**Department of Physics**

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

**Faculty**

**Professors**: Roy C. Chaney , Austin J. Cunningham, Gregory D. Earle, Ervin J. Fenyves, Robert Glosser, Roderick A. Heelis, Robert Hilborn, John H. Hoffman, Joseph M. Izen, Mark Lee, Xinchou Lou, Wolfgang A. Rindler, Myron Salamon, Brian A. Tinsley, B. Hobson Wildenthal, Anvar A. Zakhidov
**Associate Professors**: Phillip Anderson, Yuri Gartstein, David Lary
**Assistant Professors**: Mustapha Ishak-Boushaki, Anton Malko, Jason Slinker
**Senior Lecturers**:  Paul MacAlevey, Beatrice Rasmussen
**Affiliated Faculty**: Cyrus D. Cantrell (Engineering), John P. Ferraris (Chemistry), Matt Goeckner (Engineering), Chris Hinkle (MSEN), Wenchuang Hu (Engineering), Jeong-Bong Lee (Engineering), Stephen Levene (Biology), Larry Overzet (Engineering), Dean Sherry (Chemistry), Duck-Joo Yang (Chemistry), Mary Urquhart (Science/Mathematics Education)

**Objectives**

The goal of the Graduate Program in Physics is to develop individual creativity and expertise in the fields of physics. In pursuit of this objective, study in the program is strongly focused on research. Students are encouraged to begin participating in ongoing research activities from the beginning of their graduate studies. The research experience culminates with the doctoral dissertation, the essential element of the Ph.D. program that prepares students for careers in academia, government laboratories, or industry.

A Master of Science degree is offered to those seeking to acquire or maintain technical mastery of both fundamentals and current applications.

A Master of Science degree in Applied Physics is offered for students wishing to emphasize applications encountered in industrial and high technology environments.

**Admission Requirements**

The University’s general admission requirements are discussed [here](http://www.utdallas.edu/dept/graddean/CAT2010/FIRST40/admissions.htm).

The Graduate Physics Program seeks students who have a B.S. degree in Physics or closely related subjects from an accredited university or college, and who have superior skills in quantitative and deductive analysis. Decisions on admission are made on an individual basis. However, as a guide, a combined score on the verbal and quantitative parts of the GRE general test of 1200, with at least 700 on the quantitative part, is advisable based on past experience with student success in the program.

For graduate work it is assumed that the student has an undergraduate background that includes the following courses at the level indicated by texts referred to: mechanics at the level of Symon, Mechanics; electromagnetism at the level of Reitz and Milford, Foundations of Electromagnetic Theory; thermodynamics at the level of Kittel, Thermal Physics; quantum mechanics at the level of Griffiths, Introduction to Quantum Mechanics (chapters 1-4), some upper-division course(s) in modern physics, and atomic physics. Students who lack this foundation may be required to take one or more undergraduate courses to complete their preparation for graduate work.

**Financial Support**

A limited number of assistantships are awarded to those students displaying the most promise in teaching or research. Specific decisions regarding TA awards are made on an individual basis. Students who wish to be considered for financial support are encouraged to submit completed applications by February 1st for admission in the fall semester. Admission for the spring term is possible, but opportunities for financial support in such cases are extremely limited. Ph.D. teaching assistantship awardees are required to complete 12 graduate physics courses (not including research courses) during the first 24 months in residence. Continuation of support requires achievement of a minimum GPA of 3.3, and a satisfactory record in teaching or research assignments.

Financial support is preferentially provided to students in the MS/PhD track, and is generally not available for students in the Applied Masters program.

**Specializations**

The central principle in the structure of the graduate program is that a student’s progress and ultimate success is best served by early and varied research experiences coupled with individually tailored course sequences.

Current areas of research specialization in the physics program are: Atmospheric and Space Physics; Astrophysics/Cosmology/Relativity; Condensed Matter Physics/Materials Science; and High Energy Physics. Further details on the current research topics in these areas are provided below.

**Astrophysics, Cosmology and Relativity**

This research group studies fundamental problems in theoretical astrophysics, contemporary cosmology, and relativity. These research efforts typically involve analytical, numerical, and cosmological-data related projects. The group is instrumental in organizing the biennial Texas Symposia on Relativistic Astrophysics, beginning in Dallas in 1963 and recurring regularly all over the world since then. Current areas of research include: gravitational lensing (lenses) and its applications to cosmology; the acceleration of the expansion of the universe (cosmological constant, dark energy); fitting cosmological models to observational data (e.g. CMB, lensing, supernovae); dark matter; the structure of the big bang; the role of inflation; computer algebra systems applied to general relativity and cosmology; space-time junction conditions and wormholes; cosmological models of wider generality than the classical homogeneous models and their possible observational signatures. More specific information is available at: <http://www.utdallas.edu/~mishak/relativitycosmology.html>.

