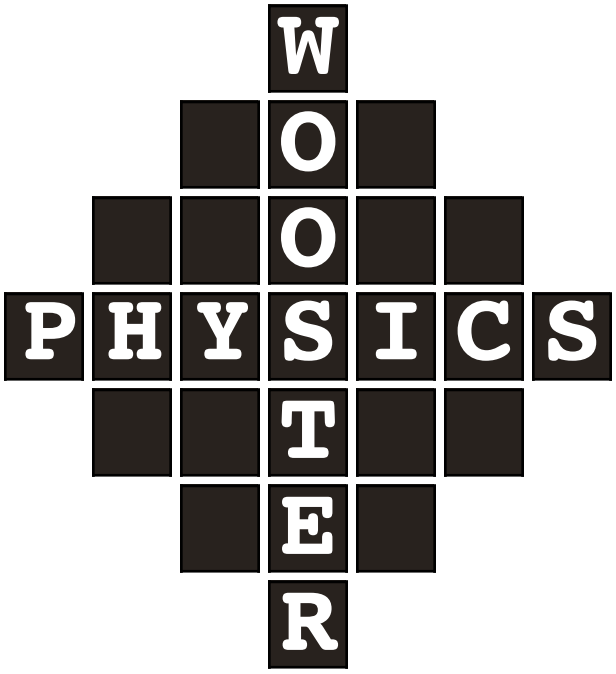
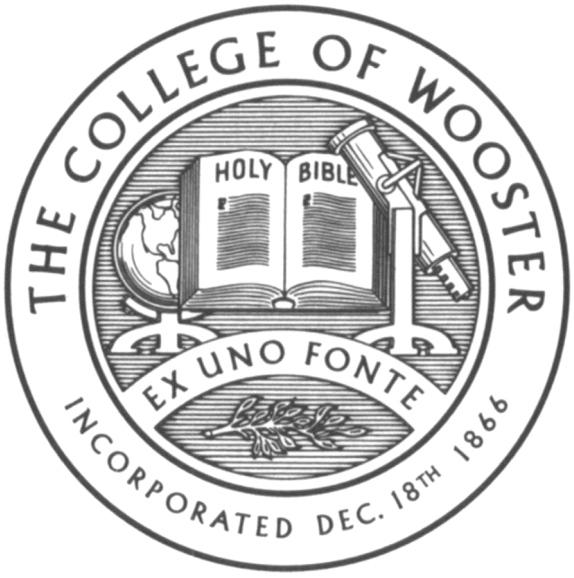


Annual Report
1998-99



http://www.wooster.edu/physics

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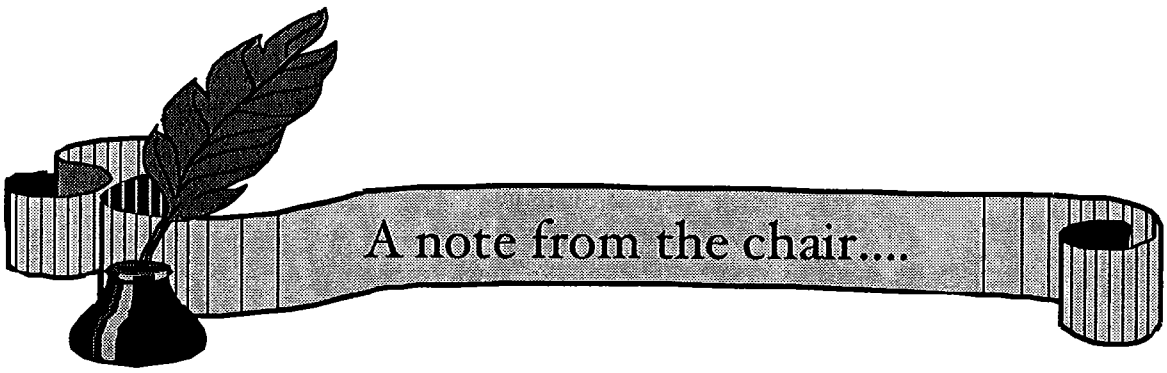


Welcome to the third Annual Report from the Department of Physics, your source for news on the activities of our faculty, staff, students, and alumni! Looking back at this past year, it was one that we are all very proud of. It has been a very productive year with an outstanding class of seniors and majors who kept us all challenged with their quest for learning and unbounded energy. As chair of the department, I feel fortunate to have a great team of faculty and staff colleagues who put forth an outstanding effort to reach our goals.

Our trip to the Centennial APS meeting was a memorable event, where we met several people with "Wooster connections" (alumni, REU students, faculty from the past, etc.). We had a resplendent display of posters from our student researchers at the conference, and we were pleased to display the Wooster seal on each poster.

The department had two very successful faculty searches, and we welcome Jennifer Goetz and Dan Ludwigsen on board. Dan will be replacing John Lindner while he is on leave at Georgia Tech for the year. We wish John a productive leave. Jennifer will be adding a new dimension to the research interests of the department with her expertise in infrared astronomy. It is very exciting and an honor to our department that Jennifer will be the recipient of the prestigious Clare Boothe Luce Professorship, which is awarded to women scientists of highest caliber early in their career.

At the moment we have construction going on in the department. The vacated Fobes library will soon house Jackie Middleton's new office, a seminar room, and a study area for our majors. Don Jacobs will move into Jackie's old office and my research lab will move into the basement room that is currently Don's office. When all this is done, we should have much better and more expanded facilities for our students.

We hope you enjoy reading about our activities of the past year. We enjoy hearing from you as well and would like to thank those who responded with information about yourselves during the past year. Thank you for your continued support of the department.

Sincerely,

Shila Garg

Shila Garg
Chair
Sgarg@wooster.edu

The Class of 1999

Joshua John Bozeday

"Josh"
Wilmett, Illinois
Physics/Computer Science
Plans: Software engineer at Motorola

Madhujit Ghosh

"Dinky"
Calcutta, India
Physics
Plans: Job market

Manon Eliene Grugel

Ashtabula, Ohio
Physics/Mathematics
Plans: Graduate School, Case Western Reserve University, Astrophysics

Andrew Jonathon Kuck

"Andy"
Gambier, Ohio
Physics
Plans: Graduate School, Stanford University, Electrical Engineering

Amy Christine Rauch

"Christy"
Columbus, Indiana
Physics
Plans: Summer researcher, College of Wooster, then job market

Paul Francis Rebillot III

Canton, Ohio
Physics
Plans: Graduate School, Washington University, Astrophysics

Nathan Daniel Schiffrik

"Nate"
Cleveland, Ohio
Physics
3/2 Engineering: Case Western Reserve University

Walter David Walkenhorst

"Dave"
Jenkintown, Pennsylvania
Physics
Plans: Job at United States Patent Office, Arlington, VA, Electronics Division

Pre Senior I.S.

Front row, from left: Josh, Christy, Manon, Nate
Second row, from left: Andy, Paul, Dave, Dinky

Post Traumatic I.S. Syndrome

Physics Faculty

Shila Garg

Associate Professor and Chairperson of Physics
Faculty member at Wooster since 1987.
B.S. Madras (India) 1970;
M.S. Sussex (U.K.) 1972;
Ph.D. Kent (U.K.) 1975.

Dr. Garg spent the Fall of 1997 on research leave. She continues to collaborate with Dr. U.D. Kini of the Raman Research Institute in India on "Periodic Instabilities in Nematic Liquid Crystals subjected to Electric and/or Magnetic Fields." She also is continuing her collaboration with Dr. Oleg Lavrentovich of the Liquid Crystal Institute at Kent State University. A new area of investigation is "Phase Transitions in a Binary Nematic Mixture," which Senior. I.S. student Christy Rauch worked on and produced excellent results.

Two of Dr. Garg's publications have appeared during this reporting period:

1) Shila Garg, Christopher Ditchman*, Nathan Schiffrik* and U.D. Kini, "Electric Field Induced Transient Effects in a Nematic Liquid Crystal in the Presence of a Stabilizing Magnetic Field," *Molecular Crystals Liquid Crystals (in press).*

2) Shila Garg, Erica Bramley*, and U.D. Kini, "Wave Structures in the Homogeneous Bend Transition of 4-n-pentyl-4-cyanobiphenyl," *Molecular Crystals Liquid Crystals*, **325**, 209 (1998)

* C.O.W. students

In the Spring of 1998, Dr. Garg taught Foundations of Physics and its lab, as well as Electronics for Scientists and its lab.

Dr. Garg attended the Council on Undergraduate Research (CUR) Councilors' Meeting and CUR Conference at Occidental College in June of 1998. While there, she chaired a panel on "Managing an REU Site" and coordinated a 90-minute presentation. She was also a panelist for a discussion on "How to Write the First Successful Grant Proposal." In July of 1998 Dr. Garg attended the 17th International Liquid Crystal Conference in Strasbourg, France and presented a paper entitled "Electric Field Induced Transient Effects in the Nematic Liquid Crystal 5CB." Dr. Garg was also invited to the Advanced Liquid Crystalline Optical Materials (ALCOM) symposium entitled "Chiral Materials and Applications." The symposium took place in Cuyahoga Falls, Ohio in February of

1999. In March, Dr. Garg made arrangements for five REU students and three seniors to present posters at the Centennial Meeting of the American Physical Society in Atlanta, Georgia. Dr. Garg conducted a workshop on REU sites during "April Dialogue" held by CUR at the National Science Foundation. At the Asheville Institute on General Education, she was in attendance as part of a team from The College of Wooster.

Dr. Garg served as a reviewer for NSF-SBIR (Small Business Innovative Research) Phase II proposals. She was reelected as a CUR Councilor for the Physics and Astronomy Division and was responsible for membership of the Physics Division. Dr. Garg is a member of the American Physical Society, International Liquid Crystal Society, Council on Undergraduate Research, and the American Chapter of the Indian Physics Association. Also, she continues to serve as director of the department's NSF-REU summer research program.

