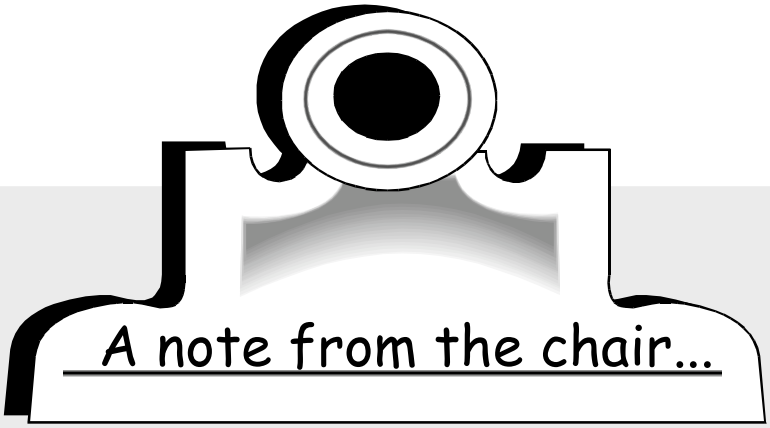
WOOSTER PHYSICS

1999-2000 Annual Report
The College of Wooster
Department of Physics
Wooster OH 44691

www.wooster.edu/physics

CONTENTS

This report produced by:
Jackie Middleton
Administrative Assistant
Department of Physics
jmiddleton@wooster.edu



A note from the chair...

Welcome to the fourth Annual Report from the physics department. I know many of you have been anxiously waiting to receive the report and have even emailed us about it. I hope you enjoy reading about the past academic year and all that has gone on in the department. I am afraid I am starting to sound like a scratched record when I say that we had an outstanding year. Each year, our students have been taking on more ambitious I. S. projects and challenging the faculty supervisors to keep up with them. Our upper-class majors have been very successful in getting summer research positions, after going through our REU program in their first and second years. The department also received its third REU site grant, so we expect to be busy at least until the summer of 2002. Four of our REU students and a senior presented posters at the March APS meeting at Minnesota. As is our tradition, we also discovered some good local restaurants!

The highlight of the year was Don's award from APS for research at an undergraduate institution. This is a very prestigious award and we celebrated it with Don giving us the same talk that he gave at the April APS meeting where he received the award. We are very proud of you, Don!

The other highlight was the Council on Undergraduate Research conference that we hosted at the College. Over 600 science faculty from across the country converged here for a few days and were duly impressed by our facilities, beauty of the campus, and our hospitality.

We are very grateful to the family of Alexandra Babcock Marshall ('35) and Robert W. Marshall for making it possible for us to remodel some of our rooms. We have a new seminar room, a study lounge and a nicer office for Jackie (large enough to accommodate all the majors that hang around her office!), and a new liquid crystal research lab facility. We are very pleased with these modifications.

We had a great year with first-time faculty Jenn Goetz and our visiting faculty Dan Ludwigsen. We wish Dan the best as he completes his thesis and looks for teaching positions. We are fortunate to have Bram Boroson with us for the coming year as a half-time leave replacement for Don. We wish Don a productive leave.

Our department's program is undergoing a review this year. We want to take a close look at our curriculum and other aspects of the program. Any comments from our alumni will be welcome. Some of you will be receiving a survey from us, so that we can learn from you how the physics program has helped you and if there are aspects of it that need to be improved.

Thank you for your continued interest in the department.

Sincerely, Shila Garg, Chair

The Class of 2000

Geoffrey Allan Bonvallet

"Geoff"
Westerville, Ohio
Plans: graduate school, University of Wisconsin
atomic/molecular/optical (AMO) or condensed matter physics

Sridhar Chandramouli

"Sri"
Juhu Mumbai, India
Plans: graduate school, University of Southern California, physics

Sean Jason English

Houston, Texas
Plans: job at National Institutes of Health, National Cancer Institute
then medical school in 2001

Andrew Walter Nowicki

"Andy"
Swanton, Ohio
Plans: job market

Timothy Collins Sir Louis

"Timmy"
Medina, Ohio
Plans: job market

Carrie Ann Williams

Mentor, Ohio
Plans: graduate school, Georgia Institute of Technology
biomedical engineering

