Newsletter of the Department of Physics, University of Arkansas

REFLECTIONS

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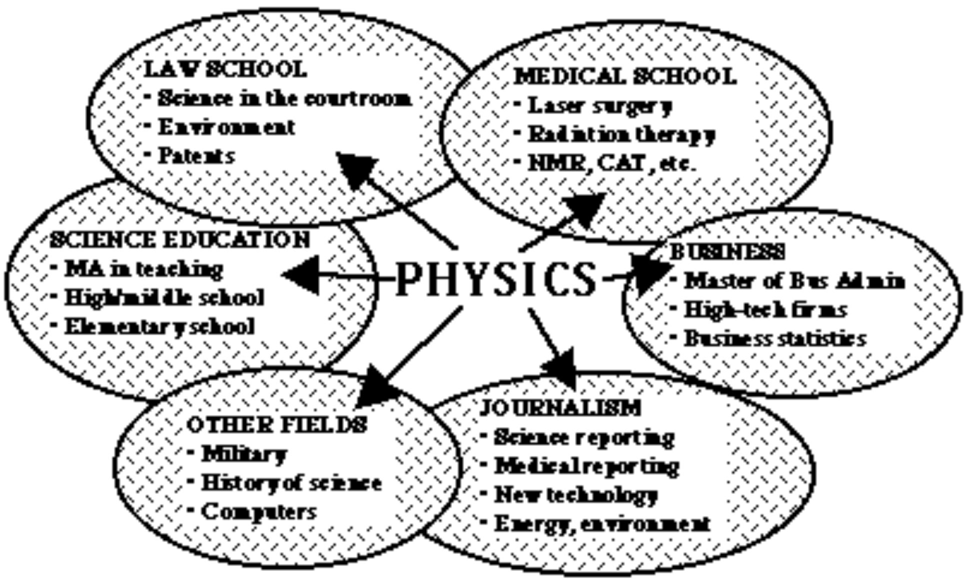
A Physics Program for Everyone: The Bachelor of Arts in Physics

Physics is not only for physicists. Anybody can get excited about the creation of the universe, atoms, or microelectronics. There are many reasons why you or someone you know might want to study physics or astronomy, "the poetry of universe," while planning a career in some other area such as those shown above. The University of Arkansas Physics Department has a degree program designed especially for these people. It is called the Bachelor of Arts (B.A.) program in physics. Unlike the Bachelor of Science program, the B.A. program is designed for students who would like to study physics and astronomy but who do not plan to make physics their life's work.



Why Would Journalists, Businesspeople, or Musicians Want a Degree in Physics?

In our high-tech, science-oriented society, nearly every profession can use individuals with a strong science background. Examples include law (science in the courtroom, environmental law, patents), business (high-tech firms, business statistics), science education, journalism (science reporting, energy and environment news), creative writing (science fiction), communication (technical writing, communications industry), history (history of science and technology), philosophy (philosophy of science), music (acoustics, instrument design, electronic music), and such science-related fields as medicine, anthropology and sociology.

The physics B.A. program provides a broad background in the physics and technology of today *and tomorrow*, for students headed toward careers in which physics can play a significant role. Training in physics and mathematics is thought by professionals in many fields to provide a unique background whose usefulness transcends the boundaries of the professional disciplines. In our increasingly technological society, scientific literacy is ever more important for the successful employee. Physics, the most fundamental science, gives students the satisfaction of studying the deepest principles of the universe while preparing them for a wide range of practical employment.

The program is flexible, to allow students plenty of time for outside electives and for fulfilling the professional requirements in medicine, business, law, journalism and other fields while completing the B.A. Degree in physics. It is designed to fulfill the needs of pre-professional students for science literacy, societal topics, and professional prerequisites.