On campus throughout the year, Dr. Garg served as a member of the Survivor Support System and on the CUR 2000 Conference planning committee. She was Chair of the Committee to Conduct Faculty Evaluation of Present Hales. She gave a Science Round Table presentation entitled "Distortions in Liquid Crystals" and gave a laser presentation to the B-WISER science camp.

Donald Colladay

Visiting Assistant Professor of Physics
Faculty member at Wooster since 1998.
B.S. Rensselaer Polytechnic Institute 1992;
M.S., Ph.D. Indiana 1993, 1998.

Dr. Colladay taught General Physics, its lab, and Math Methods during the Fall of 1998, and in the Spring he taught Particle Physics and Cultural Physical Science. The non-science majors in his Cultural Physical Science course enjoyed many interesting demos, such as atmospheric pressure by imploding a gas can, musical waveforms of various instruments, and cosmic rays in a cloud chamber.

Dr. Colladay gave several invited talks throughout the year:

1) *Extending the Standard Mode to Include CPT and Lorentz Violation*
   Plenary Session for Meeting on CPT and Lorentz Symmetry, Indiana University
2) *Breaking Lorentz Symmetry in Quantum Field Theory*
   27th International Conference on Orbis Scientiae 1998, Fort Lauderdale, FL

3) *Possible Spontaneous Breaking of Lorentz and CPT Invariance*
International Conference on Non-accelerator New Physics, Joint Institute for Nuclear Research, Dubna, Russia

During the period of this report, Dr. Colladay had two publications:
1) *Lorentz-Violating Extension of the Standard Model*
Don Colladay, V. Alan Kostelecky´
Phys. Rev. D 58 (1998)
2) *Extending the Standard Mode to Include CPT and Lorentz Violation*
Don Colladay
To appear in the proceedings of Meeting on CPT and Lorentz Symmetry

Dr. Colladay has been a wonderful colleague and teacher, as well as a good citizen of the department during the past year. Best wishes to him as he begins his new position at Colby College in Waterville, Maine.

Donald Jacobs

Victor J. Andrew Professor of Physics
Faculty member at Wooster since 1976.
B.A., M.A. South Florida 1971, 1972;
Ph.D. Colorado 1976.

Dr. Jacobs was Acting Chair of the department during Dr. Garg's leave this past fall. He taught Modern Physics and its lab, as well as a section of First Year Seminar in Critical Inquiry. A description of his Seminar follows:

Predictability in an Unpredictable World

Is it possible to predict events in the future? The kind of events that are predictable and what influences that predictability will be explored through the eyes of various people. How do you effect change? Can you chart your future? Will our environment sustain our human habitation? Science's ability to predict an outcome in the future will provide some insight into what can and can not be predicted.

Readings included Anne Moody's *Coming of Age in Mississipi,* Rachel Carson's *Silent Spring*, Ernest Callenbach's *Ecotopia*, Daniel Quinn's *Ishmael,* and James Gleick's *Chaos: The Making of a New Science*.

In the Spring, Dr. Jacobs taught General Physics and its lab, as well as Junior Independent Study. In addition to the computer simulations and three other experiments from the lab manual, juniors were required to do a self-designed experiment. Dr. Jacobs' class came up with an exciting group of self-designed experiments:

Geoff Bonvallet:	Heat Capacity of Liquid Crystal Mixtures Using DSC???
Sridhar Chandramouli	Self-Organized Criticality in Sandpiles
Sean English	Light Scattering and Spinodal in Liquid Crystal Mixtures
Andy Nowicki	Spin Effects on a Baseball's Trajectory
Tim Sir Louis:	Electronic Bouncing Ball and Chaos

Dr. Jacobs does experimental research in phase transitions of binary fluid mixtures and polymer-solvent systems, including measurements of turbidity, heat capacity, viscosity, density, and the coexistence curve on these systems. He is also developing experiments in the emerging area of self-organized criticality.

During this 20th consecutive year of involving undergraduates in his research, Dr. Jacobs had three publications appear:

1) Paul F. Rebillot* and D.T. Jacobs, "Heat capacity anomaly near the critical point of aniline-cyclohexane," *Journal of Chemical Physics* **109**, 4009 (1998).
2) F.M.F. Mascarenhas*, C.M. Spillmann*, J.F. Lindner, and D.T. Jacobs, "Hearing the shape of a rod by the sound of its collision," *American Journal of Physics* **66**, 692-697 (1998).
3) D.T. Jacobs, S.M.Y. Lau*, A. Mukherjee*, and C.A. Williams*, "Measuring turbidity in a near-critical, liquid-liquid system: a precise, automated experiment" *International Journal of Thermophysics* **20**, 877 (1999).

*undergraduate researchers

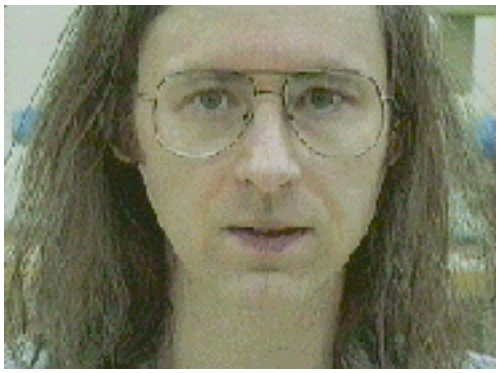
During the year, Dr. Jacobs served on a NASA shuttle experiment review panel and on an Editorial Review Board for the National Institute for Science and Technology. He reviewed articles for *The American Journal of Physics* and the *Journal of Chemical Physics*. He is a councilor for the Council on Undergraduate Research.

In June of 1998, Dr. Jacobs attended the CUR Conference in Los Angeles as well as a NASA Fundamental Physics Workshop, where he presented a paper on his turbidity results. In March of 1999, he attended the Centennial Meeting of the American Physical Society in Atlanta, and two of his students presented posters on their research.

Locally, he developed a remodeling plan for the Fobes Library, which is being converted into office space and seminar rooms. He is co-chairing the CUR 2000 Conference to be held at Wooster. He assisted with an Independent Study Workshop and was a presenter at a Senior Independent Study Workshop for new faculty.

John Lindner

Associate Professor of Physics
Faculty member at Wooster since 1988.
B.S. Vermont 1982;
Ph.D. California Institute of Technology 1989.



Dr. Lindner continued his research into the areas of the use of disorder and noise to regularize extended nonlinear systems, noise enhanced propagation, computer visualization. As a result of this research, two publications appeared and another was accepted during the period of this report:

1) F.M.F. Mascarenhas*, C.M. Spillmann*, J.F. Lindner, and D.T. Jacobs, "Hearing the shape of a rod by the sound of its collision," *American Journal of Physics* **66**, 692-697 (1998).

2) J. Lindner, S. Chandramouli*, A. Bulsara, M. Löcher, and W. Ditto,"Noise Enhanced Propagation," *Physical Review Letters,* **81**, 5048-5051 (1998).

3) W. Shew*, H. Coy*, and J. Lindner, "Taming Chaos with Disorder in a Pendulum Array," *American Journal of Physics* **67**, 709-711 (August 1999)

* student co-author

Three of Dr. Lindner's student researchers, Scott Hughes, Hanna Coy, and Sri Chandramouli, presented their results at a poster session at the Centennial Meeting of the American Physical Society in Atlanta.

In the Fall of 1997, Dr. Lindner taught Foundations of Physics and its labs, as well as Electricity and Magnetism. In the Spring, he taught Astronomy, Thermal Physics, a Foundations lab, and he led the juniors in their computer simulations for Junior I.S.

Dr. Lindner served as a reviewer for *Physics Essays* and *American Journal of Physics*. On campus, he served on several committees: Copeland Fund for Independent Study, College Scholar Exam, and Goldwater Scholarship. He presented a talk to Douglass Hall entitled "Humans on Mars." Also, he served as faculty advisor to the Society of Physics Students.

New Faces in the Department

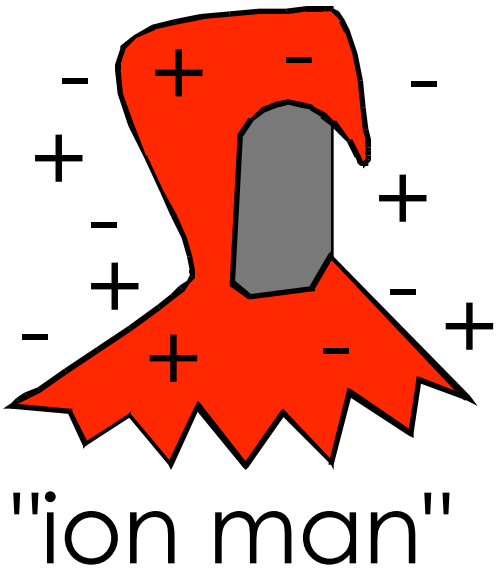
Jennifer Goetz

Assistant Professor of Physics
B.S. Binghamton 1992;
M.A. University of Rochester 1995;
Ph.D. University of Rochester exp. 1999.

The College of Wooster has been named the recipient of a prestigious Clare Boothe Luce Professorship, effective in the fall of 2000. The five-year professorship will be awarded to Jennifer Ann Goetz, who will join Wooster's faculty this fall as a tenure-track member of the Department of Physics.

Goetz is completing her Ph.D. in physics and astronomy at the University of Rochester. Her dissertation is entitled, "An Infrared Study of Highly Extincted Young Stellar Objects." Ms. Goetz brings to Wooster an area of research that is of increasing interest to our students.

At Rochester, Ms. Goetz has worked in the Near Infrared Astrophysics Lab. She has been a coinvestigator in the NASA Initiative to Develop Education through Astronomy and Space Sciences (IDEAS) Grant and has developed, distributed and presented classroom materials for hands-on activities in the Rochester City Schools.



Daniel Ludwigsen

Visiting Assistant Professor of Physics
B.A. Beloit College 1992;
Ph.D. Brigham Young University exp. 1999.