Seniors from left: Tim, Geoff, Sean, Andy, Sri

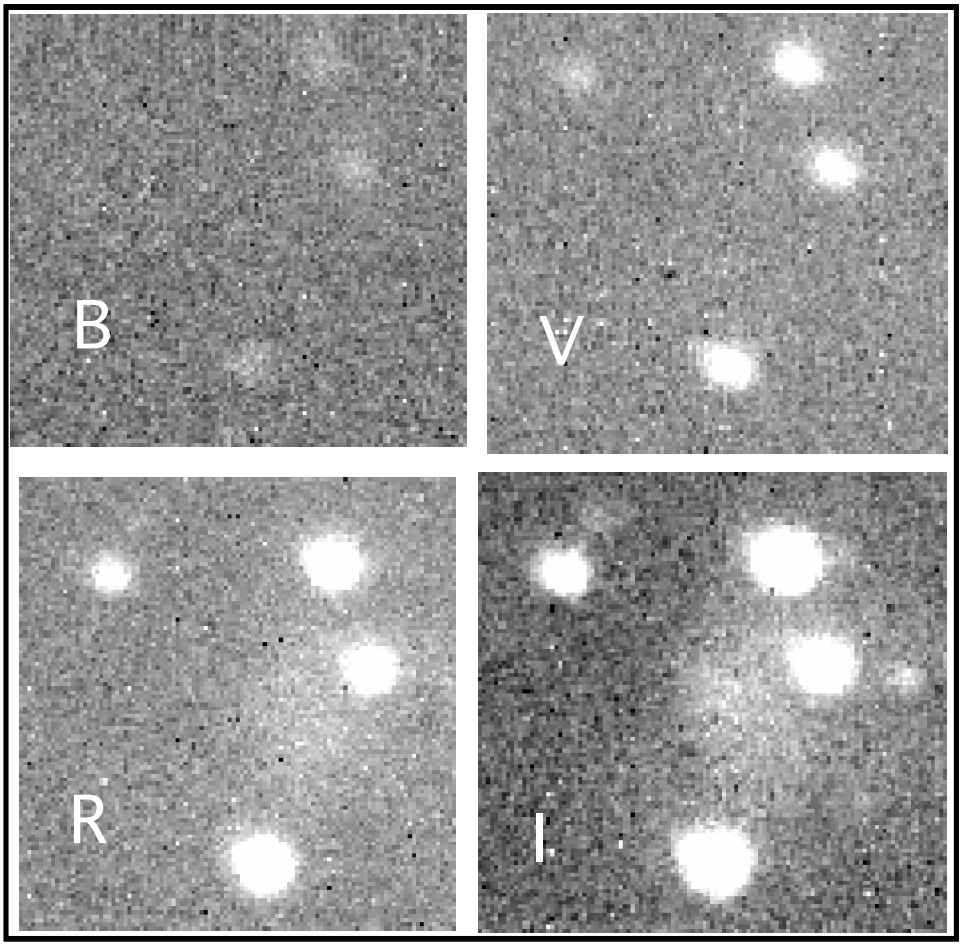
Carrie spent her senior year at Washington University in St. Louis in the 3/2 engineering program.

Senior Independent Study

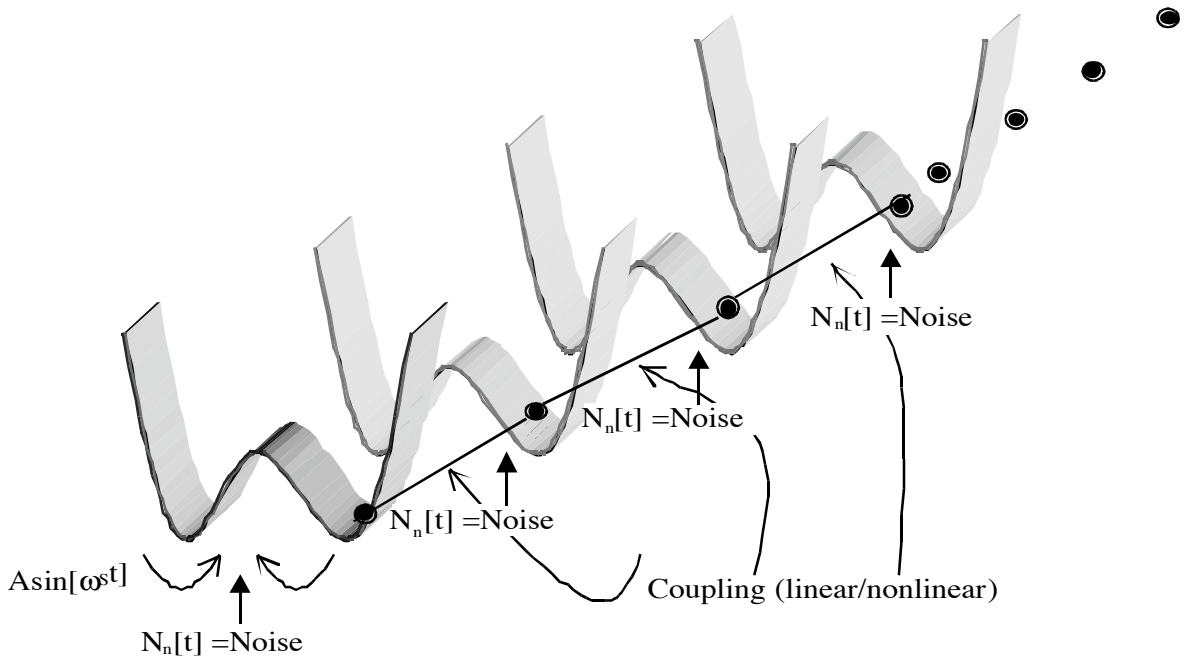
Placement of Bright S88B Objects on a Hertzprung-Russell Diagram Using Visible Light Measurements

