General University Information
President: Mitchell E. Daniels, Jr.
Dean of Graduate School: Linda Mason
University website: http://www.purdue.edu
School Type: Public
Setting: Suburban
Total Faculty: 1,931
Total Graduate Faculty: 1,931
Total number of Students: 43,411
Total number of Graduate Students: 9,795

Department Information
Department Chair: Prof. John P. Finley, Head
Department Contact: Sandy Formica, Graduate Secretary
Total full-time faculty: 59
Full-Time Graduate Students: 151
Female Full-Time Graduate Students: 22
First-Year Graduate Students: 28
Female First-Year Students: 2
Total Post Doctorates: 25

Department Address
525 Northwestern Avenue
West Lafayette, IN 47907
Phone: (765) 494-3099
Fax: (765) 494-0706
E-mail: physcontacts@purdue.edu
Website: http://www.physics.purdue.edu

ADMISSIONS

Admission Contact Information
Address admission inquiries to: Sandy Formica, Graduate Secretary, Purdue University, Department of Physics and Astronomy, 525 Northwestern Ave, West Lafayette, IN 47907
Phone: (765) 494-3099
E-mail: physcontacts@purdue.edu
Admissions website: https://www.purdue.edu/gradschool/prospective/gradrequirements/westlafayette/phys.html

Application deadlines
Fall admission:
U.S. students: December 15
Int’l. students: December 15
Spring admission:
U.S. students: September 1
Int’l. students: September 1

Application fee
U.S. students: $60
Int’l. students: $75

Admissions information
For Fall of 2019:
Number of applicants: 320
Number admitted: 97
Number enrolled: 28

Admission requirements
Bachelor’s degree requirements: Bachelor’s degree in Physics is required.
Minimum undergraduate GPA: 3.0

GRE requirements
The GRE is required.
No minimum required.

GRE Physics requirements
The GRE Physics is required.
No minimum required.

TOEFL requirements
The TOEFL exam is required for students from non-English-speaking countries.
Minimum accepted TOEFL scores:
PBT score: 550
iBT score: 80

Other admissions information
Additional requirements: TOEFL (iBT) minimum required individual scores are 18 writing, 18 speaking, 14 listening, and 19 reading.
Undergraduate preparation assumed: A good preparation for entering students includes a sound knowledge of general physics, intermediate level classical mechanics, electricity and magnetism, statistical and thermal physics, quantum mechanics and some introductory atomic, nuclear and condensed matter physics. A corresponding mathematical background includes vector analysis, linear algebra, ordinary differential equations, boundary value problems, and some knowledge of complex analysis. Admitted first year students with deficiencies in any of the above areas can be placed in courses that will supplement the undergraduate program and correct the deficiencies. Strong undergraduate preparation would be provided by adequate study of textbooks at the level of: Marion, Classical Dynamics; Griffiths, Classical Electrodynamics; Kittel & Kroemer, Statistical and Thermal Physics; and Griffiths, Quantum Physics.

Tuition and Assistantships

Teaching Assistants, Research Assistants, and Fellowships
Average stipend per academic year
Teaching Assistant: $20,783
Research Assistant: $21,275
Fellowship student: $23,909
Nine-month appointment.

Tuition year 2019–20:
Tuition for in-state residents
Full-time students: $4,996 per semester
Tuition for out-of-state residents
Full-time students: $14,397 per semester
Fees for Teaching Assistantships and Research Assistantships is $298 per semester.
Credit hours per semester to be considered full-time: 9
Deferred tuition plan: Yes
Health insurance: Available at the cost of $550 per year.
Academic term: Semester

Financial Aid
Application deadlines
Fall admission:
U.S. students: March 1
Int’l. students: March 1
**Housing**

**Availability of on-campus housing**
- Single students: Yes
- Married students: Yes
- Childcare Assistance: No

For further information
Address housing inquiries to: Graduate Housing: ghapp@purdue.edu, Married and Family Housing: pvapp@purdue.edu
E-mail: ghapp@purdue.edu
Housing aid website: http://housing.purdue.edu

