

# UNIVERSITY OF OKLAHOMA

## HOMER L. DODGE DEPARTMENT OF PHYSICS AND ASTRONOMY

Norman, Oklahoma 73019

<http://www.nhn.ou.edu/>

### General University Information

*President:* Joseph Harroz, Jr.  
*Dean of Graduate School:* Randall Hewes  
*University website:* <http://www.ou.edu/>  
*School Type:* Public  
*Setting:* Urban  
*Total Faculty:* 2,002  
*Total Graduate Faculty:* 1,770  
*Total number of Students:* 25,875  
*Total number of Graduate Students:* 5,360

### Department Information

*Department Chair:* Prof. Philip Gutierrez, Chair  
*Department Contact:* Ashley Price, Student Services  
*Total full-time faculty:* 26  
*Total number of full-time equivalent positions:* 26  
*Full-Time Graduate Students:* 84  
*Female Full-Time Graduate Students:* 13  
*First-Year Graduate Students:* 18  
*Female First-Year Students:* 6  
*Total Post Doctorates:* 7

### Department Address

440 West Brooks St.  
Norman, OK 73019  
*Phone:* (405) 325-3961  
*Fax:* (405) 325-7557  
*E-mail:* [PA-grad@ou.edu](mailto:PA-grad@ou.edu)  
*Website:* <http://www.nhn.ou.edu/>

## ADMISSIONS

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### Admission Contact Information

*Address admission inquiries to:* Graduate Recruiting and Selection Committee, Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma, 440 West Brooks St., Norman, OK 73019  
*Phone:* (405) 325-3961  
*E-mail:* [PA-grad@ou.edu](mailto:PA-grad@ou.edu)  
*Admissions website:* [http://www.nhn.ou.edu/graduate-students/apply\\_OU\\_PhysAst](http://www.nhn.ou.edu/graduate-students/apply_OU_PhysAst)

### Application deadlines

Fall admission:  
*U.S. students:* February 1      *Int'l. students:* February 1

### Application fee

There is no application fee required.  
YOU CAN APPLY IN TWO DIFFERENT WAYS. OPTION 1 (FEE BASED). Use the official online application and pay the application fee (\$50 for US applicants and \$100 for international applicants). OPTION 2 (NO FEE). Send all of your materials directly to our department. This is the no-fee application option. (See the Department's web page for Prospective Students for instructions.)

### Admissions information

For Fall of 2020:  
*Number of applicants:* 143  
*Number admitted:* 14  
*Number enrolled:* 14

### Admission requirements

*Bachelor's degree requirements:* Bachelor's degree in Physics and/or astronomy is required.  
*Minimum undergraduate GPA:* 3.0

### GRE requirements

We will NOT be requiring the general GRE for graduate admissions in 2020-2021.

### GRE Physics requirements

We will NOT be requiring the physics GRE for graduate admissions in 2020-2021.

### TOEFL requirements

The TOEFL exam is required for students from non-English-speaking countries.

Minimum accepted TOEFL scores:

*PBT score:* 600

*iBT score:* 100

Our department has a stated minimum TOEFL of 600/250/100 for paper/computer/IB or IELTS of 7.0. There is some flexibility for candidates who are exceptional in other areas. However, applicants who do not meet the Graduate College's minimum scores of 550/213/79 or 6.5 will not be considered.

### Other admissions information

*Undergraduate preparation assumed:* Marion, Classical Dynamics of Particles and Systems; French, Vibrations and Waves; Griffiths, Introduction to Electrodynamics; Saxon, Elementary Quantum Mechanics; Schroeder, Thermal Physics.

