

THE UNIVERSITY OF CHICAGO

DEPARTMENT OF PHYSICS

Chicago, Illinois 60637
<http://physics.uchicago.edu/>

General University Information

President: Robert J. Zimmer
Dean of Graduate School: N/A
University website: <http://uchicago.edu>
Control: Private
Setting: Urban
Total Faculty: 2,168
Total Graduate Faculty: N/A
Total number of Students: 12,297
Total number of Graduate Students: 6,928

Department Information

Department Chairman: Prof. Young-Kee Kim, Chair
Department Contact: Shadla Cycholl, Assistant to Chairman
Total full-time faculty: 47
Total number of full-time equivalent positions: 40
Full-Time Graduate Students: 156
First-Year Graduate Students: 28
Female First-Year Students: 3
Total Post Doctorates: 51

Department Address

5720 S. Ellis Avenue
Chicago, IL 60637
Phone: (773) 702-7006
Fax: (773) 702-2045
E-mail: physics@uchicago.edu
Website: <http://physics.uchicago.edu/>

ADMISSIONS

Admission Contact Information

Address admission inquiries to: Office of Graduate Admissions,
Department of Physics, University of Chicago, 5720 S. Ellis
Avenue, Chicago, IL 60637
Phone: (773) 702-7007
E-mail: physics@uchicago.edu
Admissions website: <http://gradadmissions.uchicago.edu>

Application deadlines

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

Application fee

U.S. students: \$90 *Int'l. students:* \$90
No mid-year admissions.

Admissions information

For Fall of 2016:
Number of applicants: 695
Number admitted: 95
Number enrolled: 25

Admission requirements

Bachelor's degree requirements: Bachelor's degree in any Physical Science or Engineering is required.

GRE requirements

The GRE is required.
Taking the GRE well in advance of submitting the application is strongly recommended so that an applicant can self-report the scores before submitting the application. Score verification is done electronically.

Advanced GRE requirements

The Advanced GRE is required.
Taking the October 29, 2016, Physics Subject Test is required.
(Registration deadline: September 23, 2016.)

TOEFL requirements

The TOEFL exam is required for students from non-English-speaking countries.
iBT score: 102
Minimum total score: 102. Minimum scores for the subsections: 26, 26, 24, and 26 (24 is the minimum required for the Speaking Section).

Other admissions information

Undergraduate preparation assumed: Equivalent of Marion and Thornton, Classical Dynamics of Particles and Systems; Reif, Statistical and Thermal Physics; Wangsness, Electromagnetic Fields; Shankar, Principles of Quantum Mechanics; Eisberg and Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles; Kittel, Introduction to Solid State Physics, 8th ed.

TUITION

Tuition year 2016–2017:

Full-time students: \$51,192 annual

Annual tuition charge per academic year is \$51,192 (or \$17,064 per quarter for three quarters). In the Summer Quarter regular Research Assistants register for a research course, and therefore the 4th quarter tuition becomes due. However, all RAs receive full tuition coverage.

Credit hours per semester to be considered full-time: 300

Deferred tuition plan:

Health insurance: Available at the cost of 3,615 per year.

Other academic fees: \$376 per quarter student life fee; \$60 one-time transcript fee.

Academic term: Quarter

Teaching Assistants, Research Assistants, and Fellowships

Number of first-year

Teaching Assistants: 24

Research Assistants: 1

Fellowship students: 7

Average stipend per academic year

Teaching Assistant: \$22,950

Research Assistant: \$22,950

Fellowship student: \$22,950

FINANCIAL AID

Application deadlines

Fall admission:

U.S. students: December 15 *Int'l. students:* December 15

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, Department of Physics, University of Chicago, 5720 S. Ellis Ave., Chicago, IL 60637.

