Graduate Study in Physics

Overview of Program

Admission

Applicants are required to complete the Graduate Record Examination General Test as well as the Subject (Advanced) test in Physics. For those whose native language is not English, the results of the TOEFL and TSE examinations must be submitted. While there is no closing date for applications, those received by January 1 will be given first priority, and notification of admission will be given by March 15.

Applications can be completed online at http://www.applyweb.com/apply/mtstug/menu.html

Financial Assistance

Most physics graduate students are awarded financial aid throughout their graduate program in the form of research and teaching assistantships, fellowships, health care and fee waivers.

Course Offerings

Courses in advanced topics such as General Relativity, Non-Linear Optics, and Astrophysics are offered in addition to the core graduate physics curriculum.

For more information on the admissions process, financial assistance and course offerings please visit http://www.physics.montana.edu/academics/gradprog.html

www.physics.montana.edu

Mountains & Minds

MSU's 11,000 undergraduate and 1500 graduate students come from all 50 states and over 60 foreign countries and are taught by over 1000 faculty members on our 1,170-acre campus.

Located in the heart of the Rocky Mountains 80 miles north of Yellowstone National Park, Bozeman is truly a remarkable community. While retaining a small town feel, Bozeman is a diverse community that prides itself on offering activities ranging from rodeos and festivals to Shakespeare and opera, with quality rivaling large metropolitan areas. The area's mountains, lakes, and streams offer unparalleled year-round recreational opportunities. Hiking, backpacking, fly fishing, whitewater rafting, and trail riding are popular in summer. In winter, Bridger Bowl Ski Area (17 miles from campus), with cross-country trails and beginner to extreme downhill runs, is one of the best powder ski areas in the country. Big Sky Resort (50 miles south) was chosen by the London Times as one of the Top 10 winter resorts in the world.

CONTACT INFORMATION:

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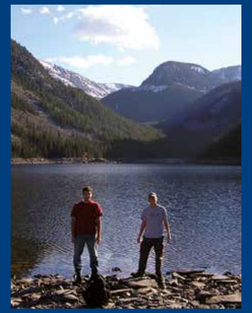
Visit our web site:
www.physics.montana.edu

Cover Image: Bozeman at Night: Aurora over the Bridger Mountains. Photo by Professor Joseph Shaw.

Left Side Image: Twilight in Montana: The blue in the sky is due to Rayleigh scattering of Moonlight. Photo by Professor Joseph Shaw.

Photo: Brian Grossenbacher



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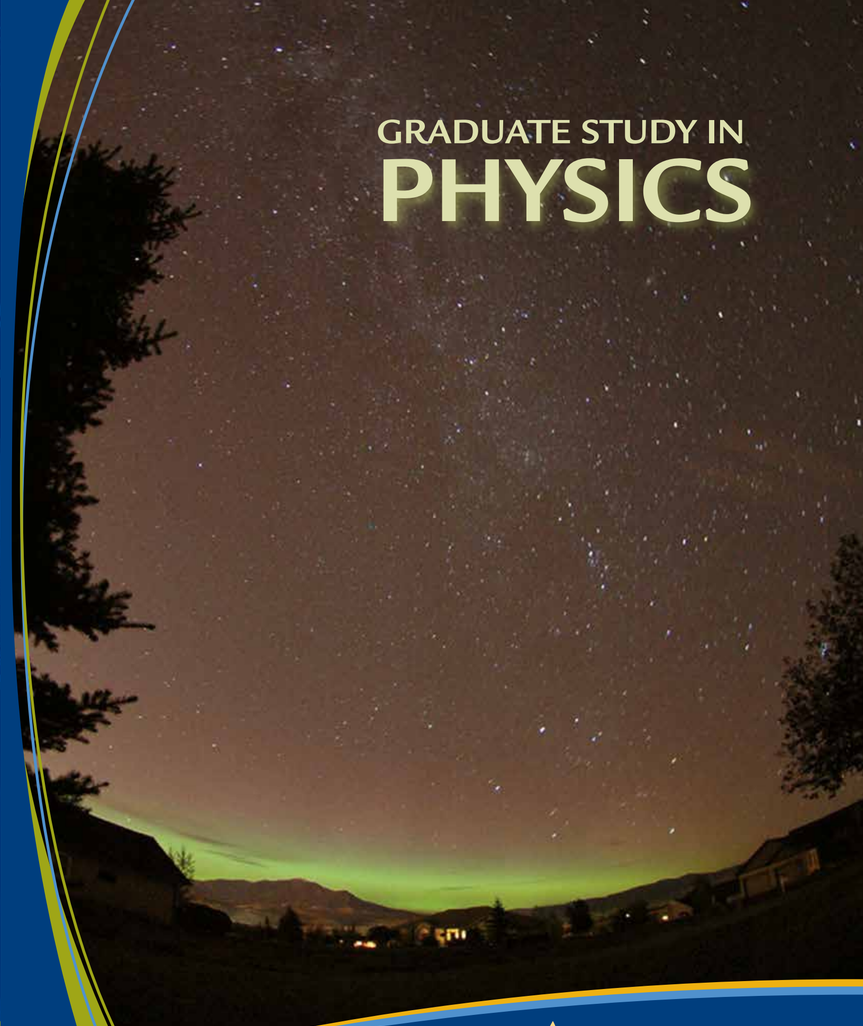
MONTANA STATE UNIVERSITY | College of LETTERS & SCIENCE

