Physics Overview

The Field - Preparation - Specialty Areas - Day In The Life - Earnings - Employment - Diversity - Career Path Forecast - Professional Organizations

The Field

Ever since Galileo, physicists have been pioneers in research, results of which enhance our daily lives. Their work enables our modern way of living by discovering and applying the way nature works. Physics research allows us to look forward to a future that holds even more exhilarating breakthroughs and advances upon which society will thrive - - a future that holds exciting opportunities for the physics students of today. Physics is the key to many doors of opportunity that open up to challenging, meaningful, and rewarding careers in industry, government, academia, and the private sector. You can be a part of this exciting future.

Physics is everywhere. It describes the world around us, from explaining the workings and making possible the luxuries and conveniences inside our homes -- such as energy efficient heat pumps, cordless phones, microwave ovens, and CD players -- to describing the motions of the galaxies in our universe. Physicists find answers to almost everything. Their studies range from the tiniest particles of matter to the largest objects in our universe. Their research has a range of applications which includes the computers that allow us to communicate with others across the globe, as well as the vehicles that allow us to traverse the globe faster, more safely, and more efficiently than would be possible without advances in physics. Physicists of the future will move society even faster along the information superhighway and drive further progress in the area of transportation. It is the physics students of today who will make contributions to improving the quality of lives in many, many areas.

Physics underlies all other basic sciences and is the basis for much of technology because it is concerned with the most fundamental aspects of matter and energy as well as the laws that govern their interactions - - the interactions which make the physical universe work. Scientists in other fields use the knowledge discovered by physicists to guide them in the study of their respective disciplines. Much of the technological equipment and techniques used by other scientists were originally developed by physicists, such as, x-rays, MRIs and other instruments used by medical doctors to safely study the human body and diagnose and treat diseases. From saving lives to saving our environment to promoting knowledge in other areas of science, physicists are key players in our future.

As a physicist, you can contribute to meeting the needs and the challenges of the future, to making things more simple and beneficial, and to furthering our understanding of the way the world works. As a student, you are forming the groundwork for your contributions to the field as you study physics. As you lay the path of your journey from physics student to physicist, you must define your career objectives. This may include refining your interest in physics into one of its many subfields and consider the type of work environment that would best suit you. Careers for Physicists helps you explore the various career areas, presents you with real-life experiences of physicists at work in these areas, allows you to examine your own interests and abilities with respect to your career goals, and provides you with additional information to assist with your career planning.

Preparation

About ecause most jobs are in basic research and development, a doctoral degree is the usual educational requirement for physicists and astronomers. Master's degree holders qualify for some jobs in applied research and development, whereas bachelor's degree holders often qualify as research assistants or for other occupations related to physics.

▶ Education and Training

A Ph.D. degree in physics or closely related fiends is typically required for basic research positions, independent research in industry, faculty positions, and advancement to managerial positions. This prepares students for a career in research through rigorous training in theory, methodology, and mathematics. Most physicists specialize in a subfield during graduate school and continue working in that area afterwards.

Additional experience and training in a postdoctoral research appointment, although not required, is important for physicists and astronomers aspiring to permanent positions in basic research in universities and government laboratories. Many physics and astronomy Ph.D. holders ultimately teach at the college or university level.

Master's degree holders usually do not qualify for basic research positions, but may qualify for many kinds of jobs requiring a physics background, including positions in manufacturing and applied research and development. Increasingly, many master's degree programs are specifically preparing students for physics-related research and development that does not require a Ph.D. degree. These programs teach students specific research skills that can be used in private-industry jobs. In addition, a master's degree coupled with State certification usually qualifies one for teaching jobs in high schools or at 2-year colleges.

Those with bachelor's degrees in physics are rarely qualified to fill positions in research or in teaching at the college level. They are, however, usually qualified to work as technicians or research assistants in engineering-related areas, in software development and other scientific fields, or in setting up computer networks and sophisticated laboratory equipment. Increasingly, some may qualify for applied research jobs in private industry or take on nontraditional physics roles, often in computer science, such as systems analysts or database administrators. Some become science teachers in secondary schools. Holders of a bachelor's or master's degree in astronomy often enter an unrelated field. However, they are also qualified to work in planetariums running science shows, to assist astronomers doing research, and to operate space-based and ground-based telescopes and other astronomical instrumentation.

About 760 colleges and universities offer a bachelor's degree in physics. Undergraduate programs provide a broad background in the natural sciences and mathematics. Typical physics courses include electromagnetism, optics, thermodynamics, atomic physics, and quantum mechanics. Approximately 185 colleges and universities have departments offering Ph.D. degrees in physics; about 70 additional colleges offer a master's as their highest degree in physics. Graduate students usually concentrate in a subfield of physics, such as elementary particles or condensed matter. Many begin studying for their doctorate immediately after receiving their bachelor's degree.