by Geoffrey A. Bonvallet
Advisor: Jennifer Goetz

Abstract: In this experiment we attempted to determine the placement of S88B stellar objects in a Hertzprung-Russell diagram. A charged-coupled device (CCD) camera was used to observe the HII region S88B at visible wavelengths through B, V, R, and I Johnson filters. Four major stars were observed and their flux densities were digitally measured and compared with those of standard photometric stars. The magnitudes of the S88B objects at each filter wavelength were calculated, and color-color and magnitude-color plots were made from the data. The data suggest that extinction significantly affected the measurements, but was not quantified. Similarly, infrared excess was apparent and reflective augmentation of lower wavelengths may also be present. Overall, the experiment demonstrated an ability to take photometric measurements of stars using the equipment available at The College of Wooster, but more data from standard stars should have been taken to improve the quality of the work.



S88B images taken with different filters. The shorter-wavelength images are dimmer.

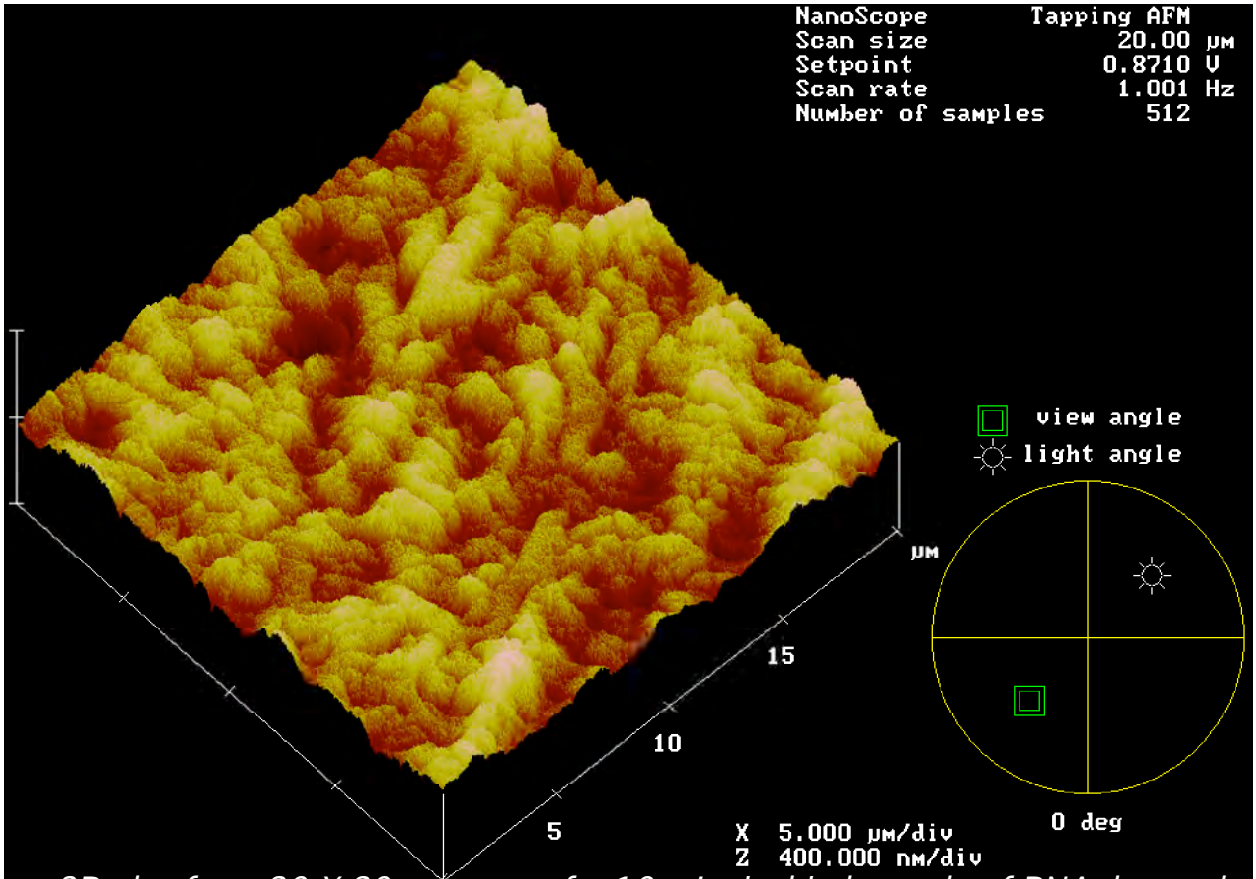


An array of noisy, bi-stable, coupled oscillators exhibits Noise Enhanced Propagation.

