## [ Introduction ]

The Homer L. Dodge Department of Physics and Astronomy at the University of Oklahoma offers a stimulating, friendly, supportive environment for graduate study. Our first-rate faculty, extensive laboratories and machine shop, outstanding research library, and wideranging computing capabilities provide everything a student needs to succeed in his or her pursuit of a master's or doctoral degree.

The University of Oklahoma is located in Norman, one of the most attractive, easy-going, and inexpensive places to live in this part of the United States. The physical environment of the Norman campus is enriched by gardens, fountains, benches, and sculptures, making it one of the most attractive and congenial of campuses. OU has much to offer graduate students in physics beyond our Department. The University of Oklahoma maintains an internationally acclaimed collection of early manuscripts in the history of science, exhibits at the Fred Jones Jr. Museum of Art and the Sam Noble Museum of Natural History, a worldrenowned Western History collection, the National Weather Center, an extensive program of plays, recitals, and films, and lectures and seminars by internationally known leaders in the sciences, humanities, arts, and government.

The Department of Physics and Astronomy provides opportunities for students to pursue federally supported cutting-edge research in four major areas of contemporary physics:

- astronomy and astrophysics;
- atomic, molecular, optical, and chemical physics;
- · condensed-matter physics;
- high-energy physics.

The many alumni of our graduate program have built successful careers as leaders in technology-related businesses, in industrial and governmental research facilities, in academic research institutions, and in science and public policy at the highest level of government.

gift from a former student Carl T. Bush which established 5 endowed lectureships

Our Department has long been known for excellence in research and teaching, including training graduate students. Among the many award winners on our current faculty are

- 7 recipients of an NSF career award;
- · 2 State of Oklahoma Gold Medalists for excellence in teaching;
- 13 University of Oklahoma Presidential Professors;
- 1 Sloan Fellow;
- · 2 Humboldt Fellows;
- 5 Fellows of the American Physical Society;
- 8 winners of the OU Regents Award for Superior Research and Creative Activity;
- 12 winners of the Regents Award for Superior Teaching; and
- 11 named professorships, three for teaching and eight for research.

We strive to create a supportive, collegial, friendly environment for all members of the Department—staff, postdoctoral research fellows, visitors, faculty, and students alike. In addition to annual social events such as picnics and holiday parties, our regular mid-afternoon tea-and-cookies break provides an informal daily opportunity for members to gather, share ideas, and chat with the many scientists from around the world that visit us throughout the year. These visitors contribute additional intellectual excitement to the Department, through our weekly colloquia, specialized seminars within the major research areas, and ongoing collaborations with faculty and students.

I hope you will find much in this brochure and on our web site to interest you and that you will want to join our community of scholars.

Greg Parker Chair

We will have completed several years of improvements in the physical environment for teaching and research-including the addition of two wings, one of which freed up offices for graduate students-and extensive renovation of the original building, including our in-house library. We continue to expand and improve our research and teaching laboratory facilities. In part, this renovation was made possible by a recent 6 million-dollar gift which supports three endowed chairs as well as research fellowships for graduate students. This year we received a 2 million dollar estate



# [ The Department ]



Research in the department is supervised by a vigorous faculty of 31 scientists who function in four cohesive research groups: astrophysics; atomic, molecular, optical, and chemical physics; condensed matter physics; and high energy physics. Externally funded research expenditures exceed \$4 million a year and the publication rate is that of nationally ranked physics and astronomy departments.

The department has a reputation for excellence in teaching as well as research. The faculty hold numerous awards in teaching at the state, university and college level. Innovative programs have been an integral part of this Department since its inception and are still its tradition:

- The Engineering Physics Program was among the first in the nation when it was begun in 1924.
- The American Association of Physics Teachers and *The American Journal of Physics* were started at OU in the 1930s.
- The New Avenues for Women Program, begun in 1971, was one of the first of its kind.

The combination of successful research programs with strong teaching traditions makes for an excellent environment in which graduate students can learn. The intermediate size of the department ensures individual attention without sacrificing breadth of opportunity.





A novel pulsed supersonic molecular beam source designed and built at OU. It required the expertise of both the instrument shop and the research group to create this small, reliable nozzle that handles a superacid and maintains high-vacuum compatibility. Such collaborative efforts between the instrument shop and experimental groups are common place.

## [ Facilities ]

The primary research facilities are, of course, those of the individual scientists. These range from nano-kelvin laser cooling chambers to high energy particle detectors and everything in between. They are discussed in detail in the group and individual research descriptions that follow. The department also has a number of shared research facilities available for use. These include our library, computing resources, a professionally staffed machine shop, electronics shop, and clean rooms for electronics assembly and nanofabrication.

The Physics and Astronomy Library is housed in Nielsen Hall and is managed by full-time staff. It keeps the full complement of books and journals needed to support the research and teaching efforts of the Department. The main library is just across street and has extended hours, a coffee shop, and our internationally-known History of Science Collection.