About 80 universities grant degrees in astronomy, either through an astronomy, physics, or combined physics-astronomy department. Currently, about 40 astronomy departments are combined with physics departments, and the same number are administered separately. With about 40 doctoral programs in astronomy, applicants face considerable competition for available slots. Those planning a career in the subject should have a strong physics background. In fact, an undergraduate degree in either physics or astronomy is excellent preparation, followed by a Ph.D. in astronomy.

Many physics and astronomy Ph.D. holders begin their careers in a postdoctoral research position, in which they may work with experienced physicists as they continue to learn about their specialties or develop a broader understanding of related areas of research. Initial work may be under the close supervision of senior scientists. As they gain experience, physicists perform increasingly complex tasks and achieve greater independence in their work. Experience, either in academic laboratories or through internships, fellowships, or work-study programs in industry, also is useful. Some employers of research physicists, particularly in the information technology industry, prefer to hire individuals with several years of postdoctoral experience.

Other qualifications

Mathematical ability, problem-solving and analytical skills, an inquisitive mind, imagination, and initiative are important traits for anyone planning a career in physics or astronomy. Prospective physicists who hope to work in industrial laboratories applying physics knowledge to practical problems should broaden their educational background to include courses outside of physics, such as economics, information technology, and business management. Good oral and written communication skills also are important because many physicists work as part of a team, write research papers or proposals, or have contact with clients or customers with nonphysics backgrounds.

Advancement

Advancement among physicists and astronomers usually takes the form of greater independence in their work, larger budgets, or tenure in university positions. Others choose to move into managerial positions and become natural science managers. Those who pursue management careers spend more time preparing budgets and schedules. Those who develop new products or processes sometimes form their own companies or join new firms to develop these ideas.

AIP University Listings

AIP offers two resources for selecting physics programs at US universities, Both are available at www.aip.org/statistics/trends/undergradtrends.html.

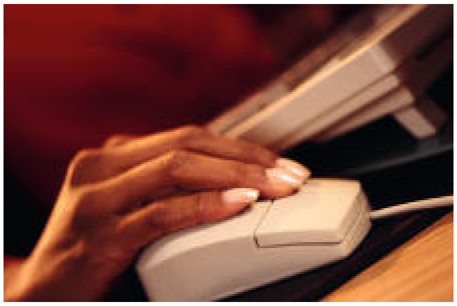
- Roster of Physics Departments: Enrollment and degree data on each degree-granting physics department in the US.
- Roster of Astronomy Departments: Enrollment and degree data on each degree-granting astronomy department in the US. .

Choosing an advisor

Your undergraduate advisor is a resource for advice on both course taking and your career goals. Your undergraduate advisor should be a person who has the expertise to understand the background required for your career goals, someone who is supportive of your aspirations, and someone with whom you are comfortable. If your advisor does not meet all three of these criteria, then you should change advisors. Set up interviews with other faculty to find the individual who is just right for you.

Undergraduate Research

How important is experience in undergraduate research? Undergraduate research experiences are very valuable for several reasons. They are an opportunity for you to assess whether this is a direction that you will find intellectually challenging and exciting. Undergraduate research provides you with an opportunity to apply the knowledge that you have learned in courses to solving real problems. It provides you with the experience of working in a team environment. Finally, your undergraduate research will show future employers what you can do.



Off Campus Experiences, Mentors, and Internships

How can off-campus work experiences help? Employers want to hire people that they are confident can do the job and succeed in their environment. The more information prospective employers have about you, e.g., course work plus work experience, the more likely they are to feel that they are making the right choice. The individual supervising your off campus work experiences will be able to provide in depth information about your ability to function in a work environment.

When you apply for your first position after earning your physics bachelors, your prospective employer will be looking at three general aspects of your background.

- The knowledge you have that is specific to the position for which you are applying, i.e., your major and related course work.
- Work experiences that you have related to the position for which you are applying. Employers will be able to contact your supervisor to find out how well you were able to apply your knowledge in a work setting.
- Your personal characteristics such as work ethic, determination, meticulousness and ability to work with others

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Specialty Areas

The following are definitions of thirty subfields of physics, listed alphabetically.

Acoustics

Acoustics is an interdisciplinary science that deals with the production, control, transmission, reception, and effects of sound, having application in the life sciences, the earth sciences, engineering, and the arts. Acoustics is the physics of sound. The study of the science is applied to noise control problems stemming from vehicle tires, home appliances, office equipment, and power tools; the design of architectural structures such as concert halls, lecture halls, and radio and television stations to optimize sound; the detection and identification of hidden objects (e.g., objects submerged in the ocean); the nondestructive evaluation of the performance and safety of critical components of equipment, such as jet engines, by analyzing acoustic emissions of the components under stress during use of the equipment; and the improvement of communication.