Noise Enhanced Propagation in an Arrayof Schmitt Triggers

by Sridhar Chandramouli
Advisor: Donald T. Jacobs

Abstract: Noise Enhanced Propagation (NEP), a recent extension of stochastic resonance, proposes that noise may be used to enhance the response of an array of coupled elements to a driving signal input at one end of the array. NEP was recently observed in numerical simulations. An array of Schmitt triggers (8 elements) was constructed as a physical system analogous to the numerical model simulated. NEP was observed in the array of Schmitt triggers as witnessed by the higher signal-to-noise-ratios recorded at the output of elements late in the array for intermediate levels of noise, than for no noise or high noise input. The optimal level of noise depends on a number of parameters such as the power supply voltage to the Schmitt trigger, resistors that make up the Schmitt triggers, and the driving amplitude into the first Schmitt trigger.



3D plot for a 20 X 20 µm scan of a 10 mL air-dried sample of DNA, located midway between the center of the sample and its edge.

The Formation of Complex Lenses from Evaporated Droplets Containing DNA

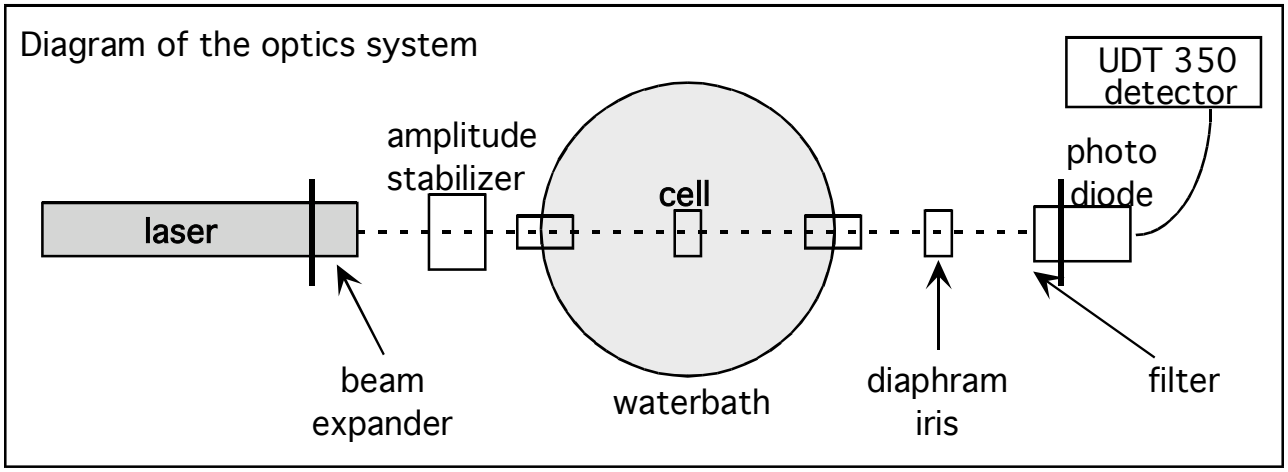
by Sean Jason English
Advisor: Shila Garg