Phone: (773) 702-7007

E-mail: physics@uchicago.edu

Financial aid website: <http://physics.uchicago.edu>

HOUSING**Availability of on-campus housing**

Single students: Yes

Married students: Yes

For further information

Address housing inquiries to: Graduate Student Housing Office, 5555 S. Ellis Avenue, Chicago, IL 60637.

Phone: (773) 753-2218

E-mail: rshousing@uchicago.edu

Housing aid website: <http://rs.uchicago.edu>

Table A—Faculty, Enrollments, and Degrees Granted

Research Specialty	2014–15 Faculty	Enrollment Fall 2014		Number of Degrees Granted 2013–14 (2008–14)		
		Master's	Doctorate	Master's	Terminal Master's	Doctorate
Astrophysics	8	–	16	–	–	3(29)
Atomic, Molecular, & Optical Physics	3	–	11	–	–	1(3)
Biophysics	3	–	6	–	–	1(7)
Chemical Physics	–	–	–	–	–	–(6)
Condensed Matter Physics	15	–	55	–	–	8(43)
Nuclear Physics	1	–	4	–	–	1(1)
Particles and Fields	19	–	53	–	–	5(37)
Physics of Beams	1	–	–	–	–	1(1)
Relativity & Gravitation	1	–	4	–	–	3(6)
Non-specialized	–	–	27	10(110)	1(5)	–
Total	51	–	149	10(110)	1(5)	12(115)
Full-time Grad. Stud.	–	–	149	–	–	–
First-year Grad. Stud.	–	–	25	–	–	–

GRADUATE DEGREE REQUIREMENTS

Master's: Although students are not admitted to study for a Master's, they may receive a Master's degree while studying for the Ph.D. For the Master's degree, there is a minimum residence requirement of three-quarters of full-time registration or the equivalent, nine quarter-length courses. In addition, a student must pass nine approved graduate courses and complete the experimental physics requirement, with a GPA of 2.5 or better overall. There is no thesis or foreign language requirement.

Doctorate: There is a minimum residence requirement of nine quarters of full-time registration. The candidate must pass the advanced physics laboratory course or participate in a first-year experimental research experience, and also pass six advanced physics courses. Four of these advanced courses must be selected from course offerings in either three or four general categories associated with active areas of contemporary physics research; the remaining two must be advanced, seminar-type elective courses. Other requirements include convening a first/introductory meeting of the Ph.D. Committee, a pre-oral meeting to discuss the substantive issues of the dissertation, defending the dissertation before the candidate's Ph.D. Committee, and submitting a paper based on the

dissertation to a recognized journal. Normally, at the pre-oral meeting, preceding submission of the thesis, the Ph.D. Committee and the student decide whether the paper to be submitted will be a single-authored or multiple-authored paper.

Thesis: Electronic submission of the final thesis to the Dissertation Office is required of all students.

SPECIAL EQUIPMENT, FACILITIES, OR PROGRAMS

The Department of Physics at the University of Chicago offers Ph.D. programs in many areas of physics. Students' formal classwork takes place in the modern lecture halls, classrooms, and instructional laboratories of the Kersten Physics Teaching Center. This building also houses special equipment and support facilities for student experimental projects, departmental administrative offices, and meeting rooms. The Center is situated on the science quadrangle near the John Crerar Science Library, which holds over 1,000,000 volumes and provides modern literature search and data retrieval systems.

Student participation is crucial to virtually all research projects, and both graduate and undergraduate research and training are given high priority. Most of the experimental and theoretical research of Physics faculty and graduate students is carried out within the Enrico Fermi Institute, the James Franck Institute, and the Institute for Biophysical Dynamics. These research institutes provide close interdisciplinary contact, crossing the traditional boundaries between departments.

In the Enrico Fermi Institute, members of the Department of Physics carry out theoretical research in particle theory, string theory, field theory, general relativity, and theoretical astrophysics and cosmology. There are active experimental groups in high-energy physics, nuclear physics, astrophysics and space physics, infrared and optical astronomy, electron and ion microscopy, and atomic physics. Some of this research is conducted at the Fermi National Accelerator Laboratory, at Argonne National Laboratory, and at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland.