Astronomy

Astronomy is the science of the celestial bodies and of their location, magnitude, motions, and constitution. The application of physics to astronomy for studying the apparent and real motions of the sun, the moon, the planets, and the stars is among the earliest contributions to the scientific method.

Astrophysics

Astrophysics is the branch of astronomy that deals with the physical and chemical composition of the celestial bodies.

Atmospheric Physics

Atmospheric Physics is the study of the physical processes and phenomena of the Earth's atmosphere, which is divided into layers on the basis of varying electrical characteristics, and varying composition.

Biophysics

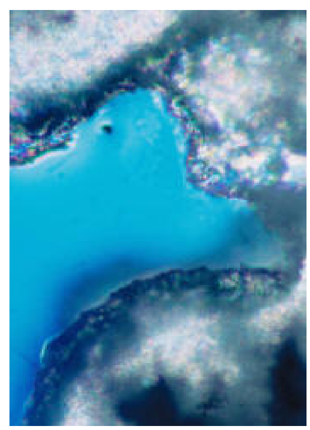
Biophysics is the application of physical concepts and techniques to the study of the principles that underlie the structures and functions of living systems; it is the study of the physical laws that create or affect biological molecules and processes. Biophysics encompasses several levels of biological organization, including the molecular level, the subcellular and cellular level, and the organ level. Molecular biophysics considers the structure of biological molecules such as enzymes, muscle proteins, and nucleic acids and how these molecules interact with various forms of energy. Study of biophysics at the subcellular and cellular level is concerned with how molecules are organized into special cell structures and how these structures perform their specialized functions. Biophysicists also study the physical principles that underlie the functioning of the ear, eye, and other body systems (e.g., the ear's response to variations in air pressure that cause sound and the transformation of energy received by nerve impulses from the eye into visual sensations such as color, sharpness, brightness, and shape). Biophysics research also has applications to medicine. For example, it provides explanation of the functional relationship of body parts and has potential impact on disease prevention through the study of the body's defense mechanisms involving proteins at the cell-membrane level.

Chemical Physics

Chemical Physics, or physical chemistry, is the use of physics to study chemical problems and to provide greater understanding of chemistry, chemical bonds, and chemical reactions. Chemical physics involves the measurement of the physical and chemical properties of compounds prior to, during, and following a chemical reaction; interprets chemical phenomena in terms of the molecules involved; and uses theory to predict rather than measure chemical properties.

Cryogenics

Cryogenics (Low Temperature Physics) is the study of matter at temperatures much colder than those that occur naturally on Earth. Low temperature physicists are concerned with phenomena such as superfluidity and superconductivity, and Bose-Einstein Condensation.



Crystallography

Crystallography is the subdivision of chemical physics that deals with the study of crystals which compose solids and are made up of rigid three-dimensional latticework of molecules that give rise to special properties such as shape, hardness, electrical conductivity, and photoconductivity.

Electromagnetism

Electromagnetism is the branch of science that deals with the physical relations between electricity and magnetism. Light is electromagnetic radiation.

Energy

Energy, as defined by physicists, is the ability to do work. Energy is one of the most basic ideas of science. Energy occurs in many forms; physicists seek to find relationships between the various forms of energy. All occurrences in the universe can be explained in terms of energy and matter. Physicists studying energy consider a system containing objects that have the ability to transfer energy back and forth among themselves. Advances in physics have had many applications in the area of energy efficiency, including the development of energy efficient lighting, windows, heating and cooling systems, and electrical power plants.

Engineering

Engineering is the application of science and mathematics by which the properties of matter and the sources of energy, or physical forces, in nature are made useful to man in the form of structures, machines, products, systems, and processes at a reasonable expenditure of time and money. Physics is closely related to engineering in that engineering uses physical principles in solving everyday problems and developing applications for the improvement of the quality of human life.

Environmental Physics

Environmental Physicists use the principles and techniques of physics to study the earth's environment. Scientists often consider factors that have an impact on the Earth's air, water, and land in their studies of the environment. Advances in physics have resulted in a number of efforts to keep the planet clean. Some examples include the application of research in laser physics and computing techniques, development of techniques to monitor levels of air pollutants; developments in materials processing and design resulting in the creation of more efficient energy generation methods and recycling techniques; and the use of geophysical methods to monitor radioactivity in the development of new clean-up technologies. Environmental Physicists have made contributions to understanding global climate change and the ozone hole.