## TUITION AND ASSISTANTSHIPS

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### Teaching Assistants, Research Assistants, and Fellowships

Number of first-year  
*Teaching Assistants:* 14  
Average stipend per academic year  
*Teaching Assistant:* \$26,400  
*Research Assistant:* \$26,400  
*Fellowship student:* \$26,400

### Tuition year 2020-21:

Tuition for in-state residents  
*Full-time students:* \$274.3 per credit  
Tuition for out-of-state residents  
*Full-time students:* \$885.1 per credit  
Our students are typically supported on teaching and research assistantships that include a tuition waiver for up to 90 hours.  
*Credit hours per semester to be considered full-time:* 9  
*Deferred tuition plan:* No  
*Health insurance:* A student health plan is provided as part of TA and RA support.  
*Other academic fees:* \$2,000/semester.

Academic term: Semester  
 Number of first-year students who received full tuition waivers: 14

**FINANCIAL AID**

**Loans**

Loans are available for U.S. students.  
 Loans are not available for international students.  
 GAPSAS application required: No  
 FAFSA application required: No

**For further information**

Phone: (405) 325-4521  
 Financial aid website: <http://www.ou.edu/financialaid.html>

**HOUSING**

**Availability of on-campus housing**

Single students: Yes  
 Married students: Yes

**For further information**

Address housing inquiries to: Housing Office, 1406 Asp Ave.,  
 Norman, OK 73019.  
 Phone: (405) 325-2511  
 E-mail: [housinginfo@ou.edu](mailto:housinginfo@ou.edu)  
 Housing aid website: <http://www.ou.edu/housingandfood.html>

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

Research Specialty	2020–21 Faculty	Enrollment 2018		Number of Degrees Granted 2019–2020 (2012–18)		
		Mas-ter's	Doc-torate	Mas-ter's	Terminal Master's	Doc-torate
<b>Astrophysics</b>	7	–	27	12(19)	1(7)	7(10)
<b>Atomic, Molecular, &amp; Optical Physics</b>	6	–	17	2(8)	1(1)	2(23)
<b>Condensed Matter</b>						
Physics	6	1	19	1(15)	–(4)	–(8)
<b>Engineering</b>						
Physics/Science	11	–	1	2(9)	–(1)	1(1)
<b>High Energy Physics</b>	7	1	23	3(22)	–	–(17)
<b>Physics and other Science Education</b>	2	–	–	–	–	–
<b>Total</b>	26	2	87	20(73)	2(13)	10(59)
<b>Full-time Grad. Stud.</b>	–	2	85	–	–	–
<b>First-year Grad. Stud.</b>	–	–	18	–	–	–

**GRADUATE DEGREE REQUIREMENTS**

**Master's:** A student must complete 30 hours of coursework with a thesis or 32 hours of coursework without a thesis taken in accordance with the general rules of the graduate college. The allowable minimum number of credits in physics and astronomy is 18 hours, 6 hours of which must be at the 5000 level or above.

**Doctorate:** The student must complete a minimum of 36 hours of coursework at the 5000 level or above, excluding the credit hours granted for preparation of the thesis or dissertation describing original research. These hours include 21 hours of specific required courses. Another 54 hours of graduate coursework are required as appropriate for the student's field of research specialization, including research hours. The qualifying examination is offered semiannually and is usually taken at the end of the first year of graduate study. The general examination for the Ph.D. degree consists of a written report and an oral examination, including a presentation of a topic

related to the field of specialization and a probing of the student's knowledge of general principles, and is taken before the student begins dissertation research. The Ph.D. in Physics may include an emphasis in astronomy or astrophysics.

**Other Degrees:** An advanced degree (M.S.) in Engineering Physics is also offered. Specialization areas include astrophysics; atomic, molecular, and optical physics; condensed-matter physics; high-energy physics; and others.

**Thesis:** Thesis and dissertation may be written in absentia.

**SPECIAL EQUIPMENT, FACILITIES, OR PROGRAMS**

The Homer L. Dodge Department of Physics and Astronomy has access to many well-equipped facilities for experimental research in atomic, molecular, and optical physics; condensed-matter physics; and materials characterization. These include UHV chambers for laser cooling and trapping, laser spectrometers, molecular beam epitaxy systems, a clean room for nanofabrication and characterization, thin-film deposition and characterization facilities, optical and electron beam lithography, atomic force microscopes, scanning tunneling microscopes, infrared spectrometers, systems for transport and magneto-optic measurements at high magnetic field and low temperature, and an independent facility for scanning and transmission electron microscopy.