GRADUATE STUDY IN PHYSICS



MONTANA STATE UNIVERSITY

Explore New Frontiers at MSU

Innovative instruction and world class research are hallmarks of the MSU Department of Physics. The MSU physics program offers Doctor of Philosophy and Master of Science Degrees. The physics faculty, with over 30 members, is committed to maintaining close contact with its 60 graduate students and postdoctoral scientists. As you look through our literature, explore our website and talk to our students, you will discover a vibrant department with a faculty recognized worldwide for its research and teaching.

Our research facilities include state-of-the-art laboratories and equipment, and ground stations that operate active satellite missions. Extensive external collaborations bring national and international experts to Bozeman and open opportunities for our students to conduct research at other world-class laboratories. On-campus interdisciplinary research programs with the departments of Chemisty and Biochemisty, Microbiology and Electrical and Computer Engineering and with the Center for Biofilm Engineering and collaborations with local industries offer additional possibilities.

Our graduates have an excellent record of finding employment in academia and industry, including high technology companies in the Bozeman area. We hope that when you consider the opportunity to perform cutting edge physics research with first-rate facilities while interacting closely with faculty and other international experts, all in beautiful surroundings that offer the widest variety of outdoor activities, you will chose graduate study in physics at Montana State University.

Astrophysics

The astrophysics group studies extreme astrophysical environments where gravity dramatically warps space and time, and matter takes on strange new forms. Current research includes studies of the role of magnetic fields, superfluidity, turbulence and crustal rigidity in Neutron Stars, and how these factors may be related to star quakes and spin glitches, and the thermal and magnetic evolution of Pulsars and Magnetars. Other topics include Active Galactic Nuclei and the Black Holes that are thought to power them, and the formation of Black Holes in the early universe.

Biophysics

Biophysics is an interdisciplinary research area that brings together people from many departments at MSU. One of the exciting topics under study is the development of the laser light cancer treatment technique of Photodynamic Therapy (PDT). We are the home of the Image and Chemical Analysis Laboratory (ICAL), providing analytical facilities to promote interdisciplinary collaboration in research, education, and industry, and strengthen existing cooperation between the physical, biological, and engineering sciences. ICAL research areas focus on biomedical applications, including nanoscale imaging, microbial adhesion, force spectroscopy, nano elasticity, and live bioprobe development.

Condensed Matter Physics

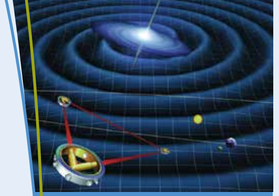
An exceptionally broad spectrum of fundamental and applied research in condensed matter physics is available to graduate students. Topics include defect characterization, ferroelectrics and piezoelectrics, fuel cells, interfacial growth, magnetism (bulk and thin film), nanotechnology, phase transitions, spintronics, superconductivity, structural studies using x-ray and neutron diffraction, and specimen synthesis including single-crystal and thin-film growth.

Students have access to state-of-the art experimental facilities at MSU and in national laboratories. We are leaders in the measurement of thermal expansion, using a novel device developed at MSU that is capable of detecting sub-angstrom length changes of specimens to study phase transitions and critical phenomena with superb resolution. Our Ion Beams Laboratory conducts experiments on thin films and buried solid-solid interfaces to reveal fundamental properties and growth mechanics of importance for fuel cells and electronic devices. Ceramics for fuel cells are fabricated and tested for their electrical properties. The spectroscopy group investigates defects in advanced materials at the atomic level using a host of techniques such as EPR, ENDOR and optical spectroscopy, with the goal of engineering new properties for novel applications in photonics and information technology. Another focus area is in understanding and characterizing dimensionally reduced materials, including nano-particles, surface terminations, and defined thin film architectures for energy production and information transfer.

