

# WAKE FOREST UNIVERSITY

## DEPARTMENT OF PHYSICS

Winston-Salem, North Carolina 27109-7507

<http://www.physics.wfu.edu/>

### General University Information

*President:* Nathan O. Hatch  
*Dean of Graduate School:* Bradley T. Jones, Dean  
*University website:* <http://www.wfu.edu/>  
*School Type:* Private  
*Setting:* Suburban  
*Total Faculty:* 1,700  
*Total Graduate Faculty:* 550  
*Total number of Students:* 8,116  
*Total number of Graduate Students:* 3,014

### Department Information

*Department Chairman:* Dr. Daniel B. Kim-Shapiro, Chair  
*Department Contact:* Melissa Mitchell, Administrative Assistant  
*Total full-time faculty:* 17  
*Total number of full-time equivalent positions:* 20  
*Full-Time Graduate Students:* 30  
*Female Full-Time Graduate Students:* 9  
*First-Year Graduate Students:* 10  
*Female First-Year Students:* 3  
*Total Post Doctorates:* 5

### Department Address

1834 Wake Forest Road  
P.O. Box 7507  
Winston-Salem, NC 27109-7507  
*Phone:* (336) 758-5337  
*Fax:* (336) 758-6142  
*E-mail:* [physics@wfu.edu](mailto:physics@wfu.edu)  
*Website:* <http://www.physics.wfu.edu/>

## ADMISSIONS

### Admission Contact Information

*Address admission inquiries to:* Dean of Graduate School, Wake Forest University, 1834 Wake Forest Road Winston-Salem, NC 27109

*Phone:* (336) 758-5301  
*E-mail:* [gradschl@wfu.edu](mailto:gradschl@wfu.edu)  
*Admissions website:* <http://graduate.wfu.edu/admissions/onlineapp.html>

### Application deadlines

Fall admission:  
*U.S. students:* January 15      *Int'l. students:* January 15  
Spring admission:  
*U.S. students:* November 1      *Int'l. students:* November 1

### Application fee

*U.S. students:* \$80      *Int'l. students:* \$80  
Typically 10-15 students are admitted, of which about 5-8 enroll.

### Admissions information

For Fall of 2018:  
*Number of applicants:* 40  
*Number admitted:* 15  
*Number enrolled:* 10

### Admission requirements

*Bachelor's degree requirements:* A Bachelor's degree in Physics is required.  
*Minimum undergraduate GPA:* 3.0

### GRE requirements

The GRE is required.  
*Quantitative score:* 160  
*Verbal score:* 150  
*Analytical score:* 3.5  
*Mean GRE score range (25th–75th percentile):* 1200-1370  
These minimum values are only guides. Meeting them does not assure admission, not meeting them does not prevent admission. International students have sometimes lower verbal and analytical writing scores.

### Subjective GRE requirements

The Subjective GRE is recommended.  
*Minimum accepted Advanced GRE score:* 640  
*Mean Advanced GRE score range (25th–75th percentile):* 660-870  
These minimum values are just guides. Meeting them does not assure admission, not meeting them does not prevent admission.

### TOEFL requirements

The TOEFL exam is required for students from non-English-speaking countries.  
*PBT score:* 575  
*iBT score:* 79

Computer-based TOEFL: 217 International English Language Testing System (IELTS): 6.5

### Other admissions information

*Additional requirements:* The verbal and analytical GRE scores quoted above are for domestic students. Occasionally, international students with lower verbal and analytical GRE scores may be admitted.

A minimum quantitative GRE score of 700 is required for domestic and international students. Quantitative GRE scores are frequently well above 700.

*Undergraduate preparation assumed:* Mechanics—Symon, Mechanics; Electricity and Magnetism—Griffiths, Introduction to Electrodynamics; Quantum Mechanics—Gasiorowicz, Quantum Physics; Thermodynamics—Kittel and Kroemer, Thermal Physics.

## TUITION

Tuition year 2018–19:

*Full-time students:* \$38,650 annual  
*Part-time students:* \$19,325 per semester

Usually, all admitted PhD students will receive a full tuition waiver and a stipend. Master's students will typically receive an 80% tuition waiver.

*Credit hours per semester to be considered full-time:* 9

*Deferred tuition plan:* Yes

*Health insurance:* Yes, variable.

*Other academic fees:* Health insurance is available for purchase. Students under the age of 26 may be covered by parents' insurance. Free satellite parking (plus shuttle) is available. Limited \$300 near-campus parking and \$500 on-campus parking is available.

