VIRGINIA TECH
DEPARTMENT OF PHYSICS
Blacksburg, Virginia 24061
http://www.phys.vt.edu

General University Information
President: Timothy Sands
Dean of Graduate School: Karen DePauw
University website: http://www.vt.edu/
School Type: Public
Setting: Rural
Total Faculty: 4,265
Total number of Students: 34,440
Total number of Graduate Students: 6,746

Department Information
Department Chairman: Prof. Mark L. Pitt, Chair
Department Contact: Mark L. Pitt, Department Chair
Total full-time faculty: 35
Full-Time Graduate Students: 85
Female Full-Time Graduate Students: 14
First-Year Graduate Students: 19
Total Post Doctorates: 17

Department Address
Robeson Hall (MC 0435)
850 West Campus Drive
Blacksburg, VA 24061
Phone: (540) 231-6544
Fax: (540) 231-7511
E-mail: info@phys.vt.edu
Website: http://www.phys.vt.edu

ADMISSIONS

Admission Contact Information
Address admission inquiries to: Graduate Program Coordinator,
Physics Department
Phone: (540) 231-8728
E-mail: gradphys@vt.edu
Admissions website: http://www.phys.vt.edu

Application deadlines
Fall admission:
U.S. students: January 5   Int'l. students: January 5

Application fee
U.S. students: $75   Int'l. students: $75

Admissions information
For Fall of 2018:
Number of applicants: 101
Number admitted: 47
Number enrolled: 18

Admission requirements
Bachelor’s degree requirements: Bachelor’s degree in Physics with a minimum undergraduate GPA of 3.0 in physics/math during the last two years of undergraduate study or, if the Bachelor’s degree is in a subject other than physics, 18 semester hours in intermediate mechanics, electromagnetism, and quantum mechanics, excluding general physics, are required.
Minimum undergraduate GPA: 3.0

GRE requirements
The GRE is required.

Subjective GRE requirements
The Subjective GRE is required.

TOEFL requirements
The TOEFL exam is required for students from non-English-speaking countries.
PBT score: 550
iBT score: 90
TOEFL scores of 20 or greater in Listening, Writing, Speaking, and Reading subsections are required.

Other admissions information
Undergraduate preparation assumed: Undergraduate preparation assumed: Thornton, Marion, Classical Mechanics; Reitz, Milford, and Christy, Foundations of Electromagnetic Theory; Griffiths, Electrodynamics; Hecht, Optics; Kittel, Kroemer, Thermal Physics; Griffiths, Quantum Mechanics; Liboff, Quantum Mechanics.

TUITION

Tuition year 2018–19:
Tuition for in-state residents
Full-time students: $6,742.5 per semester
Part-time students: $2,218.5 per semester
Tuition for out-of-state residents
Full-time students: $13,500 per semester
Part-time students: $4,470.75 per semester
Tuition for part-time is for three credit hours. Assistantships come with proportional tuition waivers.
Credit hours per semester to be considered full-time: 9
Deferred tuition plan: No
Health insurance: Yes, 90% subsidy of University negotiated plan.

Other academic fees: In-state residents, $1,012 ($550.00, part-time/three credits) per semester. Out-of-state residents: $1,314.50 ($701.00, part-time/three credits) per semester.

Academic term: Semester
Number of first-year students who received full tuition waivers: 18

Teaching Assistants, Research Assistants, and Fellowships
Number of first-year Teaching Assistants: 18
Average stipend per academic year
Teaching Assistant: $16,857
Research Assistant: $16,857
All assistantships come with tuition waivers.

FINANCIAL AID

Application deadlines
Fall admission:
U.S. students: January 5   Int'l. students: January 5

Loans
Loans are not available for U.S. students.
Loans are not available for international students.
GAPSFAS application required: No
FAFSA application required: No

For further information
Address financial aid inquiries to: Graduate Program Coordinator, Physics Department.
E-mail: gradphys@vt.edu
Financial aid website: http://www.finaid.vt.edu/
HOUSING

Availability of on-campus housing

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

For further information
Address: housing inquiries to: Housing and Life, 144 New Hall West, Blacksburg, VA 24061-0428.
Phone: (540) 231-6205
Housing aid website: http://www.housing.vt.edu

