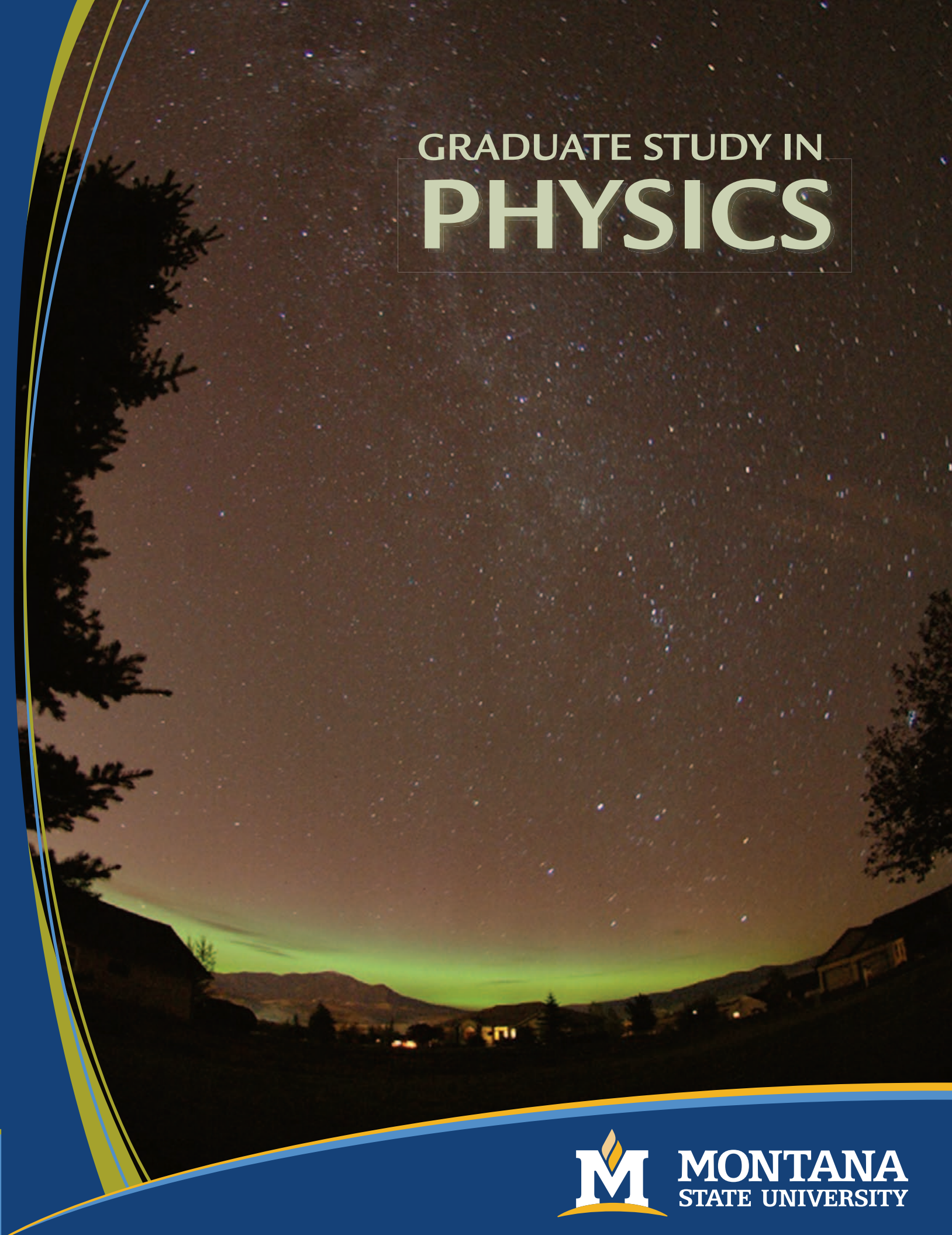
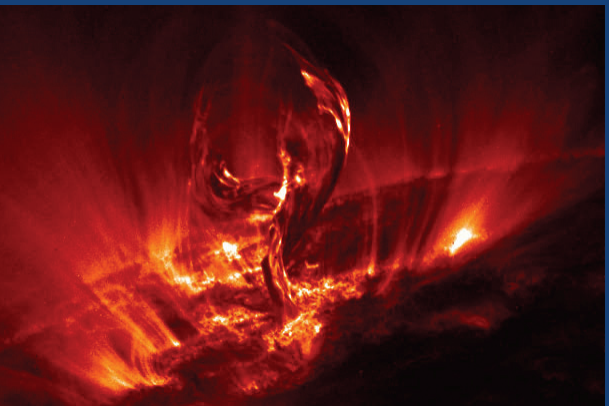