Our experimental research programs regularly make use of external facilities such as the National High Magnetic Field Laboratory, Los Alamos National Laboratory, the ATLAS detector for the Large Hadron Collider at CERN, and Oak Ridge National Laboratories. OU is a Tier 2 Data Collection Center for ATLAS.

Physics faculty form the core of the Center for Quantum Research and Technology (CQRT), which focuses on exploiting quantum resources, such as entanglement and correlations, to enhance devices and develop new technology. The CQRT is housed in newly built Lin Hall, a state-of-the-research facility with 18,000 square feet of laboratory space that meets NIST-A specifications for environmental controls.

OU is a permanent member (1/16 share) of the Astrophysical Research Consortium, which includes the 3.5-m and 0.5-m telescopes at Apache Point Observatory. OU is also a member of ASAS-SN collaboration, a global network of telescopes providing daily monitoring of celestial objects brighter than 18th magnitude. In addition, our astrophysics group routinely has access to Kitt Peak Observatory, the Very Large Array, the MDM Observatory, Subaru, Keck, Gemini, and the Cerro Tololo Inter-American observatories, as well as data from the Hubble Space Telescope, the Spitzer Space Telescope, and the Chandra X-ray telescope.

An instrument and machine shop within the Department with two full-time machinists also supports the experimental research efforts.

Theoretical work is supported by departmental computing resources and the OU Supercomputing Center for Education and Research. For astronomical research, AIPS, IRAF, and IDL software are available.

**Table B—Separately Budgeted Research Expenditures by Source of Support**

Source of Support	Departmental Research	Physics-related Research Outside Department
<b>Federal government</b>	\$2,765,865	
<b>State/local government</b>		
<b>Non-profit organizations</b>		
<b>Business and industry</b>		
<b>Other</b>		
<b>Total</b>	\$2,765,865	

**Table C—Separately Budgeted Research Expenditures by Research Specialty**

Research Specialty	No. of Grants	Expenditures (\$)
<b>Astrophysics</b>	25	\$945,838
<b>Atomic, Molecular, &amp; Optical Physics</b>	14	\$601,363
<b>Condensed Matter Physics</b>	12	\$847,627
<b>High Energy Physics</b>	9	\$680,825
<b>Total</b>	60	\$3,075,653

**FACULTY****Professor**

- Abbott**, Braden, Ph.D., Purdue University, 1994. *High Energy Physics, Particles and Fields*. Experimental high-energy physics; CERN-ATLAS experiment. (ORCID: 0000-0002-5888-2734)
- Baer**, Howard, Ph.D., University of Wisconsin, 1984. *Cosmology & String Theory, Particles and Fields, Theoretical Physics*. High-energy theory; supersymmetry; dark matter; LHC physics. (ORCID: 0000-0002-0733-2644)
- Baron**, Edward A., Ph.D., Stony Brook University, 1985. *Astrophysics, Computational Physics*. Radiative transfer; stellar evolution; supernovae; numerical astrophysics; parallel algorithms. (ORCID: 0000-0001-5393-1608)
- Blume**, Doerte, Ph.D., Georg-August University, 1998. *Atomic, Molecular, & Optical Physics, Chemical Physics, Computational Physics, Low Temperature Physics, Theoretical Physics*. Atomic and molecular physics; few-body physics; ultracold atoms; chemical physics; quantum liquids and quantum gases; Monte Carlo techniques; explicitly correlated Gaussians; development of new algorithms.
- Gutierrez**, Phillip, Ph.D., University of California, Riverside, 1983. *High Energy Physics, Particles and Fields*. Experimental high-energy physics; CERN-ATLAS experiment. (ORCID: 0000-0003-2326-3877)
- Kao**, Chung, Ph.D., University of Texas, Austin, 1990. *Cosmology & String Theory, Particles and Fields, Theoretical Physics*. Particle theory; electroweak symmetry breaking; supersymmetry and unification; CP violation; dark matter; extra dimensions.
- Leighly**, Karen, Ph.D., Montana State University, 1991. *Astronomy, Astrophysics*. Active Galactic Nuclei (AGN); spectral synthesis.
- Mullen**, Kieran, Ph.D., University of Michigan, 1989. *Condensed Matter Physics, Low Temperature Physics, Solid State Physics, Statistical & Thermal Physics, Theoretical Physics*. Theoretical solid-state physics.
- Santos**, Michael, Ph.D., Princeton University, 1992. *Applied Physics, Condensed Matter Physics, Engineering Physics/Science, Materials Science, Metallurgy, Nano Science and Technology, Solid State Physics*. Experimental semiconductor and surface physics; MBE growth of narrow gap systems.
- Strauss**, Michael, Ph.D., University of California, Los Angeles, 1988. *High Energy Physics, Particles and Fields*. Experimental high-energy physics; CERN-ATLAS experiment. (ORCID: 0000-0002-0465-5472)