Physics faculty in the James Franck Institute study chemical, solid state, condensed matter, and statistical physics. Fields of interest include chaos, chemical kinetics, critical phenomena, high Tc superconductivity, nonlinear dynamics, low temperature, disordered and amorphous systems, the dynamics of glasses, fluid dynamics, surface and interface phenomena, nonlinear and nanoscale optics, unstable and metastable systems, laser cooling and trapping, and polymer physics. Much of the research utilizes specialized facilities operated by the Institute, including a low-temperature laboratory, a materials preparation laboratory, X-ray diffraction and analytical chemistry laboratories, laser equipment, a scanning-tunneling microscope, and extensive shop facilities. Some members of the faculty are involved in research at Argonne National Laboratory.

The Institute for Biophysical Dynamics includes members of both the Physical Sciences and Biological Sciences Divisions, and focuses on the physical basis for molecular and cellular processes. This interface between the physical and biological sciences is an exciting and rapidly developing area, with a bidirectional impact. Research topics include the creation of physical materials by biological self-assembly, the molecular basis of macromolecular interactions and cellular signaling, the derivation of sequence-structure-function relationships by computational means, and structure-function relationships in membranes.

In the areas of chemical, atomic, and biophysics, research toward the doctorate may be done in either the Physics or the Chemistry Department. Facilities are available for research in crystal chemistry, degenerate quantum gases, molecular physics, molecular

spectra from infrared to far ultraviolet and Raman spectra, both experimental and theoretical, surface physics, statistical mechanics, radio chemistry, and quantum electronics.

Interdisciplinary research leading to a Ph.D. degree in physics may be carried out under the guidance of faculty committees including members of other departments in the Physical Sciences Division, such as Astronomy and Astrophysics, Chemistry, Computer Science, Geophysical Sciences, Mathematics, or related departments in the Biological Sciences Division.

Table B—Separately Budgeted Research Expenditures by Source of Support

Source of Support	Departmental Research	Physics-related Research Outside Department
Federal government	\$18,966,529	\$3,059,941
State/local government		
Non-profit organizations	\$576,130	
Business and industry	\$168,904	
Other	\$1,862,120	
Total	\$21,573,683	\$3,059,941

Table C—Separately Budgeted Research Expenditures by Research Specialty

Research Specialty	No. of Grants	Expenditures (\$)
Astrophysics	38	\$9,873,604
Atmosphere, Space Physics, Cosmic Rays	9	\$349,680
Atomic, Molecular, & Optical Physics	14	\$1,000,551
Biophysics	10	\$1,128,270
Condensed Matter Physics	43	\$1,777,289
Particles and Fields	39	\$645,374
Physics of Beams	10	\$675,911
Relativity & Gravitation	9	\$4,881,198
Solid State Physics	1	\$1,192,586
Statistical & Thermal Physics	2	\$46,268
Other	1	\$2,950
Total	176	\$21,573,681

FACULTY

Professor

Blucher, Edward C., Ph.D., Cornell University, 1988. Chairman of the Department of Physics. *High Energy Physics, Particles and Fields*. Experimental physics; particle physics.

Carena, Marcela, Ph.D., University of Hamburg, 1989. Scientist, Fermilab. *Particles and Fields*. Theoretical physics; elementary particles.

Carlstrom, John E., Ph.D., University of California, Berkeley, 1988. Professor of Astronomy & Astrophysics. *Astronomy, Astrophysics, Cosmology & String Theory*. Experimental physics and astrophysics; star formation and cosmology; observation and new instrumentation.

Chin, Cheng, Ph.D., Stanford University, 2001. *Atomic, Molecular, & Optical Physics*. Laser cooling; trapping, degenerate quantum gases.

