COLLEGE OF WILLIAM AND MARY

DEPARTMENT OF PHYSICS

Williamsburg, Virginia 23187-8795
http://www.wm.edu/as/physics

General University Information

President: W. Taylor Reveley III
Dean of Graduate School: Virginia J. Torczon
University website: http://www.wm.edu/
School Type: Public
Setting: Suburban
Total Faculty: 664
Total Graduate Faculty: n/a
Total number of Students: 8,740
Total number of Graduate Students: 2,455

Department Information

Department Chairman: Prof. Christopher D. Carone, Chair
Department Contact: Paula C. Perry, Coordinator, Physics Graduate Program
Total full-time faculty: 30
Total number of full-time equivalent positions: 28
Full-Time Graduate Students: 63
Female Full-Time Graduate Students: 12
First-Year Graduate Students: 7
Female First-Year Students: 2
Total Post Doctorates: 8

Department Address

P. O. Box 8795
Williamsburg, VA 23187-8795
Phone: (757) 221-3502
Fax: (757) 221-3540
E-mail: phys_grad_adm@wm.edu
Website: http://www.wm.edu/as/physics

ADMISSIONS

Admission Contact Information

Address admission inquiries to: Graduate Admissions Chair, Department of Physics, College of William and Mary, P. O. Box 8795, Williamsburg, Virginia 23187-8795
Phone: (757) 221-3502
E-mail: phys_grad_adm@wm.edu
Admissions website: http://www.wm.edu/as/physics

Application deadlines

Fall admission:
U.S. students: January 15 *Int'l. students*: January 15

Application fee

U.S. students: $45 *Int'l. students*: $45

Admissions information

For Fall of 2018:
Number of applicants: 59
Number admitted: 18
Number enrolled: 8

Admission requirements

Bachelor's degree requirements: A bachelor's degree in Physics or a related field is required.
Minimum undergraduate GPA: 3.0

GRE requirements

The GRE is required.
No minimum acceptable score for admissions is specified.

Subjective GRE requirements

The Subjective GRE is required.
No minimum acceptable score for admissions is specified.

TOEFL requirements

The TOEFL exam is required for students from non-English-speaking countries.
No minimum acceptable score for admissions is specified.

Other admissions information

Undergraduate preparation assumed: Marion and Thornton, Mechanics; Griffiths, Quantum Physics; Griffiths, Electricity and Magnetism; Kittel and Kroemer, Thermal Physics.

TUITION

Tuition year 2018–19:
Tuition for in-state residents
Full-time students: $15,760 annual
Part-time students: $560 per credit
Tuition for out-of-state residents
Full-time students: $33,354 annual
Part-time students: $1,325 per credit
A graduate assistantship includes a full tuition and fee waiver.
Credit hours per semester to be considered full-time: 9
Deferred tuition plan: No
Health insurance: Yes, paid by dept.
Other academic fees: Tuition and fees are paid by the department.
Academic term: Semester
Number of first-year students who received full tuition waivers: 7
Number of first-year students who received partial tuition waivers: 7

Teaching Assistants, Research Assistants, and Fellowships

Number of first-year
Teaching Assistants: 7
Fellowship students: 3
Average stipend per academic year
Teaching Assistant: $26,000
Research Assistant: $26,000
Fellowship student: $31,000
A graduate assistantship is a 12-month appointment of $26,000 that includes a full tuition waiver, fees, and health insurance at no cost to the student.

FINANCIAL AID

Loans

Loans are available for U.S. students.
Loans are available for international students.
GAPSFAS application required: No
FAFSA application required: No

For further information

Address financial aid inquiries to: Graduate Admissions Chair, Department of Physics, P. O. Box 8795, College of William and Mary, Williamsburg, Virginia 23187-8795.
Phone: (757) 221-3502
E-mail: phys_grad_adm@wm.edu

HOUSING

Availability of on-campus housing

Single students: Yes
Married students: No
Childcare Assistance: No

For further information

Address housing inquiries to: Office of Residence Life.
Phone: (757) 221-4314
E-mail: living@wm.edu
Housing aid website: http://www.wm.edu/offices/residencelife