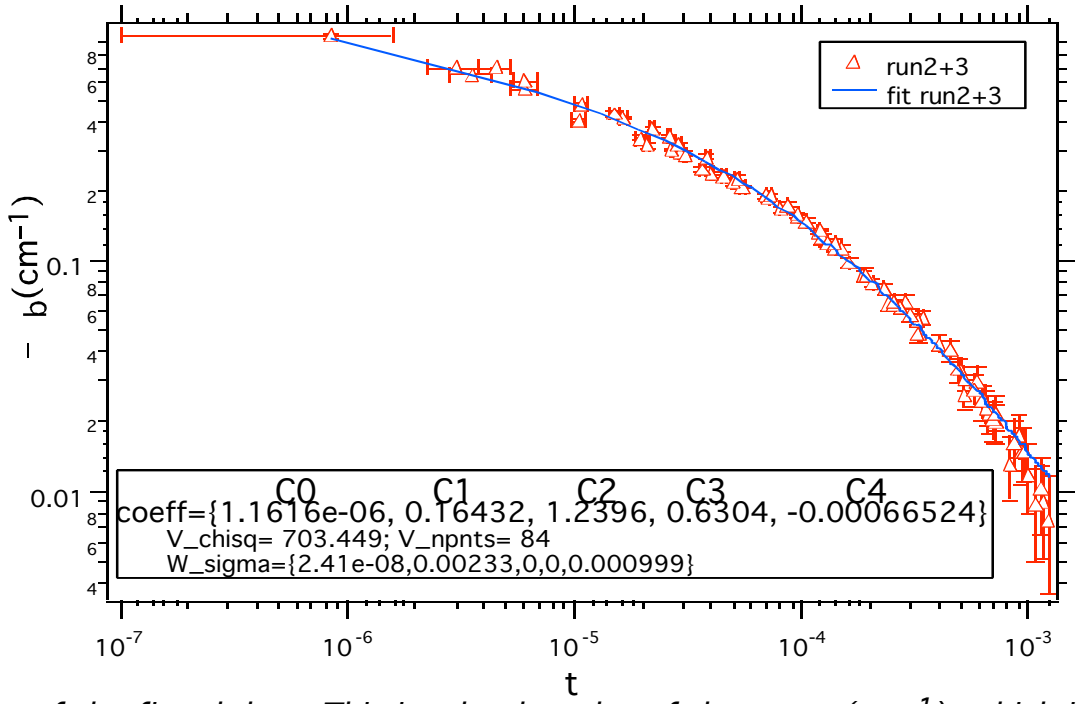
Abstract: Samples containing 50 mg/mL sonicated, calf thymus DNA, of fragment lengths 500 – 1500 base pairs, were permitted to dry naturally and by the application of heat. A conscopic cross was observed for both manners of evaporation, with and without the presence of a Bertrand lens. Based on this birefringence and the reported lens behavior of nematic liquid crystals, it was suggested that the process of evaporation resulted in a lens structure. In this study, preliminary steps were taken to verify or contradict this claim, while establishing the basic molecular and macroscopic organization of the DNA in these sample droplets. The use of scanning probe microscopy allowed for the identification of a periodic structure in the evaporated samples. If this periodicity is treated as P/2, the cholesteric pitch for the scanned regions is 1.94 ± 0.22 µm. This is in agreement with the accepted pitch range 2.2 – 3 for DNA in the cholesteric phase. A periodic ring structure was also observed for the sample with ring thicknesses determined by observation with the microscope to be (67.0 ± 9.3) µm and (29.0 ± 4.6) µm for the air-dried and heated samples respectively. It is not clear how this structure is related to the periodic structure observed by SPM. However, the presence of a steep depression, or well, at the center of the sample appears to be necessary for the lens behavior. Analysis of the sample diffraction suggests that this well and the surrounding convex regions of the sample result in the convergence of light at two maxima. This appears to verify the lens behavior of the sample observed visually. The structure of the sample was theoretically modeled as two sets of multi slits separated by an opaque obstacle, and the experimental data was compared with theoretical data obtained using the structural parameters of the sample determined from observation with the microscope. The model appears to be a reasonable first step in understanding the sample structure, but the experimental variables need to be fully identified and eliminated if necessary.

Measurement of the Turbidity of the Critically Composed Binary Fluid Mixture Succinonitrile and Water in the One-Phase Region Near the Critical Solution Point Using Light Scattering

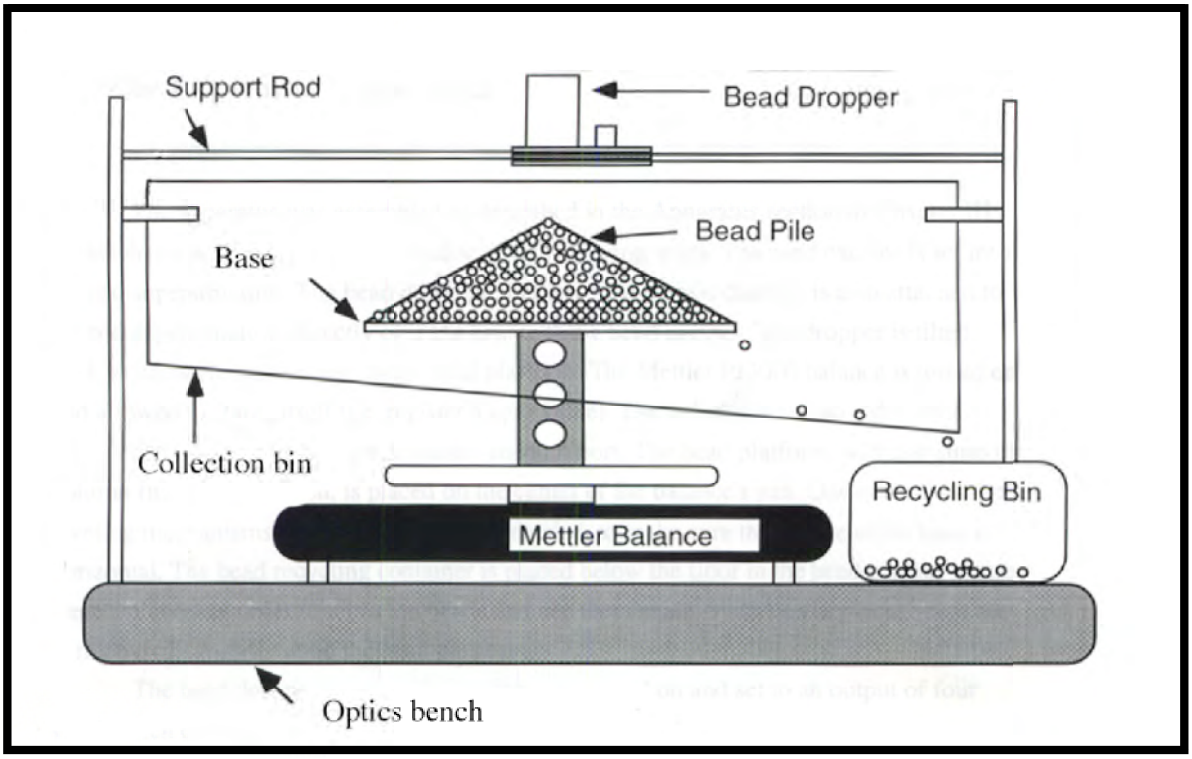
by Andrew W. Nowicki
Advisor: Donald T. Jacobs