Collar, Juan I., Ph.D., University of South Carolina, 1992. *Astrophysics, Nuclear Physics*. Experimental physics; neutrino and astroparticle physics.

Frisch, Henry, Ph.D., University of California, Berkeley, 1971. *Particles and Fields*. Experimental physics; particle physics.

Guyot-Sionnest, Philippe, Ph.D., University of California, Berkeley, 1987. Professor of Chemistry. Experimental physics; surface physics; nonlinear optical spectroscopy.

Harvey, Jeffrey A., Ph.D., California Institute of Technology, 1981. *Cosmology & String Theory, Particles and Fields*. The-

oretical physics; particle physics; quantum field theory; superstring theory.

Isaacs, Eric, Ph.D., Massachusetts Institute of Technology, 1988. Director, Argonne National Laboratory. *Condensed Matter Physics*. Experimental physics; condensed matter physics.

Jaeger, Heinrich M., Ph.D., University of Minnesota, 1987. *Condensed Matter Physics*. Experimental condensed matter physics; mesoscopic physics; high-temperature superconductivity.

Kang, Woowon, Ph.D., Princeton University, 1992. *Condensed Matter Physics*. Experimental condensed matter physics; fractional quantum Hall effect; semiconductor physics.

Kim, Kwang-Je, Ph.D., University of Maryland, 1970. Senior Scientist, Argonne National Laboratory. *Physics of Beams*. Theoretical physics; beam physics.

Kim, Young-Kee, Ph.D., University of Rochester, 1990. Deputy Director, Fermilab. *High Energy Physics, Particles and Fields*. Experimental elementary particle physics.

Kutasov, David, Ph.D., Weizmann Institute of Science, 1989. *Cosmology & String Theory, Particles and Fields*. Theoretical physics; quantum field theory; string theory.

Levin, Kathryn, Ph.D., Harvard University, 1970. *Atomic, Molecular, & Optical Physics, Condensed Matter Physics*. Theoretical physics; solid-state physics.

Littlewood, Peter B., Ph.D., University of Cambridge, 1980. Associate Director, Argonne National Laboratory. *Condensed Matter Physics*. Condensed matter theory.

Lu, Zheng-Tian, Ph.D., University of California, Berkeley, 1994. Senior Physicist, Argonne National Laboratory. *Atomic, Molecular, & Optical Physics, Nuclear Physics*. Experimental physics; atomic physics.

Martinec, Emil J., Ph.D., Cornell University, 1984. Director, Enrico Fermi Institute. *Cosmology & String Theory, Particles and Fields*. Theoretical physics; string theory; quantum field theory; elementary particles.

Mazenko, Gene F., Ph.D., Massachusetts Institute of Technology, 1971. *Condensed Matter Physics, Systems Science/Engineering*. Theoretical physics; statistical physics.

Merritt, Frank S., Ph.D., California Institute of Technology, 1976. *Particles and Fields*. Experimental physics; particle physics.

Meyer, Stephan S., Ph.D., Princeton University, 1979. Professor of Astronomy & Astrophysics. *Astronomy, Astrophysics, Cosmology & String Theory*. Experimental astrophysics; infrared astrophysics; observational cosmology.

Nagaitsev, Sergei, Ph.D., Indiana University, 1995. Scientist and Head of Accelerator Division at Fermi National Accelerator Laboratory. *Accelerator*.

Nagel, Sidney R., Ph.D., Princeton University, 1974. *Condensed Matter Physics, Fluids, Rheology, Nonlinear Dynamics and Complex Systems*. Experimental physics; condensed matter physics; nonlinear dynamics.

Oddone, Pier, Ph.D., Princeton University, 1970. Director, Fermilab. *High Energy Physics, Particles and Fields*. Experimental physics.

Oreglia, Mark J., Ph.D., Stanford University, 1980. *High Energy Physics, Particles and Fields*. Experimental physics; particle physics.

