**ADMISSIONS**

**Address admission inquiries to:** Graduate School: admission_graduate@brown.edu, Physics: physics_admission@brown.edu

**Phone:** 401-863-2600
**E-mail:** admission_graduate@brown.edu
**Admissions website:** http://www.brown.edu/academics/gradschool/application-information

**Application deadlines**

- **Fall admission:**
  - U.S. students: January 3
  - Int’l. students: January 3

**Application fee**

- U.S. students: $75
- Int’l. students: $75

The deadline listed is for the Ph.D. program. The ScM program has rolling admissions (allowing for a possible Spring semester start) with an academic year application deadline of May 1.

**Admissions information**

For Fall of 2016:

- Number of applicants: 319
- Number admitted: 55
- Number enrolled: 21

**Admission requirements**

- Bachelor’s degree requirements: Bachelor’s degree in Physics or related field is required. Applicants are expected to have a strong background in physics or closely related subjects.

**GRE requirements**

The GRE is required.

- For Ph.D. program, GRE General is required. For ScM program, GRE General is recommended.

**Advanced GRE requirements**

The Advanced GRE is recommended. For both Ph.D. and ScM program, GRE subject is recommended.

**TOEFL requirements**

The TOEFL exam is required for students from non-English-speaking countries.

- PBT score: 577
- iBT score: 90

TOEFL is not required for one whose native language is not English but who has received a degree from a university in which English is the primary language of instruction. For more information: https://www.brown.edu/academics/gradschool/application-information/international-applicants/language-proficiency/toefl-or-ielts

**Other admissions information**

**Additional requirements:** The Ph.D. program provides students with opportunities to perform independent research in some of the most current and dynamic areas of physics. Three letters of recommendation are required. The ScM program is suitable as both a means for professional development and preparation for further graduate study. The program is designed to be completed in 4 semesters with 2 courses per semester as full-time enrollment. There is flexibility to allow for completion of the degree in two, or three semesters depending on a student’s background. Two recommendation letters are required.

**Undergraduate preparation assumed:** Undergraduate requirements flexible to some extent; preference given for strong upper-class study in mechanics, E&M, wave theory, modern physics, and mathematics through partial differential equations. Purcell, Electricity and Magnetism; Schey, Div, Grad, Curl and All That; Feynman, The Feynman Lectures on Physics, Vol. II recommended; French and Taylor, An Introduction to Quantum Physics; Marion, Classical Electromagnetic Radiation; Gasiorowicz, Quantum Physics; Reif, Fundamentals of Statistical and Thermal Physics; French, Vibrations and Waves; Kibble, Classical Mechanics (2nd. ed. or later).

**TUITION**

**Tuition year 2016–17:**

- Full-time students: $50,224 annual
- Part-time students: $6,278 per credit

Average stipends listed below are for academic year 2016–17 and do not include guaranteed summer funding. The Graduate School offers incoming doctoral students five years of guaranteed financial support, including stipend, tuition remission, health-services fee, and health-insurance subsidy. For more information: http://www.brown.edu/academics/gradschool/financing-support/PhD-funding. The majority of students enrolled in master’s programs are self-supported. Domestic students may be eligible for federal direct student loans and other loans administered through the Office of Financial Aid. Master’s students are also eligible for conference travel funds. More information on: http://www.brown.edu/academics/gradschool/financing-support/Masters-Funding More informa-
FINANCIAL AID

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

For further information Address financial aid inquiries to: Office of Financial Aid, Brown University, Box #1827, Providence, RI 02912.
Phone: (401) 863-2721
E-mail: GS_Financial_Aid@brown.edu
Financial aid website: http://www.brown.edu/about/administration/financial-aid/contact-information

HOUSING

Availability of on-campus housing
Single students: Yes
Married students: Yes

For further information Address housing inquiries to: Off-Campus:, Office of Auxiliary Housing, Brown University, Box 1902, Providence, RI 02912., On-campus:, Office of Residential Life, Box 1864, Brown University, Providence, RI 02912.
Phone: (401) 863-2541
E-mail: Gail_Medbury@brown.edu
Housing aid website: http://www.brown.edu/academics/gradschool/graduate/housing

GRADUATE DEGREE REQUIREMENTS

Master’s: Approved sequence of eight semester courses. Of the eight required courses, four will be selected from the six core courses (PHYS2010, 2030, 2040, 2050, 2060, and 2140). Four additional credits at the 2000 level are required, selected with guidance based on a student’s goals and interests. Because preparation of a master’s thesis is highly recommended, as it forms an important pillar of the professional training, one of the eight required courses may be Research in Physics (PHYS2980, 2981).

Doctorate: Approved sequence of ten semester courses: six core courses (PHYS2010, 2030, 2040, 2050, 2060, and 2140) and four advanced courses. Qualifying exam normally taken at start of second year in program. Preliminary exam completed by end of third year, marking advancement to candidacy.