Abstract: An experiment on turbidity has been done on the binary liquid system of succinonitrile and water close to the critical point. The data were analyzed assuming Ornstein-Zernike scattering, which allowed the critical exponents γ and ν to be held constant while the parameters: turbidity τ_o, correlation length amplitude ξ_o, and the background turbidity τ_b were determined with a fit. The data were then compared to published data, and two-scale-factor universality was tested.





Plot of the fitted data. This is a log-log plot of the $\tau - \tau_b$ (cm^{-1}), which is turbidity minus the background turbidity vs. the reduced temperature t. The coefficients are given in consecutive order along with the respective errors in those values.



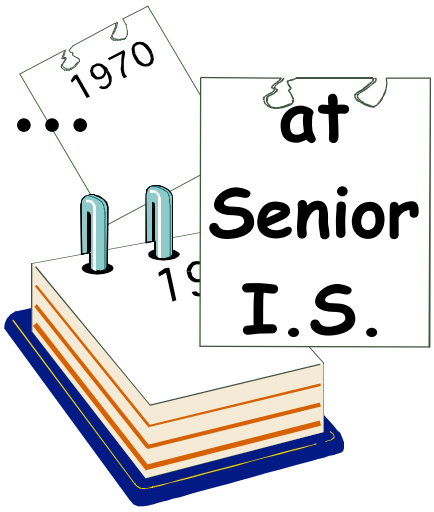
The beads are dropped onto the pile by a bead dropper. The mass of the pile is monitored by an electronic balance. A collection bin catches the beads as they fall off the pile.

Self-Organized Criticality in a Bead Pile

by Tim Sir Louis
Advisor: Donald T. Jacobs

Abstract: The theory of self-organized criticality was introduced as a new way of looking at complex dynamical systems. This theory suggests that systems which naturally evolve to their critical state will exhibit similar behaviors. One of these behaviors is the distribution of the events that occur at the critical state, which is expected to exhibit a power-law behavior. This experiment looks at the distribution of avalanches that occur in a bead pile when the pile is periodically perturbed by the addition of beads. The avalanches are measured by monitoring the mass fluctuations of the pile using an electronic balance. Glass, steel and plastic beads are used to create the piles, which are studied to see if the distribution of avalanches does follow a power law. It was found that the power-law behavior was prevalent in bead piles using all three types of beads. It appears that there is a power law for glass beads, and a separate power law for steel beads. For plastic beads, it seems as if the distribution of avalanches follows two different power laws.

A Look Back ...



Senior I.S. in 1970

Bruce A. Bartlett	Basic Architectural Acoustics: Theory and Application to Two Campus Buildings
Efren Martinez	Problems in Classical Mechanics
Dale L. Peebles	The Mathematical Foundation of Modern Physics: A Study in the Purpose and Content of Classical Mechanics
William A. Voter	A Superfluid Helium Refrigerator