Fluid Mechanics

Fluid Mechanics and Fluid Dynamics is the study of matter in the liquid state. Fluids tend to flow or conform to the boundaries of their containers. Physicists studying fluids study the physical and flow properties of liquids in order to understand turbulence, wave motion, and the interactions between structures (such as wings, ships, ocean platforms) and the flowing fluid that surrounds them.

Geology

Geology is the study of the origin of the Earth, its history, its shape, the materials that constitute it, and the processes that are or have affected it. Geologists depend on knowledge gained in physics as well as other sciences to understand the materials they are studying. Geophysics is the application of the investigation of physical phenomena in the study of the Earth and its internal composition.

History of Physics

History of Physics is a branch of historical research that is focused on the individuals, institutions, and processes involved in physics research. Efforts are made at archiving oral and visual history, important papers and books, and interpreting these artifacts.

Materials Science

Materials Science is an applied science concerned with the relationship between the structure and properties of materials. Materials science unites applications from many scientific disciplines that contribute to the development of new materials. Materials physics has had many practical applications for the benefit of mankind and the economy; for example, research in the area led to the development of Teflon which is found in everything from cookware to apparel to medical transplant materials.

Medical Physics

Medical Physics is the application of physics research to the medical arts for the design of equipment and techniques used to safely study the human body and diagnose and treat diseases. Some examples of the application of developments in physics to the medical arts are the use of magnetic resonance imaging (MRI), computed axial tomography (CAT scan), Positron Emission Tomography (PET), and x-rays, mammography equipment, and radiation in the treatment of cancer. Medical physicists also study the health effects of radiation in non-clinical environments.

Metallurgy

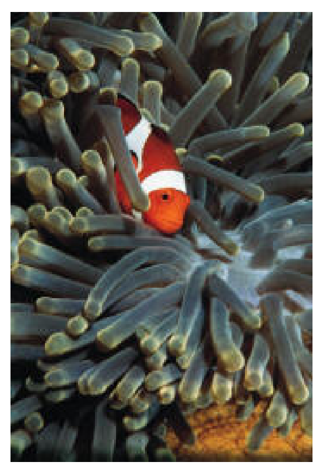
Metallurgy is the science and technology of metals - - their characteristics and behavior.

Molecular Physics

Molecular Physics is concerned with the interaction of the structure of atoms with the bonds between the atoms. Atomic Physics is the study of the structure and behavior of the atom itself (see Nuclear Physics and Particle Physics).

Nuclear Physics

Nuclear Physics is the study of the structure of the atom's nucleus and the relationship of the properties of the nucleus to the fundamental constituents and laws of nature. Nuclear physics includes the investigation of the weak and strong interactions between nuclear particles and the radiation emitted from unstable nuclei. It also encompasses the study of the splitting of nuclei into smaller parts and the merger of nuclei into larger nuclei, called fission and fusion, respectively. The application of nuclear physics in the generation of electrical power and the treatment of cancer are just two of many that have had a major impact on mankind.



Oceanography

Oceanography deals with all aspects of the oceans, including the delimitation of their extent and depth, the physics and chemistry of their waters, marine biology, and the exploitation of their resources. Oceanography is generally divided into four major categories of research - - physical being one, along with chemical, biological, and geological research. Physical oceanographers provide explanations of the physical state of the oceans, particularly the distribution of water masses, the conditions that create them, and the great currents that disperse and mix them.

Optical Physics

Optical Physics is the application of physical laws to the study of the production and transmission of light and its interaction with matter. Optical physics primarily deals with the nature and properties of light and seeks to explain the optical phenomena that cannot be explained in terms of rays (behavior of light as a wave as opposed to behavior as a particle). Optical physicists study and use lasers in much of their work.

Particle Physics

Particle Physics, also referred to as high-energy physics, is the study of the most fundamental particles of which matter is made. Elementary particles are created by high-energy particle accelerators and are also constituents of cosmic rays. A large number of elementary particles have been discovered in the last few decades and are still believed to be comprised of still more fundamental particles. Theoretical physicists working in this area are currently trying to discover a single unifying concept that relates all fundamental forces and elementary particles. Particle physics is being called the frontier of contemporary physics.

Physics Education Research

Physics Education Research is an emerging subfield of physics research that seeks to understand how students of various ages and abilities learn physics in order to improve the teaching of physics.

Plasma Physics

Plasma Physics deals with the study of the physics of plasma (a high-temperature gas of electrically charged particles), which has been called the fourth state of matter because plasmas possess properties not found in ordinary solids, liquids, and gases. Plasma is a state of matter found in stars and can be hot enough for thermonuclear reactions to occur in them. Plasma physicists have been attempting to initiate nuclear fusion by the production and manipulation of plasma in the laboratory.