Dan "Ion Man" Ludwigsen will join our department this fall as Visiting Assistant Professor of Physics. Mr. Ludwigsen's interest in the disciplines of physics and music led him to Brigham Young University's acoustics group, where his work is specialized in musical acoustics. He employs engineering numerical methods such as finite element analysis to represent the lip reed of a trombone. This model of the lips combines with the rest of the instrument to create synthesized trombone tones.

We eagerly anticipate the additions of Jenn and Dan to our department.

Judith Elwell

Lab Technician
Physics Department

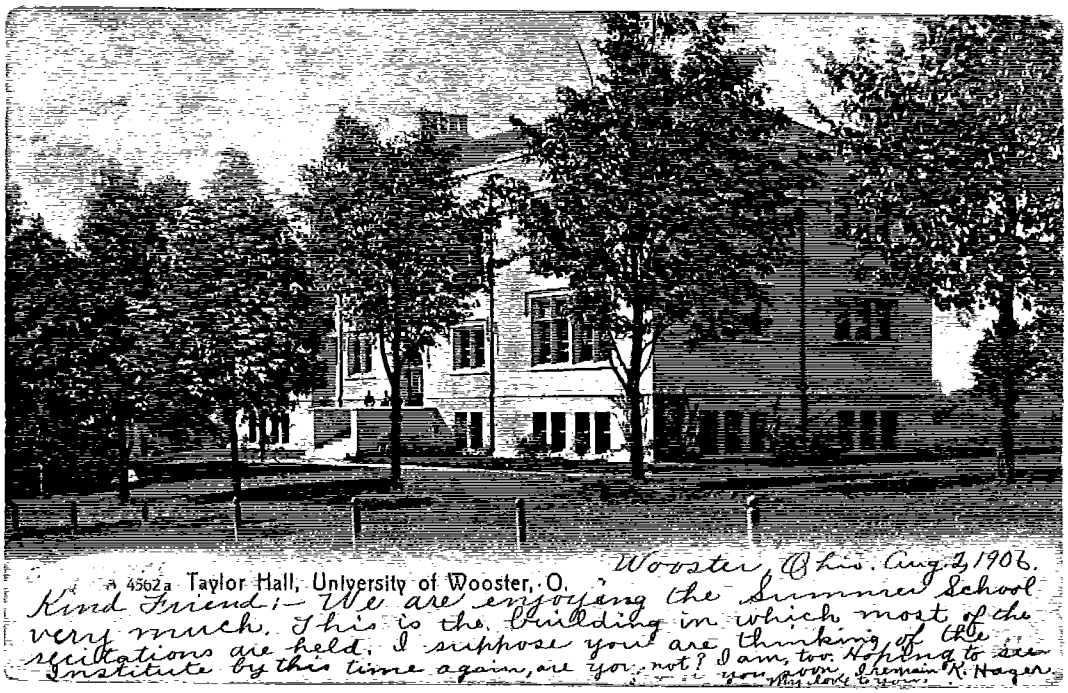
Judy is now in her 19th year as the department's lab technician. She enjoys new challenges and also getting to know the new majors and new professors. Judy has three grown daughters living in various parts of the country, as well as two ornery grandsons, Justin (age 5) and Adam (age 3).

Jackie Middleton

Department Secretary
Physics/Math/Computer Science

This past year Jackie was "ten-yeared" by the College (not the same as tenured) and received her award for surviving a decade of working for a crazed group of mathematicians and physicists. During her 11th year, she is looking forward to inhabiting her new office, which was made available by the move of the Fobes Library to the new Timken Science Library. Jackie has two teenage sons, Gabe (17) and Caleb (13), who keep her busy as a sports mom. In her spare time, she enjoys reading detective and horror novels.

A historical postcard...



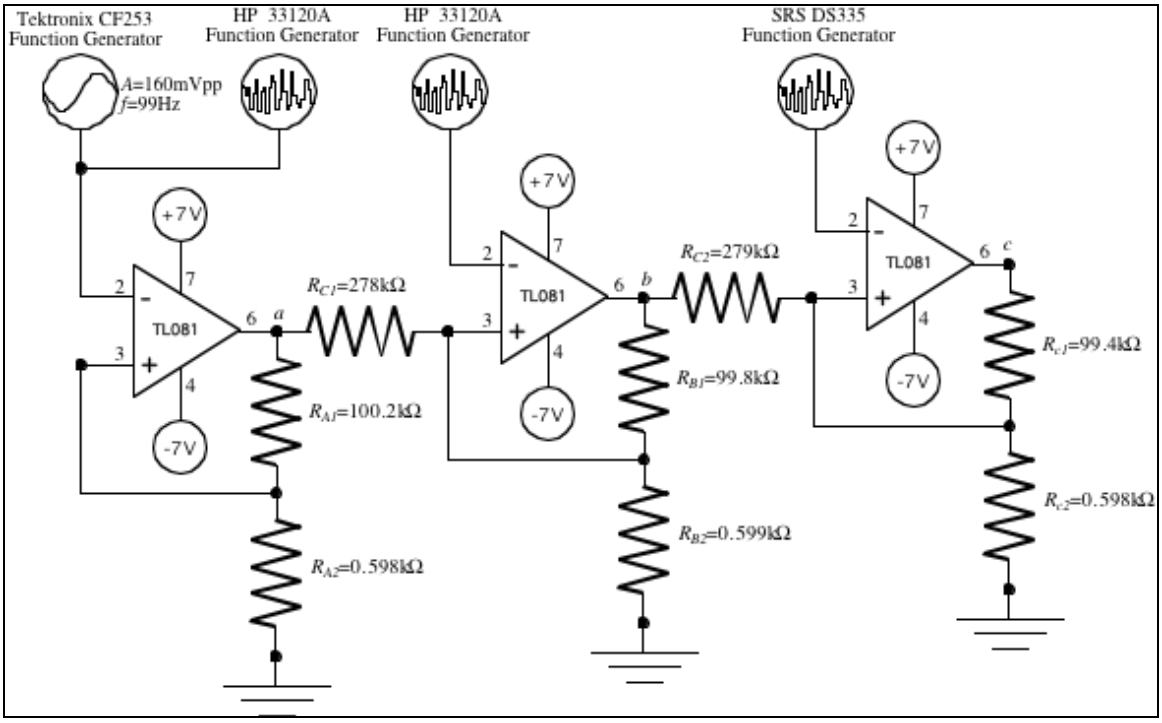
Senior Independent Study

Noise Enhanced Propagation in an Electronic Array

by Joshua Bozeday
Advisors:
John Lindner, Physics
Reuben Settergren, Computer Science

Abstract

Noise enhanced propagation is a recent extension of stochastic resonance. This experiment attempted to observe noise enhanced propagation in an electronic array. An inductor-diode circuit and a Schmitt trigger circuit were searched in the process of achieving this goal. An interactive computer simulation was constructed to model the inductor-diode system. Unfortunately, this experiment was not able to observe noise enhanced propagation in the inductor-diode circuit. However, noise enhanced propagation was obtained in an array of three resistively coupled Schmitt trigger circuits. Each Schmitt trigger circuit consisted of a TL081 operational amplifier powered by ±7V, a positive feedback resistance of 100kΩ, and a non-inverting input to ground resistance of 0.6kΩ. They were coupled together with 279kΩ resistors and the first element was driven by a sinusoidal signal of frequency 99Hz and amplitude 160mV$_{pp}$. This array was observed to exhibit stochastic resonance in the signal-to-noise-ratio at all the elements and in the propagation length of the signal. Hence, it was concluded that noise enhanced propagation had been observed.



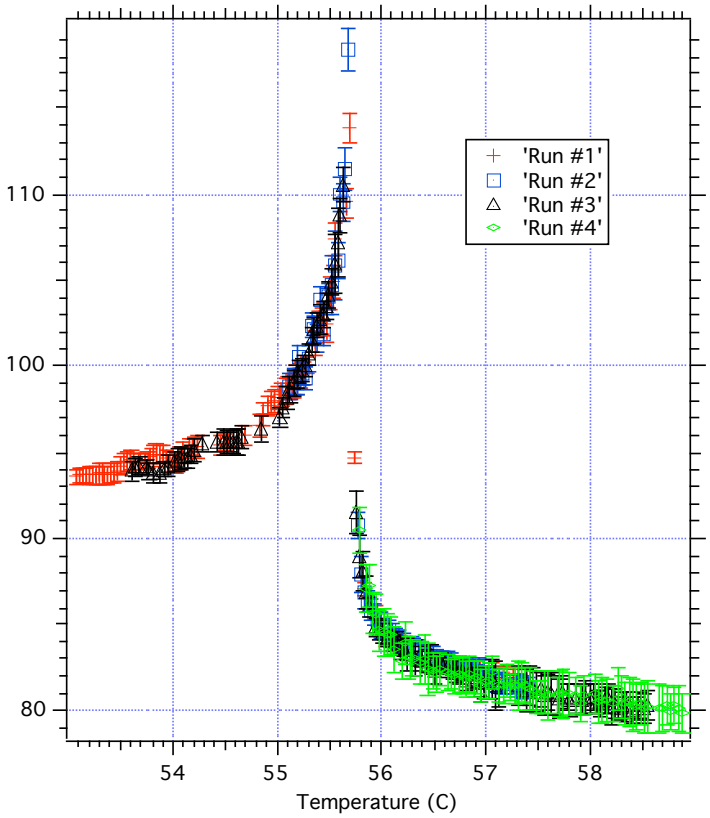
The experimental set up for searching for noise enhanced propagation

Measurement of the Heat Capacity of the Binary Fluid Mixture of Succinonitrile and Water Near the Upper Critical Consolute Point Using Adiabatic Calorimetry

by Madhujit Ghosh
Advisor: Donald Jacobs

Abstract

The temperature dependence of the specific heat capacity of a binary fluid mixture of succinonitrile-water was measured at the upper critical consolute point with the help of a computer controlled, multi-stage, adiabatic calorimeter. An Apple Macintosh computer was used for data acquisition and control of the apparatus. *LabVIEW 4.1* was used as the control program for the apparatus and to convert temperature data into heat capacity by using a custom script. Heat capacity of the binary fluid mixture, SCN-H_2O, experienced a divergence at the critical temperature. We found the heat capacity anomaly at 55.695±0.0004°C. The results confirmed the recently published theoretical and experimental values for the critical amplitude ratio. The background of the fits included the heat capacity of the cell. The system independent critical amplitude ratio for our system was found to be 0.60±0.01. The system dependent critical amplitude was found to be A^+ = 1.28±0.02 J/K and A^- = 2.11±0.02 J/K. The two scale factor universality was found to be X = 0.0172±0.023 and was found to be slightly larger than in recent experiments, but his inconsistency can be attributed to the inconsistencies in recent measurements of the correlation length of SCN-H_2O.