The program includes 24 semester-hours in physics plus four math courses. It begins with the algebra-based College Physics course, followed by a course in the fascinating ideas of modern physics, and selections chosen, by the student, from a variety of physics and astronomy courses including hands-on modules in electronics, the human implications of physics, the application of physics to technologically important devices, optics, observational astronomy, the solar system, stellar astronomy, and others. The program encourages students to branch out into a major interest area outside of physics by requiring a 9 semester-hour "special emphasis area" of study at the 3000-level (junior level) or above in a single subject outside of physics. The B.A. Degree in physics differs significantly from the B.S. Degree, in that the B.A. program is algebra-based and requires 24 hours of physics and 12 hours of math beginning with algebra, while the B.S. program is calculus-based requiring 38 hours of physics and 21 hours of math beginning with calculus.*

More Information on the New Bachelor of Arts Degree

A Distinguished Faculty

The 17-member physics and faculty is engaged in experimental and theoretical research at the leading edge of many of the most fascinating fields of physics. During 1993 and 1994, for example, physics faculty members published 3 books, published 73 articles in refereed physics journals, published 33 articles in conference proceedings, presented 48 contributed talks and 42 invited talks at professional meetings, and were awarded 3 patents. The faculty teaches all undergraduate and graduate lecture courses, is available for consultation, and supervises undergraduate research.

Faculty research fields include atomic and molecular physics, dynamics and spectroscopy of polyatomic molecules, photoacoustic spectroscopy, laser physics, quantum optics, photon statistics, quantum chaos, interaction of light with matter, squeezed states, multiphoton processes, optical pulse propagation, nonlinear optics, harmonic generation and optical parametric oscillators, optical data storage, light induced waveguides, high temperature superconductivity, superconducting thin films, Raman, Brillouin, and dynamic light scattering from condensed media, high pressure physics, physics of novel magnetic materials, physics of micro and nanostructures such as quantum dots and quantum wells, thermodynamics of liquid and solid microparticles, astrophysics of eclipsing binaries, spotted stars, flare stars, physics education, interactive learning techniques, and physics and society.

Scholarships, and Further Information

Several physics scholarships are available, for both entering freshmen and upperclassmen. Scholarship awards are typically $500 per year, renewable annually.

For a scholarship application or for further information about this program, write or telephone for our brochure "The Bachelor of Arts Program in Physics." It contains complete program descriptions, including suggested four-year curriculums for B.A. students interested in various specific fields such as medicine, law, journalism, and business, along with detailed course descriptions. For brochures, or to discuss the program, contact Art Hobson, Professor of Physics, Department of Physics, University of Arkansas, Fayetteville, AR 72701, 501-575-5918, ahobson@comp.uark.edu.*

Faculty Profile: Gay Stewart
Improving Science Fiction

Gay Stewart joined our department in May of 1994. She received her Ph.D. in experimental high energy physics from the University of Illinois at Urbana-Champaign, but her interests were drawn to the condition of science education in the U.S. She has devoted much time to the study of current models for science education both in here and abroad. This research led her to accept a position at UA to develop the new University Physics II course, the introductory calculus-based course covering electromagnetism and optics. She felt that this offered the perfect opportunity to implement ideas she had synthesized from the broad literature in interactive learning techniques and her experience in teaching and course management at a very large Ph.D.-granting institution.

U.S. educators agree that science education is slipping, but hotly debate the reasons why. Commonly, school systems are blamed for sending underprepared students into higher education. However; school systems depend on universities to provide well-trained instructors. As long as students avoid sciences courses as much as possible during college and leave the courses with an unfavorable impression of science, they will be unable to communicate the beauty and necessity of science to their own students.

College students were asked "What makes science courses so unpopular?" A frequent complaint is that science doesn't have anything to do with their daily lives. Other common complaints in introductory physics: (1) the emphasis on "how" questions, while neither asking nor answering the "why" questions; (2) the absence of a sense of community within the class; (3) laboratory experiments that are rarely in sync with the lecture.