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

<table>
<thead>
<tr>
<th>Research Specialty</th>
<th>2018–19 Faculty</th>
<th>2018–19 Enrollment</th>
<th>Number of Degrees Granted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerator Mass</td>
<td>3</td>
<td>57</td>
<td>3(2)</td>
</tr>
<tr>
<td>Spectrometry</td>
<td>1</td>
<td>148</td>
<td>148</td>
</tr>
<tr>
<td>Applied Physics</td>
<td>8</td>
<td>32(28)</td>
<td>32(28)</td>
</tr>
<tr>
<td>Astrophysics</td>
<td>1</td>
<td>3</td>
<td>3(2)</td>
</tr>
<tr>
<td>Atomic, Molecular, &amp; Optical Physics</td>
<td>6</td>
<td>10</td>
<td>6(9)</td>
</tr>
<tr>
<td>Biophysics</td>
<td>6</td>
<td>13</td>
<td>6(9)</td>
</tr>
<tr>
<td>Condensed Matter</td>
<td>13</td>
<td>53</td>
<td>53(2)</td>
</tr>
<tr>
<td>Physics</td>
<td>1</td>
<td>3</td>
<td>3(2)</td>
</tr>
<tr>
<td>Geophysics</td>
<td>4</td>
<td>8</td>
<td>4(3)</td>
</tr>
<tr>
<td>Nuclear Physics</td>
<td>11</td>
<td>13</td>
<td>13(3)</td>
</tr>
<tr>
<td>Particles and Fields</td>
<td>1</td>
<td>3</td>
<td>3(2)</td>
</tr>
<tr>
<td>Science Education</td>
<td>3</td>
<td>4</td>
<td>3(2)</td>
</tr>
<tr>
<td>Planetary Science</td>
<td>1</td>
<td>1</td>
<td>1(3)</td>
</tr>
<tr>
<td>Non-specialized</td>
<td>1</td>
<td>32</td>
<td>32(29)</td>
</tr>
</tbody>
</table>

Total: 57

Full-time Grad. Stud.: 148
First-year Grad. Stud.: 32

**Graduate Degree Requirements**

**Master’s**: Non-thesis option: completion of a minimum of 30 credit hours with at least 24 hours of approved 500–600 level courses in physics, including one laboratory course, and 6 credit hours in 500–600 level mathematics courses, which may be replaced in whole or in part by Methods of Theoretical Physics I and II: grade in a 500-level physics course must be A or B, and grade in a 600-level physics or a mathematics course A, B, or C; minimum graduate grade average of 2.8/4.0; qualifying examination must be taken; written and oral final examinations are given or waived at discretion of student’s advisory committee. More than half of the Purdue credits must be earned through the Purdue campus where the degree is conferred. Thesis option: thesis replaces nine credit hours of physics requirement: final oral examination over thesis is required.

**Doctorate**: At least 90 hours of credit hours are required for the Ph.D. plan of study. Core requirements include statistical physics (one semester), advanced electricity and magnetism (one semester), quantum mechanics (two semesters), and three graduate-level speciality courses. A core course need not be taken at Purdue if its equivalent has been taken previously. A student entering with a B.S. degree and holding a teaching assistantship needs about two years to complete all courses. A master’s degree or professional doctoral degree from any accredited institution may be considered to contribute up to 30 credit hours toward satisfying the 90 credits required for a Ph.D. degree. An average GPA of 3.0 is required in core courses. At the start of first semester, students are required to take a qualifying examination to demonstrate undergraduate knowledge of mechanics at the level of Marion, Classical Dynamics; of electricity and magnetism at the level of Griffiths, Introduction to Electrodynamics; and of modern physics at the level of Gasiorowicz, Quantum Physics. Students are formally admitted to candidacy for the Ph.D. degree only after they have passed the Ph.D. preliminary examination.

