Physics is the source of new concepts about the nature of the universe and is a driving force for new technologies. The fundamental physics research of one generation often leads to the applied physics and technology of the next. Rensselaer's graduate program in physics conducts both fundamental and applied research, in collaboration with researchers from other departments, other universities, industry, or national laboratories.

**DEGREES OFFERED**

- **Applied Physics** B.S.
- **Astronomy** M.S.
- **Multidisciplinary Science** M.S., Ph.D.
- **Physics** B.S., M.S., Ph.D.

**MAJOR RESEARCH AREAS**

- **Astronomy and Astrophysics**
  Computational astronomy, galactic structure and evolution, large astronomical surveys, dark matter.

- **Energy Research**
  Energy harvesting, conversion and transfer, solid-state lighting, complex systems and networks.

- **Nanoscience and Nanomaterials**
  Nanoelectronics, Nanophotonics, nanostructures, nano-bio interfaces.

- **Particle Physics**
  Direct detection of dark matter, lattice field theory, neutrinoless double beta decay.

- **Optical Physics**
  Plasmonic structures, light-matter interaction, terahertz spectroscopy, quantum optics and photon entanglement.

- **Condensed Matter and Statistical Physics**
  Molecular electronics, quantum molecular dynamics, semiconductor materials and devices, thin film morphologies and transport, low-dimensional systems, machine learning for materials, complex systems and networks.

**AFFILIATED RESEARCH CENTERS**

These centers provide students access to state-of-the-art facilities, including supercomputers, a class 2100 microfabrication clean room, thin film deposition laboratories, and scanning probe microscopy laboratories.

- **Center for Biotechnology and Interdisciplinary Studies (CBIS)**
- **Center for Materials, Devices, and Integrated Systems (cMDIS)**
- **Center for Computational Innovations (CCI)**
- **Lighting Enabled Systems & Applications (LESA)**
- **Network Science and Technology Center (NeST)**
Physics, Applied Physics, and Astronomy

FACULTY AND RESEARCH AREAS

PROFESSOR
Shirley Ann Jackson
NAE, President

Vincent Meunier
Department Head
Theory, modeling and computer simulation in nanoscience, including energy storage, electronic transport properties and materials by design development. Low dimensional systems, graphene-based materials and self-assembled structures on surfaces.

Joel Giedt
Associate Department Head
Strongly interacting systems beyond the Standard Model of particle physics using lattice gauge theory methods, including supersymmetric gauge theories and models of compositeness at high scales.

Gyorgy Korniss
Graduate Program Director
Statistical physics, complex systems, and networks; Synchronization and extreme fluctuations; Social dynamics; Cascading failures in complex networks.

Shawn-Yu Lin
Photic crystals, plasmonics, nano-photonic, silicon photonics, solid state lighting, solar energy applications.

Toh-Ming Lu
Materials physics, thin film morphology and texture, nanostructures for energy and electronics applications.

Heidi Newberg
Structure and evolution of the Milky Way galaxy using stars as tracers; n-body simulations to determine the density distribution of dark matter using Volunteer Computing with MilkyWay@home; large surveys including SDSS, LAMOST and Gaia.

Peter Persans
Development and implementation of advising, mentoring, and professional development programs for students.

John Schroeder
Glass and nanoparticle physics; Protein condensation and protein misfolding in human ocular systems and applications to other protein misfolding human neuro degenerate diseases.

Michael Shur

Humberto Terrones
Computation of electronic and optical properties of low-dimensional systems, including layered materials. Bridging the gaps between theory and experiment. State of the art Raman characterization to compare with first-principles theory.

Gwo-Ching Wang
Single element and compound semiconductor thin films on van der Waals substrates for optoelectronic applications. Magnetic property of ultrathin metal film using surface magneto-optical Kerr effect (SMOKE). Structural property of 2D TMDC layers and graphene using electron diffraction (RHEED and LEED).

Morris Washington
Associate Director, cMDIS; Professor of Practice, Physics
Photonics and electronic devices.

Christian Wetzel
Electronic band and defect structure of wide band gap semiconductor materials and devices for energy efficiency by means of epitaxy and optical spectroscopy. This work supports the Lighting Enabled Systems & Applications (LESA).

Shengbai Zhang
First-principles structural and electronic properties of a broad range of solid-state materials from crystalline, amorphous semiconductors, metals, to various nanostructures.

ASSOCIATE PROFESSOR
Ingrid Wilke

ASSISTANT PROFESSOR
Ethan Brown
Dark matter direct detection (XENON), neutrinoless double beta decay (nEXO), novel rare event detectors, experimental particle physics.

Moussa N’Gom
Quantum optics and wavefront structured light fields to develop new tools for light-matter interaction for imaging and to address the core problem of photon entanglement degradation.

Trevor Rhone
Exploiting machine learning tools to support materials science research. Data-driven studies of two-dimensional magnetic materials, catalytic reactions and Li-ion battery materials.

Esther Wertz
Light-matter interactions of single molecules with plasmonic nanostructures, super-resolution microscopy.

AFFILIATED FACULTY
Boleslaw Szymanski
Professor of Computer Science; Director, NeST
Network science, social networks, complex systems.

Rena Huang
Associate Professor of Electrical, Computer, and Systems Engineering
Optoelectronic devices, integration and packaging, 3-D integrated microsystems

Vidhya Chakrapani
Assistant Professor of Chemical and Biological Engineering
Semiconductor electrochemistry, advanced materials, quantum dot solar cells.

Ravishankar Sundararaman
Assistant Professor of Materials Science and Engineering
Computational material science, electronic properties, nanomaterials.

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