GRADUATE STUDY IN
PHYSICS
MONTANA
STATE UNIVERSITY



Explore New Frontiers at MSU

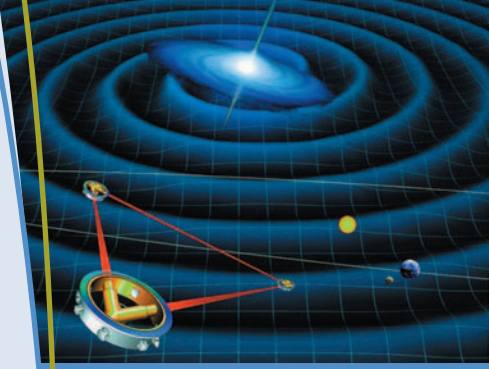
Innovative instruction and world class research are hallmarks of the MSU Department of Physics. The MSU physics program offers Doctor of Philosophy and Master of Science Degrees. The physics faculty, with over 30 members, is committed to maintaining close contact with its 60 graduate students and postdoctoral 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.

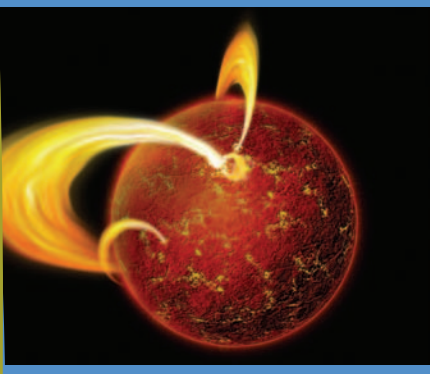
Our graduates have an excellent record of finding employment in academia and industry, including high technology companies in the Bozeman area. We hope that when you consider the opportunity to perform cutting edge physics research with first-rate facilities while interacting closely with faculty and 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, Relativity & Cosmology (ARC)

The ARC group studies extreme astrophysical environments where gravity dramatically warps space and time and matter takes on strange new forms. Neutron Stars, Black Holes and the Big Bang are our laboratories for testing gravity and ultra dense materials. The incredible conditions that occur in these astrophysical environments far exceed those attainable in any Earthbound laboratory. Our research involves many branches of physics, including general relativity, particle physics, fluid dynamics, magnetohydrodynamics and plasma physics. Current research in the ARC group focuses on Gravitational Wave Astronomy, and Neutron Star structure and dynamics. Other areas of study include determining the size and shape of the Universe; investigating quantum effects in strong gravitational fields; and energy extraction from rotating Black Holes. The ARC group studies the role of magnetic fields, superfluidity and crustal rigidity in Neutron Stars, and how these factors may be related to star quakes and spin glitches. Gravitational Wave Astronomy is an exciting new area of research that is poised to open a new window on the Universe. The ARC group is investigating how the space-based LISA gravitational wave detector and the ground based LIGO detectors can be used to study violent astrophysical events such as the collision of two Black Holes.



Laser Interferometer Space Antenna



Artist's Concept of a Highly Magnetized Neutron Star

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.

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

Condensed Matter Physics

An exceptionally broad spectrum of fundamental and applied research in condensed matter physics is available to graduate students. The 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.

State-of-the art experimental facilities at MSU enable measurements to temperatures as low as 0.3 K. 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. The Center of Bio-Inspired Nanomaterials utilizes biological molecules as templates for the synthesis of nanoparticles with unusual physical properties; this interdisciplinary effort thrives on close collaboration among biologists, chemists, and physicists at MSU. Some experiments are also conducted at facilities such as the High Magnetic Field Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, and Pacific Northwest National Laboratory.