Science education research has identified several other problems. The standard course format discourages student participation. The classes are often perceived as intensely competitive, discouraging the participation of women and minorities. Students make extremely small gains in mastery of course materials. They have trouble relating to abstract concepts. They learn little or nothing about the way scientists actually think about problems, or even about what science is. Students use formula-centered problem-solving strategies that differ from those used by experienced scientists, and the knowledge they gain in introductory physics is a randomly organized set of facts and equations, with little conceptual understanding and many misconceptions. Approaches developed to overcome these problems have had some success in small institutions, or for a particular professor, but are too expensive or complicated to transfer to large comprehensive universities. Graduate students, the future instructors of science, are inadequately trained as educators.

Dr. Stewart is developing a process model for learning in physics. The process of learning is broken up into educational actions, that is, actions that an expert educator would deem to have educational merit. These actions, once identified, are explored. Simple modifications of traditional actions, such as the way students are required to do homework, are found to cause large differences in the educational value of these actions. Once the model is well developed, it should be possible to optimize the educational value of any course for the resources available.

Dr. Stewart has recently been implementing broad changes to address the identified problems; the changes have been evolving as the model grows. Class time is devoted to answering student questions and providing a framework for their new knowledge. Quantitative experimental results provide verification of the carefully chosen homework assignments. Concepts are related to everyday phenomena familiar to the student. Students are taught how to think about physics problems. Cooperative learning, found to improve retention of female and minority students, is emphasized. Graduate and advanced undergraduate students are brought into the teaching process as apprentices. The course structure requires students to come prepared to ask questions. Concepts are presented within the framework of answering the questions, giving students an opportunity to synthesize information and taking them out of the role of passive learner. Conceptual understanding is stressed.

Laboratory activities and demonstrations that emphasize or develop the concepts take place in the classroom at just the right time. The frequent use of familiar materials provides students with personal experience with science. Exploration is encouraged, with materials made available outside of class. Pre-prepared scientific kits are used sparingly since real science rarely involves taking a box off the shelf and knowing what all the answers will be. An activity guide implementing interactive learning techniques is under development.

The course encourages students to work in groups, and it is made clear that helping someone else will not hurt anyone's grade. Students make excellent teachers for others struggling with a concept they are all trying to master. Students discover that explaining a concept aides their own understanding.

Albert Einstein wrote "The most beautiful thing we can experience is the mysterious. It is the source of all true art and science." It is the *why* of things that engages the imagination, that makes science one of the great creative endeavors of humanity. Students must leave our classes not with an assemblage of facts, but with the ability to learn science, so that they may always explore the *why*.*

Faculty Profile: Mark Filipkowski
Physics of Novel Magnetic Materials

Mark Filipkowski joined our department in the Fall of 1994, coming to us with a Bachelor's and Master's degree from the University of Pennsylvania, a Ph.D. from the University of Connecticut, and three years of Postdoctoral work at the Naval Research Laboratory. He specializes in condensed matter physics and materials research, with emphasis on the magnetic properties of thin films. His experimental methods include DC (SQUID) magnetometry and AC mutual inductance techniques, computerized megnetotransport detection, electron spin resonance, and ferromagnetic resonance spectroscopy. Upon arriving at the University of Arkansas, he had already authored or co-authored 17 refereed journal articles and two proceedings articles, and given two invited presentations and nine contributed presentations. He describes his research as follows:

With the development of techniques for producing materials not found in nature, many new and exciting phenomena have become available for study in the field of condensed matter physics. The latter is that subdiscipline of physics devoted to the study of condensed systems, such as liquids and solids. The investigation of novel human-made materials has resulted in the discovery of "new physics" of interest to the general scientific community, and has the potential for the creation of new technologies.

A significant part of the study of condensed systems involves the examination of magnetic effects. These may range from the influence of the magnetic moment of the helium nucleus on the material phases of liquid helium, to improving the properties of permanent magnets. An example of an important class of new, human-made magnetic materials consists of layered structures, in which ultrathin layers of magnetic metals such as iron are sandwiched with nonmagnetic metals such as aluminum. "Ultrathin" refers to thicknesses of several angstroms, or only a few atoms.