SPECIAL EQUIPMENT, FACILITIES, OR PROGRAMS

The faculty in Virginia Tech’s Physics Department conducts research in astronomical, mathematical, medical, nuclear, elementary particle, and condensed-matter physics. Medical and neuroscience research is conducted at sites in Arlington and Roanoke, Virginia. Much of the research activity in astronomy and experimental nuclear and particle physics utilizes off-campus facilities, while most of the instrumentation and data analysis are performed on-campus. These facilities include Brookhaven National Laboratory, Daya Bay, Fermilab, KEK, LANL, ORNL, JINAF, NRAO, Gran Sasso, and the nearby Kimballton Underground Research Facility (KURF). Telescopes used by the astronomy group include the Hubble Space Telescope, the Very Large Telescope, the Chandra X-ray satellite, the Spitzer IR satellite, and the XMM-Newton X-ray satellite.

Experimental facilities in condensed-matter physics include low-temperature facilities and variable-temperature high-magnetic-field magneto-transport systems, low-temperature optical systems, pulsed near- and mid-infrared lasers, visible-ultraviolet lasers, spectrometers, confocal microscopy and related optical characterization facilities, nanofabrication systems, thin-film materials deposition systems, materials synthesis, room-temperature and low-temperature scanning tunneling microscopy, and various other microscopy systems. More analytical and nanofabrication systems (e.g., X-ray, Auger, TEM, AFM, SIMS, SQUID, and FIB) are housed in on-campus facilities. Research is also performed off-campus, for example, at the National High Magnetic Field Laboratory.

Housed in Robeson Hall is the University’s Center for Neutrino Physics (CNP). Many theorists are members of the University Center for Statistical Mechanics, Mathematical Physics, and Theoretical Chemistry, composed of faculty from the Departments of Chemistry, Physics, and Mathematics.

The Department of Physics is also home to the Center for Soft Matter and Biophysics at Virginia Tech. This interdisciplinary research center was established in February 2016, and is administered by the Department of Physics in the College of Science. Its mission is to advance the rapidly growing research areas of soft matter and biological physics. Special attention will be extended to how these developments can address many of the most significant problems currently facing society, for example effective drug design and delivery, next generation materials, programmable biology, and models for human disease.

Virginia Tech University computing offers multiple high-performance computing systems. The Physics Department has two dedicated clusters and a distributed collection of about 200 limited-availability nodes, all running Linux. Access to supercomputers is available through national and international networks.

The Physics Department operates a professional machine shop, a computer shop, and a student shop.

Table B—Separately Budgeted Research Expenditures by Source of Support

<table>
<thead>
<tr>
<th>Source of Support</th>
<th>Departmental Research</th>
<th>Physics-related Research Outside Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal government</td>
<td>$2,696,221.71</td>
<td></td>
</tr>
<tr>
<td>State/local government</td>
<td>$171,667.68</td>
<td></td>
</tr>
<tr>
<td>Non-profit organizations</td>
<td>$110,664.14</td>
<td></td>
</tr>
<tr>
<td>Business and industry</td>
<td>$221,853.26</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>$36.15</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$3,200,442.94</strong></td>
<td></td>
</tr>
</tbody>
</table>

FACULTY

Professor

Arav, Nahum, Ph.D., University of Colorado, Boulder, 1994 Astrophysics.
Chang, Lay Nam, Ph.D., University of California, Berkeley, 1967. Theoretical particle physics.
Heflin, James R., Ph.D., University of Pennsylvania, 1990. Associate Dean for Research and Graduate Studies, College of Science. Experimental condensed matter physics; biophysics.
Minic, Djordje, Ph.D., University of Texas, Austin, 1993. Theoretical particle physics.
United States: Geographic Listing of Graduate Programs

Virginia

Montague, Read P., Ph.D., University of Alabama, 1988. Neuroscience; medical physics; biophysics.


Simonetti, John H., Ph.D., Cornell University, 1985. Astrophysics.

Täuber, Uwe C., Ph.D., Technische Universität München, 1992. Theoretical condensed matter physics.


Associate Professor

Economou, Sophia, Ph.D., University of California at San Diego, 2006. Condensed matter theoretical physics.