Rheology

Rheology applies physics to the study of the deformation and flow of matter. An example of rheology is the application of the principles behind the observation in the differences in the flow of ketchup from a bottle before and after shaking the bottle.

Solid State Physics

Solid State Physics is the branch of physics that deals with the internal structure and properties of solids in which physicists determine how the behavior of atoms and molecules within solids gives rise to their observed properties. Products of solid state physics include the transistor, which was based on theories and experiments about the electrical properties of semiconductor solids; the photoelectric cell; and the light-emitting diode.

Space Physics

Space Physics is the study of the physical properties and phenomena of the region beyond the Earth's atmosphere. Exploration of space is conducted to extend knowledge about the Earth, the solar system, and the universe beyond. Practical applications of space research includes the development of meteorological satellites that aid in weather forecasting; communications satellites that increase the number of international communications channels available and make possible the intercontinental transmission of television; navigation satellites that guide ships; military satellites that perform vital reconnaissance; geodetic satellites that allow the creation of maps of unprecedented accuracy; and many other products of space technology that are utilized on Earth.

Thermal Physics

Thermal Physics deals with the mechanical action or relationship between heat, work, temperature, and energy.

Vacuum Physics

Vacuum Physics is the study of matter in an environment at low pressure with little or no surrounding gas. Physicists can control and study a single particle without interference by passing the particle through a vacuum, using electrical and magnetic fields to guide particles to a particular target. This type of study aids in the investigation of molecular structure. Applications of vacuum science and technology lead to advances in solid state physics and other fields.

Day in the Life

More than most other majors, a physics degree is a passport into a broad range of science, engineering and education careers. Where you are likely to work will differ by the level of your highest degree.

Where Physicists Work

Where you are likely to work will differ by the level of your highest degree. Thus, the private sector (including large corporations, small companies and the self-employed) employs 60% of physics bachelors and masters compared to 30% of physics PhDs. Within the education system, most physics bachelors and masters teach in high schools, while virtually all academically-employed physics PhDs hold faculty positions in universities or 4-year colleges. The government sector includes federal agencies, government laboratories, state and local government, and the military.

Common Occupations for Physics Bachelors

The most common occupations differ by where they work, but few physics bachelors have the title, physicist. In large part, this is because most physics bachelors work in the private sector and, unlike chemistry, engineering and geology, there is no "physics" industry. Among the more common occupations is engineer, including electrical, systems, civil, and mechanical. Many physics bachelors work as computer scientists which reflects the current explosion in the demand for software development, programming, computer-related support, modeling, and computer simulations. Educator, principally at the secondary school level, is also a common career track, although comparatively few teach physics exclusively. Over time, physics bachelors are often promoted into positions that involve managing projects, people and budgets.

Early Careers of Physics Bachelors

The AIP has produced a report that examines the employment patterns of people with no degrees other than physics bachelor's degrees, five to eight years after graduation. The report includes common job activities and skills used on the job. It also describes these physics bachelors' evaluations of how well physics education prepared them for careers. The report may be viewed online at www.aip.org/statistics/trends/reports/bachplus5.pdf. Highlights include:

- Five to eight years after graduating, only about one-third of people who earned bachelor's degrees in physics do not have any additional degrees.
- Three-fourths of these physics bachelors work in science-related jobs, including software, engineering, high school teachers, and managers in technical fields. The largest group -- about one-fourth -- are employed in software jobs.
- 30% of these physics bachelors are still working in their first career-path job five to eight years after graduation.
- Those who are employed in software jobs are much less likely to use the parts of their education that are exclusive to physics than those employed in engineering, math, and science jobs.
- About 70% of those employed in engineering, math, and science rate their physics preparation highly. However, they did not rate their preparation in terms of scientific research experience, lab skills, and scientific software as highly.

Common Occupations for Physics Masters

Physics masters work primarily in science, engineering and education, although their occupations differ sharply by employment setting. Physics masters are, in general, more likely than bachelors to be hired into positions with supervisory responsibility and frequently use advanced knowledge and technical skills to solve complex problems.

A physics bachelor's is a solid foundation for a variety of advanced degrees. Over one-third of physics bachelors earn a masters degree, often after working for several years. About half earn physics master's degrees, many get degrees in engineering, computers, business administration and education, but others pursue such diverse areas as philosophy, religion and social work.

Common Occupations for Physics PhDs

There are about 35,000 physics PhDs in the workforce. While academe is a common career path for physics PhDs, it is NOT where the majority work. About 40% of physics PhDs are employed in universities and 4-year colleges, primarily as professors and secondarily as research faculty. While most work in physics departments, many PhD physicists work in departments of engineering, mathematics, materials science, polymer science, and radiation oncology to name a few.