**Associate Professor**

- Abraham**, Eric, Ph.D., Rice University, 1996. *Atomic, Molecular, & Optical Physics, Chemical Physics, Low Temperature Physics, Optics*. Experimental atomic, molecular, and optical physics; ultracold atoms and molecules; ultracold collisions; atomic clocks; quantum degenerate gases. (ORCID: 0000-0001-9263-7102)

**Biedermann**, Grant W., Ph.D., Stanford University, 2007. *Atomic, Molecular, & Optical Physics*. Quantum metrology; quantum information; quantum control; entanglement; atom-based sensing; atom interferometers.

**Bumm**, Lloyd A., Ph.D., Northwestern University, 1991. *Applied Physics, Computational Physics, Condensed Matter Physics, Engineering Physics/Science, Materials Science, Metallurgy, Nano Science and Technology, Surface Physics*. Experimental condensed-matter physics; nanophysics; surface physics and chemistry; self-assembly; scanning tunneling microscopy; surface spectroscopy; molecular plasmonics; computational modeling (density functional theory, molecular dynamics, electromagnetic), development of novel instrumentation. (ORCID: 0000-0003-2301-8193)

**Dai**, Xinyu, Ph.D., Pennsylvania State University, 2004. *Astronomy, Astrophysics*. Observational cosmology; gravitational lensing; galaxy clusters; cosmic voids; extragalactic planets; high-energy astrophysics; X-ray astronomy; AGNs; gamma-ray bursts. (ORCID: 0000-0001-9203-2808)

**Kilic**, Mukremin, Ph.D., University of Texas, Austin, 2006. *Astronomy, Astrophysics*. Observational astronomy; supernovae Ia progenitors; white dwarfs; merger systems; gravitational waves; planets; debris disks; galactic cosmochronology. (ORCID: 0000-0001-6098-2235)

**Marino**, Alberto, Ph.D., University of Rochester, 2006. *Atomic, Molecular, & Optical Physics, Optics, Quantum Foundations*. Quantum optics; atomic physics; quantum information; quantum metrology.

**Mason**, Bruce A., Ph.D., University of Maryland, 1985. *Physics and other Science Education*. Educational digital libraries; technology for physics education; faculty and teacher development.

**Schwettmann**, Arne, Ph.D., The University of Oklahoma, 2012. *Atomic, Molecular, & Optical Physics, Computational Physics, Low Temperature Physics, Optics*. Experimental atomic, molecular, and optical physics; ultracold atomic gases; Bose-Einstein condensates; cold collisions; matter-wave quantum optics; laser cooling and trapping.

