

Physics

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Photorefractive and electro-optic properties of polymers, non-linear optics, terahertz science

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Theoretical physics, nanophysics and surfaces

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Lazaros Oreopoulos
Cloud modeling and remote sensing

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Radiative transfer in clouds

PROFESSOR EMERITI

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Atmospheric lidar and remote sensing

Robert L. Rasera
Perturbed angular correlation spectroscopy, structure of materials

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Atmospheric physics

Belay Demoz
Lidar, mesoscale processes

Alexis Finoguenov
Clusters of galaxies

Mike Krainak
Atmospheric lidar

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Acoustics, sonography

Harry Winsor
Advanced technology

Physics students are trained to see and to understand nature in an especially profound way. They learn how to dissect a problem into its essential components, to understand the interrelation of the parts, and to apply mathematical and computational techniques to produce a solution. This kind of training is obviously advantageous in many professions besides physics, so physics graduates are found in professions as diverse as patent law, medicine and finance.

UMBC's Department of Physics offers a Bachelor of Science degree in Physics and is planning to offer a Bachelor of Arts degree in Physics Education in the near future. Either track can be taken as a terminal degree.

The Bachelor of Science degree qualifies a student for immediate professional employment or can be used as a basis for entrance into graduate school. The Bachelor of Arts degree is specifically designed for those students planning a career in high school teaching, and it is coordinated with the UMBC Education Department. This allows students to obtain a degree in physics education that includes certification for teaching high school physics in a four-year program. This method fulfills the Maryland requirement for new high school teachers that they major in the subject area they teach.

A special feature of both degree tracks is the opportunity for undergraduates to participate in the faculty's research programs. Many students doing this research are co-authors with their research mentors on papers at technical conferences and in research journals. To help support undergraduate research, the department presents the Langenburg Student Research Award each year to a junior or senior physics major. This cash award is to support the student during the semester he or she is performing research. The departmental honors program requires the

course Senior Research (PHYS 499), but this course can be taken as an elective by any student with consent of his or her academic advisor and a faculty research mentor. It is important for all students to work closely with their departmental academic advisor to take full advantage of the elective courses offered, especially once a particular career path has been chosen.

The department offers minors in both physics and in astronomy. The astronomy minor is aimed especially at those students interested in pursuing careers in astronomy or astrophysics.

The department also offers a combined B.S./M.S. program for highly qualified students. In 2000, the department moved into a new, 72,000-square-foot Physics Building, which includes many outstanding facilities for undergraduates. There is a tutorial center, a study room, a resource room containing a large number of texts and other books, and a computer laboratory with PCs configured for both Windows and Linux applications.

The department recently has purchased nearly \$6 million worth of new equipment, including a 0.8 meter astronomical telescope, which is housed in a dome on the roof of the Physics Building. Other special facilities in the building include: a class-100 clean room, in which state-of-the-art photonic and electronic devices can be fabricated, and a micro-scropy facility containing a scanning electron microscope with special characterization attachments and an atomic force microscope. These facilities are used by students in optics courses, in the advanced laboratory course and in undergraduate research projects.

Typically about half the graduating seniors go on to graduate school. Recent graduates have been accepted at MIT, Harvard, The Johns Hopkins University,

and the universities of California at Berkeley, Illinois and Michigan, among others.

Career and Academic Paths

The career opportunities for physics majors are numerous and varied. Many of UMBC's physics majors go on to pursue advanced degrees in physics and allied fields of science and engineering at the nation's leading graduate schools. Other physics students find employment immediately upon graduation. Recent graduates are working in electro-optics, space physics, computer modeling and semiconductor research, among other fields, with employers such as Northrop Grumman, NASA Goddard Space Flight Center, the National Security Agency and Lawrence Livermore Laboratories. Other graduates have gone on to medical or law school or to other careers for which the problem-solving skills and understanding of the physical world learned in physics courses prepare them.

The UMBC Department of Physics offers both M.S. and Ph.D. degrees in Applied Physics and Atmospheric Physics. Undergraduates making satisfactory progress in their physics and mathematics courses may obtain permission from their advisor to take graduate-level courses.

The areas of research emphasis in the graduate programs are non-linear and quantum optics, solid-state materials and nanophysics, photonics, atmospheric physics and astrophysics. All faculty have active research programs, several of which are internationally known. The external research funding of the department exceeds \$6 million per year. These funds come from such agencies as NASA, the National Science Foundation, the Office of Naval Research and the National Security Agency.

The department plays a major role in UMBC's Joint Center for Earth Systems Technology (JCET) with NASA's Goddard Space Flight Center. There are 16 JCET research faculty affiliated with the Department of Physics. The department also houses the Joint Center for Astrophysics with NASA's Laboratory for High Energy Astrophysics

Academic Advising

All students considering a major or minor in physics, or a minor in astronomy, are strongly encouraged to contact the department as soon as possible. There is a special faculty advisor for freshmen and new students. After their first year, all majors are assigned to a permanent physics faculty academic advisor until they graduate.

In addition to following each student's progress through the academic program, the faculty advisor is available to discuss such subjects as career goals, summer internships and opportunities for graduate study.

Major Program

The physics majors program consists of 72 or 73 credits distributed as follows:

► Physics Courses (47 credits)

PHYS 121
Introductory Physics I

PHYS 122
Introductory Physics II

PHYS 122
Introductory
Physics Laboratory

PHYS 220L
Introduction to
Computational Physics

PHYS 224
Introductory Physics III

PHYS 303
Thermal and
Statistical Physics

PHYS 320L
Electronics for Scientists

PHYS 321
Intermediate Mechanics

PHYS 324
Modern Physics

PHYS 330L
Optics Laboratory

PHYS 331L
Modern Physics Laboratory

PHYS 407
Electromagnetic Theory

PHYS 408
Optics

PHYS 424
Introduction to
Quantum Mechanics

Three elective credits in physics at the 300-level or higher.