New physics becomes possible in such systems due to the creation within the nonmagnetic metal of a magnetic polarization induced by the adjacent magnetic metal. The properties of the nonmagnetic metal are thus perturbed in a way heretofore impossible. Forming a complete picture of how this polarization comes about, and the nature and extent of its influence on the properties of the nonmagnetic metal, is a very active experimental and theoretical research area.

The goal of my laboratory is to understand the fundamental physical principles governing the behavior of layered and other novel magnetic systems. In this way we will contribute to the growth of knowledge in condensed matter physics, and help lay the groundwork for future technological advances.

We will explore the physics of novel magnetic materials by using such sophisticated experimental techniques as SQUID- (Superconducting Quantum Interference Device) based magnetometry, nuclear magnetic resonance, and spin-polarized transport. In addition, an extremely profitable set of interdisciplinary experiments becomes possible at the University of Arkansas through combined efforts with optical laboratories within the Department of Physics. These experiments will investigate the time dependence of magnetic phenomena using fast optical techniques, and the coupling of magnetic layers through nonmagnetic layers using the method of Brioullin light scattering.*

From the Chair

Dear Friends,

Greetings from the Physics Department! During the past year many changes have occurred in our department. Professor Gupta stepped down as chair after two eventful three-year terms. Much progress was made during his tenure as you have been reading in the newsletter. The department was fortunate to have his leadership during this period of change.

The department has continued making progress in both physics research and teaching. The number of publications and external support for research have seen continued growth over the past ten years. Professor Michael Henry joined the department last Fall. His area of expertise, nonlinear optics, strengthens our optics program even further. Another area of strength in condensed matter physics is beginning to emerge. The acquisition of a molecular beam epitaxy machine made possible by a grant from the National Science Foundation to Professor Salamo will enhance our capabilities to study structure and growth on a nanometer scale. The department is in the process of hiring a new faculty member to work in this exciting new field of nanostructures. With a young faculty, new ideas and enthusiasm, the department can look forward to continued progress in the years to come.

Another area where we have started to make progress is our undergraduate program. As many of you know, fewer and fewer of our nation's young people are opting to study physics. This is unfortunate and threatens the nation's scientific base. As you know, our exciting and mind-expanding field is not just for future physicists but is worthy of study by all students. Thus we should try to expose a wide range of students to the excitement of physics.

Our newly designed Bachelor of Arts (BA) physics degree program pursues this goal of bringing a wide range of students into our physics undergraduate program. The BA program is designed to prepare students for careers in business, law, medicine, science journalism, science education, and other fields where a physics background could be useful.

Changes are also underway in our Bachelor of Science (BS) program, in order to provide up-to-date skills to those graduates. We would love to hear your comments on what kinds of courses and skills would be useful. New strategies in physics teaching are being explored. Professor Stewart has been teaching a laboratory-based physics course. Professor Harter has been using computer simulation in his lectures to help visualize difficult concepts. Professor Richardson has thoroughly revised and modernized the introductory physics laboratories. Several innovative undergraduate laboratories are under development. We can look forward to an exciting time in physics teaching.

Beginning with this issue, Professor Art Hobson is taking over as the editor of this newsletter. He is also the coordinator of our BA/BS programs.

Finally, Paul Sharrah's History of the Physics Department project is complete! Professor Sharrah has worked hard on this project. For him it has been a labor of love. As of this writing publication bids were being awarded. You will receive a copy of this book shortly.

I want to thank all of you for your continued support to our department. Please continue to write. Better still, come and visit us. We would be delighted to hear about your experiences at the university, and your suggestions for program reform.