About 30% of PhD physicists work in the private sector. Some work in corporate labs conducting long range research. Most, however, are involved in product development, short range research, or managing projects and technical staff.

About one-quarter of PhD physicists work in Federally Funded Research & Development Centers (such as Los Alamos), government labs (such as the National Institute of Standards and Technology) or federal agencies with a scientific mission. Most of these physicists are engaged in long range research, but a variety of other activities are also common.

Working Environment

Most physicists work in a team environment, regardless of their highest degree or where they are employed. Even basic research at the PhD level is typically a team effort. As your years of experience and degree level increases, so does the likelihood that you will be supervising a team.

In the private sector, most physicists work in cross-disciplinary teams. These commonly include engineers, material scientists, chemists, computer specialists, mathematicians, and administrators to name a few. These individuals are brought together because of their unique perspectives and skills to help solve a specific problem. Within the autonomous private sector (self-employed, consulting companies and other small companies), many people with physics degrees report that they work independently. However, this largely reflects the fact that the companies in which they work are simply too small for a team environment. In this sector a significant amount of a physicist's time is often devoted to interacting with customers and clients.

Skills Frequently Used By Physics Bachelor's

Virtually all physics bachelors report that they are frequently engaged in problem solving, typically complex technical problems. It may come as a surprise that interpersonal skills are cited the second most. This is because the vast majority of physics bachelors are involved with one or more of the following: working in a team, supervising a team, working with customers and clients, or interacting with students. The following is a list of skills most commonly used by physics bachelor's. The remainder of the skills on the list depict the varied career paths pursued by physics bachelors including administration, product development, computer-related support, software development, and a variety of technical occupations. The skills profiles for physics masters and PhDs are similar except that they tend to include a higher use on most of the skills depicted especially use of physics knowledge, technical writing, and management skills.

- Advanced Computer Skills
- Advanced Mathematics
- Business Principles
- Interpersonal Skills
- Knowledge of Physics
- Management Skills
- Problem Solving
- Special Equipment and Processes
- Statistical Concepts
- Technical Writing

Further Resources

This website only describes the general trends. The demands of the job market and the common career paths pursued by physics degree recipients can and do change over time. There are several additional resources for more detailed information, most notably the Education and Employment Statistics Division of the American Institute of Physics. They produce regular reports on the common career paths of physics degree recipients, reports on the initial employment of recent physics degree recipients, and salary reports. You can find the latest data or order detailed reports at www.aip.org/statistics.

Earnings

Your earning potential is a combination of your skills and the market value of those abilities. The salaries that are common when you complete your ultimate degree will be different, in part, because of inflation and, in part, because the relative demand for technological skills constantly changes.

Variables Affecting Salaries

Although a great many variables contribute to the salary you are likely to earn, the four major factors are:

- highest degree (e.g., bachelors, masters, PhD),
- credentials (e.g., licenses, board certification, and teaching certificates),
- type of employer (e.g., academe, private sector, government), and
- years of experience.

Current Statistics

Median annual earnings of physicists is 94,240 in the most recent data. The middle 50 percent earned between $72,910 and $117,080. The lowest 10 percent earned less than $52,070, and the highest 10 percent earned 143,570.

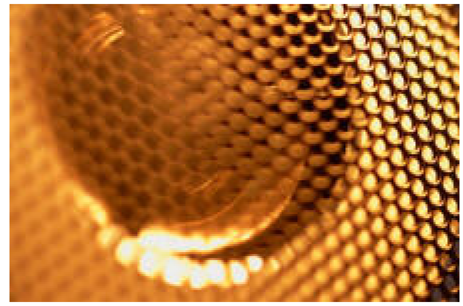
Median annual earnings of astronomers is $95,740. The middle 50 percent earned between $62,050 and $125,420, the lowest 10 percent less than $44,590, and the highest 10 percent more than $145,600.

According to a 2007 National Association of Colleges and Employers survey, the average annual starting salary offer to physics doctoral degree candidates was $52,469.

The American Institute of Physics reported a median annual salary of $80,000 in 2006 for its members with Ph.D.'s (excluding those in postdoctoral positions) who were employed by a university on a 9-10 month salary; the median was $112,700 for those who held a Ph.D. and worked at a federally funded research and development center; and $110,000 for self-employed physicists who hold a Ph.D. Those working in temporary postdoctoral positions earned significantly less.

The average annual salary for physicists employed by the Federal Government was $111,769 in 2007; for astronomy and space scientists, it was $117,570.

Employment



Physicists and astronomers hold about 18,000 jobs in the United States. Physicists accounted for about 17,000 of these, while astronomers accounted for only about 1,700 jobs. Many physicists and astronomers hold faculty positions in colleges and universities. Those classified as postsecondary teachers are not included in these employment numbers.