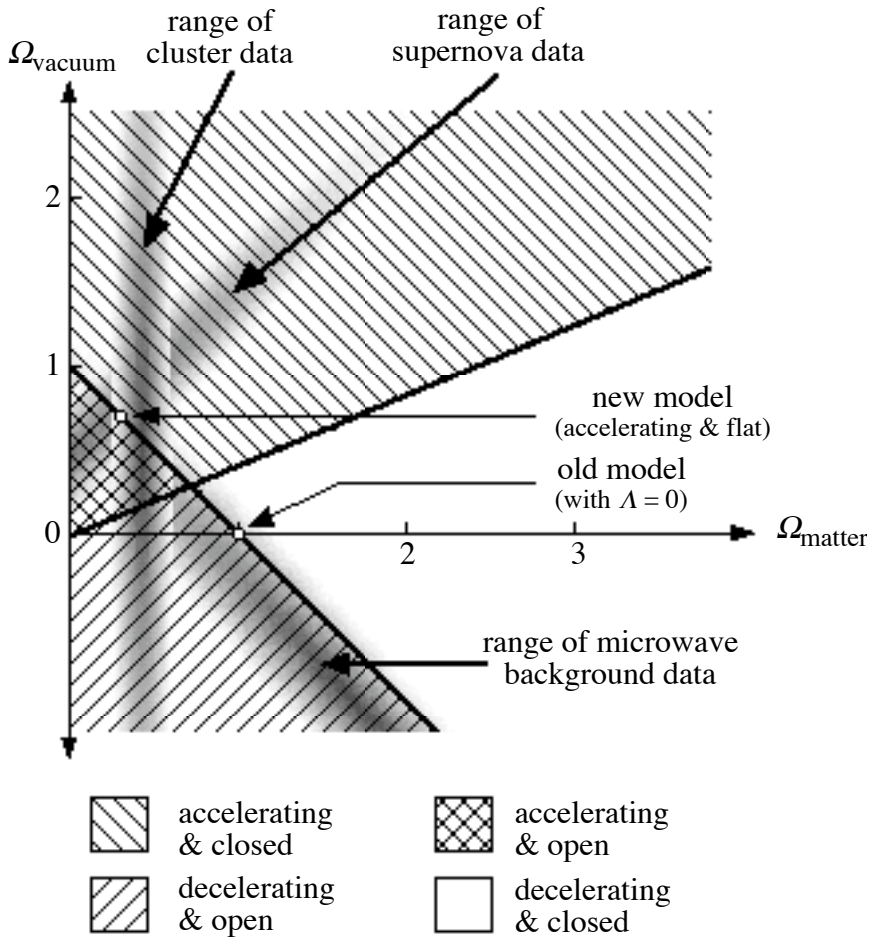
Consolidated data sets of the four runs of data used in the analysis of heat capacity anomaly in succinonitrile and water.
Notice the anomaly in heat capacity occurring around 55.7°C.

Λ

by Manon Grugel
Advisors:
John Lindner, Physics
Charles Hampton, Mathematics

Abstract

This theoretical work incorporates relativistic gravity and relativistic cosmology in an effort to understand the effects of a non-vanishing cosmological constant Λ on the universe. After a brief historical review of contemporary models of the universe, Einstein's theory of general relativity is introduced. In particular, following an introduction to tensor calculus and Riemannian geometry, Einstein's field equations with the cosmological term are developed. Then assuming a simple, but reasonable model of the universe, Einstein's field equations are reduced to a single differential equation known as Friedmann's equation, which is solved via numerical integration. Finally, the recent experimental cosmological data are reviewed and discussed in terms of the geometry and expansion of the universe.



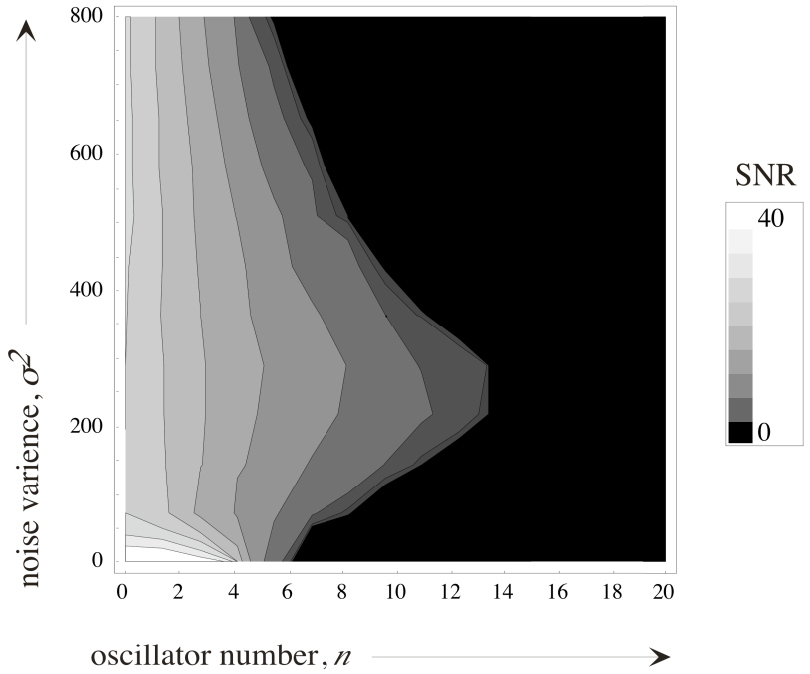
Plot of cosmological vacuum energy density versus mass energy density, showing theoretical models and experimental data

Noise Enhanced Propagation

by Andrew Kuck
Advisor: John Lindner

Abstract

Noise Enhanced Propagation (NEP) was studied in a linear array of locally coupled bistable oscillators using a distributed Macintosh computer simulation. The scaling of optimal noise variance and maximum signal propagation length with respect to coupling strength and potential barrier height were examined. For sufficiently large barrier heights, the optimal noise was proportional to the height, while the propagation length was inversely proportional to the height. The impact of the non-ideal band-limited white noise was examined, as well as the impact of filtering the output signal. Both had a predicted, minor impact on the resulting data. The optimal noise and the propagation length were found to be proportional to the square root of the coupling strength, in agreement with previous research. The relationships indicated that near zero height NEP still occurred, although a direct measurement with a monostable potential was unable to confirm this.



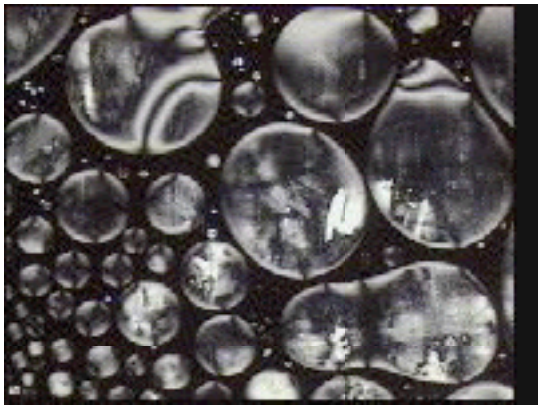
Sample contour plot

A Study of the Phase Transitions of Mixtures of the Nematic Liquid Crystals 5CB and MBBA Using Light Scattering and Microscopic Techniques

by A. Christine Rauch
Advisor: Shila Garg

Abstract

Mixtures of the nematic liquid crystals 5CB and MBBA at various concentrations were investigated by observing phase transitions using light scattering and video microscopy. Transitions were observed as samples were cooled slowly from the isotropic phase to room temperature. Bulk samples ranging in concentration from 20-60% 5CB were observed to change from an isotropic liquid to a spongy, gelatinous substance at room temperature. Thin cells (36μm) were made of each mixture, and transmitted light intensity was graphed with respect to temperature. Samples ranging in concentration from 20-60% 5CB were shown to exhibit two phase transitions, with all other samples exhibiting only one transition (isotropic-nematic). The nature of the second transition is still under investigation. A coexistence curve with transition temperature versus sample concentration was plotted. Phase transitions were further investigated by photographing samples at constant time intervals and at 58x magnification through a cross-polarizing microscope as temperature was lowered at –0.025°C/min. Several textures were observed, including schlieren brushes, salt and pepper textures, granitic textures, dendritic growth, and mosaic textures. Growth of droplets during the isotropic-nematic phase transition were measured and graphed with respect to temperature. Finally, a very thin planar surface treated cell (10μm) was filled with the 40% 5CB mixture and observed through the cross polarizing microscope as temperature decreased at –0.025°C/min in order to understand the effects of thickness on the textures observed. Regions of homeotropic alignment were observed in this cell after the mixture had cooled to room temperature, as confirmed by the rotation of the sample between cross polarizers and the observation of a cross pattern when viewed through a cylindrical Bertrand lens.