Surendra Singh, Chair

Franklin Wintker

Bachelor of Science, 1931

"To the student...I wish to impress the future value of that degree to you in every endeavor, even social services; so do not let discouragement from any source separate you from a physics degree." These are the words of Franklin R. Wintker, Sr., in a message to physics students on the occasion of the grand-opening of new physics facilities in 1994. Mr. Wintker credits his physics degree for a successful career in marketing and management with General Electric. He received his bachelor's degree in physics from the University of Arkansas in 1931, the second person to have received that degree. The first physics degree awarded by the University was to Roy Sullivan in 1928.

Mr. Wintker came to the campus almost seventy years ago, and recalls with fondness his years here and appreciates the help he received from Professor Parsons who "tried his best to make a good student out of me," and to Professor Roberds "for his special attention to radiation in the then new field of x-ray." While on campus, he held two jobs, one as twice-a-day announcer for U of A radio station KUOA, and playing lead saxophone in Mitchell's orchestra.

A Cadet Colonel in 1930, he found himself on active duty at Army Medical Center in Washington, DC after graduation. There he taught radiation physics and trained MD's as "quickie radiologists," and then completed his military duty with work on radar at Signal Corps Research Center at Ft. Monmouth, NJ Later he joined General Electric's X-Ray Corporation, now GE Medical Business, for a long and successful career which ended in retirement as District Manager of South Central District in 1971.

Mr. Wintker still keeps up with advances in physics through magazines and frequently writes to us. We appreciate his interest in his Alma Mater and wish him the best.*

News

Graduate Student News

Greg Fox received an Excellence in Teaching for Graduate Teaching Assistants Award made by the University of Arkansas Teaching Academy.

Ed Hach won the Outstanding Teaching Assistant Award presented by the Department of Physics.

Bruce Schulte was sent to Exxon Corporate Research Laboratory during Fall 1994 to work on a research project; Exxon scientists were impressed with his training, effort, and quality of work.

New Graduate Students

Ron Adams joins us from Miami University, Oxford, Ohio.

Juan Concepcion-Lopez joins us from the University of Puerto-Rico.

Dorel Guzun joins us from Moscow State Unviersity.

Kim Fook Lee joins us from the University of Malaya.

Undergraduate Student News

Joshua Adams has received a Teaching Assistantship in astronomy at the University of Deleware.

Robert Quinn of Austin, AR, participated in the summer program at Kansas State University.

Benjamin Myers of Piggott, and **Clint Wood** of Bee Branch, won Freshman physics scholarships. **Winfred De Byrd** of El Dorado,**Jonathan Earls** of Rogers, **Joshua Hamblen** of Russellville, **James Harrington** of Sheridan, **Kyle Marcrum** of Sherwood, and **Luke Post** of Batesville, won Upperclass physics scholarships.

Recent Graduates

Nianyu Bei, MS 1994, PhD 1995.
William Burkett, MA 1995.
Matthew Morin, MS 1995.
Galen Duree Jr., PhD 1995.
Greg A. Finney, PhD 1995.
Qifang He, PhD 1995.
William Kiehl Jr., PhD 1995.
Yujiang Qu, PhD 1995.
Yufang Li, PhD 1995.
Changxin Wang, PhD 1995.

Alumni News

Benjamin H. Ashmore Jr. (BS 1976) is now a senior member of the technical staff at Advanced Micro Device in Austin, Texas.

Richard Burgess (BS 1994) is an Air Force officer. He is going to Air Force Officer Training School in the fall. In the future, he plans to obtain a physics PhD.

Dr. Galen Durree (PhD 1995) accepted an appointment as Assistant Professor at Northwest Nazarene Colle in Nampa, Idaho.

Paul Glezen (BS 1989) joined IBM in July 1995. He is working for the consulting and services division.

Thomas Hays (BA 1989) is an attorney in Hope, Arkansas.

Bryant Heikkila (BS 1989) is a programmer and analyst with Hughes STX working on Voyager and Pioneer spacecraft data.

