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Physics Department Centennial: An Archival Record of Events

Rajendra Gupta

University of Arkansas, Fayetteville, rgupta@uark.edu

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Physics Department Centennial

A Celebration of One Hundred
Years of Physics
In Arkansas
2007-2008

Department of Physics
Fulbright College of Arts and Sciences
University of Arkansas

Physics Department Centennial

An Archival Record of
Events

Department of Physics
Fulbright College of Arts and sciences
University of Arkansas

Compiled and Edited by
Rajendra Gupta
With Assistance by
Donna Johnson, David Lachut, and
Wayne Atkinson
Printed
October 2010

Acknowledgements

The Centennial celebration was organized by the Centennial Organizing Committee, consisting of Physics faculty members Rajendra Gupta (Chair), Surendra Singh (Department Chair), Gregory Salamo, Min Xiao, and Michael Lieber, and by the Physics administrative staff consisting of Donna Johnson, Dianne Melahn, and James Miracle. Many others contributed to the success of these events, in particular, Charles Richardson (Emeritus Professor), Tamara Snyder (webmaster), Stephen Skinner (Laboratory Equipment Curator), Dina Wood and Patti Cox of the Fulbright College Development Office, Melissa Banks and Trisha Higinbotham of the Office of Special Events, and the staff of University Relations.

Among other things, Greg Salamo compiled and designed the Centennial Brochure, Min Xiao hosted the Centennial Distinguished Lecturer, Wolfgang Ketterle, Charles Richardson organized and presided the Reunion Session, and the Frontier Physics Research of the University of Arkansas session was organized and presided by Michael Lieber. Charles Richardson, Surendra Singh, and Rajendra Gupta collected material for, and designed the Centennial Posters.

Financial support was provided by the Physics Department and Fulbright College of Arts and Sciences.

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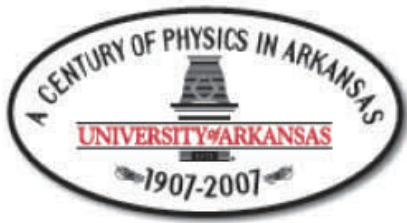
Introduction



The Physics Department celebrated its Centennial during the 2007-08 academic year. The celebrations consisted of a series of Centennial Lectures by distinguished physicists throughout the year and culminating in a three-day event from April 3-5, 2008. The event was attended by current physics faculty and students, former/emeritus physics faculty, alumni, campus officials, and guests. This booklet presents an archival record of these events. Flyers for the Centennial Lectures are shown on the next few pages and a record of the main events starts on Page 9.

First Centennial Lecture

Physics Department Centennial Lecture Series Fulbright College of Arts and Sciences



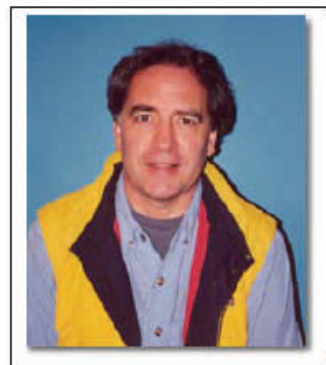
Prof. Robert H. Austin
Department of Physics
Princeton University

**Ask Not What Physics Can Do For Biology,
Ask What Biology Can Do For Physics**

Donald W. Reynolds Center
(Sam Walton School of Business)

7:00 PM – 8:00 PM
Thursday, October. 18, 2007

Reception at 8:00 PM in the lobby



After World War II physics experienced an explosive growth fueled by the arms race, the excitement of particle physics and fundamental progress in understanding materials. However, the 21st Century could well see Biology emerge as the area of science most likely to explosively grow due to deep changes in that field of science. I'll try to sketch out how these two disciplines have grown together and then try to peer into the future about how the ascendance of biology as a quantitative science could actually inject new life into physics.

Second Centennial Lecture

Physics Department Centennial Lecture Series Fulbright College of Arts and Sciences



Robert Greenler
Professor Emeritus
University of Wisconsin

Rainbows Visible and Invisible

Donald W. Reynolds Center
(Sam Walton School of Business)

7:00 PM – 8:00 PM
Thursday, Nov. 8, 2007



Reception at 8:00 PM in the lobby

Human fascination with rainbows precedes any scientific understanding of their origins. For some of us, an increased understanding of these beautiful phenomena leads to an increased aesthetic delight in seeing them. This talk will illustrate usual and unusual features of rainbows, some of which are guaranteed to be new to each person in the audience.

Third Centennial Lecture



PHI BETA KAPPA VISITING SCHOLAR PROGRAM



LAWRENCE M. KRAUSS

Ambrose Swasey Professor of Physics
Case Western Reserve University

Thursday,
Feb. 7, 2008
7:00 p.m.
Giffels Auditorium
Old Main

Free Public Lecture

Einstein's Biggest Blunder: A Cosmic Mystery Story

Einstein's greatest triumph was his General Theory of Relativity (1915), a new theory of gravity. But the theory predicted that the universe could not be static, as was believed at the time. So Einstein added an extra term to his equations, the so-called "Cosmological Constant." In less than a decade it was discovered that the universe was not static but expanding, and Einstein's extra term was not needed. He called this addition his "biggest blunder."

Over the past decade new observations have led to a revolution in cosmology. The "standard model" built up in the 1990's is now dead. Its replacement may be far more bizarre. Remarkably, most of the energy density in the universe may be contained in empty space - exactly what one would expect if Einstein's Cosmological Constant really exists. If it does, its origin is one of the biggest mysteries in physics. I will close by briefly describing possible implications for our understanding of nature and for life.

Reception Following the talk.

For more information contact Michael Lieber
575-6267 or mlieber@uark.edu



Director of the Center for Education and Research in Cosmology and Astrophysics at Case, Lawrence Krauss is the author of seven popular books, including *The Physics of Star Trek*, *Atom: An Odyssey from the Big Bang to Life on Earth...and Beyond*, and *Hiding in the Mirror: The Mysterious Allure of Extra Dimensions from Plato to String Theory and Beyond*. His major awards include the American Physical Society Lilienfeld Prize for outstanding contributions to physics and the AAAS Public understanding of Science and Technology Award.

Visit and Talk sponsored by the Alpha of Arkansas
Chapter of Phi Beta Kappa and by the Department of
Physics.

Fourth Centennial Lecture



Physics Centennial Event

Diana Buchwald, Associate Professor of History at the California Institute of Technology and General Editor and Director of the Einstein Papers Project.



Thursday, 13 March 2008
7:00 PM
Reynolds Center
Auditorium

Free Public Lecture

Collected Papers of
Albert Einstein

A half century after his death, Einstein's work is still subject to verification, modification, and expansion by theorists and experimentalists alike. His written legacy sheds much light on his intellectual development, on his transformation into a cultural icon of the 20th century, and poses many challenges for the editors of the Collected Papers of Albert Einstein. We shall explore some highlights of this project which continuously modifies our understanding of Einstein's life and work.

Centennial Celebration Main Events

The Centennial main events were celebrated from Thursday through Saturday, April 3-5, 2008. One hundred and twenty alumni and their guests, totaling some 200 from around the country and abroad, returned to Arkansas to attend. They were joined by almost all former and emeritus faculty, current physics faculty, department staff, students, campus officials, and other guests.

Wolfgang Ketterle, a 2001 Physics Nobel Prize recipient, kicked off events with the Maurer Distinguished Centennial Lecture on the evening of Thursday, April 3. The Maurer lecture series is endowed by Robert Maurer, a 1948 graduate of the Physics Department who is co-inventor of the telecommunications-grade optical fiber. Each spring, the department brings an eminent physicist (many have been Nobel Prize winners) to the campus for a public talk as part of this lecture series.

The Friday morning session began with a talk on the history of the department given by Raj Gupta. A few physics faculty members also spoke, highlighting some of the research being done in the department. The Friday afternoon program consisted of Provost Bob Smith unveiling the George Rhoads audiokinetic sculpture and a Faculty Roll of Honor, the opening of "A Century of Physics" poster exhibit, and dedicating a display of historical equipment. The Physics Library hosted the reception, and an open house of the physics research laboratories followed. Details and photographs of these events are shown on pages 16 through 31.

That evening, a gala banquet was held at the Fayetteville Town Center. It was attended by about 400 guests, including prominent officials. The program details and photographs are shown on pages 32 through 47.

The Saturday morning session was a reunion of alumni and former, emeritus, and current faculty. Centennial Medallions were presented to former and emeritus faculty for their service to the department. Faculty and alumni reminisced about their times together and told anecdotes, followed by group photographs on the steps of Old Main. The reunion pictures are shown on pages 48 through 65.

A record of Centennial media coverage is shown on pages 66 through 73, and a CD of this book, as well as some original material relating to the Centennial Celebrations, is available in the Special Collections Department of the University Libraries. Also available in the Special Collections is a four-volume set of the title pages of all physics faculty research publications from 1907 to 2007 entitled, "Centennial Collection of Physics Faculty Publications".

Physics Department Centennial Program

Thursday, April 3, 2008, 7:00 pm, Giffels Auditorium, Old Main 201

“New Forms of Quantum Matter Near Absolute Zero Temperature,” Centennial Maurer Distinguished Lecture by Wolfgang Ketterle, John D. MacArthur Professor of Physics at MIT, Director of MIT-Harvard Center for Ultracold Atoms, and 2001 Nobel Laureate. Reception to follow the talk.

Friday Morning

Frontier Physics Research of the University of Arkansas

Giffels Auditorium, Old Main 201

8:30 AM	Coffee and donuts, lobby outside the auditorium
9:00 AM	Welcome: Surendra Singh, Chair
9:05 AM	Michael Lieber, Session Presider
9:10 AM	“Physics in Arkansas—the First Century,” Raj Gupta
9:40 AM	“A Dialogue with Dr. Feynman, or how I learned to love dwarf science,” Jak Tchakhalian
10:00 AM	“Big Bangs, Small Bangs,” Julia Kennefick
10:20-10:40 AM	COFFEE BREAK
10:45 AM	“A Shining Branch of Physics—Single Molecule Physics,” Jiali Li
11:05 AM	“Searching for an Ideal Optical Medium,” Min Xiao
11:25 AM	“Excellence in Physics Education,” Lin Oliver
11:45 AM	Adjourn

Friday Afternoon

Physics Building, Dickson Street Lobby, 1:30 PM

1:30 PM	Dean Donald Bobbitt, Fulbright College
1:35 PM	Provost Bob Smith
1:45 PM	RECEPTION in the Physics Library
1:45-2:15 PM	<i>A Century of Physics</i> Poster Exhibit (Dickson Street lobby) An Exhibit of Historical Equipment used in the Department (first-floor lobby)
2:15-4:00 PM	Research Laboratories Open House

Saturday Morning

Faculty and Alumni Reunion

Giffels Auditorium, Old Main 201

8:30-9:00 AM	Coffee and Donuts (lobby outside the auditorium)
9:00-11:20 AM	Reunion, Charles Richardson, MC
10:00-10:20 AM	COFFEE BREAK
11:20 AM	Parting comments, Surendra Singh
11:30 AM	Group Photographs

Physics Department Centennial Lecture Series

Fulbright College of Arts and Sciences



Maurer Distinguished Centennial Lecture

Prof. Wolfgang Ketterle

Nobel Laureate in Physics 2001,
John D. MacArthur Professor of Physics, MIT

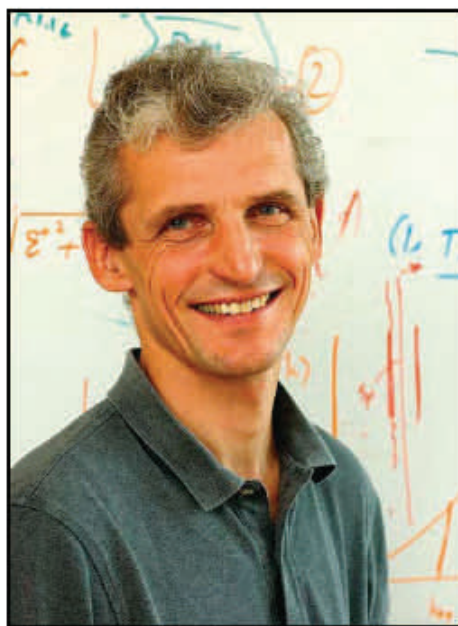
New forms of quantum matter near absolute zero temperature

Giffel's Auditorium

7:00 PM – 8:00 PM

Thursday, April 3, 2008

**Reception at 8:00 PM in hallway
outside of auditorium**



Why do physicists freeze matter to extremely low temperatures? Why is it worthwhile to cool to temperatures which are more than a million times lower than that of interstellar space? This lecture will discuss new forms of matter, which only exist at extremely low temperatures. Low temperatures open a new door to the quantum world where particles behave as waves and "march in lockstep". In 1925, Einstein predicted such a new form of matter, the Bose-Einstein condensate, but it was realized only in 1995 in laboratories at Boulder and at MIT. More recently, Bose-Einstein condensates of molecules and fermion pairs have been created and may show behavior similar to electrons in superconducting materials. A new form of high-temperature superfluidity has been discovered. In the future, we hope to use ultracold gases to create designer matter, i.e. to realize new forms of matter in the laboratory which have been discussed as model systems for many-body phenomena, but have not been observed in nature.

Centennial Maurer Distinguished Lecture



WOLFGANG KETTERLE, John D. MacArthur Professor of Physics, M.I.T., and a 2001 Physics Nobel Laureate lecturing on “New Forms of Quantum Matter Near Absolute Zero Temperature” in Giffels Auditorium on April 3, 2008.

Biographical Sketch

Wolfgang Ketterle received a diploma (equivalent to a master's degree) from the Technical University of Munich (1982), and a Ph.D. in Physics from the University of Munich (1986). After postdoctoral work at the Max-Planck Institute for Quantum Optics in Garching, Germany, the University of Heidelberg and at MIT, he joined the physics faculty at MIT (1993), where he is now the John D. MacArthur Professor of Physics, and Director of the MIT-Harvard Center for Ultracold Atoms. He does experimental research in atomic physics and laser spectroscopy and focuses currently on Bose-Einstein condensation in dilute atomic gases. He was among the first scientists to observe this phenomenon in 1995, and realized the first atom laser in 1997. His earlier research was in molecular spectroscopy and combustion diagnostics.