The Department maintains modern computing facilities. It currently houses a 112 node Xserve cluster, for use by OU researchers. This is supplemented by a network of over 40 UNIX workstations. Graduate students have exclusive access to our UNIX workstation laboratory. Hardware and software upgrades are continuously being implemented by our full-time computer staff. On-line access is available to OU's OSCER super computer, the NSF supercomputer network as well as other supercomputers for those groups with approved projects. Researchers also have access to supercomputer time at ANL, LBL, San Diego, Los Alamos, Pittsburgh, and NCSA. The Natural Sciences Computer Lab houses 30 PCs, which are used for teaching and to meet students' routine computing needs. Neilsen Hall and the OU Campus are also fully coverd by wireless internet access.

There is also a well-equipped student machine shop and a staffed in-house instrument shop, with three full-time machinists. The shop staff has experience with a wide variety of exotic materials and techniques. Instruments and equipment are developed by students and faculty in close interaction with our machinists. Using computer aided design and numerically controlled machines, they regularly produce state-of-the-art instrumentation. There is also a full-time electronics technician available for maintenance and repair of all the Department's research equipment and to assist in circuit design.





## [ The University of Oklahoma ]

S eventeen years before Oklahoma became a state, the University of Oklahoma was founded by the first legislature of the Territory of Oklahoma. The first classes were held in 1892 with 119 students and four faculty members. More than one century later, OU enrolls more than 30,000 students and has more than 2,400 fulltime faculty members. The university's annual operating budget is approximately \$1.5 billion. OU ranks number one in the nation among all public universities in the number of National Merit Scholars enrolled per capita with a record 207 National Merit Scholars in this year's freshman class.

The campus occupies over a thousand acres of green landscape. Walkways are shaded by more than 2,000 trees of 40 varieties and are surrounded by colorful floral landscaping. Campus buildings are a pleasant mixture of traditional and contemporary—eight of the 82 buildings were built before 1920.

The university community itself offers a multitude of cultural, recreational, and sports activities. Plays, musicals and dance productions are presented in the striking 700-seat Rupel J. Jones Theatre on campus. The Catlett Music Center hosts internationally known artists as well as the University Symphonic Orchestra, Symphonic Band, and other musical groups. Museum buffs will enjoy the Sam Noble Oklahoma Museum of Natural History, the largest associated with any state university, which houses more than 7 million items in its collection. The Fred Jones Jr. Museum of Art, established in 1936, has a diverse collection of nearly 10,000 objects that includes distinguished works in American painting, photographs, and Native American art. It also houses the Weitzenhoffer Collection, 33 works by such artists as Degas, Gauguin, Monet, Pissarro, Renoir, Toulouse-Lautrec, Van Gogh, and Vuillard.

OU is famous for its intercollegiate sports featuring Big 12 football in

the fall, basketball in the winter, and baseball in the spring. Students receive special rates on all sports tickets. For amateur athletes, OU's intramurals and recreational programs are among the most varied and progressive in the Big 12. An indoor/ outdoor swimming complex, modern physical fitness



center, 18-hole golf course, and multiple tennis courts round out the recreational facilities available for student use.



## [ The Region ]

U's main campus is located in the center of Norman, Oklahoma, about 20 miles south of Oklahoma City, the state capitol. With more than 100,000 residents, Norman has the advantages of small-city living along with easy access to the large city. Little River State Park and Thunderbird Lake, which are within the city limits, are a haven for swimming, water-skiing, sailing, fishing, and camping. The cost of living in Norman is among the lowest in the nation. (See chart).

Oklahoma City is another source of cultural, recreational and sports entertainment. Attractions include the Oklahoma Arts Center, the Oklahoma Museum of Art, the Oklahoma City Philharmonic, and Ballet Oklahoma. This major metropolitan center also offers the National Cowboy Hall of Fame and Western Heritage center, the Oklahoma City Zoo, the Kirkpatrick Omniplex (science museum) and Omnidome Theatre, and many other museums, theme parks, and attractions. Its diverse ethnic mix supports a variety of markets, restaurants and festivals.

Oklahoma has short, mild winters and well over 300 days of sunshine per year. The state is the meeting place between central prairie, southwest desert and midwest forest. As such, it enjoys a variety of geographies, ecologies and culture. Oklahoma has 77,000 acres in parks and recreation areas, with a large number of man-made lakes that provide miles and miles of shoreline.

It is perhaps best known for its Native American culture; the name "Oklahoma" itself comes from the Choctaw "okla" meaning "people," and "humma" meaning "red." Once known as "Indian Territory," it is still home to more Native Americans than any other state, except California. There are 39 tribal headquarters located here, and members of at least 67 tribes call Oklahoma home. The state's Native American traditions



are celebrated in a number of museums and cultural Festivals, the most famous of which is perhaps the Red Earth Festival, held each summer.

Norman, OK 1.00
Lincoln, NE 1.08
Tucson, AZ 1.12
Dallas, TX 1.13
Denver, CO 1.22
Minneapolis, MN 1.30
Philadelphia, PA 1.43
San Diego, CA 1.53
Boston, MA 1.63

Comparison of composite cost of living index, normalized to that of Norman. Source: Cost of Living Index: Comparative Data for 300 Uraban Areas, 2nd Quarter 2012, (C2ER) Council of Community and Economic Research.

