Physics CWRU

Dear Alumni and Friends:

Time flies! It seems impossible that five years have passed since our last newsletter to you. This has been a period of remarkable activity, growth, and success for the department. I am pleased to state that we are well on our way to achieving the goal that brought me to CWRU from Yale seven years ago: to build one of the premier mid-size physics departments in the country. The activities and accomplishments over the past five years are too numerous to completely cover in this letter, but let me highlight a few.

On the undergraduate front, we have completely overhauled our curriculum. The introductory physics laboratories, which were under construction at the time of the last newsletter, have been completed and now service over 600 undergraduate students each year! We have created four new exciting undergraduate physics degree programs: An Engineering Physics Major, which provides for many students the best of all possibilities: an engineering degree and a physics major; a B.S. in Mathematics and Physics, which provides our mathematically inclined students with an opportunity to study physics without sacrificing mathematical rigor, and at the same time, an opportunity for these students to pursue their interest in physics without other compromises; a new B.A. in Physics, which allows students the opportunity to experience physics at all levels of complexity while allowing sufficient flexibility so that they may pursue another major in arts or humanities; a new B.S. in Physics with teaching licensure, carried out in collaboration with John Carroll University, to encourage the preparation of first rate high school science teachers.

In addition, we have introduced a very successful full year senior project into our degree program, allowing students the opportunity to work one-on-one with a faculty member on a research project. These projects have already produced impressive research results, including numerous publications, and have provided our students with an opportunity to excel in graduate school or in the workforce. All of our work to enhance the undergraduate program seems to have paid off in increased enrollment. Indeed, bucking a national trend in declining enrollments in physics programs, we have tripled the number of our physics majors, with up to thirty students per class, making us one of the largest programs, per student population, of any research university in the country!

On the graduate front, we have continued to increase both enrollment and quality in our graduate program. Students from around the world regularly apply to our program,, and I am pleased to say that a number of our incoming students have chosen to come to CWRU over other major research institutions in the

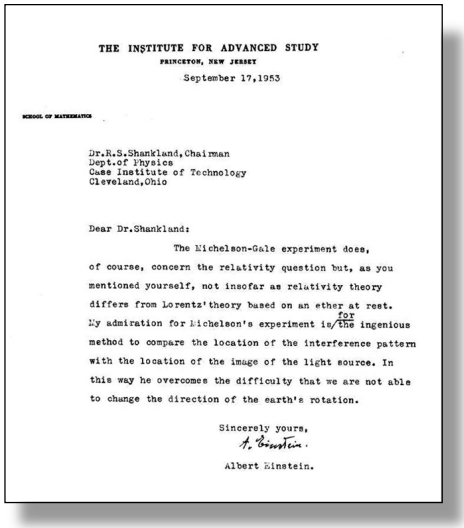
United States. We are continuing our efforts to recruit more broadly in this regard. With our exciting influx of new faculty and research programs, CWRU is becoming an increasingly attractive place to study. Most recently, we have been awarded two consecutive grants from the Department of Education to support Graduate Assistantships in areas of National Need (GANN). These have provided graduate support for six students in our various condensed matter programs.

Complementing all of these developments is the creation of a very new and exciting professional master's degree program, the Master's Degree in Physics Entrepreneurship. This program has now admitted its first set of graduate students, and follows two years of preparation during which we had alumni and other physicist-entrepreneurs back to the department to advise us of what an optimal program might consist. Throughout this period we relied on the generous support of alumnus Robert Stieglitz, who funded a seminar series in this area. Sadly Robert died two years ago, but he left the department a bequest that has allowed us to make the program a reality. We are extremely excited about the possibilities and believe it will represent a brand new paradigm in graduate education. It is currently being directed by Professor Cyrus Taylor, and you will have the opportunity to read more about the program and its students later in this newsletter

During the past five years our faculty have continued to flourish in both their teaching and research programs, and we have been fortunate to add one new faculty member to our department. Corbin Covault, currently an assistant professor at the University of Chicago, will join our department next year. He is a particle astrophysics experimentalist whose presence will bolster the already strong program of research being carried out by Associate Professor Dan Akerib. We have plans to hire two new faculty members this year, and two next year, in order to make up for retirements that have taken place over the past five years. Again, more details about faculty awards, promotions, and retirements can be found later in this newsletter.

We are very excited by all of these developments, and they are paying off. Our new faculty are carrying out award winning research, our students are better trained and more excited, and we are leading the University into the next century with new educational programs. We hope that you, our alumni, will be pleased to know of recent developments in the department and that some of you will consider pledging funds to one of several different endowments which assist in supporting physics at CWRU. The endowments which exist within the purview of the Case Alumni Association honoring former faculty include the Robert S. Shankland Fund, which helps support undergraduate education, and the Arthur H. Benade Fund, which supports several undergraduate prizes.