His awards include a David and Lucile Packard Fellowship (1996), the Rabi Prize of the American Physical Society (1997), the Gustav-Hertz Prize of the German Physical Society (1997), the Discover Magazine Award for Technological Innovation (1998), the Fritz London Prize in Low Temperature Physics (1999), the Dannie-Heineman Prize of the Academy of Sciences, Göttingen, Germany (1999), the Benjamin Franklin Medal in Physics (2000), and the Nobel Prize in Physics (2001, together with E.A. Cornell and C.E. Wieman).

Centennial Maurer Distinguished Lecture



Above: Surendra Singh, Chair, Physics Department, talking to distinguished alumnus Robert Maurer and Mrs. Barbara Maurer after Ketterle's lecture. The Maurers made a return visit to Arkansas to participate in the Centennial celebrations. Below: Ketterle talking to a couple of students after the lecture. Professor Min Xiao looks on.



Centennial Maurer Distinguished Lecture



Above: Collis Geren, Dean of the Graduate School and Vice-Provost for Research (center) and Min Xiao (Left) in discussions with Ketterle. Below: Ketterle poses with Raj Gupta, Chair of the Centennial Organizing Committee (left) and Min Xiao, official host of Ketterle (right).



Centennial Maurer Distinguished Lecture



Ketterle continued one-on-one discussions with members of the audience after the talk.
Shown here are alumnus Jim Spann (above) and alumna Amanda Allen (below).



**Physics Department Centennial Celebration
Fulbright College of Arts and Sciences**

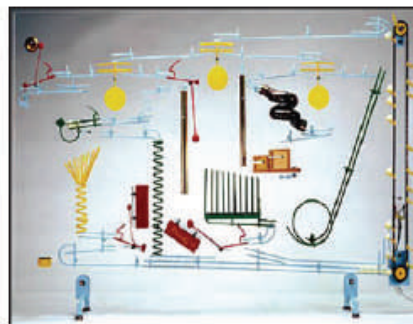


**A Celebration of a
Century of Physics in
Arkansas**

Unveiling of George Rhoads' audiokinetic sculpture and opening of the Centennial exhibits by

Provost Bob Smith

**Friday April 4, 2008, 1:30 p.m.
Physics Building**



Reception following the unveiling
Research laboratories open house
2:15 pm – 4:00 pm

George Rhoads, born 1926, was educated at the University of Chicago and the Art Institute of Chicago. During the 1960's he started to make copper kinetic fountains and rolling ball sculptures. Today his works (paintings and sculptures) are displayed in such leading museums as the Art Institute of Chicago, Museum of Modern Art (NYC), Franklin Institute (Philadelphia), Boston Museum of Science, public places such as, Logan Airport (Boston), Los Angeles International Airport, and a host of international locations, including Israel, Spain, Japan, and Australia to name just a few.

"These creations, with their moving parts and comic intricacies reflect Alexander Calder's abstract constructions on the one hand and the cartoons of Rube Goldberg on the other" says Richard Kostlanetz in New York Times Magazine, May 31, 1987.

This audiokinetic sculpture, representing the principles of physics, will delight the students and public alike and commemorate this centennial celebration for years to come.

**Physics Department Centennial Celebration
Fulbright College of Arts and Sciences**

“A Century of Physics” Posters



An exhibit of 'A Century of Physics' posters in the second-floor lobby of the Physics Building is being inaugurated. The American Physical Society, at its centennial in 1999, produced a set of eleven posters depicting the development of 'Modern Physics' from 1890's through 1990's. Each poster depicts not only what were the milestone discoveries of that decade but puts them in the context of what was happening in the fields of art, architecture, technology, etc. We have produced our own two posters depicting the birth of our department in 1907 and where we are today a century later. All thirteen posters are being displayed together.



**Physics Department Centennial Celebration
Fulbright College of Arts and Sciences**

A Display of Historical
Equipment used in
the Department



We have been able to preserve some of the equipment used for research and teaching in the Department dating back even to the period when the Department was established. A display of this equipment has been arranged in the first-floor lobby of the Physics Building.

**Physics Department Centennial Celebration
Fulbright College of Arts and Sciences**

Physics Research Laboratories Open House

1. *Voyage at the Nanoscale* - Room PHYS 101, Professor Greg Salamo
2. *Physics at Extreme Pressures* - Room PHYS 105, Professor Lin Oliver
3. *Engineering Ideal Nonlinear Optical Media* - Room PHYS 111, Professor Min Xiao
4. *Sculpting Solid-State Nanopores for Single Molecule Detection* - Room PHYS 124, Professor Jiali Li
5. *Manipulating Light Beams and Using Light Beams to Manipulate Macromolecules* - PHYS 128, Professor Surendra Singh
6. *Atomically Engineered Nanomaterials* - Room PHYS 131, Professor Jak Tchakhalian
7. *Computer Animations: Understanding Relativity and Quantum Physics* - Room PHYS 241, Professor William Harter
8. "Spin-tronics" Room PHYS 106, Professor PaulThibado
9. *Photorefractive Solitons*: Room PHYS 129, Professor Greg Salamo.
10. *Spin Exchange*: Room PHYS 122, Professor Greg Salamo.
11. *The Biophysics of neural computation*: Room PHYS 245, Professor Eitan Gross

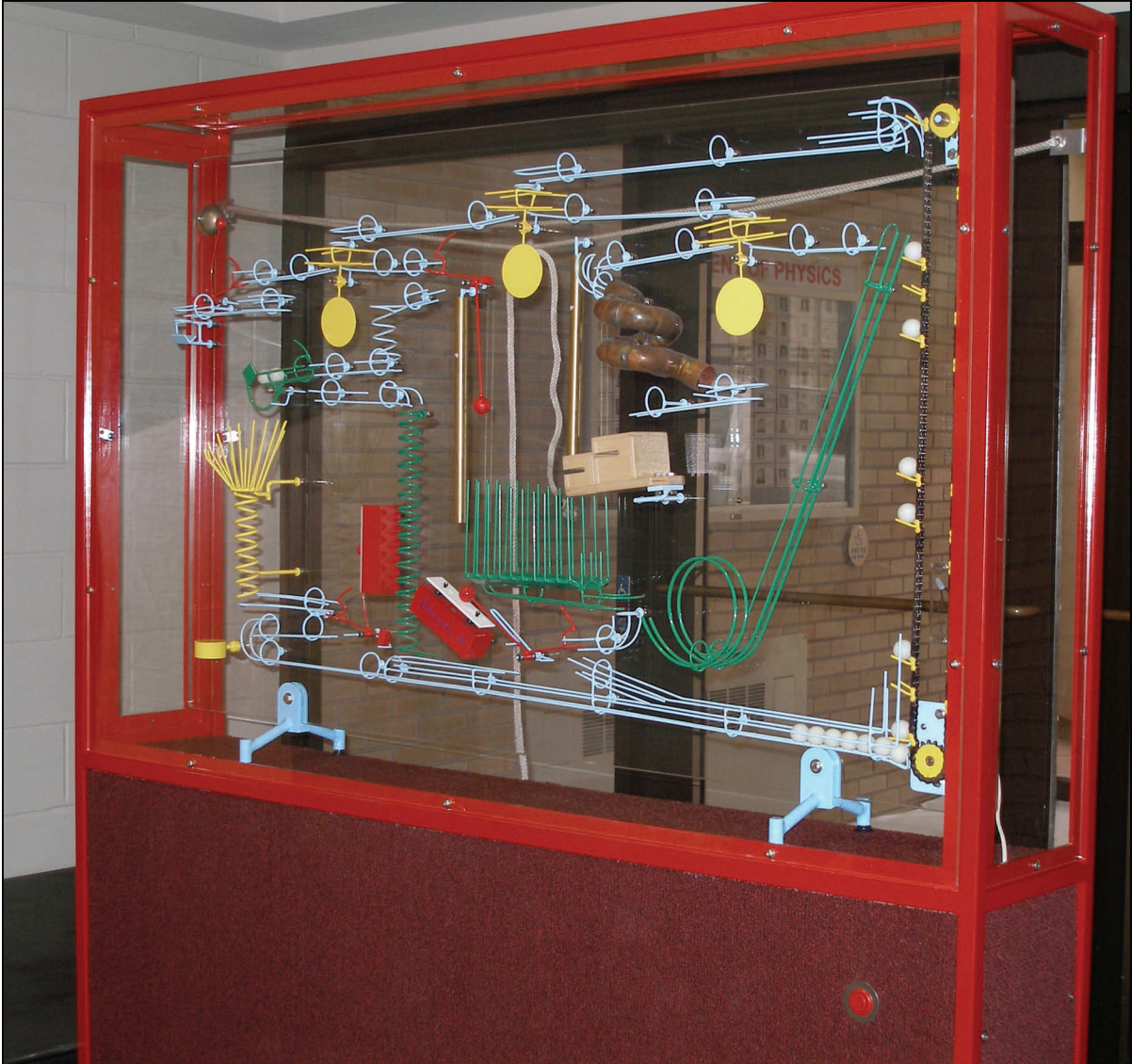


J. William
FULBRIGHT
COLLEGE
of Arts & Sciences

Unveiling of the audiokinetic sculpture



Provost Bob Smith admires the George Rhoads' "Odyssey of the Spheres" audiokinetic sculpture shortly after its unveiling in the lobby of the Physics Building.



“Odyssey of the Spheres”

by George Rhoads

This audio-kinetic sculpture, illustrating the principles of physics, commemorates the Centennial of the Physics Department (2007-2008). George Rhoads has spent the last 30 years designing rolling ball machines and wind sculptures with the primary purpose of engaging people. His paintings and sculptures are displayed in such leading museums as the Art Institute of Chicago, the Museum of Modern Art, the Franklin Institute in Philadelphia, the Boston Museum of Science, public places, such as Boston’s Logan Airport, Los Angeles International Airport and a host of international locations, including Israel, Spain, Japan and Australia. This sculpture, commissioned for the Centennial, is now on permanent display at the Dickson Street entrance of the physics building.

A Century of Physics Poster Exhibit



This poster exhibit celebrating a century (1907-2007) of physics in Arkansas was inaugurated by Provost Smith. The exhibit consists of fifteen posters (two posters were added after the Program Brochure was printed). Eleven of these, produced by the American Physical Society, trace the development of 'Modern Physics' from the 1890's through the 1990's, and four posters depict the birth of our department in 1907, where the department is today, and highlights of the accomplishments of our alumni. These four posters are shown on the next four pages. Above: Guests mingle and observe posters. Below: Alumnus David Pyrum looks at one of the posters while Ketterle passes by.



1907

Physics Department Begins

On June 11, 1907, The Board of Trustees of the University of Arkansas recognized Physics as a separate department. Prior to this it was part of Chemistry, then Engineering. Over the years, however, it had developed an impressive identity leading to this recognition, as is apparent from the catalog entry then. Thirteen lecture and laboratory courses are listed, including *Advanced Physics: the subject of Electrical Measurements is treated rather fully; the notion of an Electron is introduced*; Kinetic Theory of Gases; General Theory of Light; "special attention being given to the Electromagnetic theory"; and Elementary Acoustics: "intended primarily for students of music." There was also a weekly Journal Meeting, attended by instructors and students.

The faculty consisted of Prof. Heinrich Shapper, placed by the Board action "in charge of the Department," and three Assistants. The Department was located in Engineering Hall, not far from its present location.

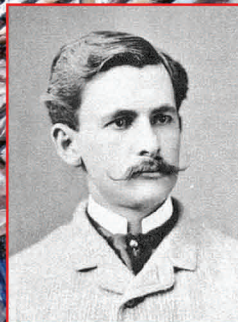
In 1908 Prof. Giles Emmet Ripley became chairman and served until 1940. ■



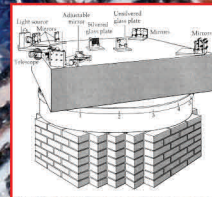
Giles Emmet Ripley, the first chairman of the department, was born June 18, 1874 in Adams County, Indiana. He was educated in Indiana public schools, at the Normal School in Marion, and at Purdue University, where he received the Master of Science degree in 1899. Before coming to Arkansas he taught at normal schools in Muncie, Indiana and Valley City, North Dakota and at high schools in Racine, Wisconsin and Marquette, Michigan. In addition to his physics chairmanship here he held the post of Dean of Men for 17 years. He and his wife Louise were the parents of two sons and a daughter, all of whom graduated from the U. of A.



Engineering Hall, first home of the newly recognized Physics Department. This building was located about 300 feet south of Old Main.



A.A. Michelson, "Master of Light." In 1907 Michelson was awarded the Nobel Prize "in recognition of his original methods in ensuring exactness in measurements, for his investigations in spectroscopy, and for his achievement in obtaining a nonmaterial standard of length." On his trip to Sweden, Michelson took a diffraction grating ruled with 10,000 lines to show the king.



The apparatus used by Michelson and Morley in their experiment to detect the existence of an ether. (Scientific American, 1964).



The Model T Ford, the latest in automobile design.



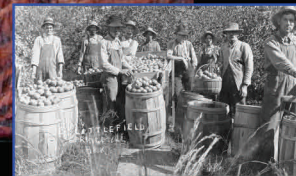
Claude Debussy published his *Iberia* in 1907, the second of his Images for Orchestra. An art that unforgettablely fuses the exterior landscape with the inner one of emotional experience." Jeremy Noble



The Washington County courthouse was completed in 1907. This building still stands, little changed, on College Avenue. (Courtesy Shiloh Museum of Ozark History/Washington County Historical Society Collection, P-489D)



A Memorial Day Parade forms on the south side of the Fayetteville square. (Courtesy Shiloh Museum of Ozark History/Washington County Historical Society Collection, P-247)



Littlefield orchard, Springdale. Apples were the principal crop in Washington County up until the '20s. (Courtesy Shiloh Museum of Ozark History/ Dr. Lloyd O. Warren Collection S-82-214-4)

2007 –

Physics at the University of Arkansas

A century after it began with a single faculty member and eleven course offerings, the Physics Department today has eighteen tenured or tenure-track faculty members, about fifteen research faculty and post-doctoral fellows, thirty-five graduate students and offers over eighty courses in lasers, quantum optics and nonlinear optics, atomic and molecular physics, nano-science and condensed matter physics, biophysics and astronomy. The Physics Department is internationally recognized for theoretical and experimental research in these areas and is an acknowledged leader in teaching innovations. The Department's research expenditures in FY 2005-06 were over \$4.6 M, most of which was obtained in competitive funding from federal agencies.