*Academic term:* Semester

*Number of first-year students who received full tuition waivers:* 8  
*Number of first-year students who received partial tuition waivers:* 2

### Teaching Assistants, Research Assistants, and Fellowships

Number of first-year  
*Teaching Assistants:* 8  
*Fellowship students:* 1

Average stipend per academic year

Teaching Assistant: \$23,193

Research Assistant: \$23,193

Fellowship student: \$25,193

Research Assistantships and some Teaching Assistantships may receive a summer bonus for a total stipend up to \$25,000.

Physics Excellence Fellows receive an extra stipend of \$2,000 annually for five years.

**FINANCIAL AID**

**Application deadlines**

Fall admission:

U.S. students: January 15

Int'l. students: January 15

Spring admission:

U.S. students: November 15

Int'l. students: November 15

**Loans**

Loans are 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: Dean of the Graduate School, Wake Forest University, 1834 Wake Forest Road, Winston Salem, NC 27109.

Phone: (336) 758-5301

E-mail: gradschl@wfu.edu

Financial aid website: <https://graduate.wfu.edu/cost-financial-aid-reynolda/>

**HOUSING**

**Availability of on-campus housing**

Single students: No

Married students: No

Childcare Assistance: No

**For further information**

Address housing inquiries to: Residence Housing, P.O. Box 7749, Wake Forest Univ., Winston-Salem, NC 27109.

Phone: (336) 758-7777

E-mail: housing@wfu.edu

Housing aid website: <http://rlh.wfu.edu/>

**Table A—Faculty, Enrollments, and Degrees Granted**

Research Specialty	2017-18 Faculty	Enrollment Fall 2017		Number of Degrees Granted 2017-18 (2013-18)		
		Mas-ter's	Doc-torate	Mas-ter's	Terminal Master's	Doc-torate
<b>Atomic, Molecular, &amp; Optical Physics</b>	2	-	3	-	-(1)	1(3)
<b>Biophysics</b>	6	2	7	-	1(1)	2(9)
<b>Condensed Matter Physics</b>	5	1	8	-(1)	-(2)	3(12)
<b>Medical, Health Physics</b>	3	-	1	-	-	-(4)
<b>Nano Science and Technology</b>	2	1	3	-	1(1)	2(7)
<b>Relativity &amp; Gravitation</b>	3	-	4	-	-	-(1)
<b>Total</b>	14	4	27	-(1)	2(5)	8(36)
<b>Full-time Grad. Stud.</b>	-	2	26	-	-	-
<b>First-year Grad. Stud.</b>	-	-	6	-	-	-

**GRADUATE DEGREE REQUIREMENTS**

**Master's:** Thirty semester hours of graduate credit; of those, at least 24 credits must be classes or seminars, and 6 credits can be research. Twelve credits hours must be at the 700 level. Courses must include Phys 711, 712, 741 (Math Methods & Classical Mechanics, Electrodynamics, Quantum Mechanics-I). Participation at the departmental seminar is required. Minimum of 12 months full-time in residence. An oral defense of the thesis and a 3.0 average on courses are required.

**Doctorate:** Courses must include Physics 711, 712, 741, 742, and 770 (Math Methods & Classical Mechanics, Electrodynamics, Quantum Mechanics-I and -II, Statistical Physics) and three more elective courses at the 600 or 700 level (of which one must be in Physics). A written General Exam at the level of material normally covered in the first year of graduate study serves as the preliminary examination. Within 18 months of completing the preliminary examination, the students submits to her/his advisory committee and defends orally a dissertation research plan. An oral defense of the dissertation, and a 3.0 average on courses are required.

**Thesis:** Thesis may be written in absentia.

**SPECIAL EQUIPMENT, FACILITIES, OR PROGRAMS**

Wake Forest is among the top 10% of tier-1 national doctoral universities (US News and World Report), despite its small size. We take pride in being able to provide the personal attention of a liberal arts college and having significant resources that are usually associated with a large research university.

The research in our department is focused on the following areas: experimental and computational biophysics; atomic, molecular and optical physics; experimental and computational condensed matter physics; computational and theoretical relativity and gravitation; medical and health physics; and nanophysics. All research laboratories contain state-of-the-art instrumentation; computational physicists have access to the large deacon cluster.