**Atmospheric And Space Physics**

Research in Atmospheric and Space Physics encompasses both theory and experiment, with emphasis on aeronomy, ionospheric physics, planetary atmospheres, atmospheric electricity and its effects on weather and climate, and space instrumentation. Much of the research occurs in the William B. Hanson Center for Space Sciences, which includes laboratory facilities for instrument design, fabrication, and testing. Faculty and students participate in ongoing satellite missions sponsored by NASA and DoD, and suborbital sounding rockets. Most students participate in analysis of large data sets from previous missions, and from ground-based optical and radar instruments at locations ranging from Greenland to South America. Particular areas of interest include large and small scale dynamics and electrodynamics, numerical modeling of the thermosphere and ionosphere, characteristics of the near earth plasma environment, the effects of solar variability on atmospheric electricity, cloud microphysics and tropospheric dynamics, plasma instabilities and irregularities, and development and testing of innovative space flight instrumentation. Computer facilities include a network of dedicated workstations and access to supercomputers. For further details see <http://www.utdallas.edu/research/spacesciences>.

**High Energy Physics And Elementary Particles**

The UTD High Energy Physics Group collaborates on the Atlas experiment at the CERN Large Hadron Collider (LHC) and the BaBar experiment, at the PEP-II asymmetric b factory located at the Stanford Linear Accelerator Center (SLAC). Atlas will search for the Higgs boson, believed to be responsible for electroweak symmetry breaking, for new physics beyond the standard model such as supersymmetric partners to known particles, and for new hadrons. Atlas data-taking will begin in 2009. BaBar measures CP violation in the decays of bottom mesons and is exploring whether the origin of this CP violation lies within the Standard Model. BaBar data is fertile ground for precision and rare decays of bottom and charm particles, and tau lepton. The group explores both charmonia and a class of unexpected particles with charm-anticharm quark content with properties that are quite different from conventional charmonium. BaBar has completed data-taking and is analyzing its data. The group's research is funded by the U.S. Department of Energy. The UTD High Energy Physics group specializes in high performance computing, simulation production, and data analysis while contributing to the commissioning and operation of experiments. Additional information can be found at: <http://www.utdallas.edu/~joe/hepweb/utdhep.html>

**Solid State/Condensed Matter Physics/Materials Science**

Materials Science is at the interface of many disciplines and involves a collaborative approach with colleagues in chemistry, and electrical engineering. Our research facilities are distributed over the physics laboratories, NanoTech Institute (nanotech.utdallas.edu) and Electrical Engineering Clean Room. Research in Materials Science involves both experiment and theory with emphasis on the physical aspects of solid state materials, optical properties of solids, Raman scattering, physical properties of thin films, and carbon nanotubes. Various nanoscale and synthetic materials are being studied for their optical, electronic, magnetic and transport properties, as well as applications in photonics, spintronics and (opto)electronics. The materials of interest include nanostructures (quantum dots and wires, fullerenes and carbon nanotubes) and low-dimensional systems, photonic band gap crystals and "left-handed" electromagnetic meta-materials, organic and polymeric materials. Unconventional superconductivity and superconducting nanostructures are also under investigation.

The interaction of nanoscale materials, such as carbon nanotubes, with biological entities are being investigated for prospective biomedical and electronic applications. For example, chemically functionalized carbon nanotubes are being studied as building blocks in transistor and sensor applications.

**Degree Requirements**

The University’s general degree requirements are discussed [here](http://www.utdallas.edu/dept/graddean/CAT2010/FIRST40/degree_prg_policies.htm).

All candidates for graduate degrees in physics must satisfy general University degree requirements. Well prepared students may demonstrate by examination adequate knowledge of the core and basic course material. In addition to the general university graduation requirements, graduation in physics requires a grade of B or better in all core courses in the M.S., Applied M.S., and Ph. D. programs

**Master of Science**

A minimum total of 32 graduate hours is required, including the core courses listed below.