The student is eligible to attempt this examination when he or she has completed the core courses with at least a B average. The Preliminary Examination Committee of a given student decides on the nature and coverage of that student’s examination. The examination may have written and oral portions. There is no department-wide preliminary examination. After passing the preliminary examination, students can devote practically all of their time to the original research that will serve as the basis for their theses. The research must be of fully professional character and publishable quality. Completion of the Ph.D. requirements includes the completion of the thesis, passing an oral examination in defense of the thesis, and preparation of the thesis material for publication.

**Other Degrees**: Computational Science and Engineering The Computational Science and Engineering (CS&E) Program at Purdue provides students with the opportunity to study a specific science or engineering discipline along with computing in a multi-disciplinary environment. The aim of the program is to produce a student who has learned how to integrate computing with another scientific or engineering discipline and is able to make original contributions in both disciplines. The Department of Physics and Astronomy is one of the original departments since the inception of this program. The participating departments now number 18 spread over five colleges. Physics CSE students must satisfy both the standard Physics departmental degree requirements and those of the CSE Program. Usually some of the math and specialty course requirements of the Physics Department can be met by courses which simultaneously contribute toward the satisfaction of the CSE requirements; however, generally, both the number of courses and grade requirement are higher for the physics students who elect to specialize in the CSE Program. M.S. graduates should be well-prepared to join and make significant contributions to interdisciplinary research teams. Ph.D. graduates are expected to become leaders in research and development at the forefront of their fields, applying advanced computational techniques and theory to solve key problems.

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

**Special Equipment, Facilities, or Programs**

Among the major facilities is PRIME Laboratory, a national center for accelerator mass spectrometry (AMS), which is based on an 8-MeV Tandem Van de Graaff accelerator. AMS is an ultrasensitive analytical technique for measuring low levels of long-
lived radio nuclides and rare trace elements, and has wide applications to the earth and space sciences, biological sciences, and materials sciences.

The department has 3,000 sq. ft. of class 10,000 cleanrooms used for assembling and testing detectors for use in high-energy physics experiments at the Large Hadron Collider at CERN near Geneva, Switzerland.

The department has an Instrument Shop and an Electronics Shop for building scientific apparatus. The Instrument Shop is staffed by a professional machinist and features a CNC (Computer Numerical Control) milling machine and CNC lathe. Many undergraduate and graduate students receive training and practical experience in machining and electronics in the Instrument Shop and Electronics Shop. Machining techniques and safety are taught by a professional machinist in the Instrument Shop. Electronics for both research and instruction are designed, built, and repaired in the Electronics Shop, which is staffed by an electrical engineer.

Purdue University has created Discovery Park for interdisciplinary research in both bio- and nano-science. The Birck Nanotechnology Center and the Bindley Bioscience Center are state-of-the-art facilities where Physics and Astronomy faculty, postdoctoral researchers, and graduate students join colleagues from other disciplines in performing ground-breaking research in nanophysics, biophysics, and quantum information science. Condensed matter experimentalists make use of synchrotron radiation sources at Argonne National Laboratory and Brookhaven National Laboratory. Physicists in High-Energy Particle and High-Energy Nuclear physics are engaged in experiments at Brookhaven National Laboratory, Fermi National Acceleratory Laboratory, and the CERN Laboratory. Astronomy and astrophysics researchers use facilities at the Whipple telescope at Kitt Peak National Observatory in Arizona, the Hubble Space Telescope, and a variety of other space-based instruments.

### 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>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal government</td>
<td>$9,978,139</td>
<td></td>
<td>$9,978,139</td>
</tr>
<tr>
<td>State/local government</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-profit organizations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business and industry</td>
<td>$5,758,664</td>
<td></td>
<td>$5,758,664</td>
</tr>
<tr>
<td>Other</td>
<td>$120,621</td>
<td></td>
<td>$120,621</td>
</tr>
<tr>
<td>Total</td>
<td>$11,857,424</td>
<td></td>
<td>$11,857,424</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>Applied Physics</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Astrophysics</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Atomic, Molecular, &amp; Optical Physics</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Biophysics</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Condensed Matter Physics</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Geophysics</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Nuclear Physics</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Accelerator Mass Spectrometry</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Particles and Fields</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Physics and other Science Education</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Planetary Science</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td></td>
</tr>
</tbody>
</table>