Senior I.S. in 1980

David R. Kaiser	Heat Capacity of a Binary Liquid Mixture Near the Critical Point

Senior I.S. in 1990

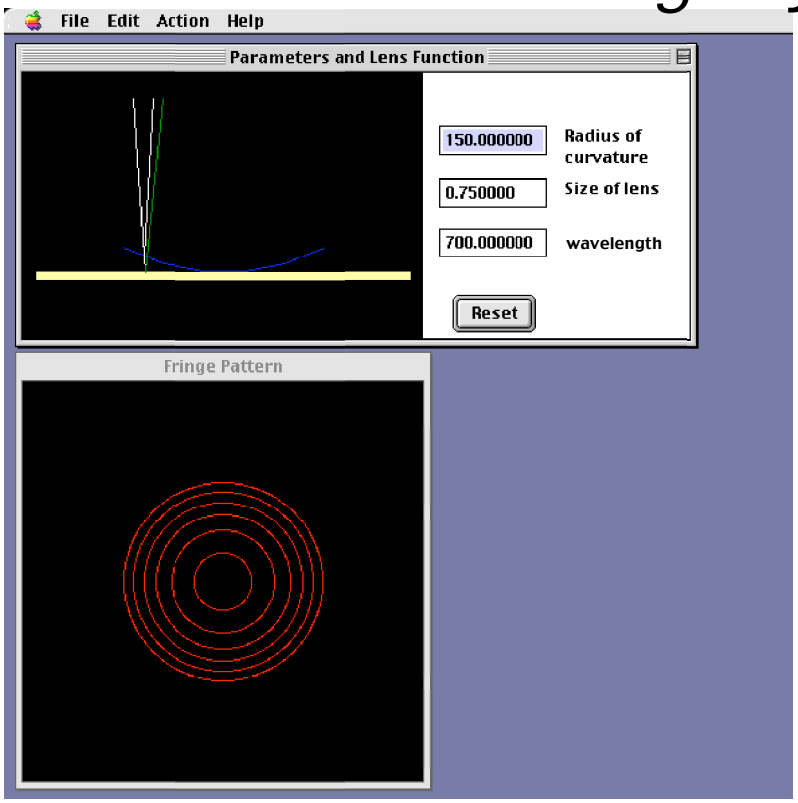
Dennis Kuhl	The Excess Volume Effect of the Binary Liquid Mixture Perfluoromethylcyclohexane + Isopropyl Alcohol
Susan Leitholf	Ion Beam Mixing in a Bismuth Silicon Bilayer
Karen McEwen	Self Organized Criticality in Sand Piles
Naseem Rahman	Electrical Properties of an Infinite Grid of Resistors

Senior I.S. in 1995

Ronald Craig	Flexoelectric Effect in the Nematic Liquid Crystal 5CB (4-cyano-4´-n-pentylbiphenyl)
Anne Flewelling	Phase Transitions in a Monolayer of Phospholipids: Using the Langmuir Balance Technique
Paul Hall	The Turbidity of the Binary Fluid Mixture Methanol-Cyclohexane Near the Critical Point: the Measurement of the Fisher Critical Exponent η
Priyavadan Mamidipudi	Effects of Magnetic Fields on the Modulated Phase of 5CB
Andrew Martin	An Automated Analysis of Swimming Behavior in *Paramecium tetraurelia*
Jared Ripps	An Investigation into the Structure of Agarose Using Laser Light Scattering