Table A—Faculty, Enrollments, and Degrees Granted

Research Specialty	2018–19 Faculty	Enrollment Fall 2017		Number of Degrees Granted 2016–17 (2012–17)		
		Master's	Doctorate	Master's	Terminal Master's	Doctorate
Applied Physics	1	–	1	–(2)	–(1)	–
Atomic, Molecular, & Optical Physics	5	–	5	2(6)	1(1)	3(9)
Biophysics	–	–	1	–(1)	–	–(2)
Computational Physics	8	–	3	–(4)	–	1(1)
Condensed Matter Physics	6	–	18	4(16)	2(3)	7(12)
High Energy Physics	6	–	9	1(8)	1(2)	2(8)
Nonlinear Dynamics and Complex Systems	3	–	2	–(3)	–(1)	1(2)
Nuclear Physics	15	–	24	6(20)	–(1)	2(12)
Physics of Beams	2	–	–	–	–	–
Plasma and Fusion	3	–	–	–(1)	–	–(1)
Total	35	–	63	13(61)	4(9)	16(47)
Full-time Grad. Stud.	–	–	63	–	–	–
First-year Grad. Stud.	–	–	7	–	–	–

GRADUATE DEGREE REQUIREMENTS

Master's: For the M.S. degree, the requirements are taking the Ph.D. qualifying exam and 32 satisfactory credits of graduate work with a B average. A student progressing toward the Ph.D. degree will usually satisfy the M.S. requirements en route. At least one semester must be spent in residence, and a minimum of one semester of teaching is required for all candidates. There are no foreign language or thesis requirements.

Doctorate: For the Ph.D., required courses include Classical Mechanics, Mathematical Physics, Quantum Mechanics I and II, Classical Electricity and Magnetism I and II, Quantum Field Theory I, and Statistical Physics and Thermodynamics. In addition, two semesters of Colloquium and Teaching Physics, at least one elective from inside and at least one outside the student's field of study may be required. The candidate must, in addition to passing the qualifying exam, demonstrate a mastery of the material in the first- and second-year courses, by either doing well in these courses or individual examinations. A student must maintain a B average for all course work. The research must be a significant original contribution. The dissertation must be approved by the candidate's faculty committee and must be successfully defended in a public oral examination. A Ph.D. candidate must teach a minimum of two semesters. There are no foreign language requirements.

Other Degrees: Ph.D. with Concentration in Computational Science.

Thesis: Thesis may be written in absentia.

SPECIAL EQUIPMENT, FACILITIES, OR PROGRAMS

The Department is housed in the William Small Physical Laboratory, which contains its own library, machine shop, makerspace, and other support facilities in addition to research and teaching laboratories, classrooms, and offices. Small was entirely renovated in 2011, and the research space in the department was doubled by adding two new wings to the building. The Physics Department has many high-performance computing clusters and access to supercomputers through national and international networks. Extensive computational resources are available through the Center for Piezoelectric Design and the nuclear/particle group. The high field solid state Nuclear Magnetic Resonance Laboratory houses a number of NMR machines, including a 17 T magnet. A 12-GeV continuous electron beam accelerator facility, Thomas Jefferson National Accelerator Facility (JLAB), and Applied Research Center (ARC) is located in nearby Newport News.

Faculty and graduate students are engaged in experiments at Fermilab (Batavia, Illinois), The Jefferson Lab (Newport News, Virginia), NASA (Langley, Virginia), Mainz Institute for Theoretical Physics and Mainz Institute for Nuclear Physics (Mainz, Germany), TRIUMF (Vancouver, British Columbia, Canada), Ash River Neutrino Laboratory (Ash River, Minnesota), Sanford Underground Laboratory (Lead, South Dakota), Daya Bay (China), CERN (Geneva, Switzerland), ORNL (Oak Ridge, Tennessee), and Joint Institute for Nuclear Research (Dubna, Russia).

The Small Hall Makerspace gives students access to professional design tools and staff support for use of 3D scanners, 3D printers, laser cutters, CNC machining equipment, controls and electronics, to aid in development from research products to commercial prototypes. The Physics Department is a partner institution in the Physics Innovation and Entrepreneurship network of the American Physical Society.

Table B—Separately Budgeted Research Expenditures by Source of Support

Source of Support	Departmental Research	Physics-related Research Outside Department
Federal government	$4,142,343	
State/local government	$1,078,327	
Non-profit organizations	$213,922	
Business and industry		
Other		
Total	$5,434,592	

Table C—Separately Budgeted Research Expenditures by Research Specialty

Research Specialty	No. of Grants	Expenditures ($)
Atomic, Molecular, & Optical Physics	5	$644,452
Chemical Physics	4	$246,900
Condensed Matter Physics	16	$1,043,393
Energy Sources & Environment	4	$112,305
High Energy Physics	7	$644,452
Medical, Health Physics	1	$50,098
Plasma, Fusion, and Nonlinear Dynamics	2	$90,874
Nuclear Physics	30	$1,767,292
Other	8	$1,081,360
Total	77	$5,681,126

FACULTY

Professor

Armstrong, David S., Ph.D., University of British Columbia, 1989. *Nuclear Physics, Particles and Fields*. Electroweak in-

teractions; electron scattering; parity violation; muon capture; experiment.