### FACULTY

**Distinguished University Professor**


Nolte, David D., Ph.D., University of California, Berkeley, 1988. Edward M. Purcell Distinguished Professor. *Biophysics, Condensed Matter Physics, Optics*. The Digital Holography and Bio-interferometry group, directed by Professor David D. Nolte, applies the sensitivity of laser interferometry to a broad range of topics that include solid state physics, plasmonics in gold films, graphene, semiconductor physics, bio-interferometry in biological physics, protein surface chemistry and holographic imaging of living biological tissues. In all these areas, the picometer sensitivity of laser interferometry provides unprecedented sensitivity to study the optical properties of materials. For example, the BioCD (Biological Compact Disk) relies on diffraction.

**Professor**

Bryan, Lynn, Ph.D., Purdue University, 1997. Professor of Curriculum and Instruction. *Physics and other Science Education*. Science teacher education, physics education; sociocultural influences on teaching and learning, particularly in international and/or rural contexts; evidence-based inquiry and reflection in teacher education; teacher knowledge and beliefs; qualitative research methods.

Caffee, Marc, Ph.D., Washington University, St. Louis, 1986. Director of PRIME Lab. *Geophysics, Other*. Accelerator mass spectrometry; application of stable- and radio-nuclides to problems in the geosciences, including quaternary landform evolution, cosmochronology, hydrology, and atmospheric processes; the development of techniques to enable the measurement of new cosmogenic nuclides.

Carlson, Erica W., Ph.D., University of California, Los Angeles, 2000. *Condensed Matter Physics*. Condensed matter theory of strongly correlated electronic systems; liquid crystalline vortex matter in type II superconductors; theory of high-temperature superconductivity; stripe phases in doped antiferromagnets; granular superconductors; analytic work and Monte Carlo simulations of the XY model; field theoretic calculation of spectral functions in quasi-one-dimensional superconductors; dimensional crossover; anisotropic bipolarons.

Chen, Yong, Ph.D., Princeton University, 2005. Professor of Electrical and Computer Engineering Director of Purdue Quantum Center Associate Director of Research for Birck Nanotechnology Center. *Atomic, Molecular, & Optical Physics, Condensed Matter Physics, Nano Science and Technology*. Experimental condensed matter physics; experimental atomic, molecular, and optical physics; nanoscience; nanotechnology.

Csathy, Gabor, Ph.D., Pennsylvania State University, 2001. Associate Department Head. *Condensed Matter Physics*. Experi-
mental condensed matter physics; new physics in 2-D electrons; BCS-like pairing of composite fermions; non-Abelian statistics and possible applications for quantum computing; solid phases in electronic systems; spin physics in low dimensional semiconductors; spectrally enhanced chemical detection with nanotube transistors.

Díaz de la Rubia, Tomás, Ph.D., State University of New York, Albany, 1989. Senior Associate Vice President for Research, Chief Scientist and Executive Director for Discovery Park, Professor of Materials Science and Engineering. Condensed Matter Physics. Tomás Díaz de la Rubia is Purdue University’s chief scientist and executive director of Discovery Park. In this position, his responsibilities include building upon Discovery Park’s foundation of excellence which has enabled high-impact research that crosses traditional academic boundaries. He works closely with the faculty and deans to help catalyze Purdue’s many strengths and build on its legacy of interdisciplinary research with global impact and public-private partnerships.

Durbin, Stephen M., Ph.D., University of Illinois, 1983. Biophysics, Condensed Matter Physics. Experimental condensed matter physics; biophysics; X-ray studies of vibrational modes in biomolecules; X-ray fluorescence imaging; X-ray holographic imaging; Sector Four at the Advanced Photon Source.