Theoretical research focuses on investigating properties of unconventional superconductors and superfluids such as heavy-fermion compounds, pnictides, and He-3,for systems in and out of equilibrium, in magnetically active materials, and inhomogeneous environments.

Gravitational Wave Astronomy

The Gravity Group studies extreme astrophysical phenomena, such as the inspiral and merger of black holes and neutron stars, in order to further our understanding of astrophysics and fundamental physics. As incredibly dense objects orbit each other, Einstein's theory of gravity predicts that they generate ripples in the fabric of spacetime. The detection of these waves will allow us to better understand black holes and neutron stars, and to test Einstein's theory in previously uncharted territory. The Gravity Group is actively involved in the worldwide efforts to detect gravitational waves using ground and space based detectors, and is part of the LIGO Scientific Collaboration.



Laser Interferometer Space Antenna

Artist's Concept of a Highly Magnetized Neutron Star

AFM phase images obtained in ICAL of a dividing Salmonella typhimurium bacterium expressing cfa/I fimbriae.

Students and postdocs work with MSU's optical-image furnace to grow single crystals of advanced materials

Students work with the EPR Spectrometer under the supervision of Prof. Galina Malovichko

Lasers and Optics

The optics faculty within the Department of Physics maintain close ties with the MSU Spectrum Lab, the MSU Optical Technology Center, and Bozeman's substantial optics industry, enhancing opportunities in these Physics Department research areas: photonic signal processing, LIDAR, remote sensing, quantum information science, laser development, laser frequency stabilization for atomic clocks, and optical material design and characterization. The MSU Spectrum Lab is an interdisciplinary academic research and development center that provides science and engineering students the opportunity to work with professional scientists and engineers and local industry on a variety of funded application-driven projects.

Solar Physics

The MSU Solar Physics Group engages in cutting-edge research on our nearest star, the Sun. Internationally recognized for our contributions to understanding the Sun's interior, surface, atmosphere, and solar wind, the Group conducts theoretical and computational research, and innovative data analysis utilizing observations from all over the world. The MSU team occupies a central role in numerous space missions, including Yohkoh, TRACE, Hinode, SDO, RHESSI, and IRIS. The group participates in operating the telescopes on these missions and has hands-on access to the complete data archives. These opportunities allow the MSU faculty and students to observe the evolving magnetic fields on the Sun's surface, to develop and test theoretic models to understand the Sun's interior and the behavior of magnetized plasmas in the Sun's atmosphere, and to build collaborations with colleagues worldwide. The Group is also active in many inspiring education and public outreach projects, through our cooperation with the Montana Space Grant Consortium.

Spectrum Laboratory

The Spectrum Lab was established in 1999 to advance the opto-electronic technologies emerging from the research laboratories of Montana State University and foster their transition to Montana companies, while providing enhanced educational opportunities for our undergraduate and graduate students. Teams of research scientists and students in Spectrum Lab and from science and engineering departments across the campus collaborate on research including photonic signal processing, LIDAR, quantum computing, laser development and stabilization, and optical material engineering and characterization.

Space Science and Engineering Laboratory (SSEL)

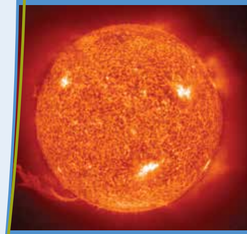
SSEL is an interdisciplinary center for experimental space research and the development of innovative space technologies. MSU students play leading roles in developing spaceflight systems including International Space Station experiments, small satellites, and sounding rocket payloads and are analyzing data from operational spacecraft. MOSES, a novel rocket borne ultraviolet imaging spectrograph, paves the way for future development of space based solar instrumentation in Montana. SSEL facilities include a satellite tracking station, cleanrooms, an optical testing lab and environmental test chambers.

Physics Education

The Physics and Astronomy Education Group endeavors to improve teaching and learning at all levels. Graduate Students pursue a Ph.D. in physics with a principal research focus on science education. Students whose primary research is in other areas may pursue a minor in science education. Members in this group have extensive expertise in: improving learning in large lecture courses; research driven curriculum development; WWW-based instructional strategies; K-12 teacher education and authentic student assessment strategies and project evaluation. Working in this group prepares students for continuing research in the growing number of physics education groups across the country, teaching at two and four year colleges and universities and for careers in educational material development

Graduate students at work on a continuous wave Raman Laser

Dramatic classroom demonstrations embrace sudent learning



SOHO image of the Sun in Extreme Ultra Violet

Students in a cleanroom working on a CubeSat