**Sellers**, Ian, Ph.D., University of Sheffield, 2004. *Condensed Matter Physics, Energy Sources & Environment, Engineering Physics/Science, Nano Science and Technology, Solid State Physics*. Next-generation photovoltaics; optical and optoelectronic spectroscopy of semiconductor quantum dots; magneto-photoluminescence; solar cell physics. (ORCID: 0000-0003-2782-0044)

**Tischler**, Joseph G., Ph.D., University of Buffalo, 2000. *Applied Physics, Condensed Matter Physics, Electromagnetism, Low Temperature Physics, Nano Science and Technology, Optics, Quantum Foundations, Solid State Physics*. Optoelectronics; nanophotonics; optical and electrical effects in condensed matter systems; physics of polaritons; experimental quantum science & technology. (ORCID: 0000-0001-9517-0229)

**Uchoa**, Bruno, Ph.D., State University of Campinas, 2004. *Condensed Matter Physics*. Quantum critical systems; Dirac materials; Chern insulators; low-dimensional systems; unconventional quasi-particles; strongly correlated systems.

**Wisniewski**, John P., Ph.D., University of Toledo, 2005. *Astronomy*. Circumstellar disks; extrasolar planets; astronomical polarimetry.

**Assistant Professor**

**Kaib**, Nathan, Ph.D., University of Washington, 2010. *Astronomy, Astrophysics, Computational Physics, Mechanics, Planetary Science*. Extrasolar planets; small bodies of the solar system (comets & asteroids); solar system dynamics; dynamics of binary star systems.

**Lewis-Swan**, Robert J., Ph.D., University of Queensland, 2015. *Atomic, Molecular, & Optical Physics, Computational*

*Physics, Theoretical Physics.* Quantum metrology; quantum simulation; dynamics of quantum information; entanglement and non-classical correlations; ultracold atoms; trapped ions; cavity-QED; stochastic phase-space methods; quantum trajectories. (ORCID: 0000-0002-0201-281X)

**Munshi**, Ferah, Ph.D., University of Washington, 2013. *Astronomy, Astrophysics.* Cosmological simulations, galaxy formation and evolution, dwarf galaxies, dark matter halos.

**Sinha**, Kuver, Ph.D., Rutgers, The State University of New Jersey, 2008. *Cosmology & String Theory, High Energy Physics, Particles and Fields, Theoretical Physics.* Early universe cosmology, string phenomenology, dark matter, physics beyond the Standard Model, collider physics. (ORCID: 0000-0001-8297-1246)

**Stupak III**, John, Ph.D., Stony Brook University, 2012. *High Energy Physics, Particles and Fields.* Experimental high-energy physics; CERN-ATLAS experiment. (ORCID: 0000-0001-9610-0783)

**White**, Daniel R., Ph.D., Ohio State University, 2016. *Physics and other Science Education.* Developing conceptual understanding and problem solving skills.

### Professor Emeritus

**Branch**, David, Ph.D., University of Maryland, 1969. Spectroscopic astrophysics; supernovae.

**Cowan**, John J., Ph.D., University of Maryland, 1976. Stellar evolution and nucleosynthesis; supernovae; cosmology.

**Doezema**, Ryan E., Ph.D., University of Maryland, 1971. Experimental solid-state physics; 2D electron systems in semiconductors; superconductivity.

**Furneaux**, John E., Ph.D., University of California, Berkeley, 1979. *Atomic, Molecular, & Optical Physics, Optics.* Precision molecular spectroscopy.

**Henry**, Richard C., Ph.D., University of Michigan, 1983. *Astrophysics.* Chemical evolution of galaxies; chemical abundances in nebulae; evolution of intermediate mass stars.

**Kantowski**, Ronald, Ph.D., University of Texas, Austin, 1966. *Relativity & Gravitation.* Gravitational lens theory.

**Milton**, Kimball, Ph.D., Harvard University, 1971. *High Energy Physics, Particles and Fields, Theoretical Physics.* High-energy theory, particularly the development of non-perturbative methods to be applied to quantum chromodynamics and other field theories; physics of the quantum vacuum.