Elliott, Daniel S., Ph.D., University of Michigan, 1981. Professor of Electrical and Computer Engineering. Atomic, Molecular, & Optical Physics. Experimental atomic, molecular, and optical physics; coherent and quantum optics.


Khlebnikov, Sergei, Ph.D., Institute for Nuclear Research of the Academy of Sciences, Moscow, 1988. Particles and Fields. Elementary particle theory; cosmology; and quantum field theory.


Lister, Matthew L., Ph.D., Boston University, 1999. Astrophysics. High-luminosity active galactic nuclei; astrophysical jets and shocks; quasars and BL Lacertae objects; very long baseline interferometry; special relativity.


Lyutikov, Maxim, Ph.D., California Institute of Technology, 1998. Astrophysics. Theoretical astrophysics; high-energy astrophysics compact objects; extragalactic astrophysics; cosmic rays; plasma astrophysics.

Malis, Oana, Ph.D., Boston University, 1999. Atomic, Molecular, & Optical Physics, Condensed Matter Physics, Nano Science and Technology. Structural and optical properties of nanostructured materials.

Manfra, Michael J., Ph.D., Boston University, 1999. Bill and Dee O’Brien Chair Professor of Physics and Astronomy Professor of Electrical and Computer Engineering Professor of Materials Engineering. Condensed Matter Physics, Nano Science and Technology. MBE growth of semiconductor nanostructures; transport properties of low-dimensional correlated electron systems.

Muzikar, Paul, Ph.D., Cornell University, 1980. Condensed Matter Physics, Other. Various aspects of geochronology form the focus of research. Specific topics include: (1) the use of cosmogenic nuclides such as Be-10 and Al-26 to determine exposure ages, burial ages, and erosion rates; (2) radiocarbon dating in archaeology and the earth sciences; (3) the application of Bayesian statistics to issues in geochronology.


Neumeister, Norbert, Ph.D., Vienna University of Technology, 1996. Particles and Fields. High-energy particle physics; phenomenon of electro-weak symmetry breaking; the origin of the matter antimatter asymmetry in the universe; the search for new physics beyond the established standard model of particle physics.


Robicheaux, Francis J., Ph.D., University of Chicago, 1991. Atomic, Molecular, & Optical Physics. Time-dependent atomic phenomena; highly excited (Rydberg) atoms; electron scattering; strong fields; ultra-cold plasmas.

Rokhinson, Leonid, Ph.D., Stony Brook University, 1996. Condensed Matter Physics. Experimental condensed matter physics; electron transport in mesoscopic systems; spintronics and spin interactions; quantum information processing; molecular electronics; nanofabrication; novel materials and devices.

Savikhin, Sergei, Ph.D., Tartu State University, 1991. Biophysics. Experimental biophysics; femtosecond optical studies of artificial and natural biological systems; membrane proteins: structure and function; structure-based computer modeling; exciton kinetics in semiconductors; molecular crystals and biological structures; biomimetic devices; ultra-fast experimental techniques.

Wang, Fuqiang, Ph.D., Columbia University, 1996. Nuclear Physics. High-energy nuclear physics, STAR at Brookhaven National Laboratory RHIC.

Xie, Wei, Ph.D., Chinese Academy of Sciences, 1997. Nuclear Physics. Experimental high-energy nuclear physics; quark-gluon plasma.

Associate Professor

Giannios, Dimitrios, Ph.D., University of Crete, 2005. Astrophysics. Theoretical astrophysics. Relativistic jets; acceleration and composition of ultra-high-energy cosmic rays; the nature of the central engine of gamma-ray bursts; the appearance of compact objects in general relativity and modified theories of gravity.

Jones, Matthew, Ph.D., Carleton University, 1997. Particles and Fields. Experimental high-energy physics.

and scattering theories; Beth Ansatz for quantum spin chains; reaction-diffusion systems.