Thesis: Preparation of a master’s thesis is highly recommended for those enrolled in the ScM program. Ph.D. written dissertation and oral defense is required.

SPECIAL EQUIPMENT, FACILITIES, OR PROGRAMS
(a) Brown is a member of Universities Research Association, Inc. (URA), part of the Fermilab Research Alliance, which operates the Fermi National Accelerator Laboratory (FNAL) in Batavia, Illinois, and other facilities. Brown physicists are involved in the D0 experiment at the 2 TeV Tevatron collider located at FNAL, as well as in the CMS experiment at the 14 TeV Large Hadron Collider (LHC) located at CERN, in Geneva, Switzerland. Brown leads experimental collaborations that operate rare particle search experiments at international underground laboratories at Gran Sasso, Italy, and Sanford Lab, Homestake Mine, South Dakota. Brown in involved with ground-based, balloon-borne, and satellite-based cosmology and astrophysics experiments. Researchers at Brown are collaborating on telescope projects in Arizona and Chile, and balloon flights launched from Texas and the Antarctic. Using equipment designed and built at Brown, as well as the National Laboratories, data are recorded in experimental runs and analyzed at Brown with extensive use of computer systems.

(b) The Physics Department is an active participant in Brown’s Institute for Molecular and Nanoscale Innovation (IMNI), an umbrella organization that supports centers and collaborative research teams in targeted areas of the molecular and nanosciences. IMNI is a “polydisciplinary” venture, with 60 faculty participants representing nine departments across campus. IMNI serves as a focal point for interaction with industry, government, and affiliated hospitals.
(c) Physics is also associated with the Institute for Brian and Neural Systems and the Center for Biomedical Engineering at Brown.

(d) Extensive computer facilities are available. These include a variety of Windows and Linux/UNIX workstations within the department, all of which are connected via Ethernet. In addition, the department has several powerful Zinux clusters for dealing with problems needing large-scale computation. Several high-speed network links provide worldwide access to experimental facilities and enable extensive and efficient use of national super-computing centers. A department web server provides access to personal home pages of faculty, staff, and students as well as general departmental information.

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>$4,913,586</td>
<td></td>
</tr>
<tr>
<td>State/local government</td>
<td>$724,588</td>
<td></td>
</tr>
<tr>
<td>Non-profit organizations</td>
<td>$554,517</td>
<td></td>
</tr>
<tr>
<td>Business and industry</td>
<td>$4,541,062</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$10,733,753</td>
<td></td>
</tr>
</tbody>
</table>

Table C—Separately Budgeted Research Expenditures by Research Specialty

<table>
<thead>
<tr>
<th>Research Specialty</th>
<th>No. of Grants</th>
<th>Expenditures ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astrophysics</td>
<td>13</td>
<td>$2,724,410</td>
</tr>
<tr>
<td>Biophysics</td>
<td>6</td>
<td>$948,931</td>
</tr>
<tr>
<td>Condensed Matter Physics</td>
<td>19</td>
<td>$2,130,987</td>
</tr>
<tr>
<td>Particle and Fields</td>
<td>25</td>
<td>$4,806,912</td>
</tr>
<tr>
<td>Physics and other Science Education</td>
<td>1</td>
<td>$124,513</td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>$10,733,753</td>
</tr>
</tbody>
</table>

FACULTY

Chair Professor

Professor
Cutts, David, Ph.D., University of California, Berkeley, 1968. Particles and Fields.
Jevicki, Antal, Ph.D., City University of New York, 1976. Quantum Field Theory (String Theory, Quantum Gravity, Black Holes, Non-perturbative and Collective Phenomena).

Tan, Chung-I, Ph.D., University of California, Berkeley, 1968. Theoretical Physics.
Volovich, Anastasia, Ph.D., Harvard University, 2002. Theoretical Physics.

Associate Professor
Stein, Derek, Ph.D., Harvard University, 2003. Applied Physics, Biophysics, Condensed Matter Physics, Fluids, Rheology, Nano Science and Technology, Polymer Physics/Science, Other.

Assistant Professor
Fan, JiJi, Ph.D., Yale University, 2009. High Energy Physics, Particles and Fields, Theoretical Physics.
Poiber, Jonathan C., Ph.D., University of California, Berkeley, 2013. Astronomy, Astrophysics.

DEPARTMENTAL RESEARCH SPECIALTIES AND STAFF

Theoretical
Astrophysics and Cosmology. Cosmological models for structure formation and particle-physics predictions of the nature of the dark matter are analyzed. Computational and analytic tools are used to predict the distribution of matter on sub- and super-galaxy scales and to aid in the design of the next generation of cosmological experiments.