Privitera, Paolo, Ph.D., Karlsruhe University, 1993. Professor of Astronomy & Astrophysics. *Astronomy, Astrophysics*. Experimental physics; ultrahigh-energy cosmic rays.

Rosner, Robert, Ph.D., Harvard University, 1976. Professor of Astronomy & Astrophysics. *Astrophysics, Fluids, Rheology, Plasma and Fusion*. Theoretical physics; fluid and plasma dynamics; solar physics; high-energy astrophysics.

Savard, Guy, Ph.D., McGill University, 1988. Senior Scientist, Argonne National Laboratory. *Nuclear Physics*. Experimental physics; nuclear physics.

- Sethi**, Savdeep S., Ph.D., Harvard University, 1996. *Cosmology & String Theory, High Energy Physics, Particles and Fields*. Theoretical physics; quantum field theory; string theory; particle physics.
- Shochet**, Melvyn J., Ph.D., Princeton University, 1972. *High Energy Physics, Particles and Fields*. Experimental particle physics.
- Son**, Dam Thanh, Ph.D., Institute for Nuclear Research, Moscow, 1995. Theoretical nuclear physics. *Theoretical Physics*.
- Turner**, Michael S., Ph.D., Stanford University, 1978. Professor of Astronomy & Astrophysics. Director, Kavli Institute for Cosmological Physics. *Astrophysics, Cosmology & String Theory*. Theoretical astrophysics; particle physics; cosmology.
- Wagner**, Carlos E. M., Ph.D., Hamburg, 1989. Physicist, Argonne National Laboratory. *High Energy Physics, Particles and Fields*. Theoretical physics; elementary particles; supersymmetric theories.
- Wah**, Yau W., Ph.D., Yale University, 1983. *High Energy Physics, Particles and Fields*. Experimental physics; particle physics.
- Wald**, Robert M., Ph.D., Princeton University, 1972. *Relativity & Gravitation*. Theoretical physics; general relativity.
- Wiegmann**, Paul B., Ph.D., Landau Inst., Moscow, 1978. Director, James Franck Institute. *Condensed Matter Physics*. Theoretical physics; condensed matter physics.

Associate Professor

- Gardel**, Margaret L., Ph.D., Harvard University, 2004. *Biophysics, Condensed Matter Physics*. Experimental biophysics.
- Wakely**, Scott P., Ph.D., University of Minnesota, 1999. *Astrophysics*. Experimental astroparticle physics, high-energy astrophysics.
- Wang**, LianTao, Ph.D., University of Michigan, 2002. *High Energy Physics, Particles and Fields*. Theoretical physics; elementary particles.
- Zhang**, Wendy W., Ph.D., Harvard University, 2001. *Condensed Matter Physics, Fluids, Rheology, Nonlinear Dynamics and Complex Systems*. Condensed matter theory.

Assistant Professor

- Biron**, David, Ph.D., Weizmann Institute of Science, 2004. *Biophysics*. Experimental biophysics.
- Grandi**, Luca, Ph.D., Università degli Studi di Pavia, 2005. *Astrophysics*. Experimental physics; dark matter, and astroparticle physics.
- Holz**, Daniel E., Ph.D., University of Chicago, 1998. *Astrophysics, Cosmology & String Theory, Relativity & Gravitation*. General relativity, astrophysics, cosmology.
- Irvine**, William T., Ph.D., University of California, Santa Barbara, 2006. *Condensed Matter Physics, Electromagnetism*. Experimental soft condensed matter; knotted fields.
- Levin**, Michael, Ph.D., MIT, 2006. *Condensed Matter Physics*.
- Miller**, David, Ph.D., Stanford University, 2011. *Particles and Fields*.
- Murugan**, Arvind, Ph.D., Princeton University, 2009. *Condensed Matter Physics, Theoretical Physics*.
- Rust**, Michael J., Ph.D., Harvard University, 2010. Assistant Professor of Molecular Genetics and Cell Biology. *Biophysics*.
- Schmitz**, David, Ph.D., Columbia University, 2008. Experimental particle physics; experimental neutrino physics.
- Schuster**, David I., Ph.D., Yale University, 2007. *Condensed Matter Physics*. Experimental condensed matter; quantum computing; superconducting circuits.
- Simon**, Jonathan, Ph.D., Harvard University, 2010. Experimental atomic, molecular, and optical physics.
- Vieregg**, Abigail, Ph.D., UCLA, 2010. *Astrophysics*.