Peterson, John, Ph.D., Columbia University, 2003. *Astrophysics*. Observational cosmology: studies of dark energy and dark matter; high-resolution X-ray spectroscopy; X-ray emission from clusters of galaxies; cooling flows in clusters of galaxies; surveys of clusters of galaxies; the Chandra and XMM-Newton X-ray Observatories; optical and X-ray astrophysics instrumentation; weak gravitational lensing of clusters and large-scale structure; optical astrophysics simulation; advanced multivariate Monte Carlo data analysis techniques; the Large Synoptic Survey Telescope (LSST).


Rodriguez, Jorge, Ph.D., University of Illinois, 1995. *Biophysics*. Theoretical biophysics; computational electronic structure of active sites in metalloproteins; density functional theory of (bio)molecules; electronic structure and mesoscopic properties of (bio)molecular nanostructures; simulation of biological Mössbauer, EPR, and X-ray spectra; (anti)ferromagnetism in molecular magnets and ferromagnetic systems.


Assistant Professor


Cui, Shawn, Ph.D., University of California Santa Barbara, 2016. Assistant Professor of Mathematics. *Quantum Foundations*. Topological quantum field theory, higher category theory, low dimensional topology, Hopf algebras, quantum invariants, topological quantum computation, quantum information.


Hung, Chen-Lung, Ph.D., University of Chicago, 2011. *Atomic, Molecular, & Optical Physics*. Experimental ultra-cold atomic and molecular physics; strongly correlated many-body physics; quantum phase transitions and non-equilibrium dynamics; quantum simulations of condensed matter and gravitational physics; novel atomic trapping and cooling techniques; quantum optics; quantum information and computation.


Jung, Andreas, Ph.D., University of Heidelberg, 2009. *Particles and Fields*. Experimental high-energy physics; measurement of top quark Yukawa coupling; direct and indirect top quark partner searches; Precision cross-section measurements and dark matter.


Lee, Kyoung-Soo, Ph.D., Johns Hopkins University, 2007. *Astrophysics*. Observational cosmology, galaxy formation, and evolution; star formation and chemical enrichment histories of distant galaxies; cosmic structure formation of dark matter; search for progenitors of galaxy clusters in the young universe.

Li, Tongcang, Ph.D., University of Texas at Austin, 2011. Assistant Professor of Electrical and Computer Engineering. *Atomic, Molecular, & Optical Physics, Nano Science and Technology*. Study the interaction of photons and matter for fundamental physics and broad applications. In particular, research related to quantum foundations and quantum photonics: spin-optomechanics of levitated nanodiamonds; macroscopic quantum mechanics of living organisms; laser cooling of atoms, molecules, and solids; cold atom nanophotonics and plasmonics; ultra-sensitive optical tweezers.

Low-Nam, Shalini, Ph.D., University of New Mexico, 2011. Assistant Professor of Chemistry. *Biophysics*. Signaling impulse-response functions initiated at cell-cell interfaces.

Ma, Alex Ruichao, Ph.D., Harvard University, 2014. *Quantum Foundations*. Lattice models, interacting topological phases, dynamical properties and quantum thermodynamics, non-reciprocal waveguide quantum electrodynamic systems.


Mugler, Andrew, Ph.D., Columbia University, 2010. *Biophysics*. Dynamic reorganization for dynamic signals; internal vs. external energy in dynamic sensing; inferring environments from sensory network structure; sensing in spatially confined environments.


Shivaram, Niranj, Ph.D., University of Arizona, 2013. *Atomic, Molecular, & Optical Physics*. Ultrafast quantum dynamics, novel UV/XUV ultrafast transient spectroscopies, VUV/XUV ultrafast spectroscopy in the weak-field regime; Soft x-ray laser from HHG and exotic laser modes in the XUV.

Research Assistant Professor

Srivistava, Brijesh, Ph.D., Indian Institute of Technology, Kanpur, 1975. Experimental high-energy nuclear physics.

Courtesey Professor


Shalaev, Vladimir M., Ph.D., Krasnoyarsk University, 1983. Robert and Anne Burnett Distinguished Professor of Electrical and Computer Engineering. *Electrical Engineering, Nano Science and Technology, Optics*. Fields and optics; bio-
medical imaging and sensing; communications, networking, signal, and image processing; microelectronics and nanotechnology.