The Department is proud of many achievements of its faculty, students and alumni. Among its current faculty members are four recipients of the NSF CAREER award, one recipient of the NSF Young Investigator Award, and three professors holding distinguished or endowed professorship or both. Five faculty members are fellows of the American Physical Society and two are fellows of the Optical Society of America.

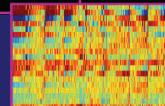
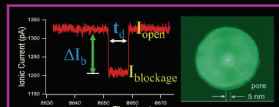
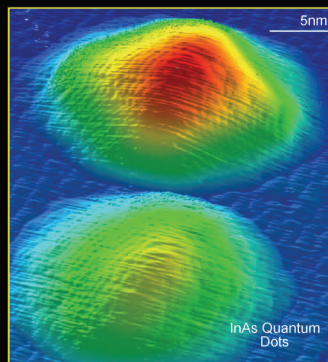
Over the past three years, the faculty and students have published more than 150 research articles in refereed journals including many in such prestigious journals as *Physical Review Letters*, *Science*, and *Nature* and accumulated approximately 3000 citations to their work. The

discovery of the thallium-based superconductor that set a world record for highest-temperature superconductor, non-diffracting light beams in photorefractive media that opened a new research frontier, and the calculation of the spectrum of the amazing molecule "buckyball" are but a few examples of pioneering research that has come out of the department.

The Department's central mission has always been to offer our students a high-quality program, the principal ingredients of which are superior teaching, a curriculum that combines the traditional knowledge with courses at frontiers of our knowledge, and faculty dedicated to excellence in teaching and research. The successful record of research is really another facet of its graduate education.

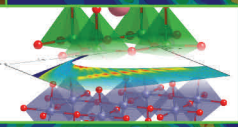
Since 2000, physics majors have won eight Barry Goldwater scholarships and one Marshall scholarship. Five students have won NSF Graduate Research Fellowships and three have received honorable mention. In addition, several physics majors have been finalists for the Truman, Marshall and Rhodes fellowships.

The Department is equally proud of the achievements of its alumni, which includes authors, professors, and entrepreneurs, who have received national honors, such as the Oersted Medal of the American Association of Physics Teachers, Fritz London Award for condensed matter physics by the American Physical Society, election to the National Inventors Hall of Fame, and National Medal of Technology.



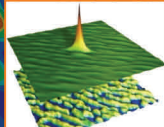
Atomic Molecular and Optical Physics: Quantum and Nonlinear Optics

Researchers in this field are exploring a wide range of topics to understand the fundamental nature of light and its interaction with atoms and molecules. Using this understanding, researchers are able to use one light beam to control another light beam, thus demonstrating an all-optical switch. Researchers are using light beams to create reconfigurable waveguides in certain materials and achieve diffractionless propagation of light. These waveguides can serve as all-optical interconnects. Another area of research involves understanding quantum computers and their fundamental and practical limitations. Researchers are also studying ways to manipulate spatial profiles of light beams to give them new capabilities for mechanical manipulation (push, rotate and trap) of biomolecules.



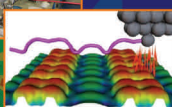
Material Science

This group came into prominence with the discovery of the thallium-based superconductor, which held the world record for highest temperature superconductivity for five years. More recently the researchers have used state-of-the-art fabrication techniques to create high-quality interfaces between a new class of materials known as transition metal oxides. Just as the understanding of atomic-scale interface between different types of semiconductors caused a revolution in materials and gave us diodes, transistors, and the whole electronic age, understanding of the behavior of electrons confined at an interface between transition metal oxides may herald a similar burst of discoveries.



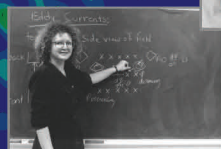
Nanoscience and Condensed Matter Physics

Researchers are exploring the possibility of using the spin of an electron for device applications. A two-tip scanning tunneling microscope, under construction, will be the first major step in realizing a transistor based on spin. By understanding the conditions of growth and control of materials in the nanometer scale, researchers have been able to produce a variety of quantum dot arrays ranging from chain-like to cube-like and organize them into molecule-like structures opening a new world of novel materials. Researchers are also using powerful computers to design new materials and predict their properties. Discoveries of new materials using this approach have opened up new research frontiers.



Astronomy

Researchers are studying properties of binary stars using a number of telescopes around the world including those at the National Optical Astronomy Observatories at Kitt Peak and Cerro Tololo Inter-American Observatory in Chile. Observed discrepancies in the motion of binary stars are being analyzed to discover new stars and planets. Another exciting area of research involves studies of quasars, which are the active galactic nuclei powered by matter falling onto a central super-massive black hole using optical and infra-red imaging techniques to understand and unravel the mysteries of the large scale structure of the universe.



Physics Education

Educators are conducting research to gain quantitative understanding of how students learn in large and small lectures and devising ways to assess learning gains objectively. Faculty members strive to explore effective ways of teaching physics and expanding career opportunities for physics students. New programs to prepare future science teachers and improve science and math education in K-12 grades have also been developed. Faculty members have initiated and are active participants in several interdisciplinary efforts, both at the graduate and undergraduate levels, to broaden and enrich student research and educational experience.



2007 -

University of Arkansas Physics Alumni

The Physics Department, University of Arkansas, has been a pioneer in physics education and research in the state of Arkansas. Since its founding as an independent department in 1907, thousands of students have attended classes taught by physics faculty. Although the physics major was not defined until 1907, the first graduating class of 1875 included William Wiegner, who went on to found the Physics Department at the University of Colorado, which today is a leading center for research in atomic physics. Several of the recent Nobel prizes have gone to that department. To date, more than 900 students have graduated from our department's graduate and undergraduate programs, including 140 doctorates, 260 masters, and about 500 bachelor degrees. They have used their specialized knowledge of physics, critical thinking skills and capacity to learn to make impressive contributions to their profession, community, nation and indeed the world, earning well-deserved recognition from their peers.

The physics department's alumni have pursued career paths that span a broad spectrum of professions. While most alumni graduating with a bachelor degree pursue a masters or doctorate in physics or related disciplines, such as engineering or environmental science, many choose law or medical school or enter the workforce using their talents for large and small corporations and federal agencies. Recent students have entered physics Ph.D. programs at Cornell, the University of Maryland and the University of Illinois, among others. Alumni with post-graduate degrees have gone on to be successful faculty members at universities such as the Universities of Illinois and Texas, Miami University, and Rose-Hulman Institute; scientists and leaders in industrial and federal labs such as Texas Instruments, Northrop Grumman, NASA, and NIST; and entrepreneurs contributing to the welfare of our society. Their achievements have been recognized by the highest awards in their professions such as the Oswald Medal of the American Association of Physics Teachers [the highest national honor bestowed upon a physics teacher], the National Medal of Technology [the highest honor accorded by the President for a technological achievement], and the Fritz London Memorial Award in condensed matter physics by the American Physical Society. A complete listing of their accomplishments could go on for pages. We are proud of all of our alumni and their achievements and their contributions to their profession and the world they inhabit. A very incomplete picture highlighting some of our alumni and their accomplishments is presented in two posters, this one and the one to the right.



Robert D. Maurer, B.S., U. of Arkansas, 1948; Ph.D., M.I.T., 1951

Maurer and his associates at Corning Labs designed and produced the first low-loss fiber-optic cable, a technology on which more than 90% of the fiber-optic network in the US is based. The National Academy of Engineering credits fiber-optic communications as one of the most outstanding engineering achievements of the 20th century, and "Maurer is truly the father of the optical fiber," said R. David Schmitt, President of the Industrial Research Institute. Maurer has received numerous national and international honors and awards over the years, which have culminated in his receiving the US National Medal of Technology in 2000 (the highest honor the president of the United States bestows upon America's leading innovators in technology). In 1980, the University of Arkansas awarded him an honorary LL.D. degree.



Ken Vickers, M.S. 1976
Engineering Manager, IC Factory, Texas Instruments, 1981-86; Currently, Director, Microelectronics Products Graduate Program, U. of Arkansas; 32 patents.



Jeffrey Roe, B.S., 1982, U. of Arkansas, Ph.D., U.C. Berkeley
Vice-President of Engineering (Medical Devices Engineering), GEAC, Inc.; Patent Attorney; Entrepreneur - 10 patents; 1982; 32 patents.



Amanda Allen, B.S., 1995
Senior Manufacturing Engineer, Lockheed Martin

Industrial Scientists

Our alumni have been employed and/or are currently employed at major corporations, including Texas Instruments, TTT Corp, Lockheed Martin, Exxon, IBM, Eastman Kodak, Ball Aerospace, Honeywell, TRW Space and Defense, Boeing Aerospace, Northrop Grumman, to name just a few, where many have held/hold leadership positions, such as group leaders and principal investigators. Many others have chosen to work at medium to small companies where they are in top management positions such as Presidents/CEOs and Vice-Presidents.



Timothy Lane, B.S., 1982, U. of Arkansas, Ph.D., Princeton U.
Physics Group Manager, General Electric, Physics American Physical Society. Presented above on the occasion of receiving the Benjamin Franklin Award for his paper.



Alan Treiblich, B.S., 1983, U. of Arkansas, Ph.D., U. of Iowa
Project manager at Lockheed Martin; author of several books, published by Prentice Hall; University Professor of the James Earl Allen Award of the American Institute of Aeronautics and Astronautics. Presented above with Allen on the right.



Richard Fitts, Ed. (Physics) 1970; M.S.E.E. 1972
Johnson Space Center, NASA, Division Chief, System Division, Mission Operations Director, 1997-2006. Oversees the work of over 400 Shuttle and Station system flight controllers.



David Mooney, Ph.D., 1990
Director of Electricity, Resources, and Building Systems, Integration Center, National Renewable Energy Laboratory.



Colleen Wilson-Hodge, B.S., U. of Arkansas, 1992; Ph.D., U. of Arkansas, 1998
Astronautics, Marshall Space Flight Center, NASA. Present here in front of Earth Satellite.



Charles Kurtz, M.S., 1985
Engineer, Argonne National Laboratory.



J. Walter Keller, M.S., 1948
In 1981, he designed an implantable pacemaker for the first time; he was the first to design a pacemaker for the automatic control of body function. His research work included investigations of numerous technological advances in pacemakers and other medical devices. Holder of numerous patents.



Charles Chaffin, M.S., 1985
President, President and CEO of Space Systems, Inc., a multinational defense company specializing in the design and production of high-reliability optical networking systems and components for strategic and aerospace.

Entrepreneurs and Inventors

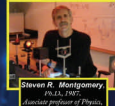
Many of our alumni have distinguished themselves as innovators and entrepreneurs.



James Hendrix, Ph.D., 1972
President and CEO, 1980-86, Chairman, 1986-88, Arkansas System. He led a small, low-budget entrepreneurial company to a multimillion dollar company serving over 1400 customers in 72 states; currently, Keller Consulting, LLC.



Robert W. Gruebel, Ph.D., 1968
Professor of Physics and Adjunct Professor of Art History, Stephen F. Austin University, TX. Director in the Navy in 1971-72. Present here on the occasion of receiving a Lifetime Achievement Award from his granddaughter, Julie, on the right.



Steven R. Montgomery, Ph.D., 1988
Assistant Professor of Physics, The U.S. Naval Academy.



Dominic Dinaggio, B.S., 1988
Naval Geographer, Naval Geographic ASW Center, Norfolk, Virginia (Naval Nuclear Power School).

Military

Physics graduates have served and continue to serve with distinction in all branches of the military as educators, researchers, scientists, and even on the front lines, both in uniform and as civilian employees.



John Brewer, B.D., 1980
Winterman, Founder and Operator, Wilderness Cellars, KS. Producer over 40 different wines, has won over 200 international awards and served as judge at international wine competitions. His wines were served at the 2002 Winter Olympics, UT.



Beresford McLean, M.S., 1979
Author. After working 20 years as an engineer, he decided to become a fiction writer. His first book, *Broken Ground*, was published in 2002.

Diverse Professions

Many of our graduates have chosen to pursue diverse professions ranging from medicine to lawmaking. In particular, a substantial number of undergraduates have gone on to medical schools and are now practicing medicine in various specialties, such as plastic surgery and oncology, to name just a couple.



Ramona Bates, M.D., Ed., 1978
Plastic Surgeon, Little Rock, AR.



Robert H. Nunnally, Jr., Ed., 1981
Commercial Litigation Attorney; Partner in Warner, Nunnally, and Gold, LLP, TX.



2007 -

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The physics department's alumni have pursued career paths that span a broad spectrum of professions. While most alumni graduating with a bachelor's degree pursue a masters or doctorate in physics or related disciplines, such as engineering or environmental science, many choose law or medical school or enter the workforce using their talents for large and small corporations and federal agencies. Recent students have entered physics Ph.D. programs at Cornell, the University of Maryland and the University of Illinois, among others. Alumni with post-graduate degrees have gone on to be successful faculty members at universities such as the Universities of Illinois and Texas, Miami University, and Rose-Hulman Institute, scientists and leaders in industrial and federal labs such as Texas Instruments, Northrup Grumman, NASA, and NIST, and entrepreneurs contributing to the welfare of our society. Their achievements have been recognized by the highest awards in their professions such as the Coersted Medal of the American Association of Physics Teachers (the highest national honor bestowed upon a physics teacher), the National Medal of Technology (the highest honor awarded by the President for a technological achievement), and the Fritz London Memorial Award in condensed matter physics by the American Physical Society. A complete listing of their accomplishments could go on for pages. We are proud of all of our alumni and their achievements and their contributions to their profession and the world they inhabit. A very incomplete picture highlighting some of our alumni and their accomplishments is presented in two posters, this one and the one to the left.



William McMillan, M.S., U. of Arkansas, 1961; Ph.D., U. of Illinois, 1964.
Bill McMillan was recognized as one of the world's leading experts in low-temperature physics, with work on liquid helium, superconductivity and liquid crystals. During a year at Cambridge, he wrote a paper that has become a classic in low-temperature theory. He joined the faculty of the University of Illinois in 1972. In 1977 he received a Guggenheim Fellowship for research at the University of Paris. The next year, he received the highest prize awarded for research in low-temperature physics: the Fritz London Memorial Award (awarded once every three years) for "his outstanding theoretical contributions to the fundamental knowledge of superconductivity." Tragically, McMillan was killed in a bicycle accident in 1984. Bill was only 48 at the time, with more than a dozen papers published or in progress during his last year. The University of Arkansas bestowed upon McMillan an honorary LL.D. degree 1979.