The College of Arts and Sciences has now established several new endowments to support our efforts. These include the Shankland-Einstein Endowment, begun by a gift from Eleanor Shankland of the letters from Einstein to Bob Shankland. These were auctioned off last year, and the proceeds are being used to establish a graduate fellowship endowment. We've also inaugurated the William L. Gordon fund to recognize Bill for over a decade of dedicated leadership. Finally, and most recently, as we describe on the next page, we have inaugurated a Leslie L. Foldy endowment fund. Following upon Les's recent and unfortunate passing, we have decided to establish a fund to attempt to create an endowed professorship in his honor. In order to achieve this goal, we will have to raise $2 million. We are hoping that alumni and friends will be excited about the possibility of establishing the Leslie L. Foldy Chair of Physics to honor one of the pre-eminent theoretical physicists of the second half of the 20th century. If you wish to contribute to this fund, please send a check to the department, payable to the Leslie L. Foldy Endowment fund.



THE INSTITUTE FOR ADVANCED STUDY
PRINCETON, NEW JERSEY

September 17,1953

SCHOOL OF MATHEMATICS

Dr.R.S.Shankland,Chairman
Dept.of Physics
Case Institute of Technology
Cleveland,Ohio

Dear Dr.Shankland:

The Michelson-Gale experiment does, of course, concern the relativity question but, as you mentioned yourself, not insofar as relativity theory differs from Lorentz' theory based on an ether at rest. My admiration for Michelson's experiment is for the ingenious method to compare the location of the interference pattern with the location of the image of the light source. In this way he overcomes the difficulty that we are not able to change the direction of the earth's rotation.

Sincerely yours,

A. Einstein.

Albert Einstein.

Alternatively, if you wish to support any of the other endowments, or to send a gift to physics, we shall be most appreciative. We depend upon our alumni for support so that we can continue our efforts to move the department into the 21st century with a running start.

You may have heard that President David Auston has resigned, citing differences with the Board. While this is a temporary setback for the University, I want to assure all our alumni that the plans and programs of the Physics Department are proceeding along full speed. I have regularly interacted with our interim President, Jim Wagner, who understands and appreciates the momentum of the department as we continue to create new programs and rise in international prominence. I can assure you all that we have his support, and the support of the board as well during this period. As far as our own efforts are concerned, we fully expect full cooperation from any new administration.

Lawrence M. Krauss
Ambrose Swasey Professor of Physics
Professor of Astronomy
Chair of the Physics Department
lmk9@po.cwru.edu

Leslie L. Foldy 1920–2001

Leslie Foldy, the Institute Professor Emeritus of Physics at CWRU, was an internationally recognized expert on quantum physics and the theory of relativity. His pioneering studies on the behavior of electrons moving at high velocities were the foundation of numerous advances in understanding the behavior of solids, molecules, atoms, and subatomic particles. Professor Foldy died January 18, 2001, of a heart attack. He was 81. Memorial contributions can be sent to the Leslie L. Foldy Memorial Fund in CWRU's Department of Physics.

Born in Sabinov, Czechoslovakia, Foldy graduated from Case Institute of Technology in 1941. After graduate work at the University of Wisconsin, he joined Columbia University in 1942 for war work on the problem of detecting enemy submarines. He earned his Ph.D. from the University of California at Berkeley under J. Robert Oppenheimer in 1948, then joined the CIT faculty. He taught at CWRU until his retirement in 1990.

Among his principal achievements was a theory of how waves scatter repeatedly from an array of obstacles. Originating from his wartime work on underwater sound, it formed the basis for countless later developments in many areas of physics.

His widest recognition, however, came from work done together with Sieg Wouthuysen of the Netherlands. They took a most important step in understanding how predictions could be made from the unification of special relativity and quantum mechanics, the two great revolutions in theoretical physics. Prior to their work, there was no method for comparing the predictions of this theory, called quantum electrodynamics, with a wealth of new atomic experiments. The "Foldy-Wouthuysen transformation,, told physicists how to predict the effects of relativity from standard quantum mechanics. The famous "Foldy term,, was a triumphantly successful example of one of these predictions.

Les was a revered colleague, teacher, and mentor whose former students are among the leaders in research and teaching in universities and laboratories throughout the world. He was active in campus anti-war activities during the Vietnam era. During that time, he played an influential role on a decision by the CWRU Faculty Senate to suspend classes after the shootings at Kent State University. He is survived by his wife Roma, son Seth of Milwaukee, daughter Erica of Boston, and two grandchildren.

THE LESLIE L. FOLDY CHAIR OF PHYSICS

After consultation with the Foldy family and members of our department, we have concluded that the most appropriate way to celebrate Professor Foldy's many years of service and devotion to Case Western Reserve University is to establish a Chair of Physics in his honor. In this way, the Foldy name and his memory will continue to be an official part of our department for decades to come.

We invite all our alumni and friends to consider participating in this effort. Endowed chairs provide very important ongoing support for a department, freeing up funds for young faculty members. A fully endowed chair currently requires gifts totaling $2 million.

Please help us succeed in establishing this memorial to the memory of Les Foldy by sending a contribution to the department, targeted to the Leslie L. Foldy Endowment Fund. I invite you to contact me personally if you would like more information on the status of this project.

