuclear physics
Bai, Mei, Ph.D., 1999, Indiana University, Bloomington: Overcoming Intrinsic Spin Resonance by Using an RF Dipole.
Ben-Zvi, Ilan, Ph.D., 1967, Weizmann Institute, Israel: Accelerator and beam physics.
Creutz, Michael, Ph.D., 1970, Stanford University, Lattice gauge theory.
Cunsolo, Alesandro, Ph.D., 1999, University of Grenoble: Condensed matter physics.
Dawson, Sally, Ph.D., 1981, Harvard University, High energy theory.
Dickerson, James, Ph.D., 2002, Stony Brook University: Experimental Condensed Matter Physics.
DiMauro, Louis, Ph.D., Experimental atomic physics.
Dierker, Steven, Ph.D., 1983, University of Illinois: Experimental solid state physics.
Forman, Miriam, Ph.D., 1972, University at Stony Brook: Cosmic rays.
Geller, Marvin, Ph.D., 1969, Massachusetts Institute of Technology: Atmospheric physics.
Hao, Yue, Ph.D., 2008, Indiana University: Accelerator physics.
Johnson, Peter, Ph.D., 1978, Warwick University: Experimental solid state physics.
Karsch, Frithjof, Ph.D. 1982, University of Bielefeld: Lattice QCD.
Ku, Wei, Ph.D., 2000, University of Tennessee: Theoretical condensed matter physics.
Litvinenko, Vladimir, Ph.D. 1989, Institute of Nuclear Physics, Novosibirsk, Russia: Accelerator physics and free electron lasers.
Maslov, Sergei, Ph.D., 1996, Stony Brook University: Theoretical condensed matter physics.
Ocko, Ben, Ph.D., MIT, 1984: Experimental condensed matter.
Peggs, Steven, Ph.D., 1981, Cornell University: Accelerator physics.
Petrovic, Cedomir, Ph.D., 2000, Florida State University: Condensed matter physics.
Tsoukas, Nikolaos, Ph.D., 1975, Ohio State University: Accelerator physics.
Raju Venugopalan, Ph.D., Stony Brook University: Nuclear theory.
Vogelsang, Werner\(^1\), Ph.D., 1993, University of Dortmund: Theory YITP.
Zhu, Yimei, Ph.D., 1987, Nagoya University: Condensed matter physics.

Affiliated Faculty

1) Member, C.N. Yang Institute for Theoretical Physics
2) Member, Simons Institute for Geometry and Physics

Number of teaching, graduate, and research assistants, fall 2013: 164

*NOTE: The course descriptions for this program can be found in the corresponding program PDF or at COURSE SEARCH.*