Averett, Todd D., Ph.D., University of Virginia, 1995. *Atomic, Molecular, & Optical Physics, Nuclear Physics*. Nucleon structure; polarized nuclear targets; spin exchange optical pumping; experiment.

Carlson, Carl E., Ph.D., Columbia University, 1968. *Nuclear Physics, Particles and Fields*. Theory.

Carone, Christopher D., Ph.D., Harvard University, 1994. Department Chair. *Cosmology & String Theory, High Energy Physics, Particles and Fields, Theoretical Physics*. Theory of elementary particles; theory.

Cooke, William E., Ph.D., Massachusetts Institute of Technology, 1976. *Atomic, Molecular, & Optical Physics, Energy Sources & Environment*. Experiment.

Erlich, Joshua, Ph.D., Massachusetts Institute of Technology, 1999. *Cosmology & String Theory, High Energy Physics, Particles and Fields, Theoretical Physics*. Theory.

Griffioen, Keith A., Ph.D., Stanford University, 1984. *Nuclear Physics, Particles and Fields*. Nucleon structure; dark matter searches; experiment.

Hoatson, Gina L., Ph.D., University of East Anglia, 1980. *Chemical Physics, Condensed Matter Physics*. Solid-state NMR spectroscopy; experiment.

Kordosky, Michael A., Ph.D., University of Texas, Austin, 2004. *High Energy Physics, Particles and Fields*. Experiment.

Krakauer, Henry, Ph.D., Brandeis University, 1975. *Chemical Physics, Computational Physics, Condensed Matter Physics, Solid State Physics*. Electronic properties of materials; quantum many-body simulations. Theory.

Lukaszew, R. Alejandra, Ph.D., Wayne State University, 1996. *Condensed Matter Physics, Electromagnetism, Nano Science and Technology, Optics, Solid State Physics, Surface Physics*. Thin films and nanostructures; experiment.

Manos, Dennis M., Ph.D., Ohio State University, 1976. Vice Provost for Research and Graduate/Professional Studies. *Applied Physics, Biophysics, Nano Science and Technology, Plasma and Fusion, Surface Physics*. Experiment.

McKeown, Robert D., Ph.D., Princeton University, 1979. Deputy Director for Science at the Thomas Jefferson National Accelerator Facility (JLAB). *Nuclear Physics, Particles and Fields*. Electron scattering and reactor neutrinos; experiment.

Nelson, Jeffrey K., Ph.D., University of Minnesota, 1994. Director of Graduate Studies. *High Energy Physics, Particles and Fields*. Neutrino oscillations; neutrino scattering; experiment.

Novikova, Irina, Ph.D., Texas A&M University, 2003. *Atomic, Molecular, & Optical Physics, Optics*. Quantum optics; experiment.

Orginos, Konstantinos N., Ph.D., Brown University, 1998. *Applied Mathematics, Computational Physics, Nuclear Physics, Particles and Fields, Theoretical Physics*. Hadron structure; lattice QCD; nuclear physics; algorithms; theory.

Qiu, Jianqei, Ph.D., Columbia, 1987. Associate Director for Theoretical and Computational Physics; Theory Center Director at the Thomas Jefferson National Accelerator Facility (JLAB). *Nuclear Physics*. Quantum Chromodynamics (QCD) and its applications in high-energy particle and nuclear physics, in particular, in theoretical and phenomenological study of the strong force; Theory.

Sher, Marc T., Ph.D., University of Colorado, 1980. *Cosmology & String Theory, High Energy Physics, Particles and Fields, Theoretical Physics*. Theory.

Tracy, Eugene R., Ph.D., University of Maryland, 1984. *Nonlinear Dynamics and Complex Systems, Plasma and Fusion*. Phase space methods in plasma wave theory; nonlinear modeling and time series analysis; theory.

Vahala, George M., Ph.D., University of Iowa, 1972. *Computational Physics, Nonlinear Dynamics and Complex Systems, Plasma and Fusion*. Lattice Boltzmann; quantum lattice algorithms; theory.