About 38 percent of physicists and astronomers worked for scientific research and development services firms. The Federal Government employed 21 percent, mostly in the U.S. Department of Defense, but also in the National Aeronautics and Space Administration (NASA) and in the U.S. Departments of Commerce, Health and Human Services, and Energy. Other physicists and astronomers worked in colleges and universities in nonfaculty, usually research, positions, or for State governments, information technology companies, pharmaceutical and medicine manufacturing companies, or electronic equipment manufacturers.

Although physicists and astronomers are employed in all parts of the country, most work in areas in which universities, large research laboratories, or observatories are located.

What Employers Look For

What do employers look for in a candidate? Obviously, most employers first look for knowledge and experience that matches their specific and immediate needs. Beyond that, however, many look for some combination of four general skills and traits. One of those is problem solving ability including intelligence, quantitative skills and a practical orientation, e.g., the ability to break a complex problem down to its elementary parts and identify a set of likely solutions. Another area is drive and aspirations including persistence, a strong work ethic, and a high standard of excellence.

A third area is personal impact which includes such traits as communications skills (writing, speaking and listening), ability to work within a team environment and a personal presence. A fourth area is leadership including initiative and entrepreneurship, which is especially important in the private sector. Employers are looking for people who can assess the strengths of their company, assess the strengths of their team and propose an idea for a new product or service that is consistent with the company's goals both.

What are the most rewarding aspects of the work physicists do?

Regardless of where they work and their specific occupations, most physics bachelors report that the most rewarding aspects of their current positions is the challenge of solving interesting and complex problems and the satisfaction of developing creative solutions to problems. The specific problems are in a variety of disciplines. The second most cited reward was working with people. These include the satisfaction of working with intelligent and creative co-workers, supervising employees and helping them develop to their full potential, and the rewards of working with customers, clients and students. Many physics bachelors, especially those in the private sector, report a great deal of satisfaction from seeing a project yield a successful and useful product. The last major category of reward reflects the intellectual satisfaction of developing new methods, processes and designs. PhD physicists also note the intellectual satisfaction of successful research and adding to the knowledge base.

Diversity

In the last two decades, there has been a steady increase in the percentage of women pursuing a career in physics. The percentage of minority employment in physics remains at a very low level.

▶ Diversity within Physics

The following chart indicates the number and percent of physics degrees granted to US citizens by minority/ethnic group status for the class of 2005.

Table 13. Number and percent of physics degrees granted to US citizens by minority / ethnic group status, class of 2005.

	Bachelor's		Exiting Master's		PhD's	
	Number	Percent	Number	Percent	Number	Percent
White	4023	85	418	87	427	86
Asian-American	227	5	21	4	35	7
Hispanic-American	182	4	18	4	17	3
African-American	165	3	15	3	11	2
Other	152	3	8	2	8	2
Total US Citizens	4749	100%	480	100%	498	100%

AIP Statistical Research Center, Enrollments and Degrees Report.

According to AIP Statistics, the following departments averaged three or more African American physics bachelor's per year, classes of 2003, 2004, and 2005.

Table 14. Departments averaging 3 or more African-American physics bachelor's per year, classes of 2003, 2004 and 2005.

	Annual Average
Xavier U (LA)	10
Benedict College (SC)	7
Dillard U (LA)	7
Florida A&M U	5
Southern U & A&M College (LA)	5
Spelman College (GA)	5
Chicago State U (IL)	4
Morehouse College (GA)	4
Norfolk State U (VA)	4
North Carolina A&T State U	4
Tuskeegee U (AL)	4
Morgan State U (MD)	3

Note: List includes only those departments who contributed degree data for all 3 years.

AIP Statistical Research Center, Enrollments and Degrees Report.

Organizations for Women and Minorities

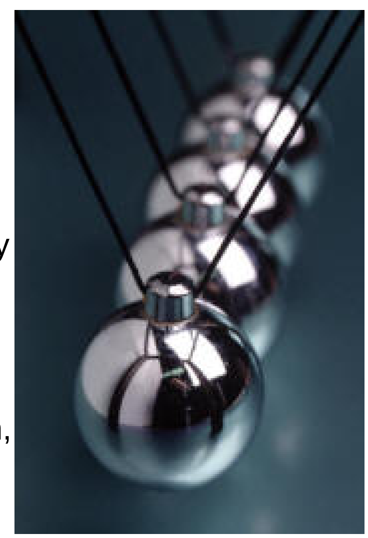
There are a number of organizations that provide advice, mentoring, and assistance to women and under-represented minorities. The following are a few such groups that focus specifically on the needs of women and minorities.