## [ Graduate Studies ]

#### **Doctoral Degree**

All PhD degree programs require a total of 90 hours, usually tailored to the needs of the individual student. These include a required 21-hour sequence of core courses and at least 15 additional hours in advanced and specialty courses. The first two years of graduate study usually focus on this work. The balance is made up of elective courses, seminars, research, and courses outside the Department, as approved by a student's thesis committee.

A set of written Qualifying Exams and oral and written Specialist Exams must also be passed successfully. A student in one of the PhD programs normally makes a first attempt at the written PhD Qualifying Exams after one or two semesters of graduate work.

Finally, the results of an original body of research must be presented as a written dissertation and successfully defended in an oral Final Examination for the PhD degree. In general, well-prepared graduate students with assistantships spend five years working toward their degree. As their program progresses, they devote increasing amounts of time to research, which can begin as early as the first semester of graduate study.

Students can choose from two options:

**PhD in Physics:** The 36 hours of core, advanced, and specialty courses must be from offerings in the Department of Physics.

**PhD in Physics (Astrophysics option):** A minimum of 12 hours of the 15 hours of advanced and specialty courses must be astrophysics courses at the graduate level.

#### **Master's Degree**

Master's degree programs require completion of 30 hours of courses and preparation of a thesis. Alternatively, 32 hours of course credit are required for a non-thesis option. A well-prepared student with an assistantship will need a minimum of four semesters to complete the degree.

Students can choose from three options.

**MS in Physics:** Both thesis and non-thesis options are available. For the thesis option, 18 hours of course work from offerings in physics are



required. In the non-thesis option, 20 hours in physics are required, and the written PhD Qualifying Exam must be passed successfully. **MS in Physics (Astrophysics option):** Only the thesis option is available. Of the required course work, 18 hours must be from offerings in physics and astronomy with no fewer than 6 hours in astronomy courses. **MS in Engineering Physics:** This degree is available under both thesis and non-thesis options. The written PhD Qualifying Exam must be passed successfully for the non-thesis option. Both options require at least 9 hours of credit must be in engineering areas outside the physics category, the amount depending upon the engineering component of the degree. **All Masters degrees require an oral exam:** the Masters thesis defense for the thesis option; or a final oral presentation for the non-thesis option.

## [ Admission and Financial Support ]



early all students admitted to the graduate program are given full financial support in the form of assistantships or fellowships, with competitive stipends. Teaching assistants generally supervise undergraduate laboratory courses, lead discussion sections in elementary courses, or assist in grading. Loads are adjusted so as to require only 10-15 hours/week, including preparation. As students progress toward their degree, they are usually expected to move to research assistantships provided by their supervisor. Additional summer support (either through teaching or research) is generally available to those students who request it.

In addition to standard assistantships, a number of fellowships are available for qualified students. The prestigious Homer L. Dodge and C.C. Lin Graduate Research Fellowships are offered to exceptional applicants. Both provide a substantial stipend for a top incoming student during his or her first two years of graduate study. The Graduate College at OU often provides stipend supplements to exceptionally talented applicants. Support under all of these programs is dependent upon satisfactory progress toward a degree.

Current policy provides all full-time teaching and research assistants with full tuition waivers and full health care benefits. The generous financial package coupled with the low cost of living in Oklahoma (especially for housing) allows students to live quite well on the stipends provided.

#### **Application Process and Admission Requirements**

The application packet, including the following components, should be mailed to the Graduate Recruiting and Selection Committee.

- Physics and Astronomy Departmental Application\*
- OU Graduate Application (Domestic and International Application packets are available on our web site)\*
- Statement of Purpose.\*
- Arrange for 3 letters of recommendation to be sent.\*
- Arrange for your official transcripts to be sent from all of the colleges and universities you have attended. (These should be sent directly to us by the institutions.)
- · GRE scores (General and Physics subject)

Additional requirements for international students:

- Confidential Financial Statement (form included in OU Graduate Application for International Applicants)\*
- TOEFL or IELTS scores (required for international applicants for whom English is your second language)

\*forms and instructions available at on our web site: http://www.nhn.ou.edu/grad/apply\_OU\_PhyAst.shtml



For questions about admission requirements and the application process, please refer to our FAQ on the web site.

To receive application forms by mail, please contact us through one of the following channels.

Mail: Graduate Recruiting and Selection Committee Homer L. Dodge Department of Physics and Astronomy University of Oklahoma 440 W. Brooks St Norman, OK 73019-2061

Phone: (800) 522-0772, extension 3961 (toll-free)

FAX: (405) 325-7557

e-mail: grad@nhn.ou.edu



Web site: http://www.nhn.ou.edu/grad



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For Graduate Information and Application return this coupon to:

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# [ HIGH ENERGY PHYSICS ]

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### [ CONDENSED MATTER PHYSICS ]

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