**Courtesy Associate Professor**


**Courtesy Assistant Professor**

**Hosseini**, Mahdi, Ph.D., Australian National University, 2012. Assistant Professor of Electrical and Computer Engineering. *Atomic, Molecular, & Optical Physics, Nano Science and Technology*. Quantum atom-optics, quantum optomechanics, nano-photonics, quantum optical computation and precision sensing.

**DEPARTMENTAL RESEARCH SPECIALTIES AND STAFF**

**Theoretical**

Astrophysics. Cosmology; cosmic microwave background; extra dimensions; experimental tests of general relativity; gravitation; plasma and high-energy astrophysics; pulsars and supernova remnants, active galactic nuclei; gamma-ray bursts; relativistic jets, massive, and supermassive black holes; space plasmas, core-collapse supernovae. Giannios, Lyutikov, Milisavljevic.

Atomic, Molecular, & Optical Physics. Ultra-cold atomic gases; electron-molecule collisions; laser-molecule interactions; time-dependent atomic phenomena; highly excited (Rydberg) atoms; strong fields; anthydrogen; few-body physics. Greene, Robicheaux, Zhou.

Biophysics. Electronic structure in metalloproteins; density functional theory of biomolecules; biomolecular nanostructures; biological Mossbauer, EPR and X-ray spectra simulations; molecular magnetism; cellular computation; molecular clustering; cell-cell communication; cell signaling thermodynamics; biological networks; information theory. Iyer-Biswas, Mugler, Rodriguez, Wasserman.

Condensed Matter Physics. Two-dimensional electron systems, Quantum dots and wires; Quantum Hall effect; Spin-orbit interactions; Spin and charge density waves; high-temperature superconductivity; Ferromagnetism and anti-ferromagnetism; spintronics; quantum fluids; Bose-Einstein condensation; phase transitions; optical phenomena; non-equilibrium dynamics; integrable models; Anderson localization; exotic materials. Biswas, Kais, Kaufmann, Lyanda-Geller, Nakanishi, Wasserman.

Nuclear Physics. Relativistic heavy-ion collisions; Quark-gluon plasma; strong, weak, and electromagnetic interactions in nuclei; Bose-Einstein condensation nuclear fusion and low-energy nuclear reactions. Molnar.

Particles and Fields. Theory and phenomenology of the standard model of elementary particle interactions; aspects of supersymmetry; Neutrino oscillations in astrophysical phenomena; Dynamical symmetry breaking; renormalization group studies; cosmological phase transitions; inflationary models of the early universe; Brane world models; string theory; string/gauge theory duality; tests of general relativity and Newtonian gravity; phenomenology of string-inspired new long-range forces; theory and phenomenology of nuclear decay. Fischbach, Khlebnikov, Krczickenski, Lashkari.


Quantum Information Science. QIS is at the frontier of several traditional research disciplines including condensed matter physics, atomic, molecular, and optical physics, information theory, applied math and computer science, and chemistry. QIS strives to harness the unusual quantum mechanical properties of superposition and entanglement to provide breakthrough advances for computing, secure communications, and novel device functionalities. This new research direction within the Department of Physics and Astronomy incorporates quantum computing with superconducting qubits, spins in semiconductors and other condensed matter systems, cold atomic ions, Rydberg, photonic systems chemical physics, quantum materials, quantum algorithm research and information theoretic analysis. Cui.

**Experimental**

Accelerator Mass Spectrometry. Tandem Van de Graaff accelerator operations; technique development for measuring long-lived radionuclides and other rare particles. applications in physics (neutron transport, trace impurities, cross sections), earth science (dating and tracing processes and events, global change, environment), and biological science (drug metabolism, toxicity). Caffee, Lifton, Muzikar.

Applied Physics. Hazardous material detection; associated particle imaging; neutron activation analysis; gamma-ray detector design; elemental analyses in medical diagnostics. Koltick.