► Other Courses (25 or 26 credits)

MATH 151
Calculus I

MATH 152
Calculus II

MATH 251
Multivariable Calculus

MATH 221
Linear Algebra

MATH 225
Differential Equations

CMSC 104
Problem Solving and
Computer Programming
OR
CMSC 201
Computer Science I
for Majors

CHEM 101
Principles of Chemistry I

► Physics Elective Courses

PHYS 305
Stellar Astrophysics

PHYS 315
Galaxies and the
Interstellar Medium

PHYS 316
Extra-galactic
Astronomy and Cosmology

PHYS 335
Physics and Chemistry
of the Atmosphere

PHYS 402
Nuclear Physics

PHYS 403
Solid-State Physics

PHYS 415
Observational Astronomy

PHYS 418
Semiconductor
Optical Devices

PHYS 425
Relativistic Physics

PHYS 428
Integrated Optics
and Holography

PHYS 430
Introduction to Materials

PHYS 440
Computational Physics

PHYS 480
Mathematical Physics

PHYS 490
Senior Seminar

PHYS 499
Senior Research

Physics and mathematics courses that serve as prerequisites to other required courses must be satisfied with a grade of no less than "C." The cumulative GPA of physics courses at the 300 and 400 level, required for the physics major, must be at least 2.0.

For physics majors, the suggested sequence of courses starts with the basic core, which is usually completed by the end of the first three semesters at UMBC. The basic core consists of PHYS 121, PHYS 122, PHYS 122L, CMSC 104 or CMSC 201, CHEM 101, MATH 251 and all of its prerequisites.

For example,

First Year

Fall
MATH 151
CMSC 104
CHEM 101

Spring
MATH 152
PHYS 121

Sophomore Year

Fall Semester
PHYS 122
PHYS 122L
MATH 251

Especially well-prepared freshmen entering with at least one year of high school calculus may elect to begin the introductory physics sequence in the fall semester of their first year. For example,

First Year

Fall
MATH 151
CMSC 104
PHYS 121

Spring
MATH 152
PHYS 122
CHEM 101

Sophomore Year

Fall Semester
PHYS 224
PHYS 122L
MATH 251

Completion of the basic core will prepare all students to enter PHYS 324 in their third semester. A sample program starting in the third semester is as follows:

Sophomore Year

Spring semester
PHYS 224 (if not taken earlier) OR PHYS220
PHYS 324
PHYS 320L

Junior

Fall
PHYS 303
PHYS 330L
MATH 221

Spring
PHYS 321
PHYS 331L
PHYS 220 or
PHYS elective

Senior

Fall
PHYS 407
PHYS 331L (if not taken earlier)
Electives

Spring
PHYS 408
PHYS 424
Electives

Physics Minor Program

To obtain a minor in physics, a student must complete at least 22 credits, including PHYS 121, 122, 224, and four upper-division lecture or laboratory courses (12 credits) chosen by the student with the consent of the physics advisor. If PHYS 122L is included among the courses, the requirements can be satisfied with only 21 total credits. Students interested in the physics minor should contact the department for details.

Astronomy Minor Program

A minor in astronomy is offered to students who are preparing for a career in astronomy or astrophysics or to those who are interested in an in-depth survey of modern astronomy. The minor is open to students with a major in any discipline. The minor consists of 18 credits: PHYS 121, 122, 305, 315, 316 and 415. PHYS 122 is a prerequisite to the last four courses. Students have the opportunity to use the department's 0.8 meter Cassegrain telescope in research projects that are integrated into the astronomy courses. Students pursuing the astronomy minor will be assigned an advisor in the Department of Physics.

Honors Program

Students must apply for admission to the departmental honors program by the end of the first semester of their junior year. There is a university requirement of a GPA of 3.5 or better in the major and at least nine credits of honors course work. For physics majors, these requirements are met by taking PHYS 490H: Senior Seminar, PHYS 499H: Senior Research Physics and six credits of elective courses. PHYS 490H: Senior Seminar is taken in the semester prior to PHYS 499H: Senior Research. An honors course in mathematical physics is also offered (PHYS 480H).

Combined B.S./M.S. Program

This program is open to highly qualified advanced undergraduate students majoring in physics. UMBC Graduate School regulations allow nine graduate-qualified credits to be taken as an undergraduate and applied toward the M.S. degree. For the combined B.S./M.S. program in physics, these include PHYS 407, 408 and 424. The subsequent 21 graduate credits are taken as a graduate student and are selected according to the individual student's interests with the approval of a graduate advisor, but they must include PHYS 605.

Students wishing to participate in the B.S./M.S. program must apply before the end of the junior year. Application to the Graduate School for admission to the program must be made at least one semester prior to completion of the requirements for the B.S. degree. Graduate School regulations require the maintenance of a 3.0 GPA in courses taken for the M.S. degree.

Student Organizations

UMBC's chapter of the Society of Physics Students is open to all students. In 1999, it received an "Outstanding Chapter" award from the national office of the society. The chapter has its own study room in the Physics Building and sponsors activities such as on-campus speakers and social events. In addition, UMBC has a chapter of Sigma Pi Sigma, the national honor society in physics.

Special Opportunities

Undergraduates have the opportunity to participate for credit or as student assistants in faculty research programs. The department also employs students as tutors and laboratory assistants.