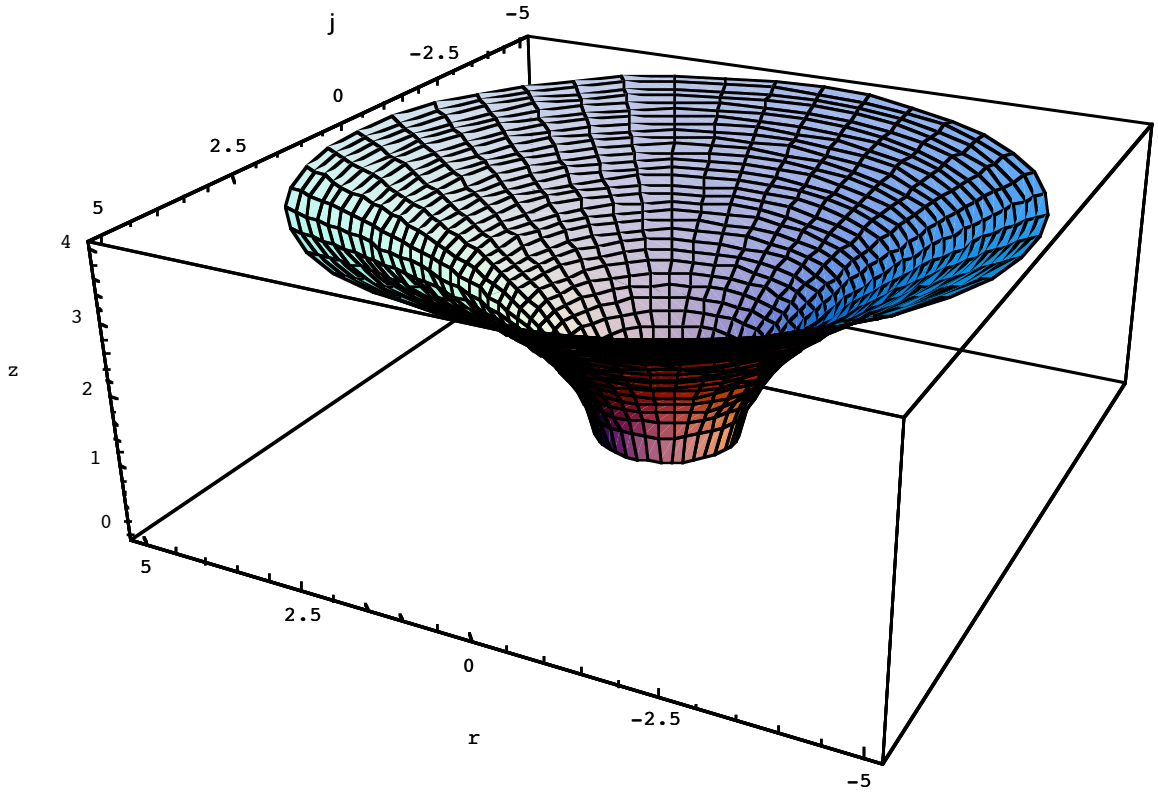
Phase transition from isotropic to nematic of a mixture of 5CB and MBBA

Static Traversable Wormholes and the Violation of Energy Conditions

by Paul Rebillot
Advisor: Donald Colladay

Abstract

Raychaudhuri's equation, which relates the expansion, shear, and rate of expansion of geodesic congruences, is used to analyze for a specific case of a Morris-Thorne Wormhole. This wormhole geometry is found to violate the strong and null energy conditions. With explicit values of the expansion and shear of a set of timelike geodesic congruences, we go on to examine the physical meaning of each of these quantities. The expansion describes how an infinitesimal volume element changes with proper time along a geodesic. The volume element decreases, obtains a minimum at the throat, and then increases as it comes out of the wormhole. The eigenvalues of the shear tensor describe how a sphere will deform as it enters the wormhole. As a sphere enters the wormhole, it is shown that a sphere will flatten along its two angular axes, and will elongate along an axis that is a linear combination of the length and time coordinates.



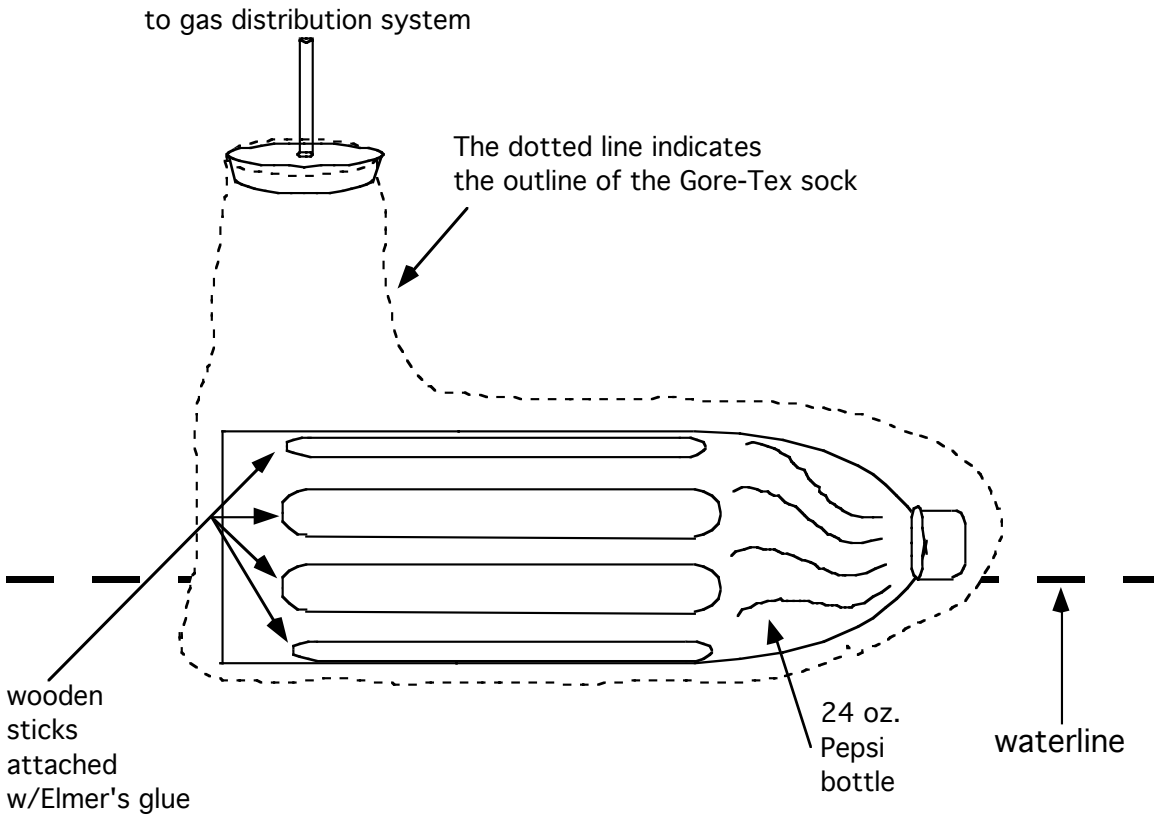
A Schwarzchild black hole embedded into three dimensions

Reducing Viscous Drag Using Microbubbles

by David Walkenhorst
Advisor: Donald Jacobs

Abstract

A water flow tank was designed and built, in which the force on a model boat was studied. This model boat utilizes a Gore-Tex sock as an outer membrane. Both nitrogen and helium are bubbled through this membrane, and the effect of the force is examined when water flow is on and off, and different gas flow rates are also used. Experimentally, the viscous drag using helium was found to be 23±4.3% less than the viscous drag when nitrogen was used. A second data set confirmed this result, finding that the viscous drag using helium was 25±4.3% less than the viscous drag when nitrogen was used. The construction and use of the model boat and flow tank are described in detail.



The model boat.
This figure shows the 24 ounce Pepsi bottle with wooden sticks glued to it, to facilitate gas movement throughout the sock.

Looking Back on I.S.

1989

Bryan R. Johnson
Calculating a Dimension of a Strange Attractor

John M. Mandryk
Using Energy Relationships for the Verification of the Modeling of a Vaulting Pole Based on the Elastica Theory of Euler

Donald L. Mosteller
A Photon Correlation Spectroscopy Study of Brownian Motion

John G. Scudder
Escape! A Computer Solution to the Restricted Three-Body Problem

Craig E. Selby
Coexistence of the Binary Fluid Perfluoromethylcyclohexane Isopropyl Alcohol

Shoaib Zaidi
3/2 Engineering Program, University of Rochester

1994

William Antel
Chaotic Dynamics on Rippled Surfaces

Serhan Babaoglu
3/2 Engineering Program, Washington University

John Cuff
Electric-Field-Induced Freedericksz Transition in the Nematic Liquid Crystal 5CB

Rohan Defonseka
Measurement of the Heat Capacity Anomaly of the Binary Fluid System Triethylamine-Water Near the Critical Solution Point Using Adiabatic Calorimetry

Michael Hunter
Spatiotemporal Chaos on a Sphere of Duffing Oscillators

Stephen Nichols
Study of the Effects of an Electric Field on Agarose Gel by Neutron Scattering

Yifeng Xiang
Measurement of the Polymer-Solvent Interaction Parameter χ of Agarose Gels Using Differential Scanning Calorimeter

Junior Independent Study

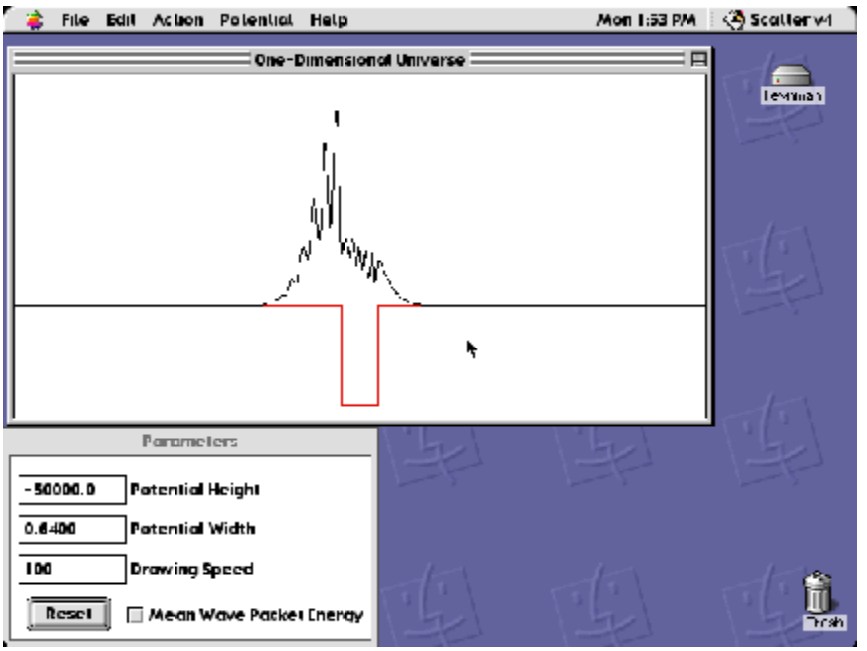
Junior I.S. is a full course that integrates a laboratory experience in Thermal, Electricity and Magnetism, Optics, and Mechanics while developing the student's writing and analysis skills, literature searching ability, and problem solving strategies. While designed to prepare the students for their required senior research project, Junior I.S. also challenges the students via experimental situations, numerical simulations, and computer-based data acquisition and analysis using *LabVIEW* and *Igor* software.