Lawrence M. Krauss

Promotions and Honors for Our Faculty

Krauss Honored for his Research and Communicating the Excitement of Physics

Awarded Prizes by AAAS, APS, and AIP

Last year, **Lawrence Krauss** was recognized by the AAAS with the awarding of the Award for Public Understanding of Science and Technology. This prize was won in 1995 by Carl Sagan. Krauss was specifically cited for his "global impact as a science communicator and the ability to maintain an active science career while writing several books about physics for the general public.,,

Subsequently, Krauss was named the winner of the Julius Edgar Lilienfeld Prize by the American Physical Society. This is one of the highest honors of the society for "a most outstanding contribution to physics.,, Krauss' citation reads: "For outstanding contributions to the understanding of the early universe and extraordinary achievement in communicating the essence of physical science to the general public.,,

In April 2001, we learned that Lawrence had been chosen as the recipient of the AIP's Andrew Gemant Award, recognizing "the accomplishments of a person who has made significant contributions to the understanding of the relationship of physics to its surrounding culture and to the communication of that understanding.,, (Previous awardees are: R. R. Wilson, Abraham Pais, Steven Weinberg, Stephen Hawking.)

And just to top off the year, Lawrence was elected Fellow of the APS.

Lawrence has extended his series of books describing, for the non-technical reader, the exciting developments in particle-astrophysics and cosmology. His latest work *Atom* has just been released. In it he traces the life of an oxygen atom from its component quarks in the Big Bang through stellar, planetary, and biological evolution and on into the future.

Two New Professorships

Two more members of the physics faculty have been recognized for their teaching and scholarship. **Cyrus Taylor** is now the Armington Professor of Physics. The Armington Professorship was established to "encourage the development of qualities of individual initiative tempered with appropriate concern for the rights of others.,, **Arnie Dahm** has been named Institute Professor of Physics, joining Les Foldy and Bob Brown as the third physicist to be so honored.

Two NSF Career Awards

Dan Akerib

Glenn Starkman

Dan Akerib and **Glenn Starkman** have both been awarded NSF Career Awards. These awards are made to young researchers who have demonstrated that they are well on their way to productive research careers. Dan's project is entitled "A Research and Development Plan: Detecting WIMP Dark Matter and Developing Physics and Cosmology Exhibits with the Great Lakes Science Center.,, Glenn's is "Dark Matter and Mass: from the Early Universe to the Laboratory,,.

A Sloane for Mathur

Harsh Mathur

Harsh Mathur, who specializes in condensed matter theory, has been awarded a very prestigious Sloane Fellowship for his work in electron waves in random media, mesoscopic physics, geometric phases, and chaos.

APS Fellow Brown

Bob Brown, who, along with his longtime collaborator Mark Haacke, recently published an exhaustive text on magnetic resonance imaging, has been named Fellow of the APS. In February 2001, Bob and his former student, Hiroyuki Fujita, organized a major international workshop on MRI Hardware on the CWRU campus. More than 220 participants from fifteen countries took part in this event of the International Society for Magnetic Resonance in Medicine. The workshop explored the state-of-the-art in MRI hardware developments; technology trends in MRI; RF and gradient coils and electronics; magnet and spectrometer designs; and other topics of interest to MRI scientists, physicians, engineers and students.

Professorships

It is a pleasure to report that Gary Chottiner, Walter Lambrecht, Kathy Kash, and Tanmay Vachaspati have all been promoted to full professor.

Even though he has taken over the duties of director of undergraduate studies, **Gary Chottiner** somehow finds time to continue his surface physics research program. Working closely with faculty and graduate students from the department of chemistry, his research focuses on lithium/metal, lithium/semiconductor and lithium/polymer interfaces, and other material systems of interest for energy storage.

Walter Lambrecht continues the work on electrons in materials that he and Ben Segall have pioneered. Much of his recent work has focused on the emerging area of wide-band-gap semiconductors, such as diamond and silicon carbide. These materials have the promise to revolutionize the electronics and opto-electronics technologies.

Kathy Kash studies the optical properties of quantum semiconductors by the ingenious manipulation of excitons trapped in quantum wires and dots. Her work dovetails nicely with other research in optical materials within the department.

Tanmay Vachaspati is studying the potential role of magnetic monopoles, cosmic strings, and domain walls in the formation of the structure observed in the universe. He is interested in the connections between such topological defects and the particles of the Grand Unified Theory.

Also promoted are **Dan Akerib**, **Glenn Starkman**, and **Harsh Mathur** who have become tenured associate professors. Dan's work on the search for cold dark matter is nearing the installation of his cryogenic detectors in the Sudan mine in Minnesota.

Glenn, in addition to his ongoing work on cosmic topologies, has been studying the possibilities of directly observing planets beyond our solar system by using a space based telescope in conjunction with a large occulting sail to block light from the parent star.

Harsh's interests concern a wide range of physics problems. Among these is work on electron waves in random media, which has important implications for the development of ever-smaller semiconductor devices.

What Are We Doing These Days?

What with all the retirements from the department over the past several years, some of our alumni may be wondering about who the current members of our faculty are and what they do. We invite you to check out our Web site: http://erebus.phys.cwru.edu/phys/index.shtml

Try the "Faculty,, and the "Research,, links to learn about the research being done in our department.

Five New Emeriti

There have been several retirements since the last newsletter: **John McGervey**, **Bill Fickinger**, **Stefan Machlup**, **Ben Segall**, and **Bill Tobocman** have been awarded emeritus status. They join **Marshall Crouch**, **Bill Gordon**, **Dick Hoffman**, **Glenn Frye**, and **Tom Jenkins** on the list of faculty members who have devoted 30, 40, or more years to teaching and research in our department.

We sadly report that both John McGervey and Dick Hoffman are very ill, and we extend our best wishes to their wives and families.