Jack B. Swift, B.S., U. of Arkansas, 1965; Ph.D., U. of Illinois, 1968.
Research Fellow, Harvard University, 1969-71; Alfred P. Sloan Foundation Fellow, 1973-75; Professor, U. of Texas, 1977-2006.

Academic Researchers
Graduate hold professorships at various universities in the US and abroad, distinguishing themselves in academic research.



Perry Rice, Ph.D., 1988.
Professor, Miami U. Ridge published in the field of quantum optics.



Tak-San Ho, Ph.D., 1981.
Research Chemist, Princeton U., 1987 - in situ.



Julie (Smith) Kesselbach, B.S., U. of Arkansas, 1989.
Ph.D., California Institute of Technology, 1993.
Post Doctoral Fellowships, Oxford University and Ohio State U.; Assistant Professor, U. of Arkansas, 2007 - in situ.



Justin Vines, B.S., U. of Arkansas, 2006.
Cornell University.
Barry M. Goldwater Scholar (2003).

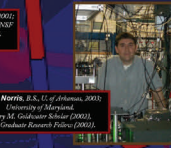


Hannah DeBerg, B.S., U. of Arkansas, 2007.
University of Illinois.
Barry M. Goldwater Scholar (2007), NSF Graduate Research Fellow (2007).

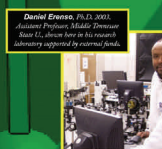
Graduate Students
Physics majors have gone on to pursue graduate studies at prestigious private and public universities and schools such as Cornell, Princeton, CalTech, and the Universities of Illinois, Maryland, Michigan, and Colorado, to name just a few. In the recent years, two physics majors have been named Barry M. Goldwater Scholars and five have been recipients of the prestigious NSF Graduate Research Fellowships.



Laura Fields, B.S., U. of Arkansas, 2001.
Barry M. Goldwater Scholar (2000), NSF Graduate Research Fellow (2001), Cornell University.



David Norris, B.S., U. of Arkansas, 2003.
University of Maryland.
Barry M. Goldwater Scholar (2003), NSF Graduate Research Fellow (2003).



Daniel Ennen, Ph.D., 2001.
Assistant Professor, Middle Tennessee State U.; research done in his research laboratory supported by external funds.



Wallace Hilton, Ed.D., U. of Missouri - Columbia, 1983; M.S., Physics, U. of Arkansas, 1986.
Lect. Professor, William Jewell College, MO; Recipient of the Coersted Medal in 1978 (The highest award given by the American Association of Physics Teachers).



Karen Williams, M.S., U. of Arkansas, 1988.
Ph.D., U. of Oklahoma, 1989.
Professor, East Central U., OK; President of STS National Council for four years (2001-2003); in addition to many leadership roles in the national STS Association of North American Science Teacher award, 2004 (a national award).



Juan Rodriguez, Ph.D., 1996.
East Professor of Physics, Gateway College, IL.
Chair, Department of Physics and Engineering, 1997-2000; 2006 - in situ. Research done in his research laboratory supported by external funds.

College Professors
Alumni hold or have held faculty positions at various colleges across the country and have made important contributions by providing leadership to physics departments, being exemplary teachers and advisers, or by setting up excellent research laboratories. Many alumni have won national awards for their work.



Dianne Phillips, M.Ed., 2007.
Math and Science Faculty, Northwest Arkansas Community College; Co-developer of a teaching model that is receiving national attention.



Brian Monson, Ph.D., 1995.
Physics Instructor and Science Department Chair, Arkansas School of Health, Science, and Arts; innovative research projects involving ASHS students. Externally funded research.

K-14 Teachers
Many of our graduates have chosen to teach K-12 and community colleges.



Garvin Wattahene, Ph.D., 1991.
Physics teacher, Arkansas School of Health and Science; innovative research projects involving ASHS students. Externally funded research.



Reception in the Physics Library



A reception in the Physics Library followed the unveiling of the audio-kinetic sculpture, centennial posters, and other exhibits.



Faculty Roll of Honor



This "Faculty Roll of Honor" names faculty members who have made significant contributions to the Physics Department over the past one hundred years. Provost Bob Smith unveiled this plaque on April 4, 2008 to commemorate the Physics Centennial. Below is the complete list of the names :

Giles E. Ripley	1908-1940	Carol J. Webb	1972-1980
Bernard Brown	1914-1918	Donald O. Pederson	1972-
Charles B. Crofutt	1923-1926	Gregory J. Salamo	1975-
Samuel R. Parsons	1923-1931	Rajendra Gupta	1978-
Wesley M. Roberds	1927-1942	Claud H. Lacy	1980-
Lloyd B. Ham	1932-1957	Peter W. Milonni	1980-1989
Paul C. Sharrah	1942-1982	Surendra P. Singh	1982-
George D. Lingelbach	1947-1966	Howard J. Carmichael	1983-1989
Herman M. Schwartz	1949-1978	William G. Harter	1985-
Zaboj V. Harvalik	1948-1957	Allen M. Hermann	1986-1989
Berol L. Robinson	1952-1956	Zhengzhi Sheng	1988-1999
Raymond H. Hughes	1954-1990	Reeta Vyas	1989-
Otto H. Zinke	1959-1988	Julio Gea-Banacloche	1990-
Glen T. Clayton	1960-1972	Min Xiao	1990-
Stephen M. Day	1961-1983	William F. Oliver III	1992-
Charles E. Jones	1962-1970	Gay B. Stewart	1994-
Arthur S. Hobson	1964-1999	Paul M. Thibado	1996-
Charles B. Richardson	1966-1997	Kenneth G. Vickers	1998-
Richard J. Anderson	1966-1989	Laurent Bellaiche	1999-
Fui T. Chan	1969-2000	Huaxiang Fu	2002-
Michael Lieber	1970-	Jiali Li	2002-

Display of Historical Equipment



This exhibit displays some of the equipment used for research and teaching in this department over the years. Several pieces date back to the early 20th century. This display was formally inaugurated by Provost Bob Smith on April 4, 2008 to commemorate the department's Centennial.



Detailed Program of Research Laboratories open house—Page 1

Research Laboratories Open House

Friday, April 4, 2:15-4:00 PM



1. *"Voyage at the Nanoscale"* PHYS 101, Professor Greg Salamo

Nature provides us with breathtaking examples of elegant and functional nanosystems. From magnetic bacteria that sense the earth's magnetic field using nanosized bar magnets to the nanoparticles that give a peacock feather its brilliant color, the world around us is filled with examples of nanomaterials in action. Amazingly, the rules that govern the behavior of these tiny structures are not yet known. The research in our facility explores the mysteries of nature at a small scale. It is clear that this is a time of exciting challenges that present opportunities to develop answers to questions about the mysteries of life itself. In this tour we will discuss our recent efforts to uncover these rules and your opportunity to be part of this adventure. Our students develop the skill to grow and see nanostructures, to model and understand their unusual behavior, and to creatively utilize them for a new generation of nanoscale devices. There has never been a more exciting time to be in science and I hope to make this clear during the tour.

2. *"Physics at Extreme Pressures"* PHYS 105, Professor Lin Oliver

Understanding the properties of materials has driven much of modern research in the physical sciences and it will continue to do so for the foreseeable future. In our research program, we are interested in answering questions about how various liquids, solids, and biological materials behave under extreme conditions of very high pressures. What new material phases exist as pressure increases and what are the properties of these phases? How do biological systems behave as pressure, temperature, and chemical environment change? What is the nature of phase transitions between these various phases? Come learn how we achieve very high pressures by squeezing materials between diamonds, the hardest known material - one that is itself formed at high pressures. See first hand how we probe the properties of materials under these extreme conditions using lasers, optical methods, and rubies.

3. *"Engineering Ideal Nonlinear Optical Media"* PHYS 111, Professor Min Xiao

Interactions of laser beams with a multi-level atomic medium can generate atomic coherence among different atomic levels, which can be used to modify and control the linear and nonlinear optical properties of medium. We experimentally demonstrated the great reduction of linear absorption and increase of linear dispersion of an atomic medium to one weak probe laser beam by employing another laser beam, which can be used to control the group velocity of light pulses propagating in the medium. Also, the third-order nonlinearity of the atomic medium can be enhanced and controlled by the additional laser beam. Using controllable linear and nonlinear optical properties in such ideal optical media, we have demonstrated many interesting phenomena, such as optical bistability, multistability, instability, chaos, and stochastic resonance. We demonstrated generations of co-existing high-order nonlinear optical processes (such as four-wave mixing and six-wave mixing) and their interferences. Such engineered optical media, with controllable linear and nonlinear optical properties, can be used for building efficient elements in all-optical communications and quantum information processing.

4. *"Sculpting Solid-State Nanopores for Single Molecule Detection"* PHYS 124, Professor Jiali Li

Nanoscale pores function as membrane channels in all living systems, where they serve as sensitive electro-mechanical devices that regulate electrical potential, ionic flow, and molecular transport through the cell membrane. Studies of nanopore fabrication and their characterization for single molecule transport through solid-state membranes not only will expand our knowledge in this interdisciplinary field, it will also lead to man-made cell membranes, single molecule detectors, and eventually single DNA and protein sequencers. During the lab tour two exciting aspects of this research are going to be demonstrated:

- I. How to make molecular size solid-state nanopores in silicon nitride membranes.
- II. How a nanopore based single molecule detector can detect a *single* DNA molecule.

5. *"Manipulating Light Beams and Light Beams to Manipulate Macromolecules"* PHYS 128, Professor Surendra Singh

We are interested in studying light and its application to the study of nanoparticles and biopolymers. We use optical elements such as lenses, polarizers, and beam splitters to manipulate the spatial structure of optical beams to generate optical vortex beams carrying orbital angular momentum. Such beams can exert force as well as torque on objects that refract or scatter such beams. One of the tools in our research where such beams can be used to manipulate macromolecules is an optical tweezers, which works on the following principle: Light exerts a force (and a torque) when it is refracted or scattered by an object. Although negligible for ordinary objects at normal intensities, this force can become substantial in the optical

Detailed Program of Research Laboratories open house—Page 2

region of a strongly focused laser beam and can be used to manipulate, trap, drag, and rotate micro and nano-scale dielectric or biopolymer particles. This effect will be demonstrated.

6. “*Atomically Engineered Nanomaterials*” PHYS 131, *Professor Jak Tchakalian*

Our vision is to *search and create new artificial tailor-made nanoscale materials*, structures and devices out of building blocks which Nature does not permit in the bulk. Our approach is based on the idea that by combining such antagonistic building blocks we may create materials and devices with novel and often very unusual properties and functionality. The main topics we are actively engaged are:

- Advanced characterization of strongly correlated nanostructure by soft X-Ray absorption spectroscopy, resonant X-ray scattering and neutron reflectivity.
- Physics of polar oxide surfaces and surface reconstruction in nano-size ferroelectrics materials.
- Fabrication of multi-scale nanostructures with laser MBE.
- Computer modeling for rational design of electronic and structural properties of novel nanoscale material.
- Physics of hybrid bio-organic-inorganic nanomaterials and nanodevices. Fabrication of novel bio-functionalized nanomaterials.
- During the visit I will explain principles behind the operation of pulsed laser deposition and show how to use our advanced Atomic Force Microscope to investigate nanomaterials.

7. “*Computer Animations: Understanding Relativity and Quantum Physics*” PHYS 241, *Professor William Harter*

The Computer Graphics and Animation studio/classroom is providing insights into quantum mechanics and relativity that have gone undiscovered until now. This is helping to unify these subjects and suggest novel experiments involving quantum rotation-vibration of molecules such as Buckyball (C60). Computer animation also helps with old mechanics such as a war machine called the trebuchet. Such knowledge helps you improve your tennis or golf swing, too!

8. “*Spin-tronics*” PHYS 106, *Professor Paul Thibado*

The evolution of making faster computer chips (Moore's Law) has reached a fundamental milestone. Gate lengths are now so small that quantum mechanical tunneling is shorting out the transistors. This is making it an exciting time to be a physicist. Revolutionary approaches to making transistors are being pursued as the industry has reached this critical point. One approach is to utilize the spin (quantized magnetic moment) of the electron (spintronics). This new degree of freedom may be used to make a novel multi-functional transistor that could replace hundreds of normal transistors. Naturally, resulting in an overall size reduction as well as an overall reduction in power consumed. One striking application example is the possibility of developing base-10 logical computing vs. binary logic:

8 Normal Transistors

2 Independent (On/Off) Positions
 $2^8 = 256$ unique configurations (one byte)

8 Spin Transistors

10 Independent Spin-Orientations
 $10^8 = 100,000,000$ unique configurations

In this lab, we focus on making ferromagnetic semiconductors using molecular beam epitaxy (MBE) to build spin-transistor device structures. We can also study the spin-dependent tunneling properties of the electron with atomic-scale resolution. In particular, we can identify which atomic-scale structures efficiently scatter the electron's spin. For this project we have built a low-temperature scanning tunneling microscope (STM) with two independently controlled tips. These tips can be brought as close together as one nanometer. This equipment forms a three-terminal device similar to a transistor.

9. “*Photorefractive Solitons*” PHYS 129, *Professor Greg Salamo*

Photorefractive effect is being studied to create reconfigurable waveguides in and achieve diffractionless propagation of light. These waveguides can serve as all-optical interconnects.

10. “*Spin Exchange*” PHYS 122, *Professor Greg Salamo*

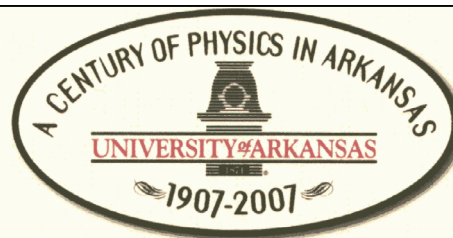
Femtosecond laser are being used to study spin exchange and relaxation in semiconductors

11. “*The Biophysics of neural computation*” PHYS 245, *Professor Eitan Gross*

The neuronal cells in our brain are connected via synapses to form neural networks that are capable of high level information processing. We study cooperative dynamics of neural networks in the brain and their emergent properties such as phase-transitions, chaos, oscillations and synchrony. In addition, we are working on developing novel supervised and unsupervised learning algorithm by defining the basic laws that govern synaptic electrical signal processing and the efficacy of information transfer from the synapse to the axon through the cell body (soma). Computer simulations are used extensively in these studies to model single neurons as well as networks of interconnected neurons, using statistical mechanics of equilibrium and non-equilibrium systems, mean-field theories, theory of nonlinear dynamics and stochastic processes. On the experimental level we are studying the molecular mechanisms by which sensory input signals modulate the strength of the synaptic connections between the cells in the network and the role of voltage-gated channels in the process. Our ultimate goal is to understand human cognitive functions on the molecular level.