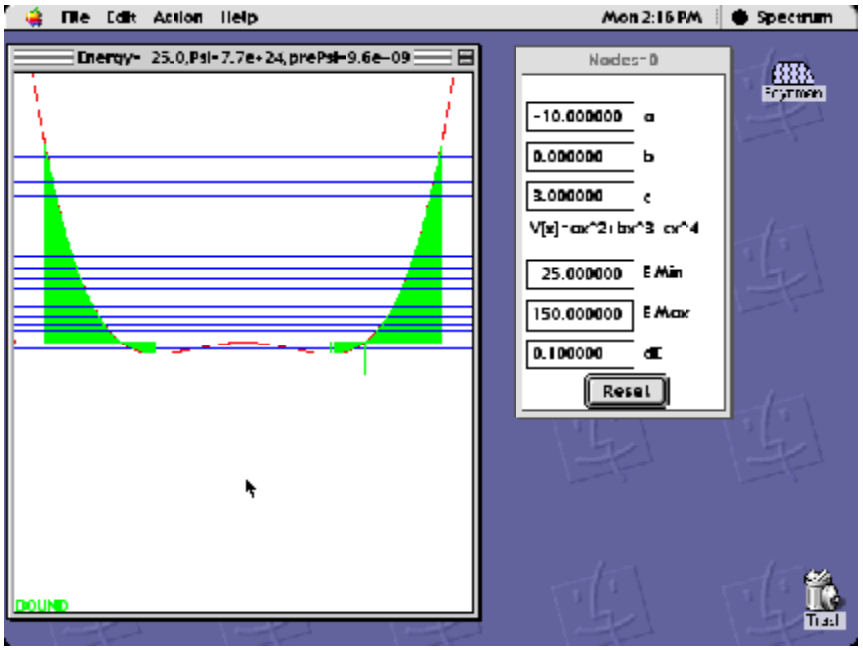
This past spring, each of the five juniors in Don Jacobs' Junior I.S. course performed five experiments, including one self-designed project and a computer simulation. The principles behind the computer simulation requirement are:

- Computers are tools that allow us to attack and solve problems not ordinarily encountered in the undergraduate curriculum
- Computer models help us identify essential physics responsible for interesting behavior, not reproduce nature exactly
- They elucidate physics, not numerical methods (which are merely tools)
- They are built on shells that exploit the modern Mac GUI
- They employ C/C++ and the Code Warrior IDE
- They can be classical or quantum

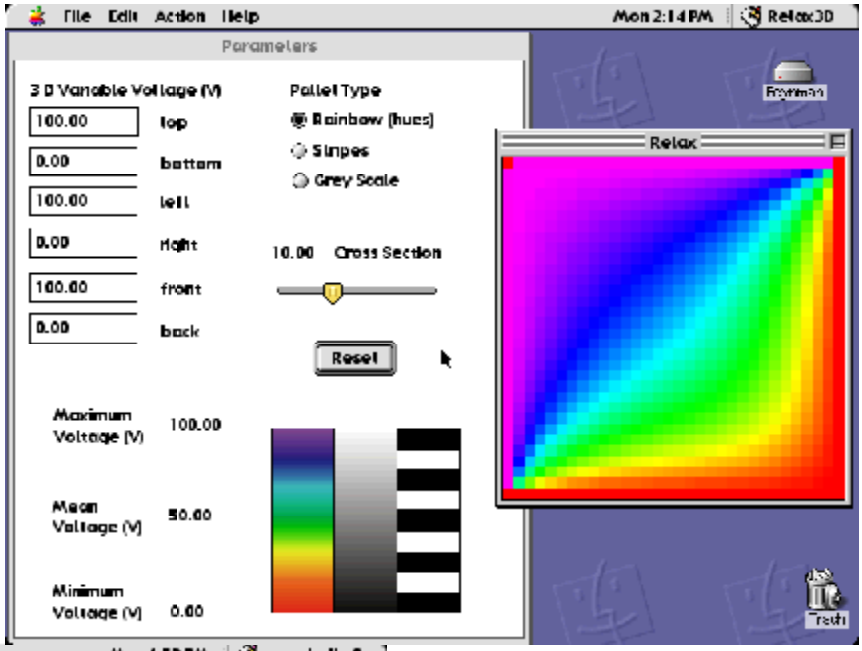
1999 Computer Simulations

Scatter
by Geoff Bonvallet

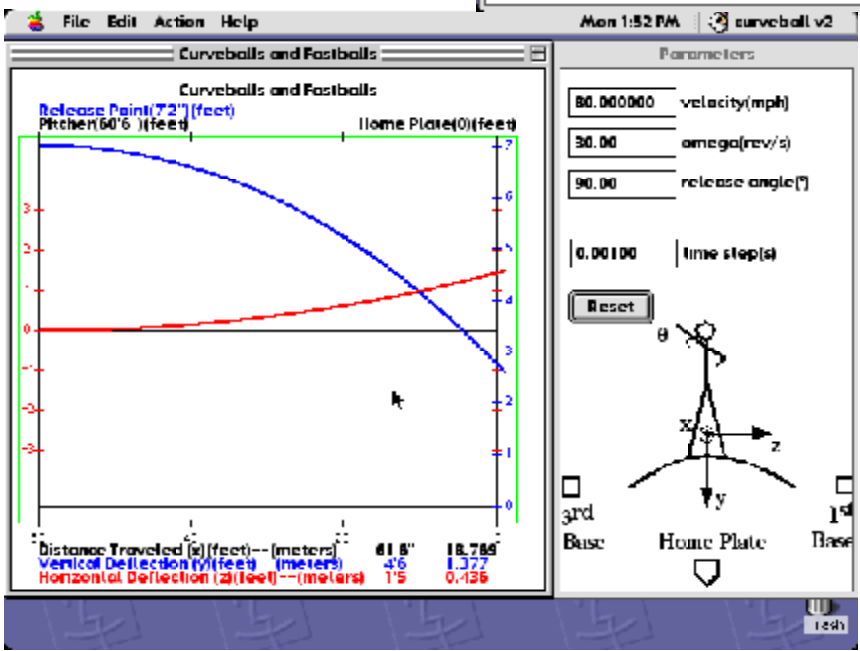




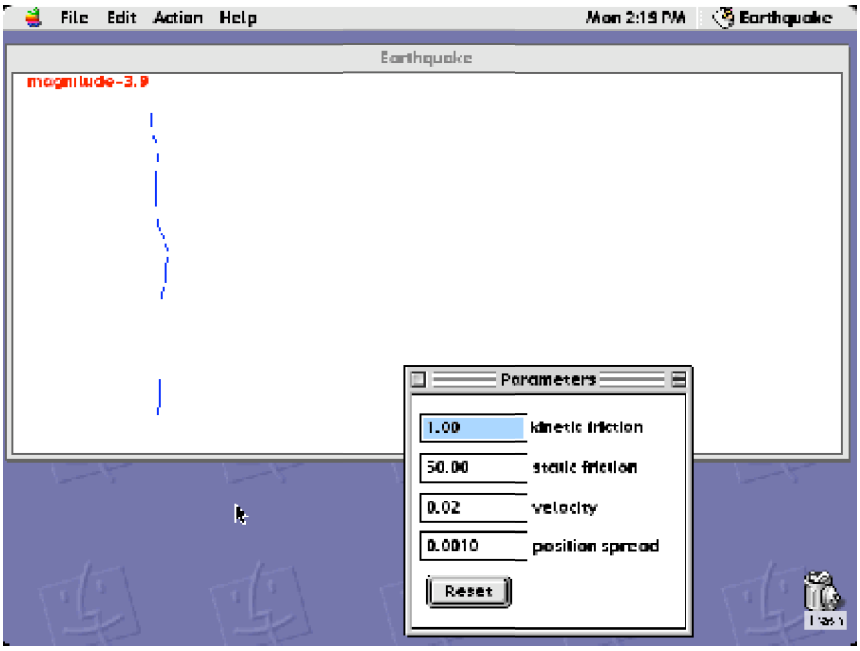
Spectrum
by Sri Chandramouli



Relax
by Sean English



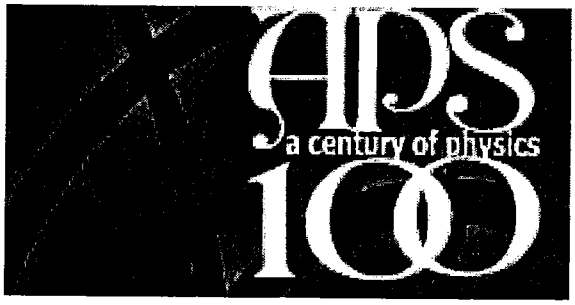
Curveball
by Andy Nowicki



Earthquake
by Tim Sir Louis

Front row, from left: Tim Sir Louis, Geoff Bonvallet
Second row, from left: Andy Nowicki, Sri Chandramouli, Sean English

Centennial Meeting Of the American Physical Society Atlanta, Georgia March 21 – 26, 1999