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

Research in optics and lasers at MSU extend from exploring fundamental physics to development of optical instruments and photonic devices. Research areas include: developing and studying new types of optical materials, sensors, and lasers; using optical crystals as novel photonic processing devices; exploring the non-linear response of molecules to laser pulses shorter than a trillionth of a second; and applying advanced laser and non-linear optics technologies to remote sensing and medical applications. Collaborations with researchers in the Optical Technology Center, Spectrum Lab, and Bozeman's growing optics industry provide enhanced research opportunities.

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.

Graduate students at work on a continuous wave Raman Laser

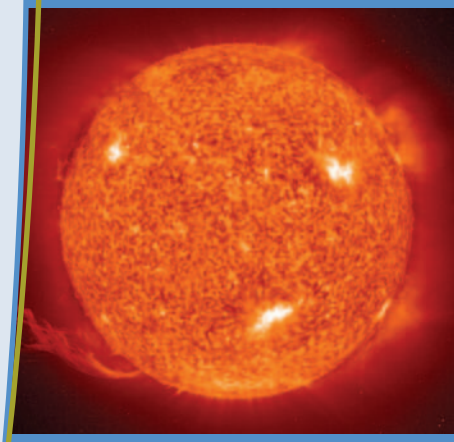
Physics Education

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

Dramatic classroom demonstrations embrace sudent learning

Solar Physics

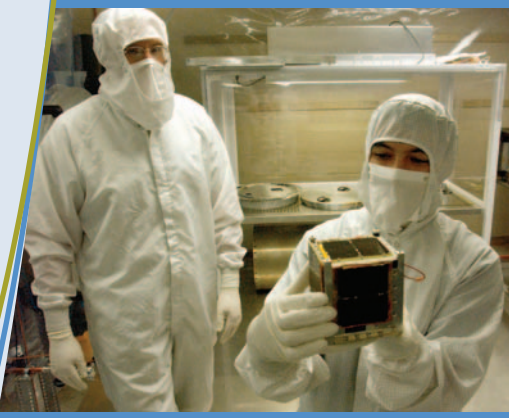
The Solar Physics group conducts diverse research aimed at understanding the Sun as a star and as the source of space weather. The group is internationally known for theoretical and computational research in magnetohydrodynamics and radiation transfer, for collaborations with a worldwide cadre of observers and theorists, and for the group's central role in several space missions. The TRACE mission images the solar transition region and corona with unprecedented spatial resolution. The RHESSI mission studies solar flares with innovative combinations of X-ray and gamma-ray imaging and spectroscopy. MSU's involvement in the Hinode mission benefits from the group's expertise with ground-based instrumentation for magnetic field measurements, and extensive experience with X-ray imaging during the Japan/US/UK Yohkoh mission. The AIA telescopes will extend the high-resolution heritage of TRACE to NASA's first "Living with a Star" mission, the Solar Dynamics Observatory, whose scientific scope extends from the interior of the Sun to the outer reaches of its corona.



SOHO image of the Sun in Extreme Ultra Violet

Space Science and Engineering Laboratory (SSEL)

SSEL is a center of expertise with faculty, staff and facilities for space research and space technologies. MSU students play leading roles in developing spaceflight systems including rocket propulsion, 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 tracking station, cleanrooms, an optical testing lab and environmental test chambers.



Students in a cleanroom working on a CubeSat

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 31 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.

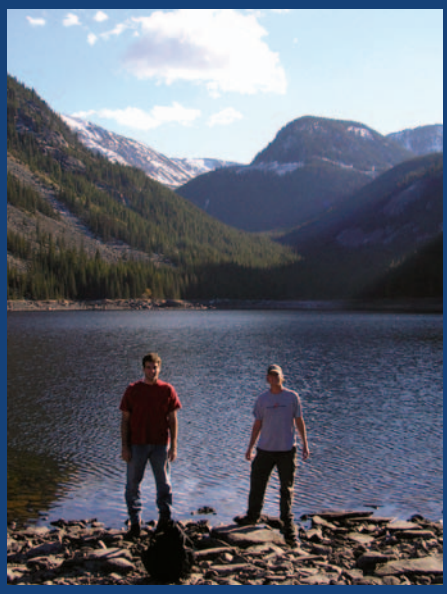
For more information on the admissions process, financial assistance and course offerings please visit http://www.physics.montana.edu/academics/gradprog.html

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.



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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.

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