Vahle, Patricia L., Ph.D., University of Texas, Austin, 2004. *High Energy Physics, Particles and Fields*. Neutrino oscillations; development of future neutrino facilities; experiment.

Zhang, Shiwei, Ph.D., Cornell University, 1993. *Computational Physics, Condensed Matter Physics, Solid State Physics*. Quantum many-body simulations; strongly correlated systems; Theory.

Associate Professor

Aubin, Seth A. M., Ph.D., Stony Brook University, 2003. *Atomic, Molecular, & Optical Physics*. Ultracold quantum gases; precision measurements; laser cooling and trapping; experiment.

Mikhailov, Eugeniy E., Ph.D., Texas A&M University, 2003. *Atomic, Molecular, & Optical Physics*. Quantum optics; experiment.

Qazilbash, M. Mumtaz, Ph.D., University of Maryland, College Park, 2004. *Condensed Matter Physics, Low Temperature Physics, Nano Science and Technology, Optics, Solid State Physics*. Infrared and optical spectroscopy; near-field infrared nanospectroscopy; metal-insulator transitions; structural instabilities; superconducting and density-wave transitions; experiment.

Rossi, Enrico, Ph.D., University of Texas, Austin, 2005. *Condensed Matter Physics, Nano Science and Technology, Solid State Physics, Theoretical Physics*. Electronic properties of materials; graphene; two-dimensional electron systems; strongly correlated electron systems; theory.

Assistant Professor

Deconinck, Wouter, Ph.D., University of Michigan, 2008. *Nuclear Physics, Particles and Fields*. Parity; parity violation; electron scattering; fundamental symmetries; Jefferson Laboratory; physics innovation and entrepreneurship; experiment.

Dudek, Jozef J., D.Phil., Oxford, 2004. *Nuclear Physics*. hadronic; nuclear; theory.

Stevens, Justin R., Ph.D., Indiana University, 2012. *Nuclear Physics*. Hadron spectroscopy and structure; experiment.

Emeritus

Champion, Roy L., Ph.D., University of Florida, 1966. *Atomic, Molecular, & Optical Physics*. Experiment.

Eckhause, Morton, Ph.D., Carnegie Mellon University, 1962. *Nuclear Physics, Particles and Fields*. Experiment.

Gross, Franz L., Ph.D., Princeton University, 1963. *Nuclear Physics, Particles and Fields*. Theory.

Kossler, William J., Ph.D., Princeton University, 1964. *Condensed Matter Physics, Nuclear Physics, Physics of Beams*. Experiment.

McKnight, John L., Ph.D., Yale University, 1957. *History & Philosophy of Physics/Science*. Foundations of quantum theory.

Perdrisat, Charles F., Ph.D., Swiss Federal Institute of Technology, 1961. *High Energy Physics, Nuclear Physics, Particles and Fields*. Measurements of the proton structure from elastic electron scattering; experiment.

Petzinger, Kenneth G., Ph.D., University of Pennsylvania, 1971. *Condensed Matter Physics*. Theory.

Remler, Edward A., Ph.D., University of North Carolina, 1963. *Nuclear Physics, Particles and Fields*. Theory.

Schone, Harlan E., Ph.D., University of California, Berkeley, 1960. *Condensed Matter Physics*. Experiment.

von Baeyer, Hans C., Ph.D., Vanderbilt University, 1964. *Particles and Fields, Theoretical Physics*. Theory; public understanding of science.

Walecka, J. Dirk, Ph.D., Massachusetts Institute of Technology, 1958. *High Energy Physics, Nuclear Physics, Particles and Fields*. Theory.

Welsh, Robert E., Ph.D., Pennsylvania State University, 1960. *Nuclear Physics, Particles and Fields*. Experiment.

Adjunct Professor

Bosted, Peter, Ph.D., Massachusetts Institute of Technology, 1980. *Nuclear Physics*. Experiment.

Buck, Warren W., Ph.D., William & Mary, 1976. Theory.

Delos, John B., Ph.D., Massachusetts Institute of Technology, 1970. *Atomic, Molecular, & Optical Physics, Chemical Physics, Medical, Health Physics, Nonlinear Dynamics and Complex Systems, Theoretical Physics*. Chaos; theory.

Melnitchouk, Wally, Ph.D., University of Adelaide, 1993. *Nuclear Physics, Particles and Fields*. Theory.

Richards, David, Ph.D., University of Cambridge, 1984. *Computational Physics, Nuclear Physics, Particles and Fields*. Theory.