Physics of Condensed Matter. Research problems currently under investigation include interference and interaction in mesoscopic systems, including the quantum Hall effect, quantum
Rhode Island

Brown U., Phys.

Physics of Elementary Particles. Current activities include studies in quantum field theory; quantum chromodynamics; gauge/gravity duality; non-perturbative methods in field theory; solitons; monopoles; spontaneous symmetry breaking; lattice field theories; renormalization group; field theoretic approaches to condensed matter; gauge theories of weak and electromagnetic interactions; grand unification theory and phenomenology; phenomenology of scattering and production processes; the quantum theory of gravitation; supersymmetry; supergravity; superstrings; cosmology; Beyond Standard Model phenomenology including supersymmetry phenomenology; Higgs physics; collider physics; dark matter models; and detection. Alexander, Fan, Jevicki, Lowe, Spradlin, Tan, Volovich.

Experimental

Astrophysics and Cosmology. The origins and evolution of the universe are being measured. We are carrying out measurements of the Cosmic Microwave Background from satellite, balloon-borne and ground-based missions to understand the early Universe. We are also using the highly redshifted 21 cm line of neutral hydrogen to map out the three-dimensional structure and evolution of the universe through the epochs of reionization and first star-formation. This work is done using dedicated low-frequency radio interferometers in South Africa and Western Australia. Wide-field optical and near-infrared surveys are being carried out with telescopes in Arizona and Chile to map out the gravitational lensing signal and measure the shear correlation function and the growth of clustering over cosmic time to measure the evolution of the dark energy equation of state. Studies of mass substructure from gravitational lensing maps of clusters of galaxies taken with HST and ground-based telescopes are being used to measure the clustering properties of dark matter. Investigations using the next generation of wide-field survey instruments to map the galaxy group and cluster distribution out to high redshift are being planned. Studies of the galaxy interaction and star formation properties through optical photometry, spectroscopy, NIR photometry, and radio spectral line observations are being carried out. We are also pursuing the direct detection of dark matter using large detectors located in underground laboratories. Direct detection is at the cusp of astrophysics, cosmology and particle physics. The discovery of Weakly Interacting Massive Particles would have a major impact on all these fields. Work focuses on the world-leading LUX experiment, and the future LZ experiment, both based at Sanford Laboratory in the US. Work also continues in studying and developing new technologies for the. Dell’Antonio, Gaitskell, Pober, Tucker.

Biological Physics. Research problems currently under investigation include: the development of single-molecule sequencing technology for DNA and for proteins using nanopores and mass spectrometry; studies of polymer physics, electrodynamics, and fluid dynamics using nanofluidic chips; electronic DNA barcode sequencing; biomechanics and rheology of protein networks regulated by physical mechanisms; biophysical mechanism of bacterial swimming, swarming and adhesion; biomechanics and force sensing in soft matter, including live cells. Ling, Stein, Tang.

Condensed Matter Physics. Research interests include: superconductivity; electron correlation effects in disordered metals and nanostructures; spintronic effects in nanostructures and devices (for example, magnetic quantum tunneling and giant spin Hall effect); spin-logics and magnetic memories; strongly correlated electronic systems in epitaxial or low dimensional systems; high performance magnetic materials with enhanced spin polarization, induced magnetic anisotropies, or large spin-orbit coupling; quantum wires and dots; topological insulators and solids; electronic and magnetic processes probed by NMR; magnetic resonance studies of exotic quantum phases of matter and superconductivity in high magnetic field; spin manipulation in systems where spin is not a good quantum number; studies of ultrasonic and thermal properties of solids using picosecond laser pulses; nano-photonics. Mitrovic, Valles, Xiao.

Physics of Elementary Particles. The properties of elementary particles and their interactions are being investigated, with current effort focused on the study of proton-proton collisions at the highest available energy with the CMS experiment at the Large Hadron Collider at CERN and proton-antiproton collisions at the previous energy frontier facility: the DO experiment at Fermilab Tevatron accelerator. The CMS program is focused on searches for new particles, forces, and properties of space-time, beyond the predictions of the Standard Model of particle physics. That includes searches for supersymmetry and other heavy partners of the known particles, extra spatial dimensions, and new forces. In addition to this avenue to discovery, the CMS and DO programs include precision measurements of the properties of electroweak and strong interactions, in particular measurement of the top-quark properties.

An important component of the current DO and near-future CMS program is the search for the last missing piece of the Standard Model-the Higgs boson. High-performance LHC Computing Grid networking and video conferencing facilities provide tight links between Brown, CERN, and Fermilab. Local computer cluster connected to the Grid allows for massive parallel computing support of the D0 and CMS physics program. Cutts, Heintz, Landsberg, Narain.

View additional information about this department at www.gradschoolshopper.com