Emeritus

- Abella**, Isaac D., Ph.D., Columbia University, 1963. *Atomic, Molecular, & Optical Physics, Optics, Physics and other Science Education*. Experimental physics; quantum optics; atomic physics; laser spectroscopy.
- Cronin**, James W., Ph.D., University of Chicago, 1955. *Astrophysics, Particles and Fields*. Experimental physics; particle physics; ultrahigh-energy γ -ray astronomy.
- Eastman**, Dean E., Ph.D., Massachusetts Institute of Technology, 1965. *Condensed Matter Physics*. Experimental physics; condensed matter physics.
- Freund**, Peter G. O., Ph.D., University of Vienna, 1960. *Particles and Fields*. Theoretical physics; particle physics; field theory.
- Geroch**, Robert P., Ph.D., Princeton University, 1967. *Relativity & Gravitation*. Theoretical physics; general relativity.
- Hildebrand**, Roger H., Ph.D., University of California, Berkeley, 1951. *Astronomy*. Experimental physics; infrared astronomy.
- Kadanoff**, Leo P., Ph.D., Harvard University, 1960. *Computational Physics, Condensed Matter Physics, Nonlinear Dynamics and Complex Systems, Statistical & Thermal Physics*. Theoretical physics; hydrodynamics; statistical physics.
- Levi-Setti**, Riccardo, Ph.D., University of Pavia, Italy, 1949. Experimental physics; ion microscopy; secondary ion mass spectrometry; ion-solid interaction.
- Müller**, Dietrich, Ph.D., University of Bonn, 1964. *Astrophysics*. Experimental physics; cosmic rays; high-energy astrophysics.
- Nambu**, Yoichiro, Tokyo, Japan, 1952. *Particles and Fields*. Theoretical physics; particle physics; field theory.
- Parker**, Eugene N., Ph.D., California Institute of Technology, 1951. *Astrophysics, Plasma and Fusion*. Theoretical physics; astrophysics; plasma physics; space physics.
- Pilcher**, James E., Ph.D., Princeton University, 1968. *High Energy Physics, Particles and Fields*. Experimental physics; particle physics.
- Rosner**, Jonathan L., Ph.D., Princeton University, 1965. *High Energy Physics, Particles and Fields*. Theoretical physics; particle physics; field theory.
- Schiffer**, John P., Ph.D., Yale University, 1954. Senior Physicist, Argonne National Laboratory. *Nuclear Physics*. Experimental physics; nuclear physics.
- Witten**, Thomas A., Ph.D., University of California, San Diego, 1971. *Condensed Matter Physics, Polymer Physics/Science*. Theoretical physics; weakly connected matter.

Lecturer

- Gazes**, Stuart B., Ph.D., Massachusetts Institute of Technology, 1983. Undergraduate Program Chair. *Nuclear Physics*. Experimental physics; nuclear physics.
- Reid**, David D., Ph.D., Wayne State University, 1995. Executive Officer. *Atomic, Molecular, & Optical Physics, Physics and other Science Education, Relativity & Gravitation*. Theoretical physics, discrete space-time, electron- and positron-gas scattering; physics pedagogy.