**1. M.S. Core courses (12 hours)**

PHYS 5301 Mathematical Methods of Physics I
PHYS 5311 Classical Mechanics
PHYS 5320 Electromagnetism I
PHYS 6300 Quantum Mechanics I

**2. M.S. Elective courses (18 hours)**

In addition to the core courses, 20 hours of additional graduate level physics courses must be successfully completed by M.S. candidates in physics, with prior approval from the Graduate Advisor. Up to 6 hours of elective credit may be satisfied through approved industrial internships, supervised research, or the satisfactory completion and defense of an M.S. thesis. Prior approval for these options must be obtained from the Graduate Advisor.

**Master of Science in Applied Physics (MSAP**)

The MSAP degree is intended as a terminal degree that does not lead to the Ph.D. track. A minimum of 32 graduate credit hours are required for the MSAP degree. Students in this degree plan must successfully complete a minimum of 16 semester credit hours of MSAP core courses, including PHYS 5301. All core courses in the M.S./Ph.D. track are acceptable MSAP core courses, as are courses from the Augmented MSAP Core Courses List provided below. Approved elective credit hours in the MSAP program include any graduate level physics courses, as well as approved graduate-level courses in electrical engineering, computer science, biology, geosciences, chemistry, and operations research. Specific courses should be chosen with the guidance of the graduate advisor for the MSAP program

**Augmented MSAP Core Course List**
PHYS 5305 Monte Carlo Simulation Method and its Applications
PHYS 5315 Scientific Computing
PHYS 5316 Applied Numerical Methods
PHYS 5317 Atoms, Molecules and Solids
PHYS 5318 Atoms, Molecules and Solids II
PHYS 5321 Experimental Operation and Data Collection Using Personal Computers
PHYS 5371 Solid State Physics
PHYS 5372 Solid State Devices

**Doctor of Philosophy**

A minimum of 24 credit hours in the graduate core sequence are required for the Ph.D. degree, plus additional courses specified by the student’s thesis committee chair. The required core courses must include Phys 5301, 5302, 5311, 5313, 5320, 5322, 6300, and 6301. Students in space sciences must also take Phys 6383.

A candidate must also take a minimum of 3 elective courses, 1 from within his/her area of specialization and 2 selected from outside the student’s specialty area. Additional courses may be required to satisfy the particular degree requirements and/or to ensure sufficient grounding in physical principles. The graduate advisor and the student’s supervisory committee must approve course selections. A minimum of one year residency after admission to the doctoral program is required.

Ph. D. students are required to take a comprehensive qualifying examination. The first opportunity to take the exam is in the fall semester of the first year of graduate study – taking advantage of this opportunity allows the qualifier to be attempted up to 3 times. Students who choose not to take the qualifier in their first semester are required to take it in the second fall semester in residence. Satisfactory performance on the qualifier allows continuation with financial support beyond the second fall term. Students who fail the qualifier in the second fall semester and wish to remain in the graduate program are required to retake the exam in the subsequent spring semester – failure to pass the qualifier on this attempt will result in loss of financial support from the university in subsequent semesters, and ineligibility to complete the remaining Ph. D. degree requirements.

After a student has completed the required course work with the minimum GPA of 3.3, passed the qualifier examination, and decided upon his/her field of specialization, a committee is formed to guide the student’s dissertation work. Once a dissertation topic has been identified, the student must submit a proposal that outlines the present state of knowledge of the field and presents the research program the student expects to accomplish for the dissertation. This proposal must be approved by the committee and the Department Head.

A seminar on the dissertation proposal must be presented, followed by an oral examination conducted by the faculty on the proposed area of research and related topics. The Supervising Committee shall determine by means of the exam and any ancillary information whether the student is adequately prepared and has the ability to conduct independent research. The approved dissertation proposal is then filed with the Dean of Graduate Studies. A manuscript embodying a substantial portion of the dissertation research accomplished by the student must be submitted to a suitable professional refereed journal prior to the public seminar and dissertation defense. A public seminar, successful defense of the dissertation, and its acceptance by the Supervising Committee conclude the requirements for the Ph.D. In lieu of the traditional dissertation, and at the discretion of the supervising professor, a manuscript dissertation following the guidelines published by the Graduate Dean’s Office may be substituted.

**Core Course listing for Doctor of Philosophy (24 credit hours required, 27 for Space Science.)**

PHYS 5311 Classical Mechanics
PHYS 5313 Statistical Physics
PHYS 5320 Electromagnetism I
PHYS 5322 Electromagnetism II
PHYS 5301 Mathematical Methods of Physics I
PHYS 5302 Mathematical Methods of Physics II
PHYS 6300 Quantum Mechanics I
PHYS 6301 Quantum Mechanics II
PHYS 6383 Plasma Science (Space Science students only)