**Table B—Separately Budgeted Research Expenditures by Source of Support**

Source of Support	Departmental Research	Physics-related Research Outside Department
<b>Federal government</b>	\$1,040,442.05	\$310,860.16
<b>State/local government</b>		
<b>Non-profit organizations</b>	\$11,902.2	
<b>Business and industry</b>	\$20,219.29	
<b>Other</b>	\$252,736.96	\$294,188.81
<b>Total</b>	\$1,325,300.5	\$605,048.97

**Table C—Separately Budgeted Research Expenditures by Research Specialty**

Research Specialty	No. of Grants	Expenditures (\$)
<b>Biophysics</b>	6	\$534,733.65
<b>Condensed Matter Physics</b>	14	\$879,532.92
<b>Nano Science and Technology</b>	3	\$466,114.68
<b>Optics</b>	1	\$23,115.86
<b>Relativity &amp; Gravitation</b>	1	\$25,857.36
<b>Total</b>	25	\$1,929,354.47

**FACULTY**

**Chair Professor**

**Kim-Shapiro**, Daniel, Ph.D., University of California, Berkeley, 1993. Director, Translational Science Center. *Biophysics*. Un-

derstanding how blood flow is regulated, particularly by nitric oxide, nitrite and other nitrogen oxides. Various forms of spectroscopy, using light (including polarized light) to learn about biological structure and function.

### Professor

- Anderson**, Paul R., Ph.D., University of California, Santa Barbara, 1983. *Relativity & Gravitation*. General relativity; quantum field theory in curved space.
- Bonin**, Keith D., Ph.D., University of Maryland, 1984. Department Chair. *Atomic, Molecular, & Optical Physics, Biophysics, Nano Science and Technology, Optics*. Atomic physics; nanophysics; biophysics; optics.
- Carroll**, David L., Ph.D., Wesleyan University, 1993. Director, Nanotechnology Center. *Nano Science and Technology*. Nanostructures and nanotechnology.
- Guthold**, Martin, Ph.D., University of Oregon, 1997. Director of Physics graduate program. *Biophysics, Nano Science and Technology*. Biophysics.
- Holzwarth**, Natalie A. W., Ph.D., University of Chicago, 1975. *Condensed Matter Physics*. Theoretical solid state physics; electronic structure of bulk solids, surfaces, and molecules.
- Macosko**, Jed, Ph.D., University of California, Berkeley, 1999. *Biophysics*. Biophysics of molecular motors and biopolymers.
- Matthews**, Eric G., Ph.D., University of North Carolina, 1977. Associate Provost of Information Systems. *Condensed Matter Physics*. Thermally stimulated depolarization of defects in insulators; ab initio calculations of defect properties.
- Salsbury**, Fred, Ph.D., University of California, Berkeley, 1999. Undergraduate Advisor. Director, Interdisciplinary Program in Structural and Computational Biophysics. *Biophysics, Computational Physics*. Computational biophysics.

### Associate Professor

- Carlson**, Eric, Ph.D., Harvard University, 1988. *Astrophysics, Particles and Fields, Relativity & Gravitation*. Astrophysics and particle physics.
- Cho**, Samuel, Ph.D., University of California, San Diego, 2007. *Biophysics, Computational Physics, Computer Science*. Computational biophysics, protein and RNA folding, biomolecular assembly, molecular machines, GPU-based programming.
- Cook**, Gregory B., Ph.D., University of North Carolina, 1990. Undergraduate Advisor. *Astrophysics, Relativity & Gravitation*. General relativity and relativistic astrophysics.
- Jurchescu**, Oana, Ph.D., University of Groningen, Netherlands, 2006. *Condensed Matter Physics, Nano Science and Technology*. Nanostructures and nanotechnology.
- Thonhauser**, Timo, Ph.D., Karl-Franzens University, Austria, 2001. *Computational Physics, Condensed Matter Physics*. Density functional theory.

### Emeritus

- Shields**, Howard, Ph.D., Duke University, 1956. *Biophysics*. Biophysics, EPR, (working in the lab of Prof. Kim-Shapiro).

### Research Professor

- Holzwarth**, George M., Ph.D., Harvard University, 1964. *Biophysics*. Physical properties of normal and cancerous cells, dependence of cell growth on substrate properties.
- Kerr**, William C., Ph.D., Cornell University, 1967. *Statistical & Thermal Physics*. Theoretical solid-state and statistical physics; structural phase transitions.
- Williams**, Richard T., Ph.D., Princeton University, 1974. *Atomic, Molecular, & Optical Physics, Condensed Matter Physics, Optics*. Femtosecond laser studies of defects and electrons in solids.