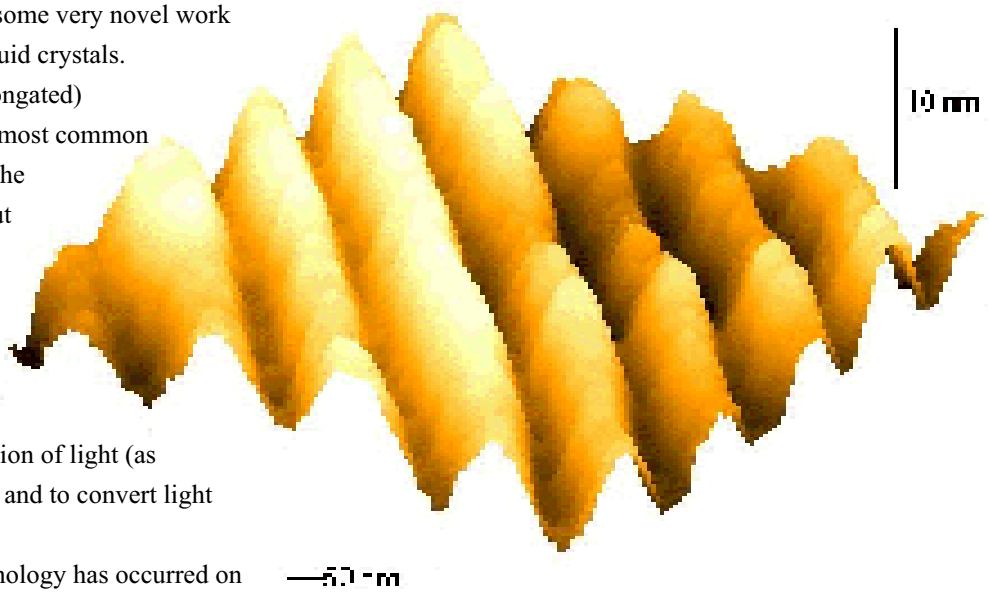
Ben Segall and Bill Tobocman are continuing their research in electron structure and medical ultrasound tomography respectively. Stefan Machlup is also to be found in his office, where he continues to study the biological effects of em fields.

Bill Gordon spends much of his time working in the department on his papers and on various alumni-related projects. Tom Jenkins has been traveling and enjoying visits with his family, as well as actively promoting environmental and defense issues through the Sierra Club.

Bill Fickinger has been doing some traveling and enjoys working on several projects within the department, for example, putting this newsletter together and organizing the Robert Shankland and the Dayton C. Miller files and Miller's turn-of-the-(last)-century acoustic equipment. He has been compiling a directory of physics faculty, from Elizur Wright, hired by Western Reserve in 1829, to Corbin Covault who will arrive in 2001. Fickinger's plan is to put together a "departmental time line,,, tracking our research interests over the past 170 years. A common thread among most of our emeriti is that they find it difficult to sever their ties to the department.

Liquid Crystals and AFM Nanolithography

Chuck Rosenblatt's group is doing some very novel work on controlling the optical properties of liquid crystals. These materials consist of ansiotropic (elongated) molecules that form oriented phases. The most common of these is the "nematic,, phase, whereby the molecules orient along a particular axis but otherwise have no long-range positional order. Because of their anisotropic electrical and optical properties, liquid crystals can be electrically manipulated to produce many useful optical properties, including the ability to rotate the polarization of light (as in the ubiquitous twisted nematic display) and to convert light from linear to elliptic polarization.



AMF microscope image of a substrate after rubbing with a stylus

To date, most of the science and technology has occurred on length scales of order 2 micrometers and above. For the past year, however, the group has engaged in nanolithography of the substrates that comprise a liquid crystal cell. This is done by first depositing a polyimide on the substrate and then using the ultrafine stylus of an atomic force microscope (AFM) to scribe patterns into the polyimide. When two substrates are placed together to form a cell, which is then filled with a liquid crystal, the liquid crystal molecules align parallel to the local rubbing direction. In consequence, we have created cells with individual pixels as small as 100 nm, facilitating the design of novel electrooptic devices.

For example, a major issue in optical communications is the ability to non-mechanically switch a laser beam from one fiber to another. Using the AFM nanolithography technique, Rosenblatt's group has created an architecture, based on optical grating concepts, that can switch the direction of the beam, independent of its polarization. Despite these technological successes, they continue to bear in mind that this is a physics, not an engineering, department. Thus, with the ability to manipulate the liquid crystal director on such short length scales, they are also investigating concepts such as elasticity and the effects of surface roughness on phase transitions.

Physics and Astronomy Departments Co-operate in Attracting Graduate Students

A student coming to CWRU may decide to seek a doctorate in physics or in astronomy. Often a student will find it difficult to choose between the two programs. The two departments have been looking at the common elements in their requirements with the intention of attracting additional excellent students. By arranging the content and timing of the required courses, the graduate committees of the two departments expect to make it possible for the student to matriculate and commence his or her studies, while deferring for at least one year a final decision on which degree to pursue. This proposal stems from experiences common to both departments in which an attractive candidate for graduate study has chosen a graduate program at a competing university because of perceived greater flexibility.