Mariani, Camillo, Ph.D., University of Rome, 2008. Experimental nuclear and particle physics.


Soghomonian, Victoria, Ph.D., Syracuse University, 1995. Experimental condensed matter physics.


Assistant Professor


Barnes, Edwin, Ph.D., University of California at San Diego, 2006. Condensed matter theoretical physics.

Cheng, Shengfeng, Ph.D., Johns Hopkins University, 2010. Experimental condensed matter physics.


Gray, James, Ph.D., University of Sussex, 2001. Theoretical particle physics.

Horiuchi, Shunsaku, Ph.D., University of Tokyo, 2009. Astroparticle physics.

Nguyen, Vinh, Ph.D., University of Amsterdam, Zeeman Institute, 2004. Experimental condensed matter physics.


Tao, Chenggang, Ph.D., University of Maryland, 2007. Experimental condensed matter physics.

Research Faculty

Özcan, Alpay, Ph.D., Washington University, St. Louis, 2000. Neuroscience; medical physics.


DEPARTMENTAL RESEARCH SPECIALTIES AND STAFF

Theoretical

Condensed Matter/Statistical Physics. Theoretical investigations of a wide range of systems, both in thermal equilibrium and driven far from equilibrium, are being carried out using both analytical techniques and computational approaches. Research interests include phase transitions, critical phenomena, electronic, transport, and optical properties of a variety of physical systems. Examples include universal properties and scaling behavior in magnetic systems, topological matter, structural phase transitions, boson localization, driven diffusive systems, branching, and annihilating random walks, vortex transport and flux pinning in superconductors, chemical reactions, population dynamics, and percolation problems. Research is also carried out on electronic, transport, and optical properties of materials, interfaces, semiconductor heterostructures, molecular devices, biological systems, and ultracold quantum gases. Analytical approaches include classical Landau-Ginzburg theory as well as modern techniques such as coherent-state path-integrals and field theoretic renormalization group analysis are used to study problems in quantum mechanics; molecular dynamics; dynamical systems; equilibrium and non-equilibrium statistical mechanics. Computational approaches include numerical solutions of Master and Langevin equations, Monte Carlo simulations of model systems and first-principle approaches for ground state and transport problems within density functional theory. Collaborations with numerous members in other departmental and theoretical investigations of a wide range of systems, both in thermal equilibrium and driven far from equilibrium, are being carried out using both analytical techniques and computational approaches. Research interests include phase transitions, critical phenomena, electronic, transport, and optical properties of a variety of physical systems and quantum information science. Examples include neutrinos, gamma-ray, and other cosmic messengers. Another special focus is on string theory and M theory, especially string compactifications, supersymmetric field theories, and mathematical aspects of string theory. Research is also carried out on QCD and other gauge theories, supersymmetric, and otherwise, in three and four dimensions. Anderson, Chang, Gray, Horiuchi, Huber, Minic, Sharpe, Takeuchi.

Experimental

Astrophysics. The group at Virginia Tech is active in extragalactic astronomy and studies of radio transients. Current extragalactic research is concerned with measuring stellar and supermassive black hole mass assembly history in galaxies from multivavelength surveys and the observation and interpretation of mass outflow from active galactic nuclei (AGNs). This work has impact on studies of the formation of galaxies and galaxy clusters and the way these structures trace the underlying dark matter distribution. Searches for radio transients...
Virginia Polytechnic Inst. & State U., Phys.

are under way in collaboration with searches for gravity wave signals (e.g., by LIGO, the Laser Interferometer Gravitational Wave Observatory). This work has impact on the study of high-energy or explosive astrophysical events (e.g., supernovae, mergers of compact objects, and the explosion of primordial black holes) and implications for work at the frontier of fundamental physics (e.g., the existence of gravitational radiation and extra-spatial dimensions). Research facilities currently used include the Hubble Space Telescope, the Herschel Space Observatory, the Spitzer Space Telescope, the Chandra X-Ray Observatory, the Very Large Telescope, the Long Wavelength Array (LWA), and the Eight-meter-wavelength Transient Array (ETA). Arav, Horiuchi, Simonetti.