Dr. Kelly Knowlton (MS 1977) obtained a PhD in Geophysics from Texas A&M in 1990, and is doing research in Earth satellite imagery with NASA at the Johnson Space Center. Dr. Knowlton has married and has no children as yet.

Robert Maurer (BS 1948), now retired from the Corning Glass Company, received a Citation for Distinguished Alumni by the Arkansas Alumni Association.

Dr. Mansour Mortezavi (PhD 1991) was appointed Assistant Professor of Physics at the University of Arkansas at Pine Bluff.

Robert H. Nunnally Jr. (BA 1981) has been practicing law for ten years, in commercial litigation. He is section leader for Compuserve in the California Forum Business and Science Section, and is a shareholder with the law firm of Rubinstein and Perry.

Edward Qubain (BS 1992) is a physics graduate student at the University of Texas at Austin, currently researching quantum canonical transformations.

Charles E. Scharlau (BS 1985) has left Boeing and accepted a position with SEA, Inc., where he works on embedded software and marine radio design.

Jact Swift (BS 1965), Professor of Physics at the University of Texas at Austin, was elected a Fellow of the American Physical Society.

Alan C. Tribble (BS 1983) published a book entitled *The Space Environment. - Implications for Spacecraft Design*, published in 1995 by the Princeton University Press. He is employed as a Principal Investigator by Rockwell International's Space Systems Division in Doweny, CA, where he was recently nominated Engineer of the Year.

Faculty News

Mark Filipkowski discovered a new type of interlayer coupling in magnetic/nonmagnetic layered structures (see the article about his work, in this issue).

Julio Gea-Banacloche had a paper chosen to be published in the reprint volume *Resonant and Collective Phenomena in Quantum Optics*.

William Harter won this year's J. W. Fulbright College of Arts and Sciences' Master Teacher Award for his innovative computer-based teaching methods. He has developed a new research and teaching program, "Control It," and updated several other programs with new subject matter and improved technology for current computers.

Michael Henry joined the faculty during the past year, becoming our seventeenth faculty member. This is the largest we've ever been.

Art Hobson's textbook *Physics: Concepts and Connections* (Prentice-Hall, 1995) is now adopted on 51 campuses. He continued as editor of the quarterly newsletter *Physics & Society*.

William Oliver is setting up a new teaching laboratory in the optical properties of materials, funded by the National Science Foundation.

Charles Richardson has reconstructed the University Physics and College Physics laboratories and written manuals for them.

Gay Stewart has developed a new University Physics II class format (see the article about her work, in this issue).

Reeta Vyas directed a summer research project on "Women and Minority Participation in Graduate Education," and presented physics demonstrations for primary and high school students for the Women in Science Exhibition at the University of Arkansas Museum.

Min Xiao set up a new teaching laboratory in applied nonlinear optics, funded by a National Science Foundation grant.

Gregory Salamo published 8 articles, **Zhengzhi Sheng** published 9 articles, and **Min Xiao** published 7 articles. Almost all faculty members contributed one or more articles to the year's total of 33 refereed papers and 20 papers in published conference proceedings. The faculty also gave 17 invited and 25 contributed talks at meetings.*

Thank You

Friends and alumni continue to support the department through their annual gifts. We acknowledge support the following people during the past year:

Dr. Darrell W. Collier, Col. Gary and Dr. Caryl Culp, Dr. William Daniel Evans, Ms. Betty Gabriel (Rockwell International), Dr. and Mrs. Allen Hermann, Mr. Clint Jaco, Mr. William C. Meek (Xerox Foundation), Mr. J. David Pyrum, Ms. Donna Price (Lockheed Martin Corp.), Mr. Charles and Mrs. Karen Scharlau, Dr. Alan Tribble, Mr. Hardy Walton Jr., Dr. James Watson Jr, Mr. Ying Xin.

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Errors and omissions in these lists are sincerely regretted.*

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