**Morrison**, Michael, Ph.D., Rice University, 1976. Theoretical atomic and molecular physics, particularly electron and positron collisions and near-threshold excitations.

**Parker**, Gregory, Ph.D., Brigham Young University, 1976. *Atomic, Molecular, & Optical Physics, Chemical Physics, Computational Physics, Theoretical Physics.* Theoretical molecular physics specializing in rearrangement collisions.

**Romanishin**, William, Ph.D., University of Arizona, 1980. Extragalactic astronomy; clusters of galaxies; active galactic nuclei.

**Ryan**, Stewart, Ph.D., University of Michigan, 1971. Applied physics; materials characterization.

**Skubic**, Patrick, Ph.D., University of Michigan, 1977. *High Energy Physics, Particles and Fields.* Experimental high-energy physics; CERN-ATLAS experiment. (ORCID: 0000-0001-6342-9283)

**Watson**, Deborah K., Ph.D., Harvard University, 1977. *Atomic, Molecular, & Optical Physics, Theoretical Physics.* Theoretical atomic and molecular physics; many-body systems; group theory methods; Bose-Einstein condensates; ultracold Fermi systems.

### Adjunct Professor

**Beasley**, William, Ph.D., University of Texas, Dallas, 1974. Meteorology.

**Crompton**, Robert, Ph.D., University of Adelaide, 1954. Electron and ion diffusion.

**MacGorman**, Donald, Ph.D., Rice University, 1978. Atmospheric electricity.

**Snow**, Joel, Ph.D., Yale University, 1983.

### DEPARTMENTAL RESEARCH SPECIALTIES AND STAFF

#### Theoretical

**Astronomy.** Cosmology; extragalactic astronomy; nucleosynthesis; stellar atmospheres; stellar evolution; supernovae; gravitational lensing; active galactic nuclei; planet formation; planetary dynamics. Baron, Kaib, Leighly, Munshi.

**Atomic, Molecular, & Optical Physics.** Atomic and molecular collisions; ultracold Fermi systems; coherent control of bimolecular collisions; dimensional perturbation theory; electron molecule collision; molecular bosonic gases; optical lattices; computational physics; conical intersections; quantum metrology; quantum simulation. Blume, Lewis-Swan, Parker, Watson.

**Condensed Matter Physics.** Low dimensional quantum systems, Dirac materials, graphene, carbon nanotubes, strongly correlated materials, topological matter. Mullen, Uchoa.

**High Energy Physics.** Quantum field theory; particle physics phenomenology; general relativity; collider physics; supersymmetry; Casimir effect; cosmology; dark matter. Baer, Kantowski, Kao, Milton, Sinha.

#### Experimental

**Astronomy.** Binary and variable stars; extragalactic astronomy; extragalactic H regions; supernovae; white dwarfs; gravitational lensing; active galactic nuclei; star formation; circumstellar disks. Dai, Kilic, Leighly, Wisniewski.

**Atomic, Molecular, & Optical Physics.** Atom-based sensing; atomic and molecular scattering; Bose-Einstein condensation; cooling and trapping; hybrid quantum systems; laser spectroscopy; non-linear optics; quantum optics. Abraham, Biedermann, Marino, Schwettmann.

**Condensed Matter Physics.** Molecular beam epitaxy; narrow-gap semiconductors; chemically synthesized nanoparticles; scanning probe microscopy (AFM & STM); electron microscopy (SEM & TEM); nanofabrication; surface physics; molecular plasmonics; nanophotonics, surface plasmon and surface phonon polaritons, optoelectronics, infrared detectors and photovoltaics; single photon emitters; quantum cascade lasers; magneto-optics; topological insulators. Bumm, Santos, Sellers, Tischler.

**High Energy Physics.** Experimental investigation of the fundamental particles and interactions, and searches for new particles and interactions, using the ATLAS detector at the CERN LHC. Abbott, Gutierrez, Skubic, Strauss, Stupak III.