The Banquet

The banquet program is shown on the right. Dinner was attended by about 400 guests. In addition to alumni, former and emeritus faculty, current physics faculty, staff and students, also in attendance were Professor Ketterle, Vice-Chancellor for University Advancement and Chancellor-Designate David Gearhart, Provost Bob Smith, Vice-Chancellor Don Pederson, Graduate School Dean and Vice-Provost for Research Collis Geren, Fulbright College Dean Don Bobbitt, several other deans and prominent campus officials, a representative of the Board of Trustees, State Senator Sue Madison, and guests. The details of this program and a few photographs are shown on pages 33 through 39. A brochure highlighting the contributions of the department to research and teaching and outreach activities was distributed to all guests, and it is reproduced on pages 40 through 47.



Reception

Entertainment is provided by former Physics Department Chair Dr. Allen M. Hermann on trombone, along with Claudia Burson on piano, Dr. James R. Greeson on guitar and Darren Novotny on drums.

Banquet

Welcome

Dr. Surendra P. Singh
Chair, Department of Physics

Menu

Salad

Baby spinach with Mandarin oranges, toasted almonds and balsamic vinaigrette

Entrée

Cashew crusted chicken on wild rice pilaf with asparagus, grilled cherry tomatoes and lemon beurre blanc

-or-

Portobello and leek risotto with shaved Parmesan and vegetables

Dessert

New York cheesecake with chocolate sauce and berries

Program

Remarks

Dr. Donald R. Bobbitt
Dean, J. William Fulbright College of Arts and Sciences

Dr. G. David Gearhart
Vice Chancellor for University Advancement

Closing

Dr. Surendra P. Singh

The Reception



During the reception period, music was provided by former UA physics chair Allen Hermann (trombone), accompanied by Claudia Burson (piano), Jim Greeson (guitar), and Darren Novotny (drums). Hermann is a world-renowned jazz trombonist. While living in New Orleans, Hermann was featured regularly with a leading Bourbon Street band, the Dukes of Dixieland. He has performed all over the world, appeared with such luminaries as Ella Fitzgerald, Tony Bennett, Julie London, and Peggy Lee, been a member of such well-known bands as Lionel Hampton, Buddy Morrow, and Doc Cheatham, played with President Bill Clinton, and recorded eight albums including "The Jazz Trombone" with the legendary Carl Fontana--one of the outstanding examples of jazz trombone artistry in the annals of recorded music.



Physics Chair Surendra Singh welcomes the guests to the Banquet



The Centennial Banquet



Above: Chancellor-Designate David Gearhart (right) greets Barbara Maurer and Robert Maurer (extreme left) while Physics Chair Surendra Singh (partially hidden) looks on. Below: Ketterle chats with alumnus Xue Min Ye and Mrs. Ye, while Min Xiao (left) looks on. Dr and Mrs. Ye traveled from Beijing, China to participate in the celebrations.



The Centennial Banquet



Above: Provost Bob Smith (standing) with former Fulbright College Dean Bernard Madison (left) and Fulbright College Associate Dean John Hehr (right). Below: Professor Greg Salamo (blue shirt and navy blue jacket) and Mrs. Pam Salamo (next to him) with alumni (left to right) Kevin Tennal, David Ramer, Paul Breaux, Tarlok Aurora, and guests.



The Centennial Banquet



Guests at the banquet. Above: Raj Gupta (extreme left) with invited guests. Below: Graduate students and guests.



Fulbright College Dean Donald Bobbitt makes
remarks



Chancellor-Designate David Gearhart addresses
the gathering



The Centennial Brochure-Page 1

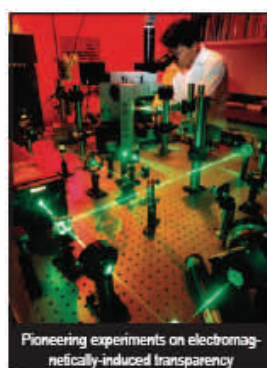
1907-2007

100 YEARS OF INNOVATION

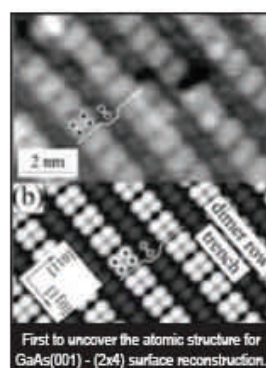
IN PHYSICS AT THE UNIVERSITY OF ARKANSAS



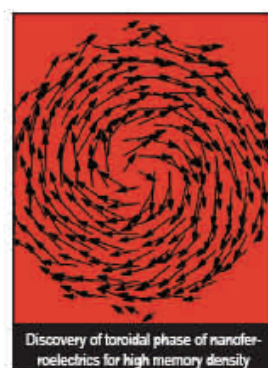
First observation of thallium high temperature superconductor



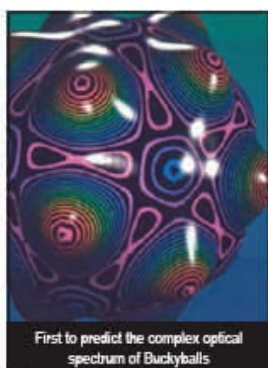
Pioneering experiments on electromagnetically-induced transparency



First to uncover the atomic structure for GaAs(001) - (2x4) surface reconstruction.



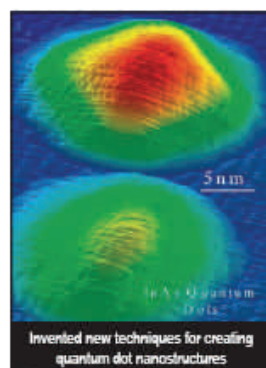
Discovery of toroidal phase of nanoferroelectrics for high memory density



First to predict the complex optical spectrum of Buckyballs



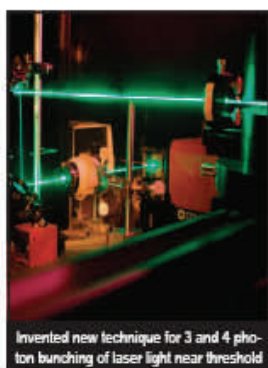
First at photothermal spectroscopy of combustion in a flame



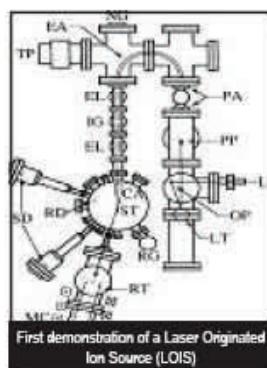
Invented new techniques for creating quantum dot nanostructures



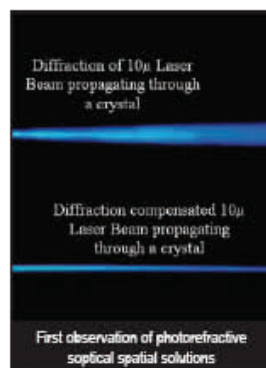
Measured change in science education in the Arkansas K-12 schools



Invented new technique for 3 and 4 photon bunching of laser light near threshold



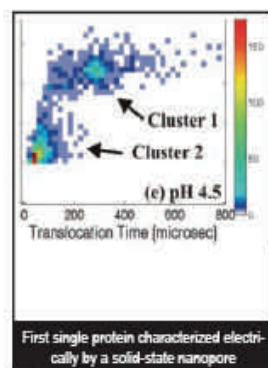
First demonstration of a Laser Originated Ion Source (LOIS)



Diffraction of 10μ Laser Beam propagating through a crystal

Diffraction compensated 10μ Laser Beam propagating through a crystal

First observation of photorefractive optical spatial solutions



First single protein characterized electrically by a solid-state nanopore

The Centennial Brochure-Page 2

Building on the first 100 years...

In the Beginning

Since 1907, the best and the brightest have come to the physics department at the University of Arkansas to study some of the most difficult problems in physics. It began with a single faculty member, 11 courses, a paper in *Physical Review* in 1926, and a master's degree program in 1939. It grew stronger in 1954 with a National Science Foundation grant, a doctoral program in 1959 and the first doctoral graduate in 1964.

Today, there are 18 faculty members and over 80 courses. Publications have increased to 75 per year, citations to over 1,000 per year, and external funding to nearly \$5 million per year. Faculty discoveries have started new fields in science, won career and presidential NSF awards, founded an NSF Center in Nanoscience, and started a University-wide Institute of Nanoscale Science and Engineering.

From the *first* precision measurement of the Lamb shift of the $n=4$ level of He^+ that tested quantum theory, to the *first* measurements of depolarization collision cross-sections for noble-metals that advanced our understanding of atoms, to the dramatic discoveries of the thallium high temperature superconductor that set a world record and a photorefractive optical spatial soliton that started a new field in optics, innovation has been a trade mark of research in physics at Arkansas.

Our first 100 years of physics have also been marked by teacher workshops that have impacted nearly 1,000 high school teachers, an innovative bachelor of arts physics program that expanded career opportunities for physics under-

graduates, an in-house planetarium that impacted thousands of students, undergraduate research that prepared students with detective-like skills, and by a legion of faculty who have a strong commitment to delivering a quality education in physics.

Graduates have gone into diverse fields ranging from basic to applied physics research to law and medicine. Currently the program has nearly 100 physics majors, 40 doctoral students,

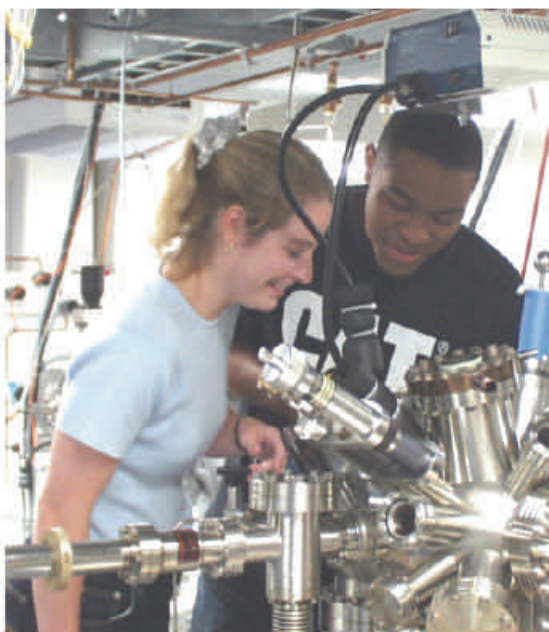
and teaches physics to nearly 2,000 students every year. Students now have the opportunity to take courses with an emphasis on "hands-on" experience using state-of-the-art laboratory facilities in new research areas ranging from quantum and nonlinear optics to surface science, nanoscience and nanofabrication to biophysics.

Many physics graduates as well as faculty have distinguished themselves, from the co-inventor of the optical fiber to the head of big industrial fabrication facilities, to winners of Goldwater Scholarships, the Oersted Medal of the American Association of Physics Teachers, the National Medal of Technology, and the Fritz London Memorial Award.

Indeed, the first 100 years of physics at the University of Arkansas has seen many breakthrough achievements. Here we wish to celebrate these achievements by giving a small glimpse of the high quality of *Research and Teaching* that has been possible and by describing our vision for innovation in the future in atomic-molecular physics; quantum-nonlinear optics; condensed matter and nanoscience, biophysics, astronomy, and physics education.



Arkansas Nanomaterials Growth & Imaging Facility



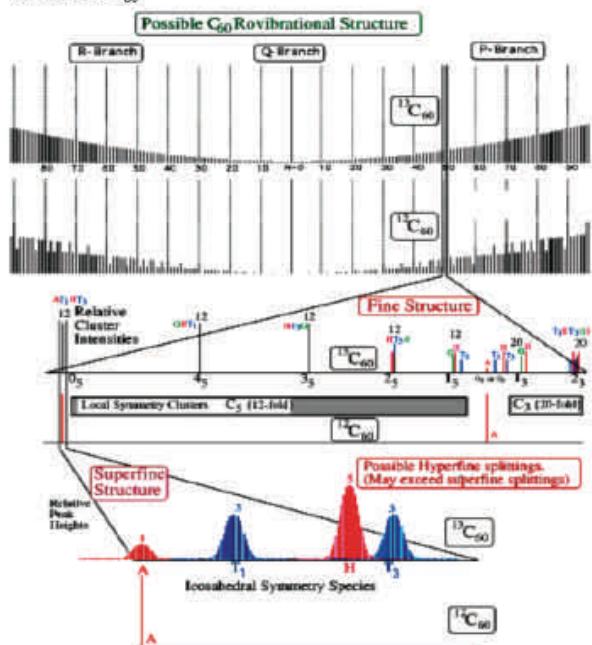
Undergraduates Imaging Nanostructures

Accomplishments & Vision

Innovation in Atomic/Molecular Physics

For example, Professor Harter and his students made the remarkable discovery of “Buckyball” beginning with the first theory and prediction of the rotational/vibrational spectra of this unusual molecule. These predictions led to the discovery that this amazing form of carbon really exists.

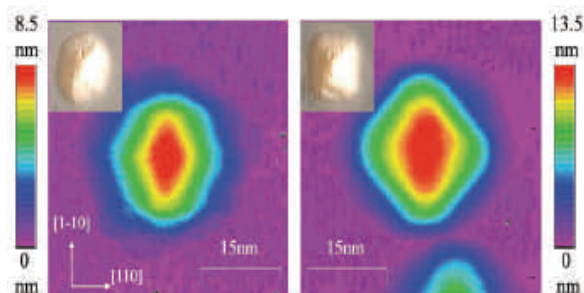
Building on this discovery, this team is now exploring C_{60} composed of one or all carbon 13 atoms. A pure carbon 12 C_{60} buckyball is a giant “Boson” while a C_{60} molecule made of carbon 13 would be a giant “Fermion” with over an octillion of possible nuclear spin states – and an incredible potential gain in computer memory. But there are challenges; the predicted spectra of carbon 13 C_{60} (partially shown below) are more complex than carbon 12 C_{60} . Fortunately, the information needed to model carbon 13 C_{60} was revealed in their investigation of carbon 12 C_{60} .