Timken Fellow Chooses Astrophysics Theory

As a junior in high school, Manon Grugel was fortunate to participate in the mentorship program sponsored by the Rotary Club. She learned about dark matter and the fate of the universe from Lawrence Krauss, who had volunteered to be her mentor. After she completed her B.A. in physics and math from the College of Wooster, she enrolled at CWRU as a graduate student in physics with financial help from the Timken Fellowship. She is once again working with Krauss, this time on a project involving constraints on the cosmic equation of state. She hopes to complete a Ph.D. in particle astrophysics and to go on to do theoretical research at an academic institution.

Corbin Covault
Experimental Astrophysicist Joins the Faculty

Over the past half-dozen years, the department has been extremely fortunate in attracting a group of successful young researchers and teachers to its ranks. The latest addition is **Corbin Covault** who has been at the University of Chicago since 1990, where he has been active in research as an experimentalist in high-energy astrophysics and gamma-ray astronomy. He did his B.S. at MIT and his Ph.D. at Harvard. He has played a innovative role in the undergraduate teaching program at Chicago.

Corbin is currently working on the Solar Tower Atmospheric Cherenkov Effect Experiment (STACEE). This experiment features a ground-based detector of 40 to 300 GeV gamma-rays from astronomical sources. They have reported on their first results: the detection of the Crab Nebula at about 100 GeV. He expects to continue work in this collaboration when he arrives at CWRU next year, as well as being involved in a satellite-based experiment, GLAST, which is planned for launch in 2005.

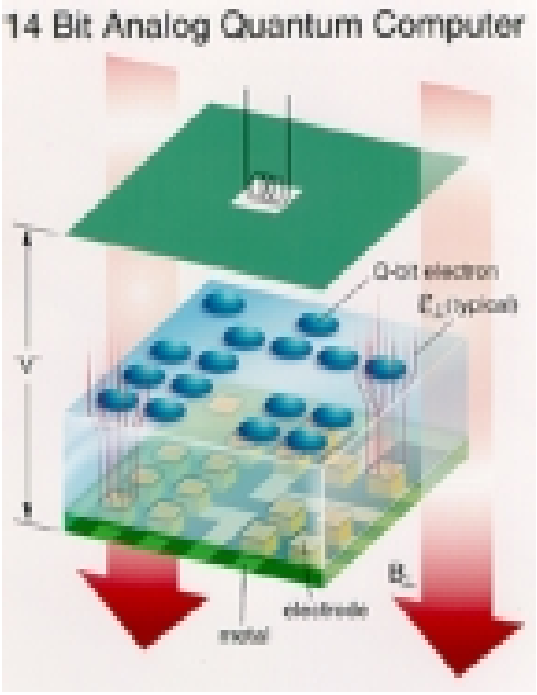
Corbin's addition to the department will provide a perfect complement to the WIMP search experiment that is the principal interest of Dan Akerib who has been with the department for five years. This experimental astrophysics research will in turn balance the theoretical astrophysics work being done by Glenn Starkman, Tanmay Vachaspati, and Lawrence Krauss. Our undergraduate majors and graduate students have profited from the research opportunities in both astrophysics theory and experiment.

Qubits Floating on Helium

Arnold Dahm has recently initiated a new long-range program in the physics department that is aimed at building a quantum computer. Quantum computers will be millions of times faster than ordinary computers by using super-parallel processing and will be able to solve large-scale simulations that conventional computers cannot attack because of time limitations. They will be used to factor huge numbers into their primes for encryption purposes and to solve other large problems.

A conventional computer is binary, that is, it has "bits,, that are in one of two states, either 0 or 1. Computing operations involve changing the value of one or more bits. Quantum computers are made up of quantum bits (qubits). A qubit is comprised of an 'admixture' of a 0 and a 1. It is described as $b(0) + c(1)$. Here b^2 and c^2 are the probabilities of finding the qubit in states 0 and 1, respectively. These bits are comprised of quantum mechanical states that can be manipulated. The computer "program,, is written by specifying the value of b and c for each bit. Calculations are made by letting neighboring qubits interact for predetermined amounts of time (This changes the values of b and c for these qubits.) and by changing the values of b and c for particular qubits by an external means. The solution to the problem is found by measuring which qubits are in states 0 and 1 at the end of the calculation.

Prof. Dahm's system consists of electrons on the surface of a liquid helium film. Helium is a dielectric that attracts electrons to the surface but prevents them from penetrating into the bulk liquid. The proposed qubits are made up of the two lowest quantized energy levels of the system, which are the quantum-mechanical ground state (0) and the first excited state (1). A fraction of the excited state is admixed into the ground state by imposing microwave radiation at the energy difference between the two states.



Electrons (the spheres) are supported above a liquid helium film and confined by the electric field generated by voltages applied to the electrodes beneath the film. The source of electrons is in the hot filament above the hole in the upper electrode.

The Coldest Spot in Town

Our New Low-temperature Facility

The transformation of the old van de Graaf accelerator room in the basement of Rockefeller into a new low-temperature particle detector facility has recently been completed. The space has been modified to house an RF enclosure and a dilution refrigerator. **Dan Akerib** and his group are using the refrigerator to test and develop particle detectors for use in an astrophysics experiment to search for weakly interacting massive particles (WIMPs).