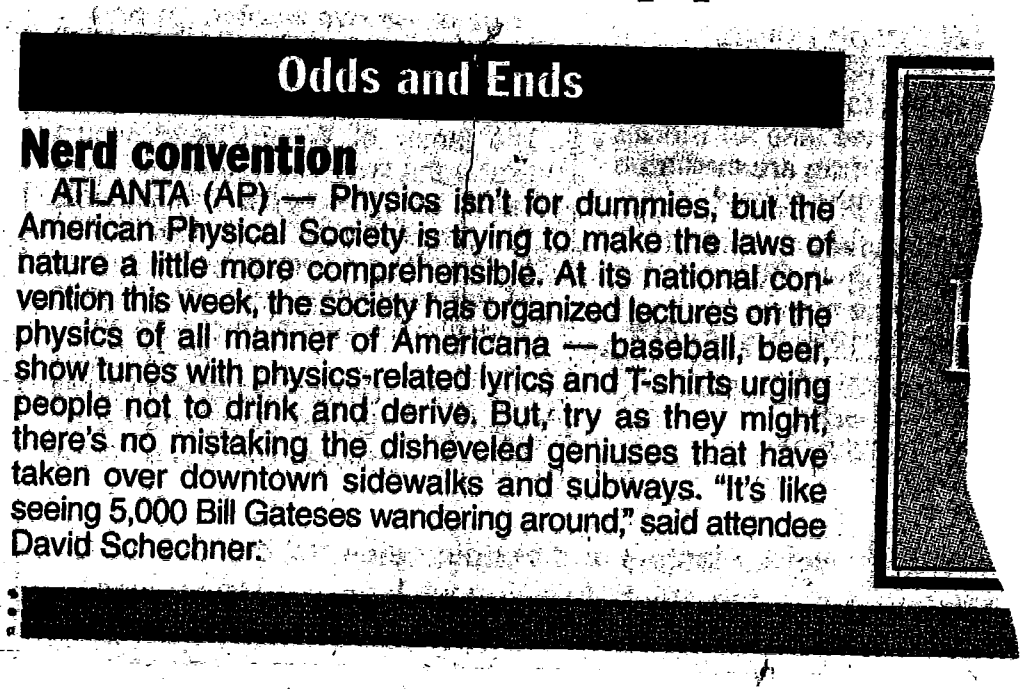


The American Physical Society celebrated its 100th Anniversary in conjunction with the 1999 APS Centennial Meeting, which represented the largest technical agenda ever presented by APS or any other physical society. The meeting was held at the Georgia World Congress Center. The annual APS general meeting, usually scheduled in March, and the Joint APS and AAPT meeting, usually scheduled in April, were combined into one six day meeting from March 21- 26, 1999. An estimated 7,000-8,000 physicists from around the world attended the meeting, including approximately 40 Nobel Laureates.

Bill Richardson, U.S. Secretary of Energy, delivered the keynote address. Most of Richardson's talk focused on the future, beginning with a summation of President Clinton's efforts to promote world leadership in basic science, mathematics, and engineering. Another area of concern to Richardson is the need to improve communication between the American people and the physics community.

The Nobel Discoveries Exhibit described how 100 years of Nobel Prize works and allied fields have improved peoples' lives. The APS historical exhibit, specially designed to celebrate the Centennial, told the story of the birth and growth of the Society, its journals, and 100 years of physics, and included the Centennial Time-line Wall Chart, which marked a century of milestones in physics.

From an unknown Atlanta newspaper:



Odds and Ends

Nerd convention

ATLANTA (AP) — Physics isn't for dummies, but the American Physical Society is trying to make the laws of nature a little more comprehensible. At its national convention this week, the society has organized lectures on the physics of all manner of Americana — baseball, beer, show tunes with physics-related lyrics and T-shirts urging people not to drink and derive. But, try as they might, there's no mistaking the disheveled geniuses that have taken over downtown sidewalks and subways. "It's like seeing 5,000 Bill Gateses wandering around," said attendee David Schechner.

The Wooster Contingent
"Proud to be Physics Nerds"

Front row, from left: Shila Garg, Kelle Cruz (REU '97), Alice Churukian (COW '91), Hanna Coy, Rachel Costello, Scott Hughes
Second row, from left: Don Jacobs, Paul Rebillot, Sri Chandramouli, Christy Rauch, Don Colladay, Dinky Ghosh, Chris Templeman

The College of Wooster made its presence known at the Centennial Meeting. Shila Garg, Don Jacobs, Don Colladay and Judith Elwell made the journey by minivan, accompanied by three Wooster seniors and five REU summer researchers, of which four were Wooster students. Each of these eight students made a poster presentation:

Chaotic Brownian Billiards
Scott Hughes*, John F. Lindner, and William Ditto

Scaling Laws for Noise Enhanced Propagation
Sridhar Chandramouli*, Andrew Kuck*, John F. Lindner

Static Traversable Wormholes and the Violation of Energy Conditions
Paul Rebillot* and Don Colladay

Taming Chaos
Hanna Coy†, Woodrow Shew*, and John Lindner

Heat Capacity Anomaly in Succinonitrile and Water
Madhujit Ghosh*, Shaun McClellan†, and Donald Jacobs

Phase Separation of Binary Nematic Liquid Crystal Mixtures
A. Christine Rauch*, Shila Garg

Predicting Earthquakes from Sand Piles Using Self-Organized Criticality
Rachel Costello*, Donald Jacobs

Investigation of Electric Field Induced Wall and Zigzag Structures in the Nematic Liquid Crystal 5CB
Chris Templeman*, Shila Garg

† Students from other colleges who did REU research at Wooster
* COW students

The highlight of the trip for everyone involved was attending a lecture by Professor Stephen Hawking. Dr. Garg was said to be pleading with complete strangers for tickets to the event so that the entire Wooster contingent could attend. Apparently she was so persuasive that she ended up with one EXTRA ticket, which she gave to a very grateful undergraduate. From the program:

The American Physical Society
is proud to present the
1999 Julius Edgar Lilienfeld Prize
to

Stephen Hawking

University of Cambridge

"For boldness and creativity in gravitational physics, best illustrated by the prediction that black holes should emit black body radiation and evaporate, and for the special gift of making abstract ideas accessible and exciting to experts, generalists, and the public alike."

Professor Hawking will present his Lilienfeld Lecture entitled

The Universe in a Nutshell

Wednesday, March 24, 1999 8:30 p.m.
Atlanta Civic Center

Look what else our students do!
(or…we are not just science geeks)

Contrary to popular belief, our physics majors do not spend *all* their time in the annals of Taylor Hall! Our majors are involved in all kinds of extracurricular activities, including music, sports, and community service. We are proud to claim such a well-rounded group of young people as our physics majors.

Paul Rebillot '99 was a trumpet play for all four years in the Scot Marching Band, Symphonic Band, AND Jazz Band. He was a member of Xi Chi Psi, a section which organizes campus blood drives for the American Red Cross. Paul was also a Resident Assistant in Armington Hall and for the Xi Chi's. For extra fun, Paul played intramural sports, including soccer, ultimate frisbee, basketball.

Scott Hughes '01 is also a member of the Marching and Symphonic Bands, in which he plays French horn. He also plays piano for fun. He has run light and sound board for Theatre Department productions, and is a member of Xi Chi Psi and the Sciences and Humanities Program. Scott is a College of Wooster College Scholar.

Geoff Bonvallet '00 describes himself as a "band geek in addition to being a physics geek. Geoff plays trombone in the Scot Marching Band and the Symphonic Band. Geoff is also a member of the Science and Humanities Program.

Christy Rauch '00 served as president of Women in Science and was a member of the Marching Band. She was a disc jockey and world music director for WCWS (the College radio station). Christy also served on the Cultural Events Faculty Committee.

Josh Bozeday '00 participated in intramural soccer and ultimate frisbee. He also served as an officer in the College's Circle K club, a division of Kiwanis which is an international service organization that combines community service, fellowship, and outstanding leadership development. Through the club, Josh tutored children at Lincolnway Elementary School once a week.

Lauren Ault '01 enjoys mountain biking, soccer, basketball, ultimate frisbee, and rock climbing. However, her all-time favorite pastime is tormenting Jackie the physics secretary!

Tim Sir Louis '00 is a member of the College of Wooster track team. This year, Tim set two school records. The first record was set in the pole vault (15-4 1/4) and the second was set in the decathlon (5787 points). Tim also earned All-North coast Athletic Conference honors in both events by finishing second in each at the NCAC Championship Meet. Way to go TIM!

Amy Lytle '01 is a piper in the Scot Marching Band. She serves as treasurer of Women in Science. Amy is also a College of Wooster College Scholar.

Andy Nowicki '00 just completed his third year as catcher for the Fighting Scots Baseball Team. In addition to baseball, Andy spends a lot of time caring for two very special friends, Clarence and Phoenix, his pet iguanas.

Research Experience for Undergraduates

Summer 1999
Supported by the National Science Foundation
and The College of Wooster

In the six summers of our REU site, we have established and run a strong program that provides valuable training of undergraduate students. We had four women and five men participants in the summer '99 site and all these undergraduates were directly trained by three faculty. We recruited four students from off campus from undergraduate institutions that are not active in research. We consider this to be an extremely successful summer research period.

The summer research experience site ran from May 17 to July 23, 1999. The research community consisted of four faculty members and nine students supported by the REU grant, one student supported by Dr. Garg's RUI grant, and one student supported by Dr. Jacob's PRF grant.. There were a few structured general activities in which all the students participated, such as instructions on literature search from databases, the use of *LabView* software for data acquisition, etc. In addition, individual research groups had intensive small group training during the first week on the theories relevant to the projects. These involved daily lectures and discussions. Students were also instructed on the use of instrumentation or software for simulation. There were weekly seminars, which started out in the initial weeks with faculty presentations; starting in the third week of the research period, two students made presentations of their research each week. These oral presentations were followed by questions and discussions among the group. The summer program concluded with a poster session on the last day, to which the scientific community on campus was invited. The students were also required to submit a written report of their individual summer project. Thus the participants acquired many research and presentational skills.