Astrophysics. Studies of ultra-short-period pulsating variable stars, neutron stars, black holes, supernova remnants, interstellar medium, active galactic nuclei, relativistic jets, formation and evolution of galaxies, clusters of galaxies, cosmic background radiation, cosmic rays, dark matter, and dark energy; Satellite-based astronomical observations in infrared, optical, UV, X-ray, and gamma-ray wavelengths; ground-based very-high-energy gamma-ray experiments (VERITAS); radio astronomy and interferometry; optical survey (LSST); direct dark matter search (XENON). Finley, Lang, Lee, Lister, Peterson.

Atomic, Molecular, & Optical Physics. Bose-Einstein condensates; ultra-cold atoms and molecules; two-pathway coherent control processes; quantum photonics; quantum manipulation of atoms and molecules with lasers; quantum optomechanics; AMO-solid state/nano hybrid quantum systems; precision measurements. Chen, Elliott, Hosseini, Hung, Li, Malis, Shivarman.

Biophysics. Modeling real nervous systems and learning and memory in simple neural systems; vibrational properties of metalloproteins and other biomolecules; Nuclear Resonant Vibrational Spectroscopy of heme proteins; resonant Raman scattering and FTIR of cytochromes and heme compounds. Terahertz time-delay spectroscopy macromolecule vibrations; single molecule spectroscopy of photosynthetic complexes (PS I); live cell, single molecule imaging of membrane molecule dynamics and interactions; cellular timekeeping; signatures of transient dynamics in single cells; sustained biological symmetry breaking. Durbin, Iyer-Biswas, Low-Nam, Notle, Pushkar, Ritchie, Savikhin.

Condensed Matter Physics. Raman scattering and photoluminescence of semiconductors; non-linear optics of semiconductors and their quantum well-structures; graphene and carbon nanotubes; nanoscience, nanomaterials, and nanodevices; metallic surfaces; resistivity of metals; X-ray studies of quasi-crystals; X-ray synchrotron physics; magnetic materials; quantum transport in GaAs/AlxGa1-xAs microstructures; fractional quantum Hall effect; scanning probe microscopy;
Si/SiO2 interface roughness; 2D materials; Topological insulators and related materials. Banerjee, Chen, Csathy, Diaz de la Rubia, Durbin, Malis, Manfra, Nolte, Rokhinson, Shalaev.

Geophysics. Rock mechanics and physics of rocks; physical acoustics of heterogeneous materials and discontinuities; volumetric non-destructive imaging of opaque materials; hydrology and percolation physics. Nolte, Pyrak-Nolte.

Nuclear Physics. Relativistic nuclear collisions; quantum chromodynamics; quark-gluon plasma; analysis of Relativistic Heavy Ion Collider (BNL) and Large Hadron Collider (CERN) reaction products. Wang, Xie.

Particles and Fields. Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider; Collider Detector at Fermilab (CDF); Higgs boson particles; Supersymmetric (SUSY) particles; Electroweak interactions; precision measurement of the Standard Model; particle astrophysics; Large Synoptic Survey Telescope; dark matter particles; XENON Dark Matter search. Jones, Jung, Lang, Neumeister.

Physics and other Science Education. Science teacher education; sociocultural influences on teaching and learning; Evidence-based inquiry in teacher education; teacher knowledge and beliefs; student attitudes and perceptions of physics. Bryan, Carina Rebello, Sanjay Rebello.

Quantum Information Science. QIS is at the frontier of several traditional research disciplines including condensed matter physics, atomic, molecular, and optical physics, information theory, applied math and computer science, and chemistry. QIS strives to harness the unusual quantum mechanical properties of superposition and entanglement to provide breakthrough advances for computing, secure communications, and novel device functionalities. This new research direction within the Department of Physics and Astronomy incorporates quantum computing with superconducting qubits, spins in semiconductors and other condensed matter systems, cold atomic ions, Rydberg, photonic systems chemical physics, quantum materials, quantum algorithm research and information theoretic analysis. Hood, Ma.

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