Venkataraman, Malathy D., Ph.D., University of Kerala, 1968. *Chemical Physics*. Spectroscopy.

Adjunct Assistant Professor

Walker-Loud, André P., Ph.D., University of Washington-Seattle, 2006. *Astrophysics, Computational Physics, Nuclear Physics, Particles and Fields, Theoretical Physics*. Nonperturbative QCD; implications of the standard model; theory.

Lecturer / Lab Supervisor

Hanni, Hani, Ph.D., Tennessee, 2000. Director of Teaching Laboratories. *Physics and other Science Education*.

DEPARTMENTAL RESEARCH SPECIALTIES AND STAFF

Theoretical

Condensed Matter Physics. Electronic properties of materials; surface physics; high-temperature superconductivity; ferroelectrics; ultra-cold atoms; graphene; two-dimensional systems; strongly correlated electron systems; electron-phonon dynamics; computational physics. Krakauer, Rossi, Zhang.

High Energy Physics. Electroweak phenomenology and symmetry breaking; extensions of the standard model; supersymmetry, grand unification and extra dimensions; string theory; cosmology. Carone, Erlich, Sher.

Medical, Health Physics. Heart rates and respiration of infants in neonatal intensive care units. Delos.

Nonlinear Dynamics and Complex Systems. Order and chaos in classical and quantum systems; atoms in strong fields; atomic and molecular collisions. Delos, Tracy, Vahala.

Nuclear Physics. Perturbative and nonperturbative QCD; lattice gauge theory; effective field theories for hadrons. Carlson, Dudek, Melnitchouk, Orginos, Qiu, Richards, Walker-Loud.

Particles and Fields. Electroweak phenomenology and symmetry breaking; extensions of the standard model; supersymmetry, grand unification and extra dimensions; string theory; cosmology. Carone, Erlich, Sher, Walker-Loud.

Plasma and Fusion. Magnetohydrodynamics; kinetic theory; turbulence; numerical simulation of plasmas; applications to fusion; nonlinear dynamics and chaotic signal process; ocean waves; developing type II quantum computer algorithms for MHD; supercomputers are used at DoE-NERSC, DoD-NAVO, DoD-ERDC, and Earth Simulator (Japan). Tracy, Vahala.

Experimental

Atomic, Molecular, & Optical Physics. Atomic, Molecular, & Optical Physics. Ultracold quantum gases (Bose-Einstein condensates and degenerate Fermi gases), slow and stored light, quantum properties of light, atom-based non-classical light generation, precision measurements (time, fields, and fundamental symmetries), the study of biological systems using AMO techniques, intense laser-matter interactions. Aubin, Cooke, Mikhailov, Novikova.

Condensed Matter Physics. Infrared and optical spectroscopy; near-field infrared nanospectroscopy; phase transitions (metal-insulator, structural, magnetic, superconducting, and density wave); nuclear magnetic resonance; piezoelectrics and high dielectric microwave ceramics; thin films (metallic, magnetic, superconducting for SRF applications, correlated-electron-materials) and nanostructures; electron-phonon dynamics; plasmonics and magneto-plasmonics. Hoatson, Lukaszew, Qazilbash.

High Energy Physics. Experiments at Fermilab, Daya Bay, Ash River, SURF, and CERN; neutrino masses and mixing; CP violation in neutrinos; neutrino interactions on nucleons and nuclei; structure of the weak current; reactor and long baseline neutrino oscillation experiments. Kordosky, McKeown, Nelson, Vahle.

Nuclear Physics. Intermediate energy experiments at Jefferson Laboratory and other facilities; measurements of the structure of nucleons and nuclei via electromagnetic and electroweak interactions; precision tests of the standard model and dark matter searches with electron scattering; hadron spectroscopy; hyperpolarized nuclear targets. Armstrong, Averett, Bosted, Deconinck, Griffioen, Kordosky, McKeown, Perdrisat, Stevens.

Particles and Fields. Experiments at Fermilab, Daya Bay, Ash River; neutrino masses and mixing; CP violation in neutrinos; neutrino interactions on nucleons and nuclei; structure of the weak current; reactor and long baseline neutrino oscillation experiments. Kordosky, Nelson, Vahle.

Physics of Beams. Particle accelerator physics; relativistic electron beams; synchrotron radiation; free-electron lasers; relativistic electrodynamics; superconducting RF cavity surface physics; design and optimization of future accelerator facilities. Lukaszew, Nelson.

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