These particles are candidates for the long-sought "dark matter,, which appears to permeate the cosmos and is so far revealed only through its gravity. Since the particles are not only weakly interacting (like neutrinos), but also relatively slow moving (about one-thousandth the speed of light—slow for an elementary particle!), they deposit only a small amount of energy when they occasionally scatter from a nucleus in a particle detector. The individual germanium and silicon detectors being developed have masses of 250 and 100 grams each, respectively. Each is coated with a film of superconducting tungsten. An array of these detectors is then maintained at about 20 mK. An interacting WIMP will deposit in the order of 10 keV in the detector causing a microkelvin change in temperature in the tungsten, enough to drive it normal.

Preliminary results already indicate that the WIMP flux is less than that expected in some supersymmetry models and less than the rate reported by a competing European group. The detectors will soon be installed in an iron mine in northern Minnesota, where the 2,000-foot overburden will shield them from cosmic radiation.

The millikelvin refrigerator

The Day the Lions Fell

One day in November 1996 an unusually early lake-effect snow hit Cleveland—putting about a foot and a half of very wet stuff on Rockefeller's roof. At about 7 P.M. there was a loud whoosh-thud, first at the front of the building, shortly after at the rear. Not only did all the snow slide down the ceramic roof tiles, but most of the stone lions and grape bunches went along for the ride. The falling debris took off the nice little balcony over the front door, broke up the front steps, and flattened all the wonderful old cherry trees. Luckily, no one was in the impact zone.

After the avalanche, the wrecking ball was brought in to knock down the recalcitrant lions.

One theory is that our new use of the attic as teaching labs may have altered the heat flow through the roof, precipitating the avalanche. In any event, it took until April 1998 to get the building back to Dayton Miller's specifications. For over a year the building hid within a cage of scaffolding, accessible only through scruffy plywood tunnels. Some of the hundred-or-so lions landed unharmed in the snow, but many had to be replaced by new terra cotta castings. A few of the less gravely injured hundred-pound cats were spirited away during the night and can be seen decorating offices and gardens around town. All the repairs were completed, the balcony returned to the pigeons, and new trees and bushes planted in time for the 1998 graduation day.

Foldy and 't Hooft Feted


Gerardus 't Hooft

In April of 2000, the department and many of its friends enjoyed an extraordinary double-header event: the Michelson Lecture by the 1999 Physics Nobel Laureate, Gerardus 't Hooft and a Festschrift honoring Les Foldy's 80th birthday. Professor 't Hooft presented the fifth lecture in the current Michelson series to a packed Strosacker Auditorium. In an animated version of his Nobel lecture, 't Hooft described his work with Martinius Veltman, which resulted in the successful mathematical treatment of the gauge theory of elementary particles. Krauss described 't Hooft's impact on particle physicists as astounding, with almost all major ideas associated with particle physics since the 1970's being related to 't Hooft's work—including the observation of the top quark and today's string theory.

Our guest remained with us through the weekend so that he could join in the Foldy celebration. Not the least of his activities in Cleveland was his attendance, along with a dozen members of the department, at a Cleveland Indians baseball game. The club-owner's box was turned over to the party to celebrate the Laureate's visit to Cleveland—complete with a welcoming salute on the big score-board.

On the following day, the Foldyfest took place: *"Modern Understanding of The Strong Interaction and Other Broad-ranging Aspects of Professor Foldy's Physics Life."* In a daylong symposium, six talks were given: Some were descriptions of the important theoretical physics work done by Prof. Foldy, while others included reminiscences of his interactions within the department for the past fifty years. The participants, including many of Les' former students, enjoyed presentations by professors 't Hooft, James Bjorken, Ken Kowalski, Frank Wilczek, Mark Wise, and Phil Taylor.

Michelson Post-doctoral Lectureship A Uniquely Successful Program

The 2001 Michelson Post-doctoral Lectureship was awarded to Jonathan Feng, a graduate of Stanford, who is currently at the Center for Theoretical Physics at MIT. In this program, each year a young scholar is invited to spend a week in the department, during which time he or she presents three seminars and a colloquium. The scholars are chosen from among nominees suggested by senior physicists at the nation's prestigious universities and laboratories. Dr. Feng is one of the brightest young stars in the field of high energy physics phenomenology. His lectures examined supersymmetry, dark matter, and current determinations of the cosmological constant.

In the spring of 2000, the department hosted Keith Schwab as the fourth lecturer in this unique program. Dr. Schwab is Senior Physicist for the National Security Agency at the University of Maryland. His topic was the experimental observation of quantum effects in macro- and mesoscopic systems, including the observation of a universal quantum of thermal conductance.

The preceding guest lecturers in the program were Thomas Walther from Texas A&M University, who spoke on applications of laser spectroscopy; Christopher Fuchs from Caltech, who spoke on quantum information theory; and Joe Mohr from the University of Chicago, who spoke on cosmic x-rays, galaxy clusters, and cosmology.

The lectureship program is organized by Glenn Starkman (gds6@po.cwru.edu), who will be happy to receive suggestions from our alumni.

Rockefeller Restored and Rededicated

After two years of musical chairs, moving physics offices and laboratories around the campus, the Rockefeller renovation was completed in the spring of 1996. April 23 brought drenching rain to Cleveland, but the rededication celebration made for a fine day in Rockefeller. Events started with an opening ceremony in the Shankland Lecture Hall, which included a welcome from then President Agnar Pytte, and a presentation by Bill Fickinger, which included a brief history of the physics done in Rockefeller between 1905 and 1940 featured many of Dayton Miller's original lantern slides.