Innovation in Quantum/Nonlinear Optics

Since its beginning in 1975 the research program in quantum and nonlinear optics, under Professors Xiao, Singh, Salamo, Vyas, and Geo-Banacloche, has pushed the frontier of discovery to uncover the nature of light and its interaction with matter.

For example, Professor Xiao and his students were *first* to demonstrate enhanced dispersion and slow moving light with electromagnetically induced transparency (EIT) in a three-level atomic system. They also used EIT to directly demonstrate an



Scanning Tunneling Microscope View of Two Different shaped Quantum Dots

enhanced Kerr nonlinearity, four-wave mixing, six-wave mixing, as well as to use this system in a cavity to investigate controllable optical bistability, multi-stability, all-optical switching, chaos, and dynamic instability. Building on these remarkable discoveries they are now pursuing coherence experiments that are designed to demonstrate new schemes for quantum information processing, as well as investigating coherence in new materials, such as, interacting quantum dots like the two different dots shown above.

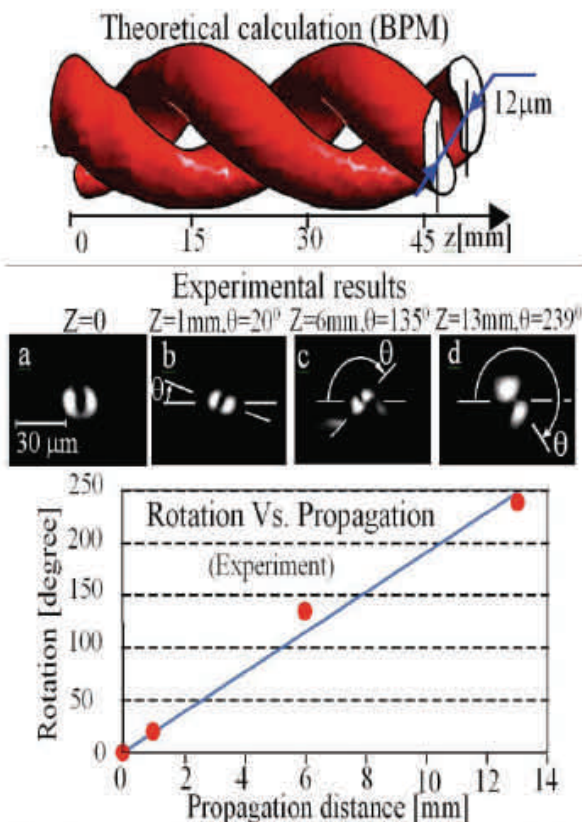
Complimenting this effort, Professor Geo-Banacloche and his students have developed models that revealed the underlying physics in many of Xiao's pioneering EIT experiments. Building on these studies, they developed a theoretical treatment designed for large quasi-classical fields that led to a better understanding of the phenomenon of quantum entanglement. In fact, his team has led the discovery of an important minimum energy requirement for quantum logical operations and now they continue to explore the minimum energy constraints needed to use quantum logic. Along the way they are revealing new mysteries of quantum mechanics that can be tested experimentally.

Meanwhile, Professor Singh's team has made experiments that provide direct evidence for the random motion of the optical field under the influence of quantum noise, demonstrated the



Exploring Optical Vortex Interference from a HeNe Laser

Building on the first 100 years...



First demonstration that two optical beams can spiral around each other

non-equilibrium tri-critical behavior of a laser, and the behavior of optical vortices, all of which adds to our understanding of what light is. Their research on effects of intensity fluctuations on nonlinear optical processes gave new evidence that photons in a light beam tend to bunch together. Building on this work, they are now exploring the nature of light by investigating the quantum statistical properties of photons from different optical sources.

Adding to these discoveries, Professor Vyas and her students have investigated the interaction of atoms with specially prepared optical beams. In this case, the atom and optical beam behavior show oscillations due to the oscillatory nature of the arrival of quanta of energy in the light beam. Complementing experiments by Singh, her team is developing models for the statistical properties of photons from parametric oscillators, which can function like lasers but retain their quantum mechanical behavior.

Professor Salamo and his students predicted and demonstrated for the first time that an infinite train of optical pulses, arbitrary in temporal shape, evolves through the interaction with

atoms, practically ignoring relaxation and dephasing effects, to a shape-preserving, low loss, infinite train of optical pulses which are ideal for optical communication systems.

In addition to the temporal solitons, or light propagation that does not spread over time, they were also first to show photorefractive spatial solitons, or light propagation without spatial spreading. A laser beam, focused to ten microns on a crystal, normally diffracts. But Salamo's team started a new field of optics when they discovered a novel way to compensate for diffraction so that the propagating optical beam kept the same size and shape, throughout the crystal, much like an "optical wire." They also showed that when two such optical non-diffracting beams enter a crystal, they amazingly spiral about each other (shown at left) as they propagate through a crystal. Building on these discoveries, they are exploring new concepts with arrays of coupled optical waveguides as reconfigurable optical interconnecting wires.

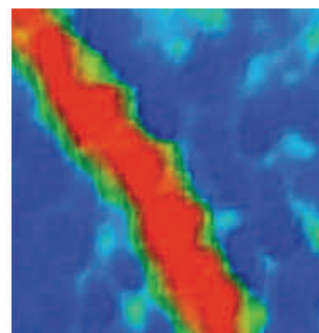
Building on these rather remarkable achievements, this group of scientists is pursuing the next great discoveries on the nature of light.

Innovation and Discovery in Condensed Matter/Nanoscience

Professors Paul Thibado, Laurent Bellaiche, Huaxiang Fu, William Oliver, Jak Chakhalian and Greg Salamo are leading discovery of the underlying physics of novel nanoscale materials.

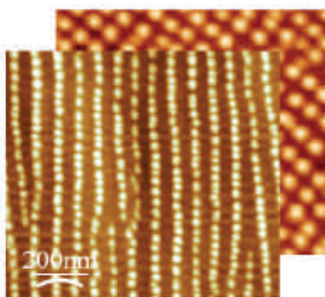
For example, spintronics offers the possibility of using the spin of an electron as opposed to its charge for a device. Professor Thibado and his students demonstrated spin-injection from a half-metal ferromagnetic tip on a scanning tunneling microscope (STM), into a semiconductor with near atomic scale resolution. They quantified the spin-relaxation time via the polarization of the recombination luminescence. They also ended a ten-year controversy

by resolving the atomic structure for the ordered GaAs(001)-(2×4) reconstructed surface. Now they are building an STM that uses two tips to image one sample. The ferromagnetic tips allow injection of electrons with one spin orientation at one point on the sample and take them back out a few nanometers away through the other tip.



Recombination luminescence indicating spin relaxation

The Centennial Brochure-Page 5



Quantum Dots naturally arrange into ordered patterns

This will be the first spin transport characterization and research tool capable of coherently studying single nanoscale structures.

Meanwhile, Professor Bellaiche and his students discovered that ferroelectricity amazingly reappears at high pressure, contradicting

a 30-year-old belief and opening *a new field of research*. They also developed a numerical tool that extends the reach of first-principles techniques and allows computation at *finite-temperature* of piezoelectric, dielectric and structural properties of materials. The use of this tool already explained the existence of a recently discovered monoclinic phase, and provided a very successful explanation for the Giant piezoelectricity found in material currently used in piezoelectric transducers and actuators.

Likewise, Professor Henry Fu and his students have initiated a *new field* of research by studying ferroelectric materials with size on the nanometer scale. They discovered a previously unknown type of phase transition that does not exist in bulk materials.

The new structural phase promises to increase the storage density of nonvolatile ferroelectric random accessed memories by *five orders of magnitude!*

Supporting these same theoretical studies, Salamo and his colleagues are growing nano-ferroelectrics by molecular beam epitaxy. Here, they are building on many years of experience with quantum dot growth. For example, they demonstrated how control of diffusion and strain can produce quantum dot arrays that take a form ranging from a chainlike to cube-like lattices of quantum dots. (shown at top of page)

In addition to organized arrays of quantum dots, they were also first to exploit a modified "droplet" growth method to organize the dots into molecule-like structures. (shown above) This opens a world of novel materials with behavior that is very different from a single quantum dot.

Most recently, Professor Chakhalian and his group have uncovered the nature of orbital reconstruction and covalent

bonding at an oxide interface. At the nanoscale modern microelectronics relies on the properties of interfaces between two different semiconductors. Being able to determine these characteristics known only to exist at the interface between metal oxides should allow synthesis of materials in which the bonding across oxide interfaces can be manipulated in a predictable fashion. Such a system may exhibit properties beyond those attainable in semiconductor heterostructures to create innovative electronic devices.

In a different direction, Professor Oliver and his students have developed a new method for determining the limits of the metastable super-cooled liquid state at very high pressures. Their research facility covers pressures from atmospheric pressure to as high as 20 gigapascals while simultaneously varying temperature from ~ 6 K to 600 K. These capabilities have been used to determine the phase diagram for materials like glycerol, a prototypic intermediate strength glass-forming system. They are now focused on salol, a more fragile glass-forming system. This technique will also be interesting to apply to nanoferroelectrics and quantum dots, which can have dramatic changes in their properties under high pressure.

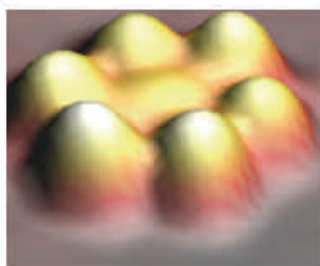
Together, these investigations of size, surface, and interface effects have opened a new set of mysteries for this group to solve.

Innovation and Discovery in Bio Physics

Beginning only a few years ago, research in biophysics is a new direction for the physics department. However, the young program, led by Professors Li and Gross, already has exciting results.

Professor Li and her students, using molecular passage through a voltage biased solid-state nanopore, detected and characterized long molecules. As a molecule passes through the nanopore (shown in (a) on the next page), it blocks current flow through the pore (shown in (b,c)). The distribution of duration and magnitude of observed current blockage events show for the first time that a significant fraction of the events obey a rule of constant charge deficit, indicating that molecules are passing through the nanopore clustered in folded and unfolded configurations (shown in (d-e)).

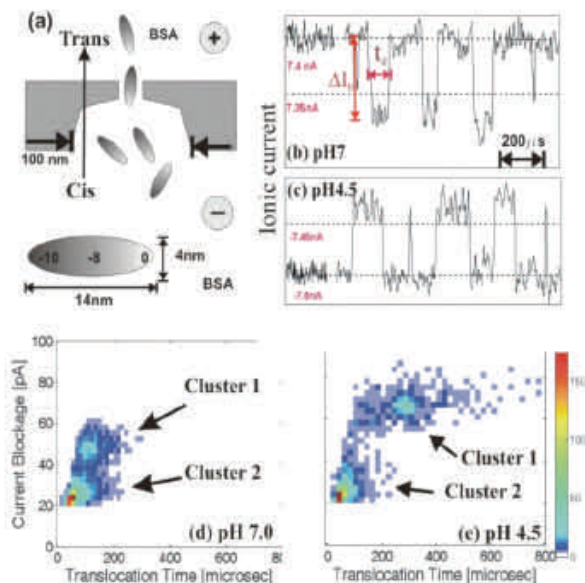
In another direction, using near-field scanning optical microscopy, Professor Gross and his students are the first to carry out non-linear optical imaging of electric fields in lipid raft nano-domains. This is important since membrane areas that contain lipid rafts are characterized by high dipole electric fields due to the presence of high cholesterol. Eitan's group examined the dipole potential image across the membrane of a nerve cell stained with voltage-sensitive dye. The dipole potential shows "hot spots." An examination of these hot spots reveals that they



Quantum Dots organize to form a molecular structure

The Centennial Brochure-Page 6

Building on the first 100 years...



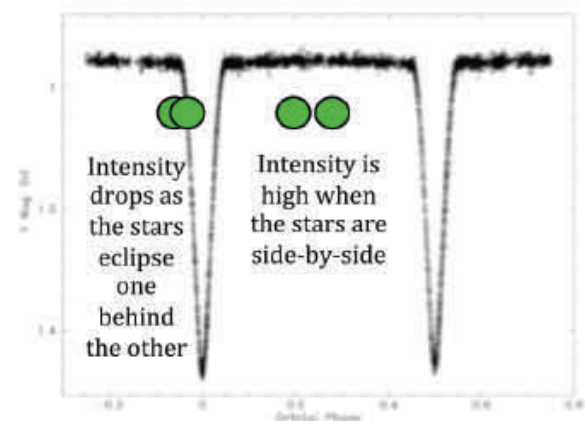
contain lipid rafts, shedding light on the role of lipid rafts in synaptic plasticity and learning function.

These are just a few examples of the new world of physics at the nanoscale in biological systems in which they plan to make a difference.

Innovation and Discovery in Astronomy

With the recent development of a new inter-disciplinary program in Space Sciences, Astronomy at Arkansas, has entered a new era under the leadership of Professors Lacy and Kennefick,

For example, Professor Lacy and his students have investigated the properties of binary stars by watching their intensity using a number of telescopes around the world, including at the National Optical Astronomy Observatories at Kitt Peak,



Ariz., Cerro Tololo Interamerican Observatory in La Serena, Chile, and a pair of robotic WebSopes. The data are used to test theories of how stars change as they age. In most cases, current theories of stellar evolution successfully fit these data, but there have been cases where they found some surprises. In one case, an eclipsing binary actually stopped eclipsing – twice! In another case, the rate of motion of two binary stars in relation to one another does not match the predictions of the general theory of relativity. They explain this by proposing an undetected third star.

Meanwhile, Professor Kennefick and her students have focused their efforts on understanding the properties of quasars. Using optical and near-infrared imaging obtained online and at Kitt Peak, they are first to find evidence for evolution in the quasar spectral index with lookback time. This affects computed quasar absolute magnitudes and therefore the determination of the growth of structures in the universe. It also affects studies of the accretion processes in the quasar centers.

Both of these astronomers are part of the new Arkansas Center for Space and Planetary Sciences and are pursuing a better understanding of the physics mysteries in the universe.

Innovation in Undergraduate Education

Professors Gay and John Stewart, Oliver, Hobson, Salamo, and Vickers are developing unique experiments in physics education.