DEPARTMENTAL RESEARCH SPECIALTIES AND STAFF

Theoretical

Astrophysics & Cosmology. Cosmology and early universe particle physics. Big-bang nucleosynthesis. Tests of the Big Bang model. Ultrahigh-energy cosmic-ray processes. Baryogenesis and cosmological phase transitions. Topological defects. Inflationary cosmology. Cosmic microwave background radiation. Dark matter. Formation of structure in the universe. The

cosmological constant and dark energy. Aspects of string cosmology. Solar and stellar astrophysics. Astrophysical fluid dynamics. Holz, Parker, Robert Rosner, Turner, Wagner, Wang.

Atomic, Molecular, & Optical Physics. Trapped Fermi and Bose gases. Ionization dynamics. Inner-shell physics of atoms, molecules, and clusters, strong-field and electron-correlation effects. Free-electron lasers. Ultrafast laser-induced phenomena. Electronic many-body theory. Non-Hermiticity in quantum mechanics. Kathryn Levin.

Condensed Matter Physics. Macroscopic dynamics of materials, interfacial singularities, and non-linear processes. Turbulent, chaotic, and stochastic behavior in hydrodynamic and other dynamical systems. Spatial self-organization in polymers, surfactant monolayers, colloids and cell assemblies. Physics of magnetic and superconducting materials (systems) driven by a strong interaction. Physics in low dimensions. Fermi liquid and non-Fermi liquid states in many body systems. High temperature superconductivity. Quantum phase transitions. Phase ordering kinetics and defect dynamics. Non-perturbative phenomena in electronic systems; strongly correlated electronic systems, magnetism. Transition between jammed and fluid states in granular matter, glass-forming liquids, and magnetic flux lattices. Integrable models of statistical mechanics and quantum field theory. Stochastic processes. Irvine, Kadanoff, Kathryn Levin, Michael Levin, Littlewood, Mazonko, Murgan, Son, Wiegmann, Witten, Zhang.

Particle Physics & String Theory. String theory and unification, duality in gauge theory and string theory, solitons and topological structures, precision electroweak measurements, dark matter candidates, effective field theory, electroweak baryogenesis, low-energy supersymmetry, CP violation, heavy quark physics, confinement in QCD, quantum theory of black holes, large extra dimensions, fermion mass hierarchy, integrable systems. Carena, Freund, Harvey, Kutasov, Martinec, Nambu, Jonathan Rosner, Sethi, Son, Wagner, Wang.

Relativity & Gravitation. Black holes. Asymptotic structure. Gravitational radiation. Mathematical aspects of general relativity. Quantum field theory in curved space-times. Quantum gravitation. Alternative theories. Geroch, Holz, Wald.

Experimental

Astrophysics. Studies of the cosmic microwave background radiation spectrum and anisotropy with ground and space-based detectors. Search for polarization in the cosmic background radiation. Measurements of the Sunyaev-Zel'dovich effect for clusters of galaxies. Measurements of intergalactic radiation fields. High-energy gamma-ray astrophysics with atmospheric Cherenkov telescopes. Development of giant air shower array (Auger Project) for investigation of the highest energy cosmic rays. Development of large detectors for high-energy cosmic rays on space and balloon payloads. Experimental investigations of cosmic ray electrons and of the elemental and isotopic abundances of cosmic-ray nuclei over a wide energy range. Investigations of solar, magnetospheric, and heliospheric phenomena with satellite and deep space missions. Cosmic dust studies. Development of instruments to detect polarization in the far-infrared emission from interstellar clouds. Investigation of the magnetic field structure of dense cloud cores. Airborne and mountain-top polarimetry. Direct searches for non-baryonic dark matter. Accelerator-based nuclear astrophysics experiments. Carlstrom, Collar, Cronin, Grandi, Hildebrand, Müller, Meyer, Privitera, Viereg, Wakely.

Atomic, Molecular, & Optical Physics. Bose-Einstein condensation of molecules and fermionic superfluids. Laser cooling

and trapping of atoms. Scalable quantum manipulation and quantum computation. Testing time-reversal symmetry in atoms and nuclei. Chin, Lu, Simon.