### Research Associate Professor

- Basu**, Swati, Ph.D., University of Illinois at Urbana-Champaign, 1994. Understanding how blood flow is regulated, particularly by nitric oxide, nitrite and other nitrogen oxides. Various forms of spectroscopy, using light (including polarized light) to learn about biological structure and function. (Works in the lab of Prof. Kim-Shapiro). *Biophysics*. Prof. Basu is working in Prof. Kim-Shapiro's group.
- Ucer**, K. Burak, Ph.D., University of Rochester, 1997. *Atomic, Molecular, & Optical Physics, Optics*. Ultrafast lasers and spectroscopy.

### Teaching Associate Professor

- Dostal**, Jack, Ph.D., Montana State University, 2009. Lecturer. *Physics and other Science Education*. Physics education.

### Adjunct Professor

- Bourland**, J. Daniel, Ph.D., University of North Carolina. *Medical, Health Physics*. Radiation oncology.
- Santago**, Peter, Ph.D., North Carolina State University, 1986. Chair, Computer Science. *Computer Science, Medical, Health Physics*. Image enhancement.

### Adjunct Assistant Professor

- Hall**, Adam, Ph.D., University of North Carolina, Chapel Hill, 2007. *Biophysics, Nano Science and Technology*. Nanopores, Nanobiotechnology.

## DEPARTMENTAL RESEARCH SPECIALTIES AND STAFF

### Theoretical

- Biophysics. Computational and theoretical biophysics, computational systems biology, protein structure/function relationships, biological network modeling, signal transduction network modeling, molecular physics, drug discovery. Cho, Salsbury.
- Condensed Matter Physics. Computational materials physics: simulation and prediction of energy storage materials, development of "first principles" simulation methods, condensed matter theory, semi-classical electron dynamics, Berry phase effects, nonlinearity, computational and theoretical materials science, condensed matter physics, solid state physics, density functional theory, first-principles calculations, NMR, van der Waals forces, magnetization. Natalie Holzwarth, Kerr, Matthews, Thonhauser.
- Gravitational. Gravitational physics, general relativity, numerical relativity, black holes, neutron stars, compact binaries, initial data, gravitational waves, quantum field theory in curved space, particle physics. Anderson, Carlson, Cook.

### Experimental

- Atomic, Molecular, & Optical Physics. Electron spin resonance in irradiated organic solids, transport properties, semiconductor trapping centers, laser materials, ultrafast spectroscopy, excitons, scintillators, energy research, optics, optical trapping, mechanical effects of light, optogenetics, optical microscopy. Bonin, Ucer, Williams.
- Biophysics. Optics, optical trapping, mechanical effects of light, optogenetics, optical microscopy, motor proteins, kinesin, optical and electron paramagnetic spectroscopy, hemoglobin, nitric oxide, nitrite, sickle cell disease, cardiovascular disease, nanobiotechnology, atomic force and optical microscopy, single molecule experiments, protein-DNA interactions, thrombosis and hemostasis, nanofibers, electrospinning, tissue engineering, drug discovery, Center for Translational Science. Basu, Bonin, Guthold, Hall, George Holzwarth, Kim-Shapiro, Macosko, Shields.

Condensed Matter Physics. Organic and flexible electronics, transport properties, semiconductor trapping centers, laser materials, ultrafast spectroscopy, excitons, scintillators, energy research. Carroll, Jurchescu, Ucer, Williams.

Energy Sources & Environment. The Center is engaged in a broad range of projects from the development of medical technologies, to green energy technologies, to the understanding of the environmental and ethical implications of such nano-based technologies, material design and synthesis, carbon nanotubes, metal nanoparticles, quantum dots, polymers, cage

structures, solar cells, biofuels, batteries, high-efficiency organic transistors, new lighting systems, antibiotic resistance, wound healing, tissue regeneration. Carroll, Jurchescu.

Nano Science and Technology. Nanostructures and nanotechnology, nanomotors, solar cells, meta materials and negative index materials, organic electronics, thin-film transistors, field-effect transistors, organic semiconductors, single crystals, microstructure. Bonin, Carroll, Guthold, George Holzwarth, Jurchescu, Macosko.

***View additional information about this department at [www.gradschoolshopper.com](http://www.gradschoolshopper.com). Check out the “Why Choose Us?” section, find out more about the department’s culture and get links to social media networks.***