In one example, Professor Gay Stewart and her students have developed a program to prepare graduate students as future faculty and high school teachers, all with NSF support. In addition, along with Professors Hobson and Salamo, she has played an important role in an NSF GK-12 program that places graduate students in middle school math and science classrooms to not only improve the depth of science instruction, but to help graduate students gain awareness of the needs of the public school system. (see students building trebuchet below) Importantly, each of these programs has resulted in measured improvement in learning based on test student scores and interviews.



The Centennial Brochure-Page 7



She also works together with Professor John Stewart and their students seek to understand "educational systems" by identifying a reproducible basis set for the system and then characterizing systems over that basis set. For example, they are characterizing the information in introductory physics textbooks while developing a detailed measurement of the textbook's linguistic features.

Even more recently, the university received a grant from the Howard Hughes Medical Institute to support an experiment called "STUDIO" or Science and Technology Undergraduates Developing Interdisciplinary Research. Here students are guided by faculty members from cross-disciplinary departments and work at the boundaries between the sciences and between science and engineering using state-of-the-art methods and equipment. For example, imagine a chemistry major designing and growing colloidal quantum dots; a physics student characterizing the photoluminescence of the structure; while a student in

biology is using the quantum dot as a tag to image DNA, and the three of them are analyzing the observed behavior.

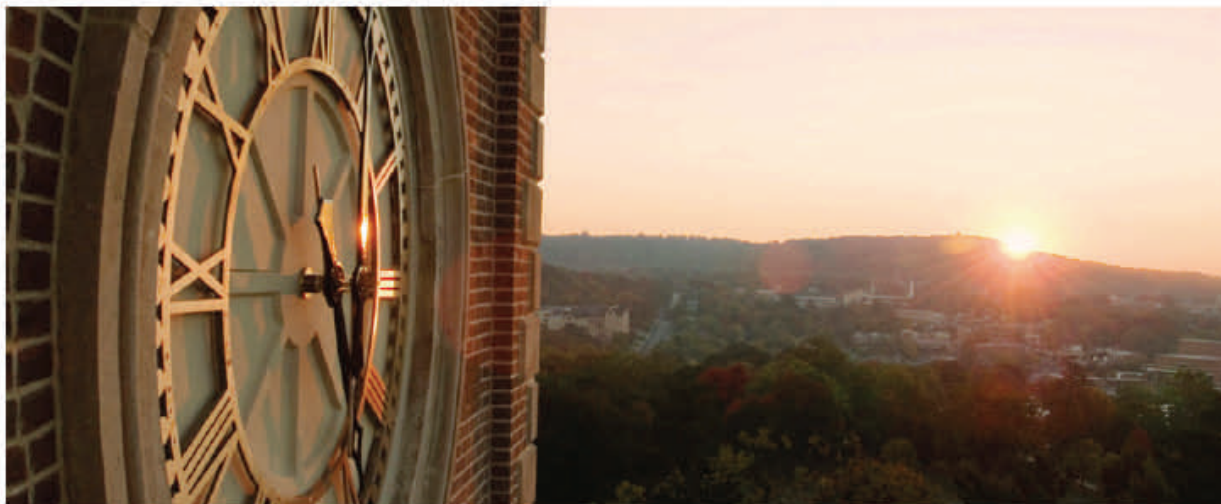
This effort is complemented by Professor Oliver's "Research Experience for Undergraduates". This summer NSF program brings college juniors to campus to conduct research side-by-side with faculty and graduate students over a 10-week summer period as they develop a detective mind-set by carrying out experiments designed to solve a mystery.

Professor Hobson developed a unique textbook that is adopted on over 120 campuses and targeted toward science-literacy. It is a socially conscious book, written for non-scientists and scientists alike, who want a broad introduction to the great ideas of classical and modern physics and their connection to society. It emphasizes modern topics such as quantum uncertainty and general relativity with complementing social implication topics, such as global warming, energy, and technological risk.

Innovation in Graduate Education

Graduate education has seen a new and exciting microelectronics-photonics (μ EP) masters and doctoral program that is unique in the nation, has nearly 60 students and, since its beginning in 1999, 40 graduates that have made their career in Arkansas and throughout the nation. It is designed to create an individual that can skillfully germinate original ideas within a team structure, and do so while balancing the true costs of implementing the ideas in a useful product for society.

It is the physics department's goal to produce the next generation of science and engineering graduates who are fully prepared to drive the advancement of basic science as well as new and novel applications. Our vision is to accomplish this goal by developing student talent through faculty, creative ideas, and state-of-the-art tools.



The Centennial Brochure-Page 8

Building on the first 100 years.....

The First 100 Years of Physics Faculty

Giles E. Ripley

C. B. Crofutt

Wesley M. Roberds

Paul C. Sharrah

Herman M. Schwartz

Berol L. Robinson

Otto (Bud) Zinke

Stephen M. Day

Art S. Hobson

Richard J. Anderson

Michael Lieber

Donald O. Pederson

Rajendra Gupta

Peter W. Milonni

Larry S. Merkle

William M. Harter

Z. Z. Sheng

Laurent Bellaiche

Urbano Oseguera

Mm Xiao

William F Oliver III

Mark E. Filipkowski

Huaxiang Fu

Julia Kennefick

B. Brown

R. Parsons

Lloyd B. Ham

George D. Lingelbach

Z. V. Harvalik

Raymond H. Hughes

Glen I. Clayton

Charles E. Jones

Charles B. Richardson

F T. Chan

Carol J. Webb

Gregory J. Salamo

Claud H. Lacy

Surendra P. Singh

Howard J. Carmichael

Alan M. Hermann

Paul Thibado

Eitan Gross

Reeta Vyas

Julio Gea-Banacloche

Gay Stewart

Michael Henry

Jak Tchakhalian

Ken Vickers

Contact us at:
Chairman of the Physics Department
University Of Arkansas
Physics Department
Fayetteville, Arkansas 72701
479-575-2506
<http://www.uark.edu/depts/physics/>

Reunion—Saturday, April 5, 2008



A reunion of the Physics faculty, staff, and alumni was held in Giffels Auditorium on the morning of April 5th. The picture above shows the audience. Emeritus/Former Faculty were honored by a presentation of Centennial Medallions. Emeritus/Former Faculty and Alumni reminisced about the days when they were here. Following this ceremony, faculty, staff, and alumni posed for pictures on the steps of Old Main. Some of these pictures are shown on the next few pages.

Medallions were presented to the following:

Arthur S. Hobson, Emeritus Professor
Otto H. Zinke, Emeritus Professor
Charles B. Richardson, Emeritus Professor
Fui T. Chan*, Emeritus Professor
Raymond H. Hughes, Emeritus Professor
Richard J. Anderson, Former Professor
Stephen M. Day, Former Professor
Charles E. Jones*, Former Professor
Allen M. Hermann, Former Professor
Howard J. Carmichael, Former Professor
Herman M. Schwartz**, Emeritus Professor (Deceased)
Paul C. Sharrah**, Emeritus Professor (deceased)
George D. Lingelbach**, Former Instructor (deceased)
S. Jean Eaton, Former Office Manager
Robert Maurer***, Distinguished Alumnus

* Unable to attend. The medallion was mailed to them.

** Presented to their offsprings

*** Unable to attend the Reunion session. The medallion was mailed to him.

Reunion



2007-2008 Faculty

Row 1: Associate Professor Huaxiang Fu, Professor Rajendra Gupta, Professor Julio Gea-Banacloche, Professor Reeta Vyas

Row 2: Assistant Professor Julia Kennefick, Assistant Professor Jacques Tchakhalian, Professor Laurent Bellaiche, Research Professor Kenneth Vickers, Associate Professor Jiali Li, Instructor Tamara Snyder, Laboratory Curator Stephen Skinner

Row 3: Professor William Harter, Associate Professor William Oliver, Professor Claud Lacy, Professor Michael Lieber, Professor and Chair Surendra Singh

Row 4: Professor Paul Thibado, Professor and Vice-Chancellor for Finance and Administration Donald Pederson, Distinguished Professor Min Xiao, Associate Professor Gay Stewart, Research Assistant Professor John Stewart, Distinguished Professor Gregory Salamo

Not Present: Eitan Gross

Reunion



2007-2008 Current, Former and Emeritus Faculty

Row 1: Huaxiang Fu, Howard Carmichael, Allen Hermann, Raymond Hughes, Rajendra Gupta, Julio Gea-Banacloche, Reeta Vyas

Row 2: Arthur Hobson, Otto Zinke, Julia Kennefick, Jiali Li, Tamara Snyder, Richard Anderson

Row 3: Charles Richardson, Jacques Tchakhalian, Laurent Beliaiche, Kenneth Vickers, Surendra Singh, Stephen Skinner

Row 4: William Oliver, Claud Lacy, Michael Lieber, Stephen Day, Gregory Salamo

Row 5: William Harter, Paul Thibado, Min Xiao, John Stewart

Row 6: Eitan Gross, Donald Pederson, Gay Stewart

A Group picture of those attending the reunion



Office Administrative Staff And Alumni Reunion



Physics Department Administrative Staff: Jim Miracle, administrative secretary; Dianne Melahn, accounting tech; Donna Johnson, office manager.



Professor Raymond Hughes and Alumna Carolyn Cloud Stanley

The Hughes and Zinke Groups



Row 2: Charles Stigers, H. Raymond Dawson, Ralph Carruth

Row 1: Xuemin Ye, Ray Hughes, Roger Miller



Row 2: Ken Osborne, Ron Norris, Raymond Higdon, Roger Hartman

Row 1: David Ross, Otto Zinke, Charles Manka (on sidewalk)

Day and Richardson Groups



Row 2: David Sloop, Charles Fowler, Atha Lamar (Pigg), Leroy Humphries
 Row 1: Frank Biggs, Tarlok Aurora, Stephen Day, Arthur C. Cunningham



Row 2: Bruce Shulte, James Spann, Charles Kurtz
 Row 1: Tamara Snyder, Charles Richardson, Atha Lamar (Pigg)

Anderson and Lieber Groups



Row 3: Ralph Carruth (in white)
Row 2: Ramona Bates, Xuemin Ye
Row 1: James Watson, Richard Anderson



Row 1: John Carter, Keith Andrew, Michael Lieber, Michael Schillaci
Row 2: Amanda Allen, Tacy Joffe-Minor

Pederson and Salamo Groups



Row 3: Steve Montgomery, Ken Vickers, Rudy York (in top row)
Row 2: Xuemin Ye, Roger Miller (standing on second and third steps)
Row 1: Tarlok Aurora, John Brewer, Don Pederson, Ron Foster (on first step)



Row 3: Steven Montgomery, Kevin Tennal
Row 2: Paul Breaux, Sergio Afonso, Brian Monson
Row 1: David Ramer, Greg Salamo, C.Y. Chen, Jan Yarrison-Rice

Gupta and Lacy Groups



Row 2: Allen Rose, David Pyrum, Brian Sawyer, Qifang He, Kevin Tennal
Row 1: Paul Glezen, Raj Gupta, Karen Williams



Bruce Shulte, Cynthia Sexton Proctor, Claud Lacy, and Jeffrey Sabby

Singh and Carmichael Groups



Row 2: Mansour Mortazavi, Marvin Young, Greg Holliday
Row 1: Daniel Erenso, Surendra Singh, Thomas Akin



Howard Carmichael and Perry Rice

Carmichael/Xiao and Vyas Group



Howard Carmichael and Min Xiao



Qifang He, Amanda Allen, Reeta Vyas, Daniel Erenso, Brian Sawyer

Gea-Banacloche and Oliver Groups



Juan Salazar Serna, Julio Gea-Banacloche, Timothy Burt



Bruce Schulte, William Oliver, Chris Wells

Stewart and Bellaiche Groups

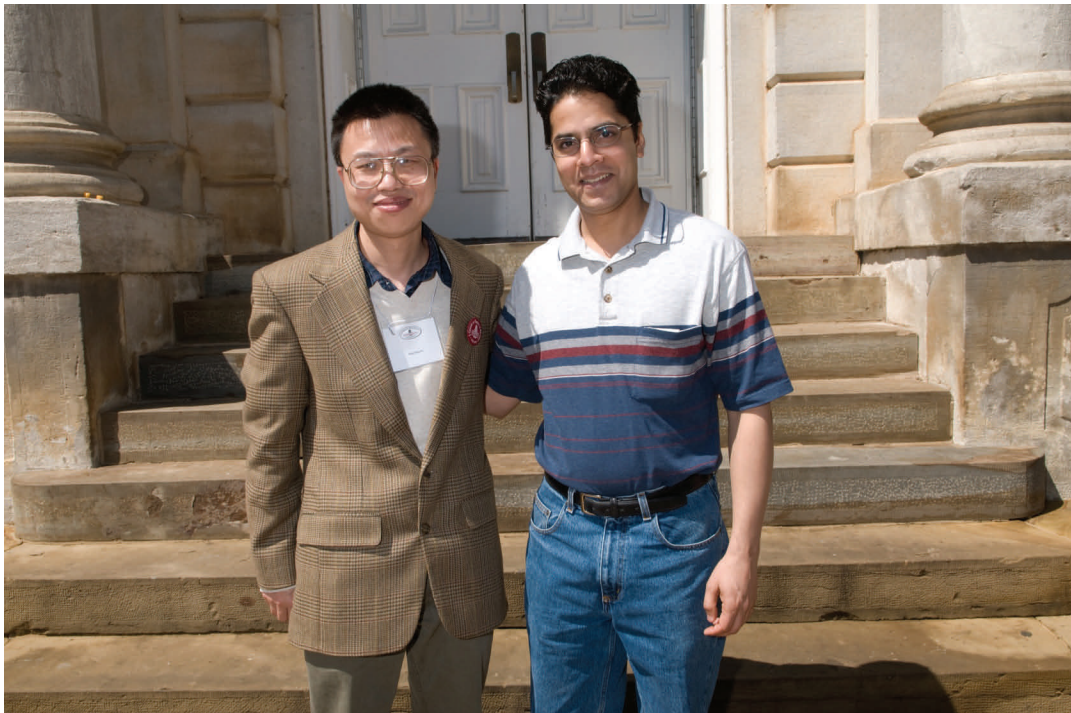


Row 2: Stephen Highland, Stephen Skinner, Jon Osborn
Row 1: David Norris, Kjell Tengesdal, Gay Stewart, Jon Osborn, Dianne Phillips



Alireza Akbarzadeh and Laurent Bellaiche

Fu Group and Clayton Group



Huaxiang Fu and Dileep Karanth



James K Hendren and Robert Gruebel (Prof. Clayton, is deceased)

Chan and Kennefick Groups



K.Y. Chen and Sergio Afonso



Julia (Smith) Kennefick and Shelley Bursick

Alumni with Undergraduate Degrees



Row 4: Jeff Sabby, Stephen Skinner

Row 3: David Norris, Dianne Phillips, Brian Sawyer, Chris Wells, Brian Hart

Row 2: Amanda Allen, Ramona Bates, Julia (Smith) Kennefick, Thomas Akin

Row 1: Bruce Schulte, unidentified, Tacy Joffe-Minor, Paul Glezen, Ken Vickers

Alumni with Degrees Received between 1959 and 1969



Row 3: Carolyn Cloud Stanley

Row 2: Gary Culp, Tom Atwood, Atha Lamar (Pigg), Raymond Higdon

Row 1: Kenneth Osborne, James Hendren (on first step in blue jacket), Robert Gruebel, David Ross,
Charles Simpson

News Release 1-Page 1



NEWS

University Relations • 800 Hotz Hall • Fayetteville, AR 72701
(479) 575-5555 • FAX (479) 575-4745 • <http://dailyheadlines.uark.edu>

THURSDAY, MARCH 27, 2008

PHOTO: Available for download at <http://dailyheadlines.uark.edu/>.