Alumni Richard Garwin, (B.S.'47), IBM Fellow and science adviser to three presidents, and James Krumhansl, (M.S.'40), professor at Cornell, shared reminiscences of studying physics here and made some encouraging remarks on the direction the department is taking.

Research and teaching labs were open throughout the day. Lawrence Krauss lectured on *"The Physics of Star Trek"* for a large audience in Strosacker. Bob Brown, Glenn Starkman, and Kathy Kash presented talks on physics teaching and research at CWRU. Many alumni and friends spent a pleasant day in Rockefeller, where a catered lunch was served to all. The guests found especially interesting their interaction with physics majors who prepared a poster session describing their senior projects. The event was well covered by the *Cleveland Plain Dealer (PD)* and local television news, resulting in a full-page spread in the Sunday *PD*.

Physics Entrepreneurship M.S.

Under the leadership of **Cyrus Taylor** and with the generous help of a CIT graduate, the late Robert Stieglitz (B.S.'62, Ph.D.'68), the department has inaugurated a new graduate program leading to a Master's degree in Physics Entrepreneurship. The purpose of the program is to provide students who have some background in physics and an interest in technological innovation with the training and experience they need in order to effectively apply their skills to real world problems in innovation.

The two-year program will consist of courses taught by the Department of Physics, including a new two-semester sequence on Modern Physics and Innovation and a core of courses taught by the Weatherhead School of Management: New Venture Creation and Technology Entrepreneurship. The student will submit a physics master's thesis involving an entrepreneurially oriented project. The thesis will typically arise from an entrepreneurially oriented internship in a sponsor company or from a student-designed research project that will be the basis for launching a new venture.

Out of a large pool of applicants, five students were chosen for the program's first class. These students have degrees in physics or engineering, ranging from the B.S. to the Ph.D.

Michael Fisher: Michelson Lecturer

In February 1999 the distinguished physicist Michael E. Fisher presented the 1999 Michelson Lecture: "Pictures, Models, Approximations and Reality: Phase Transitions and our Understanding of the Physical World.,, Fisher, a Distinguished University Professor at the University of Maryland, currently works in statistical mechanics, the theory of condensed matter, physical chemistry, and the associated foundational and mathematical problems. His contributions to the modern theory of critical phenomena and phase transition have been essential to the understanding of these areas of physics.

From Professor Fisher's abstract: "the talk addresses the question: 'What is the role of the theorist in modern science?' The power of analogy based on physical pictures and simple models will be illustrated in the context of recent ideas concerning phase transitions and critical phenomena in fluids and magnets, and in alloys and polymers. The significance of the concepts of shape and singularity in the search for universality will be explained; the role of symmetry and dimensionality in our current insights will be touched upon.,,

Department Hosts "Town Meeting" on National Missile Defense

In the fall of 2000, several of the physics faculty invited the Congresswoman Stephanie Tubbs-Jones (a CWRU alumna) to meet with them to discuss the proposed National Missile Defense system (NMD). She was interested in the opinions and concerns of the physics community about the desirability and feasibility of various approaches to ballistic missile defense. As a result of that discussion, the department offered to host an open "town meeting,, on the subject. The event took place on April 30. In addition to the congresswoman, the panel included Lawrence Krauss, Phil Taylor, and Sean Kay, who is chairman of the International Studies Program at Ohio Wesleyan. The program was organized by Bill Fickinger and Ben Segall, who believe that our students and others in the university community should learn about the long-standing debate over missile defense. Many of our physics alumni (see Garwin article, Page 11) are part of the national defense community, and no doubt some of today's students will follow them. This meeting allowed a few of them to think about some of the military, political, and technological questions associated with national defense.

New Undergraduate Degree Programs

When most of you were students here, there were two options in the physics major: B.S. and B.A. The majority of our grads earned a B.S., while a few did the B.A., often in conjunction with a series of education courses. During the past few years, the number of physics tracks has at least doubled with the introduction of a B.S.E. in engineering physics, a B.S. in mathematics and physics (not mathematical physics), a physics B.S. with emphasis on mathematics, and, currently on the drawing boards, a B.S. in biological physics.

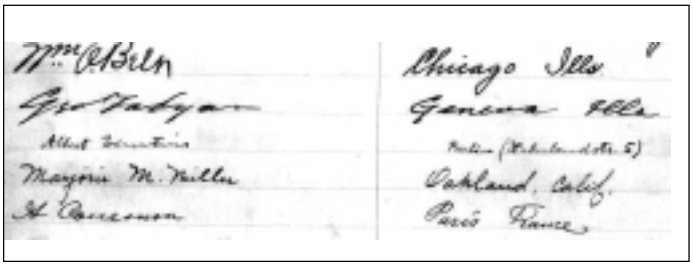
Many of our undergraduate students come to CWRU with both a strong interest in physics and the desire to find a good engineering position. The new B.S.E. in Physics is earned within the Case School of Engineering, through the physics department. The student must complete the new "Case Core,, most of the required B.S. physics courses, and a four-course sequence within a selected engineering department, as well as complete a senior research project under the joint supervision of a physics and an engineering professor. The first two B.S.E. students will graduate this spring, and there are seven of them in the following class.