Biophysics. Cell migration and division, physical aspects of biological organization, mechanical behavior of cells, regulation of cell physiology, nonlinear dynamics, computational biology, time-resolved fluorescence, confocal microscopy, protein-engineering, signal transduction, gene expression, mathematical modeling, large-scale simulations, stochastic and self-assembly processes, elasticity of polymer networks, optical and holographic traps, single-molecule biophysics, nonlinear optics methods, noise and information in intracellular pathways and interneuronal communication, homeostatic regulation of single neuronal function and of the function of small neural circuits, design principles of biological networks, biophysics in vivo — quantifying behavior and physiological activity of neurons, high-power computation (grid and parallel computing), biophysics of sleep. Biron, Gardel, Rust.

Condensed Matter Physics. Optical and electronic transport in normal and superconducting nanocrystals and arrays. Collective effects at ultra-low temperatures including (fractional) quantum Hall effect, vortex tunneling, metal-insulator transitions, and magnetic quantum critical points. Symmetry-breaking and fluctuations in heavy fermion, organic, and high-Tc superconductors. Nonlinear dynamics and flow properties of granular materials. Scaling behavior of liquid flow and droplet breakup. Mathematical analysis and computer simulation of singularity formation. Universal scaling behavior of relaxation phenomena in supercooled liquids and glasses. Microscopic kinetics and dynamics of phase transitions in colloidal suspensions. Manipulation by dynamic optical holographic traps. Molecular regulation within living cells. Self-assembly and morphology of ultrathin polymer films. Biological properties of the cytoskeleton of eukaryotic cells. The mechanical behavior of cells. Chin, Guyot-Sionnest, Irvine, Isaacs, Jaeger, Kang, Nagel, Schuster, Simon.

Nuclear Physics. Studies of the nuclear many-body system: Nuclear structure and interactions, nuclear reactions in astrophysics, nuclear matter under extreme conditions, precision measurements of critical information to nucleosynthesis along the r- and rp-process paths. Low-energy experiments in fundamental interactions and symmetries, exotic nuclear structure, double beta decay, coherent nuclear scattering. Production, cooling and trapping of rare isotopes, R&D for the Rare Isotope Accelerator (RIA) project. Non-nucleonic degrees of freedom in nuclei and phenomena requiring a quark description. Collar, Lu, Savard, Schiffer.

Particles and Fields. Measurements of properties of the top quark. Searches for supersymmetric particles, the Higgs boson, and other new physics. Precision tests of the standard model in W and Z decays. Studies of pp interactions at center-of-mass energies of 1800 GeV. High-precision measurement of CP violation parameters in K decays; high-sensitivity search for rare K decays and for CPT violation. High-precision measurements of hyperon rare decays. High-precision measurements of electroweak interactions at LEP, both near the Z0 and at center-of-mass energies up to 200 GeV. Searches for new physics including the Higgs boson and supersymmetry; precision measurement of Mw. Preparation for the ATLAS experiment at the LHC (high-energy pp interactions at 14 TeV). Research and development on muon colliders and neutrino factories. Use of facilities at Fermi National Accelerator Laboratory and at CERN. Blucher, Frisch, Young-Kee Kim, Merritt, Miller, Nagaitsev, Oreglia, Pilcher, Jonathan Rosner, Schmitz, Shochet, Wah.

Physics of Beams. Investigation of particle and photon beams and their mutual interactions with the goal of developing novel accelerators or radiation devices. Some current topics are production and acceleration of high-brightness electron beams for linear colliders and free electron lasers; beam dynamics in ionization cooling for muon colliders and neutrino

factories; self-amplified spontaneous emission for intense, coherent X-rays; miniature IR radiation source via Smith-Purcell process using electron microscope beams. Theoretical and experimental programs at the Enrico Fermi Institute on campus, at the Argonne National Laboratory Advanced Photon Source, and the A0 facility in Fermilab. Kwang-Je Kim.

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