Physics Department to Unveil an Audiokinetic Sculpture During Centennial Celebration

FAYETTEVILLE, Ark. – In 1907, shortly after Einstein published his theory of relativity, the University of Arkansas created its physics department.

Over the next century, the department has blossomed into a thriving research group, with professors who study the properties of novel materials, many of which they create themselves in the laboratory. The physicists perform cutting-edge research in quantum and non-linear optics, nanoscience, ferroelectric studies and complex oxide interfaces.

The physics department will be celebrating its centennial with a series of events April 3, 4 and 5. The first will be the Centennial Robert Maurer Distinguished Lecture, given by 2001 Nobel laureate Wolfgang Ketterle at 7 p.m. April 3 in Giffels Auditorium, Old Main. The talk will be open to the public. This lecture will be followed by a series of talks on the history and current research in the department at 9 a.m. Friday in Giffels Auditorium.

On the afternoon of April 4 a George Rhoads audiokinetic sculpture will be unveiled by Provost Bob Smith at 1:30 p.m. in the Dickson Street lobby of the physics building.

“This audiokinetic sculpture, representing the principles of physics, will delight the students and public alike and commemorate this centennial celebration for years to come” says Surendra Singh, chair of the physics department.

Rhoads was educated at the University of Chicago and the Art Institute of Chicago. During the 1960s he began making copper kinetic fountains and rolling ball sculptures. Today his paintings and sculptures are displayed in such leading museums as the Art Institute of Chicago, the Museum of Modern Art, the Franklin Institute in Philadelphia, the Boston Museum of

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Science, public places such as Boston's Logan Airport, Los Angeles International Airport and a host of international locations including Israel, Spain, Japan and Australia.

"These creations, with their moving parts and comic intricacies reflect Alexander Calder's abstract constructions on the one hand and the cartoons of Rube Goldberg on the other," wrote Richard Kostlanetz in New York Times Magazine.

The unveiling will be followed by laboratory tours and the chance to see an exhibit of old physics instruments, posters depicting the milestone discoveries in physics since the birth of "modern physics" and an open house tour of its research laboratories. The instruments on display date back to the turn of the 20th century and include a hand-cranked vacuum pump, surveying instruments, slide rules, mechanical calculators, the first desktop computer and the first laptop computer.

"It is nice to be able to see what equipment we have been using through the years," said Raj Gupta, who has been collecting this equipment during his tenure at the university. These events are open to the public. This also will be a rare opportunity for the public to see the department's cutting-edge research laboratories, including its laser physics and nonoscillation laboratories.

The laboratory tours and old equipment exhibit will give visitors a chance to see how completely the physics department has transformed itself during the last century. From the first full-time physics teacher hired in 1908, physics has grown into a department of 18 tenure-track faculty and about 15 research faculty and post-doctoral associates. Faculty members have published more than 150 papers in the last three years, many in such journals as *Science*, *Nature*, *Physical Review Letters*, *Nature Physics* and *Nature Materials*. During that same time period, papers published by physics department faculty members have been cited by other researchers about 3,000 times.

The first undergraduate physics degree was awarded in 1928, the first master's degree in 1939 and the first doctorate in 1964; today there are about 100 physics majors and 35 graduate students in the department.

Physics research began in the 1920s, although it was not a university mandate at the time, Gupta said. The research program at the university continued to grow, and today the department has specialties in quantum laser physics and nanotechnology. Because of the research results of faculty members, the physics department was able to create the Center for Semiconductor Physics in Nanostructures, funded by a \$7.8 million grant from the National Science Foundation.



NEWS

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MONDAY, MARCH 31, 2008

Maurer Lecture by Nobel Winner to Highlight Celebration of Physics Centennial

FAYETTEVILLE, Ark. – The man who shared a Nobel Prize in physics for causing atoms to “sing in unison” and discovering a new state of matter will speak on campus April 3.

Nobel laureate Wolfgang Ketterle, director of the MIT-Harvard Center for Ultracold Atoms, will give the Centennial Robert Maurer Distinguished lecture “New Forms of Quantum Matter Near Absolute Zero Temperature” at 7 p.m. Thursday, April 3, in Giffels Auditorium, Old Main. The lecture is free and open to the public.

The lecture is part of a series of events the physics department of the J. William Fulbright College of Arts and Sciences has planned to mark its centennial and celebrate the achievements of its faculty, students and alumni.

In his lecture, Ketterle will describe a new form of matter called Bose-Einstein condensate, which exists at temperatures a million times colder than those in the depths of outer space. Bose-Einstein condensation is a state of matter that occurs when atoms are cooled to temperatures near absolute zero. Under such conditions, a large number of particles become locked together in the lowest quantum state of the system. Ketterle was one of the first scientists to observe this phenomenon in 1995.

Light can be corralled into behaving in a certain way; thus a laser beam differs from a light bulb, because in a laser beam the light particles have the same energy and oscillate together. In the Bose-Einstein condensate, Ketterle and his colleagues have been able to achieve the same effect in matter, using atoms instead of light particles. In fact, Ketterle

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The Robert D. Maurer Distinguished Lecture Series was established in 1995 to honor an alumnus who is often called “the father of optical fiber.” His research into the properties of pure glasses led to the development of optical waveguides, which replace wires with thin glass fibers and electrical current with light pulses. This technology continues to drive telecommunications in the 21st century.

For information on the lecture and other centennial events, please visit <http://www.uark.edu/depts/physics/centennial/index.html> to learn more.

CONTACT:

Raj Gupta, professor, department of physics
J. William Fulbright College of Arts and Sciences
(479) 575-5933, rgupta@uark.edu

Melissa Lutz Blouin, director of science and research communications
University Relations
(479) 575-5555, blouin@uark.edu

FAYETTEVILLE

Physics alumni mark 100 years of UA program

BY TRACIE DUNGAN
ARKANSAS DEMOCRAT-GAZETTE

FAYETTEVILLE — Two years into his engineering studies at the University of Arkansas, David Norris switched his major to physics, earned his bachelor of science and kept going.

"I enjoyed how the teachers in physics encouraged us to ask questions about the things we were studying," said Norris, a 1998 graduate of Parkview High School in Little Rock.

He preferred exploring ideas to focusing on scientific applications, he said. He is seeking a doctorate in physics at the University of Maryland after graduating from UA in 2003.

Norris is among the nearly 200 alumni of UA's physics department — there are only 700 in all — who reunited on campus this week to celebrate the program's centennial.

As a crowd of alumni, faculty and students gathered in the Physics Building lobby Friday afternoon to remember those changes, Provost Bob Smith unveiled a fun, physics-based audiokinetic sculpture for the occasion — an electric-powered contraption sandwiched between two panes of glass.

Reminiscent of the 1960s-era board game Mouse Trap, only more vertical, the sculpture's

See **PHYSICS**, Page 6B

Media Coverage –1
Arkansas Democrat Gazette, April 5, 2008.



Arkansas Democrat-Gazette/JASON IVESTER

A crowd gathers Friday at the physics department of the University of Arkansas at Fayetteville for the unveiling of the sculpture "Odyssey of the Spheres." The audiokinetic work by artist George Rhoads has been installed there to honor the department's centennial.

Media Coverage-2

(Arkansas Democrat Gazette, April 5, 2008– cont.)

Physics

• Continued from Page 1B
mini-pingpong balls clanged, clattered, bounced, rolled and dinged upon their release through a maze of tubes, pulleys, chimes, conveyors and other gizmos.

Smith finished his speech over the racket, noting that on this occasion, the themed necktie he wore was a Jerry Garcia design entitled "Like a twittering machine."

The alumni reunion also included exhibits, lab demonstrations, tours and Thursday night's Robert Maurer Lecture by Nobel laureate Wolfgang Ketterle. The director of the MIT-Harvard Center for Ultracold Atoms spoke on "New Forms of Quantum Matter Near Absolute Zero Temperature."

Originally, physics at UA was taught as part of the chemistry or engineering programs, but became a separate major in the 1907-08 course catalog, said Raj Gupta, a physics professor who has worked at UA since 1978.

The first peer-reviewed, published research paper didn't follow until 1926. In the 1930s and 1940s, the research mostly consisted of X-ray diffraction and acoustics, and there was some classified weapons research for the government. In the '50s and '60s, the university added more administrators to coordinate research as it moved toward more federally funded research and graduate education programs.

In 1987, UA physicists Allen Hermann and Zhengzhi Sheng achieved a highly publicized, major scientific breakthrough with the world's first observation of a thallium high-temperature superconductor. The university later used \$3 million from the discovery's licensing fee income to establish an endowment that finances a Washington-based lobbyist to help it land government research contracts campuswide.

Former UA physics professor



Arkansas Democrat-Gazette/DAN HALE

Raj Gupta, a physics professor at the University of Arkansas at Fayetteville, talks Thursday about his department's history next to a display case of equipment. The UA department is celebrating its 100th anniversary.

Richard Anderson of Alexandria, Va., and Don Pederson, now UA's finance chief, recalled being part of a three-member team on a project dubbed LOIS. The team, which also included Ray Hughes, was the first to demonstrate a laser-originated ion source.

"It produced low-energy, heavy multicharged ions," Pederson said. In the days before nanotechnology, scientists would scatter the ions onto surfaces to see how they would respond. The ions were created as tools for other research projects.

There was William Harter's discovery of an unusual, soccer ball-shaped molecule made of carbon nanotubes dubbed "Buckyball," which led to a Nobel prize in chemistry for researchers elsewhere who took the research further.

"He was the first to theoretically predict that this structure could exist in nature," Greg Salamo, a UA distinguished professor of physics, said of Harter, adding that science is all about standing on the shoulders of those who have gone before.

UA physics may attract and

serve fewer students than some other campus departments, but faculty say Arkansas is not alone in that respect.

And UA was recognized nationally last year at an American Association of Physics Teachers symposium as thriving among its physics counterparts around the country, said Surendra P. Singh, chair of the physics department.

It posted the third-highest growth in physics bachelor degrees awarded among doctoral-granting universities for a period ending in 2005, a 148 percent increase to 19 degrees, and matched or nearly matched other fast growers in actual numbers, according to the journal *Interactions* in an article exploring why the rate of physics majors has fallen nationally since 1970.

UA committed to bolstering its undergraduate physics numbers in 1994 by bringing in Gay B. Stewart to improve teaching, Gupta said. Stewart is still there, as an associate professor.

Steve Highland, an alumnus from Duluth, Minn., called Stewart a "miracle worker" for students there.

Physics Department Marks Milestone



Graduate student Blake Anderson looks at George Rhoads' audiokinetic sculpture Friday at the University of Arkansas physics building during the centennial celebration of the physics department at the university.

UNIVERSITY PROGRAM KNOWN FOR NANOTECHNOLOGY RESEARCH

By Dan Craft

THE MORNING NEWS • DCRAFT@NVAONLINE.NET

FAYETTEVILLE — The czar in Russia was having problems in 1908. The Chicago Cubs were about to win the World Series. Automaker Henry Ford introduced the revolutionary Model T.

University of Arkansas students got their first chance to take one of 11 classes offered in the field of physics.

A century later, the physics department is bigger, with 85 undergraduates, 30 graduate students and 28 faculty members. Much of the research, however, is a whole lot smaller.

"You literally can't see my research. It's being built one atom at a time," said graduate student Rob Sleezer. "The machinery is big, but the product is very small."

Sleezer's work with micro-electrics is just one aspect of nanotechnology, the microscopic structures that have become a signature area and brought national recognition to the department.

"We're talking about something that's one one-millionth the width of a human hair. It's almost down to the size of an atom," said Greg Salamo, a professor in the department.

SEE PHYSICS PAGE 2A

Media Coverage-4 (Morning News, April 5, 2008 –Cont.)

PHYSICS: Creation Showing Lighter Side Of Physics Unveiled

CONTINUED FROM PAGE 1A

Faculty, students, alumni and friends got a firsthand look at some of the amenities at a centennial celebration Friday.

The department also unveiled the Physics Instrumentation Museum, a collection of some of the many research tools used over the past 100 years.

From sextants and telegraph keys to cathode-ray tubes and slide rules, oscilloscopes and early computers, the display documents the changes in technology, both used in physics research and developed through advances in the field.

"I last taught in 1992, and the research is evolved far beyond what it was when I was here," said Don Pederson, the vice chancellor for finance and administration. "It's hard to fathom the changes over a century."

Also unveiled Friday was a creation showing off the lighter side of physics.

"I last taught in 1992, and the research is evolved far beyond what it was when I was here. It's hard to fathom the changes over a century."

DON PEDERSON

Vice chancellor for finance
and administration

The Odyssey of the Spheres is a moving, noisemaking sculpture by George Rhoads that incorporates different principles of physics, using moving balls to create different sounds.

Back in the lab, Sleezer admits that low-tech is still an important part of his work. Ports on the "ridiculously expensive" molecular beam epitaxi machine he uses are wrapped in something that looks suspiciously like household aluminum foil.

"Oh, yeah, we use a lot of that stuff," he said.