The math and physics B.S. is jointly administrated by the two departments. This major is a synergistic, coherent, and parallel education in mathematics and physics, which provides an excellent education in logical thinking and an in-depth, broad technical problem-solving ability.

These new programs have resulted in a significant increase in the number of physics majors. Currently, we have twenty-nine B.S., 5 B.S. with math concentration, thirteen B.S.E., 3 B.A. and two B.A. teaching.

Visitors Come to Call

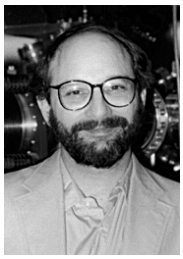
Among Bob Shankland's collection of "Millerabilia,, is the original of Miller's "Visitor Registry.,, The entries begin in 1907 with a visit by a delegation of three physics professors from England and, after more than 500 signatures, ends in 1940. Interspersed among visits by individual physicists, deans, and college presidents are groups of various kinds. Four Miller's from Oakland, California, drop by in 1908, while a foursome from the Aeolian Company and a delegation from Siemens in Berlin visit in 1911. There are musicians from the Boston and New York symphonies, and a certain Louis P. Fritze, "1st Flutist Sousa's Band.,,



In the first week of January 1930, the nineteen members of the National Research Council Science Advisory Committee on Physics were the guests of Case. Karl T. Compton writes, "Thanks Professor Miller for his hospitality and co-operation with work of this committee. The facilities extended have made possible a most valuable and interesting meeting.,, In 1939, Karl K. Darrow lectures on the "Properties of Liquid Helium,, and Arthur H. Compton on "The Mesotron.,,

At the 1920 meeting of the APS executive committee are Theodore Lyman, George B. Pegram, Henry Crew. Jesuit Henry A. Heras from Barcelona visits in 1921 with Father Krance of St. Ignatius College, Cleveland; and on the same page one Albert Einstein of Berlin (Haberlandstr. 5) signs in a small neat hand. H. A. Lorentz visits in April 1922 (presumably to discuss Miller's measurements of ether drift), with a note by Miller: "Lectured in my Lecture Room. Case and WRU. Auspices. 400 present.,, (ed. There must have been many standees!)

Chottiner New Director of Undergraduate Studies



On his retirement in December 1999, **Bill Fickenger** turned over to **Gary Chottiner** the duties of Director of Undergraduate Studies. Curricular issues, course scheduling, AP credit, senior projects, proficiency exams, and recruiting programs are some of his responsibilities. Gary has greatly improved the physics undergrad website, http://erebus.phys.cwru.edu/phys/undergrad/undergrad.html where you can learn about our major programs, courses, students, and senior project program.

DOEd Grants for Graduate Students

Kathy Kash reports that the physics department has been awarded two grants from the U.S. Department of Education under the GAANN fellowship program ("Graduate Assistance in Areas of National Need,,). These grants will support a total of nine Ph.D. students for three years each, in the areas of research in optical materials and optoelectronic devices. The graduate students are doing basic and applied research in a variety of areas including bulk crystal growth, nonlinear optics, nanotechnology, photonic crystals, liquid crystals, and imaging technology.

Richard Garwin (CIT BS '47), Designer of H-Bomb?

In a *Science Times* article (24 Apr '01), the *N.Y. Times* explores the role of alumnus Richard Garwin as a key player in the original design of the thermonuclear weapon. The contributions of the then 23-year-old University of Chicago faculty member, who fifty years ago was spending the summer at Los Alamos, were recently acknowledged in an interview with Dr. Edward Teller. Dr. Garwin has often expressed a wish that H-bombs could entirely be done away with. He continues to work vigorously toward nuclear arms reduction.

Using His Noggin in the Cause of Science

Tim Peshek, senior physics major and treasurer of the Physics and Astronomy Club, volunteers to help Director of Laboratories John Fons demonstrate conservation of momentum. (That's a lead block under the wooden block into which John is about to hammer a nail.) John has been doing a great job in organizing the introductory teaching labs and the lecture demonstrations. Tim survived the procedure and, in fact, plans to remain at CWRU to do graduate work with Dan Akerib's group.

Galileo's Pumpkin Drop

At noon on a bright splendid day in late October of 1999, a large crowd gathered on the Case Quad in front of Strosacker for the 2nd Annual Galileo Pumpkin Drop. After much fanfare, two pumpkins, one large and one small, were dropped from the roof of the building in a repeat of the famous experiment at Pisa. This time, our friends from plant maintenance provided a lever-operated trap door to ensure that the two doomed fruits would be launched simultaneously.

Coincidentally, this was the day of the Inauguration of CWRU's president, who, on his way to the celebratory luncheon, stopped by to join in the fun, climbing the ladder to the roof and pulling the lever.

His first remark later that day in his inaugural speech was that he was pleased to announce that the CWRU physicists had once again shown that gravity was doing what gravity should. Our senior physics majors designed a great meter stick to hang from the building to allow videocam images of the falling pie-fillings to be used to measure gravity. Several hundred students celebrated the successful outcome by snarfing a wedge of pumpkin pie and a cup of cider.

Physics CWRU

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