- American Association of Physics Teachers - Committee on Women (www.usafa.af.mil/dfp/aaptwip/aaptwip.html)
- American Physical Society - Committee on the Status of Women in Physics (www.aps.org/educ/cswp)
- Association for Women in Science (www.awis.org)
- National Society of Black Physicists (www.nsbp.org)
- Society for the Advancement of Chicanos and Native Americans in Science (www.sacnas.org)
- National Society of Hispanic Physicists (www.hispanicphysicists.org)

Career Path Forecast

Physicists and astronomers should experience average job growth but may face competition for basic research positions due to limited funding. However, those with a background in physics or astronomy may have good opportunities in related occupations.

Employment of physicists and astronomers is expected to grow at 7 percent, about as fast as the average for all occupations during the 2006-16 decade. The need to replace physicists and astronomers who retire or otherwise leave the occupation permanently will account for many additional expected job openings.



Federal research expenditures are the major source of physics- and astronomy-related research funds, especially for basic research. Although these expenditures are expected to increase over the 2006-16 projection period, resulting in some growth in employment and opportunities, the limited science research funds available still will result in competition for basic research jobs among Ph.D. holders. However, research relating to biotechnology and nanotechnology should continue to see strong growth.

Although research and development expenditures in private industry will continue to grow, many research laboratories in private industry are expected to continue to reduce basic research, which includes much physics research, in favor of applied or manufacturing research and product and software development. Nevertheless, people with a physics background continue to be in demand in information technology, semiconductor technology, and other applied sciences. This trend is expected to continue; however, many of the new workers will have job titles such as computer software engineer, computer programmer, or systems analyst or developer, rather than physicist.

In recent years the number of doctorates granted in physics has been somewhat greater than the number of job openings for traditional physics research positions in colleges and universities and in research centers. Recent increases in undergraduate physics enrollments may also lead to growth in enrollments in graduate physics programs, so that there may be an increase in the number of doctoral degrees granted that could intensify the competition for basic research positions. However, demand has grown in other related occupations for those with advanced training in physics. Prospects should be favorable for physicists in applied research, development, and related technical fields.

Opportunities should also be numerous for those with a master's degree, particularly graduates from programs preparing students for related work in applied research and development, product design, and manufacturing positions in private industry. Many of these positions, however, will have titles other than physicist, such as engineer or computer scientist.

People with only a bachelor's degree in physics or astronomy are usually not qualified for physics or astronomy research jobs, but they may qualify for a wide range of positions related to engineering, mathematics, computer science, environmental science, and some nonscience fields, such as finance. Those who meet State certification requirements can become high school physics teachers, an occupation in strong demand in many school districts. Some States require new teachers to obtain a master's degree in education within a certain time. Despite competition for traditional physics and astronomy research jobs, graduates with a physics or astronomy degree at any level will find their knowledge of science and mathematics useful for entry into many other occupations.

Despite their small numbers, astronomers can expect good job prospects in government and academia over the projection period. Since astronomers are particularly dependent upon government funding, Federal budgetary decisions will have a sizable influence on job prospects for astronomers.

Professional Organizations

Professional organizations and associations provide a wide range of resources for planning and navigating a career in physics. These groups can play a key role in your development and keep you abreast of what is happening in your industry. Associations promote the interests of their members and provide a network of contacts that can help you find jobs and move your career forward. They can offer a variety of services including job referral services, continuing education courses, insurance, travel benefits, periodicals, and meeting and conference opportunities. The following is a partial list of professional associations serving physicists. A broader list of professional associations is also available at www.careercornerstone.org/assoc.htm.

American Institute of Physics

The American Institute of Physics (AIP) began in 1931 for the purpose of promoting the advancement and diffusion of the knowledge of physics and its application to human welfare. It's mission is to serve physics, astronomy, and related fields of science and technology. In addition, In preparation for the World Year of Physics 2005, the Statistical Research Center of AIP developed an extensive global database (www.aip.org/statweb/form.jsp) of learned and scientific societies in physics and related disciplines.

- Acoustical Society of America - http://asa.aip.org
- American Association of Physicists in Medicine - www.aapm.org
- American Association of Physics Teachers - www.aapt.org
- American Astronomical Society - www.aas.org
- American Crystallographic Association - www.hwi.buffalo.edu/ACA
- American Geophysical Union - www.agu.edu
- American Institute of Physics - www.aip.org
- American Physical Society www.aps.org
- American Vacuum Society - www.vacuum.org
- Optical Society of America: www.osa.org
- Sigma Pi Sigma Honor Society - www.aip.org/education/sps/sigpisig.htm
- Society of Physics Students - www.spsnational.org
- The Society of Rheology - www.rheology.org