All the students were assistants for a three hour long laser workshop, which was part of our yearly BWISER (Buckeye Women in Science, Engineering and Research) program. In addition to the scientific program, there were many informal and recreational activities planned for the summer research period. The group had a weekly picnic lunch where faculty and students explored the various parks in the area. There were softball and soccer games among the larger summer student community. We had our annual trip to an amusement park, an observational session using our telescope, meals at faculty homes and cook-outs.

Society of Physics Students

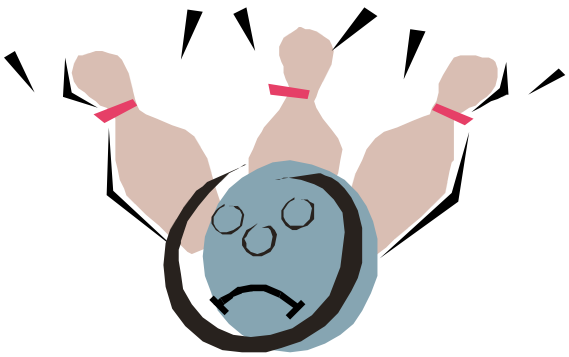
1998-99 Officers

President: Dave Walkenhorst
Vice-President: Paul Rebillot
Treasurer: Josh Bozeday
Secretary: Christy Rauch

Advisor: John Lindner

Events

- Picnic Lunch and Canoeing, Sunday 2 May 1999
- Lecture by Patrick McGraw, UNC Chapel Hill, Friday 23 April 1999
  Flux Tubes, Strings, and Features Great and Small
- Taylor Bowl 10 @ Wednesday 21 April 1999
- Lecture by Dan Ludwigsen, Brigham Young University, Monday 19 April 1999
  Physical Modeling of a Trombone Player's Lips
- Lecture by Elaine Kirkpatrick, University of Nebraska, Friday 26 February 1999
  Reversal Behavior in Nanostructured Magnetic Materials
- Lecture by Janice Hudgings, *University of CA Berkeley,* Monday 22 February 1999
  Mixing Light and Semiconductors: A Bright Idea
- Lecture by Jennifer Goetz, University of Rochester, Friday 19 February 1999
  Examining Massive Star Formation at Near Infrared Wavelengths
- Fall Senior I.S. Oral Reports, Thursday 3 December 1998
- Great Lakes Science Center trip, Saturday 21 November 1998
- Lecture by J. Eric Goff, Indiana University, Thursday 19 November 1998
  Photon-Drag Effect in Metals
- Lecture by Bill Antel '94, Ohio University, Tuesday 20 October 1998
  Induced Ferromagnetism in Platinum: How to Make a Magnet
- Science Block Party, Friday 9 October 1998
- Dinner & Dessert Night, Wednesday 16 September 1998

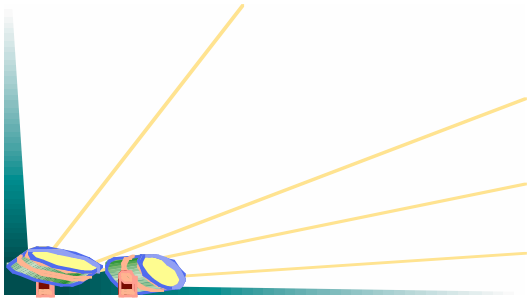


TAYLOR BOWL X

The Physics Club suffered a crushing defeat at the hands of the Math Club in Taylor Bowl X.

Final Results:
Physics 104
Math 121.4

The giant slide rule will remain in the math department for another year.



Alumni Spotlight

Bruce Bartlett
Class of 1970

Bruce lives in Elkhart, Indiana and is employed as a microphone design engineer at Crown International. There he designs and tests high quality microphones for recording studios, sound-reinforcement systems, and broadcast. Bruce reports that a lot of physics is involved in his work.. Acoustically, a microphone is a combination of several damped resonant systems, acoustical phase-shift networks, and surfaces that are sonically reflective, absorptive or diffractive. Electrically, a microphone uses static electricity fields or magnetic fields.

Roger France
Class of 1973

Roger lives in Colorado Springs, CO and works for MCI Worldcom. His job includes mainframe performance engineering, where he spends most of his time identifying performance bottlenecks in critical applications and trying to implement improvements. He telecommutes from his home, going into the office once a week.

Roger's wife Mary Beth (Atchison '73) teaches fourth grade. Oldest daughter Robin will graduate from Fort Lewis College this fall with a degree in psychology. Son Ryan just completed his second year at Washington University, where he is studying physics. In fact. Ryan's teaching assistant this past year was '97 Wooster grad Francesca Mascarenhas. Roger also has a daughter Megan entering 9th grade and son Mason entering 6th grade. Roger says, "Maybe we'll get one of these kids to Wooster yet!"

Paul R. Stauffer
Class of 1975

Paul is a hyperthermia physicist in the Radiation Oncology Department of the University of California, San Francisco. In support of his clinical activities, his research involves both the development of improved microwave and ultrasound applicators for applying heat to tissue and thermal dosimetry characterization of new hyperthermia induction techniques. This research is accomplished with a combination of theoretical modeling, engineering development, and equipment performance evaluation with phantom, animal, and human patient subjects.
http://itsa.ucsf.edu/%7Eradonc/physics.html

Ann Mowery
Class of 1982
Ann lives in Avon Lake, Ohio and teaches physics at Bay Village High School. She has been at the forefront of implementing the discovery-based physics curriculum into high school physics.

Daniel Hogenboom
Class of 1987
Dan received his Ph.D. in electrical engineering from Northeastern University in 1996. His thesis experimentally investigated the magnetic properties of high temperature superconductors. He then worked as a post-doctoral researcher at the optical Science Lab at Northeastern for two years, working on a variety of projects including laser radar, holographic imaging, and the construction of an optical magnetic field sensor. He is currently a scientist at Textron Systems in Wilmington, MA where he is involved with their laser radar program.

Palani Sakthivel
Class of 1988
Palani is a Senior Process Engineer for Eaton Corporation's Fusion Systems Division in Rockville, Maryland. His company makes equipment, such as photostabilizers and ashers, for the chip manufacturing industry. Palani is involved in the research, development, and characterization of ashers. You might ask, what is an asher? Basically, an asher uses a downstream microwave plasma to "ash" or strip photoresist and other residue from a wafer.

John Scudder
Class of 1989
John received his Master's degree in Computer Science and Engineering from the University of Michigan in 1996. Also in that year, John co-founded Internet Engineering Group in Ann Arbor, Michigan. His company provides advanced software and network engineering services to network service providers and router companies. John reports that the company is doing well.
http://www.ieng.com/~jgs

Craig Selby
Class of 1989
After switching career interests a few times, Craig graduated for Ohio State University in 1998 with a degree in veterinary medicine. He then joined his wife Nancy Irvine D.V.M. ('90-chemistry) as co-owner of the Daisy Hill Animal Hospital in Ashland, Ohio.

Dennis Kuhl
Class of 1990
Dennis finished his Ph.D. in physics at Michigan State in 1996, after which he began a postdoc at the Center for Science and Mathematics Teaching at Tufts University. At CSMT, Dennis studied conceptual difficulties that students have learning physics and developed materials to improve conceptual learning. CSMT found that an activity-based,

guided discovery approach can significantly improve conceptual learning in introductory physics. Dennis also studied the use of Interactive Lecture Demonstrations (ILDs) in various instructional settings. Dennis recently accepted a teaching position at Bridgewater State College in Bridgewater, Massachusetts.

Prashant Jain

Class of 1993

After spending two years as a software engineer for Fujitsu Network Communications in the Bay Area, Prashant now works in Munich, Germany for Siemens Corporate Technology. His new job involves marketing emerging computer technologies in Europe. On the personal side, Prashant has been happily married for 2.5 years.

Mark McKinney

Class of 1993

After leaving Wooster, Mark received his MBA and for several years now has been working at New Resources Corporation in Cleveland. His job involves analysis, programming, writing user and technical documentation, and testing. The platform on which he does most of his work is an IBM Midrange. He has completed assignments in various industries including manufacturing, logistics, distribution, and retail. Mark says that his profession is "exciting, challenging, rewarding, and does not have anything to do with quantum mechanics, thank goodness." Mark would enjoy email: *mckinnem@newresources.com.*

William Antel

Class of 1994

Earlier this year, Bill completed his Ph.D. in physics at Ohio University. He has taken a post doc at Argonne National Labs working at the Advanced Photon Source synchrotron. Last fall, Bill made a visit to Wooster and gave a talk in our department entitled "Induced Ferromagnetism in Platinum: How to Make a Magnet."

Michael Hunter

Class of 1994

Mike lives in Strongsville, Ohio and is employed by the Kirby Company in Cleveland as a software engineer/internet manager. He designs and develops medium- to large-scale websites and e-commerce solutions for his company and other companies which Kirby owns. The websites enable their business partners to access data and programs for the mainframe and UNIX systems using the web. Since Kirby sells many products over the internet, Mike's projects involve everything from graphic design to programming (C++, Java, and Perl) to server installation and configuration. He designs network setups for companies which do not have internet connectivity. Also, Mike is in the process of using his experience to start a consulting company.

Department of Physics Annual Report 1998-99

Alumni Information Sheet

Name _____

Home Address _____

_____

Telephone _____ Class _____

Business Address_____

_____

_____

Telephone _____ e-mail _____

URL _____

Occupation

_____

Title

_____

(Include business card, if available)

If your occupation is related to the field of physics, please attach a brief description of the area you are working in.

Anything else you would like to share with us for our files is also welcome.

fax: (330) 263-2516 or e-mail: *sgarg@wooster.edu*

or mail to: Shila Garg
Physics Department
College of Wooster
Wooster, OH 44691

Thank you for responding to this request!

God said…

$$\oiint \vec{E} \cdot d\vec{a} = Q$$

$$\oint \vec{B} \cdot d\vec{l} - \frac{d}{dt} \iint \vec{E} \cdot d\vec{a} = I$$

$$\oiint \vec{B} \cdot d\vec{a} = 0$$

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…and there was light