Biophysics. Topics include biosensors using ionic self-assembled multilayers on fiber gratings; targeted delivery of functionalized nanoparticles using laser techniques in nanomedicine; nanoscale structure and dynamics of biomimetic lipid membranes, topologically tunable membranes for biosensing and biosorting applications, tailoring structural and dynamical hierarchy in polymeric systems for reliable designs of advanced functional materials; and voltametric chemical detection methods for subsecond measurements of neurotransmitters in the human brain during active decision-making. Experimental approaches include near-infrared laser techniques, self-assembly techniques, optical characterization, voltametric methods, temporally resolved fluorescence microscopy, x-ray and neutron scattering, ps-ns spectroscopy, imaging, MD simulations, and molecular biology techniques. Ashkar, Heflin, Khodaparast, Montague.

Condensed Matter Physics. Research includes semiconductors, heterostructures, oxides, magnetic materials, polymers, self-assembled nanostructures, lithographic nanostructures, metallic nanoparticles, biological systems, new quantum states of matter, and quantum mesoscopic systems, using nonlinear optics, terahertz science, ultrafast dynamics, transport, scanning probes, and low-temperature physics techniques. Topics addressed include nonlinear optical response in self-assembled organic materials; optoelectronic applications and photovoltaics of semiconducting polymers; hierarchical structure and dynamics of soft materials; plasmonic enhancement of nonlinear optical and photovoltaic effects; spintronics; mesoscopic physics, spin physics, and quantum physics of metals, semimetals and semiconductors; magnetization dynamics in complex oxides; quantum transport, low-temperature physics, and magnetic properties; quantum and spin coherence effects in the solid state; quantum information processing architectures; nanoscience and nanofabrication techniques; energy storage and conversion; gigahertz and terahertz spectroscopy of biological systems; ultrafast dynamics of quantum systems; and nanometer-thick materials with robust spin-driven physics, with potential room-temperature applications in computing and communications technologies. Ashkar, Cheng, Emori, Heflin, Heremans, Khodaparast, Nguyen, Robinson, Soghomonian, Tao.

Neuroscience and Medical Physics. Topics include computational models of cognitive functions to gain insight into healthy and injured brain cognition and the characterization of cognitive phenotypes, both supported by magnetic resonance imaging; the use of medical physics to study sleep; the transitions between wake and sleep states in the brainstem; the interplay between sleep and stress on brain networks; multisource-multimodal data analysis methods, including but not limited to medical imaging and bioinformatics, with initial focus on prostate cancer and multiple sclerosis; development of new diffusion magnetic resonance imaging methods for assessment of brain white matter integrity; development of mobile health systems for military medics development of open source electronic health record architectures. Experimental efforts use functional magnetic resonance imaging, positron emission tomography, and electroencephalography. A study of interacting subjects uses new models of social exchange and uses the new technique of hyperscanning. Ozcan, Montague, Mun, Wong.

Nuclear and Particle Physics. Much of our research in this area explores the properties of neutrinos, the primary focus of the Department’s Center for Neutrino Physics. Current experimental activities include measurement of neutrino mixing angles with the Daya Bay reactor neutrino experiment in China and with liquid-argon-based accelerator neutrino detectors, including the Short Baseline Neutrino Program at Fermilab and CERN’s ProtoDUNE SP. Faculty are involved in solar neutrino studies with Borexino and in searches for neutrinoless double beta decay with CUORE, both at Gran Sasso Underground lab in Italy. The department manages the Kimballton Underground Research Facility (KURF), a nearby low-background laboratory (1,700-foot depth), which supports VT and external experiments. Future experiments are in development to constrain sterile neutrinos and fundamental neutrino parameters (CHANDLER, NULAT, DUNE). Heavy-flavor physics (b and c quarks and tau leptons) is studied to probe CP violation and other phenomena at the Belle and Belle II experiments at KEK in Japan. Electron scattering experiments (e-Ar, QWEEK and MOLLER) are carried out at Jefferson Laboratory (Newport News, VA) to understand neutrino interactions in matter and to test the standard model using parity-violating scattering experiments. The department has laboratory space and machine/electronic shop support for significant equipment contributions to our experiments. Link, Mariani, O’Donnell, Pilonen, Pitt, Vogelaar.