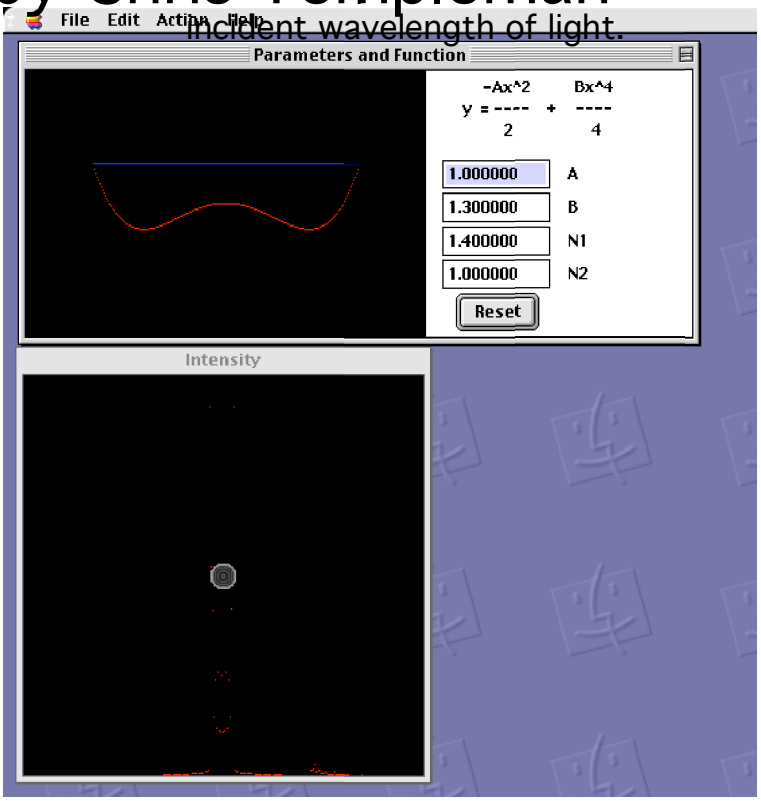
Junior Independent Study

Newton's Rings by Amy Lytle



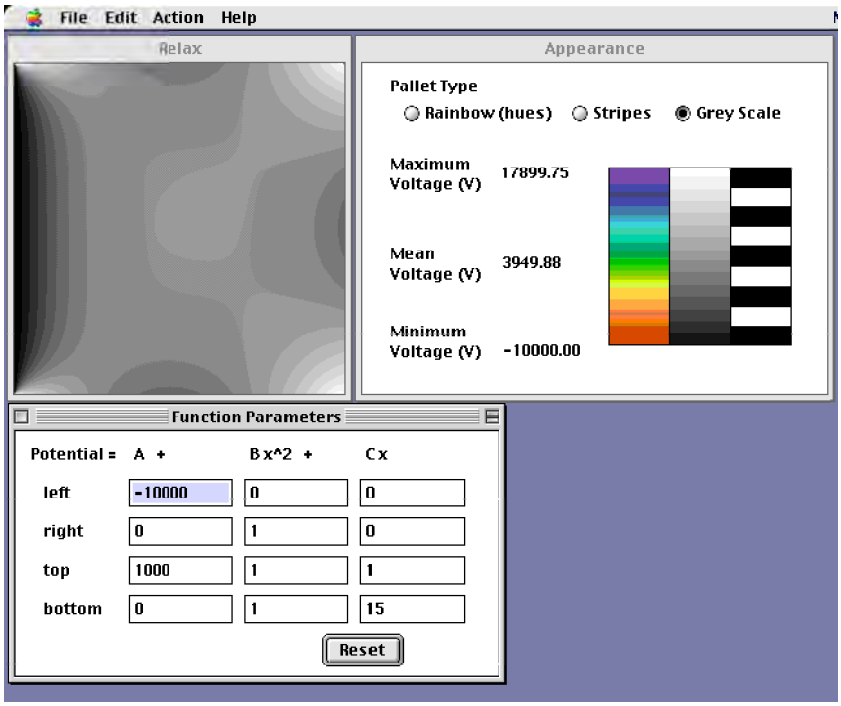
The program *Newton's Rings* attempts to simulate the interference pattern produced by a system in which two optical surfaces of different curvatures are placed in contact. *Newton's Rings* identifies the locations of the constructive interference fringes produced by the system of an optical flat surface adjacent to planoconvex lens, with a user-defined diameter and radius of curvature. Employing the theory of thin film interference, the calculated interference pattern effectively maps out the contour of the lens. This simulation would be helpful in identifying defects and imperfections in the contour of a lens by predicting the shape of the fringes produced by a certain shape of lens with a certain incident wavelength of light.

Interference IV by Chris Templeman



Laser light has been shown to produce interference patterns on a screen when it passes through a desiccated DNA droplet. *Interference IV* considers two macroscopic properties of these droplets. The simulation produces a two-dimensional (2D) interference pattern by considering the index of refraction and the shape of the droplet. The droplet was assumed to have axial symmetry and the cross section of the droplet was modeled as a fourth degree polynomial. In the program, the user is able to manipulate this polynomial as well as the indices of refraction of the droplet and the surrounding medium.

Relax2D by Scott Hughes



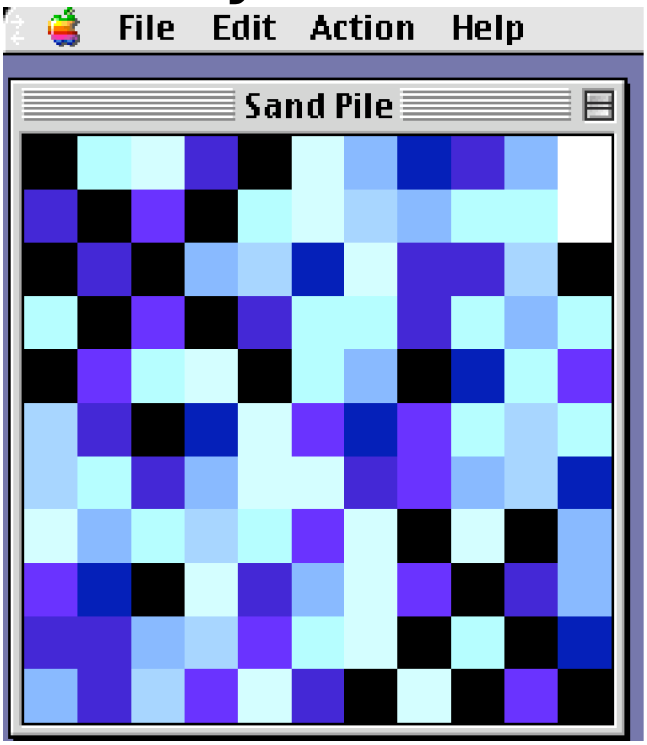
Electrostatics deals with the effects of charged particles that are not moving and the stationary electric fields resulting from the interaction of several such particles. At the heart of this study is Laplace's equation:

$$\nabla^2 V = 0.$$

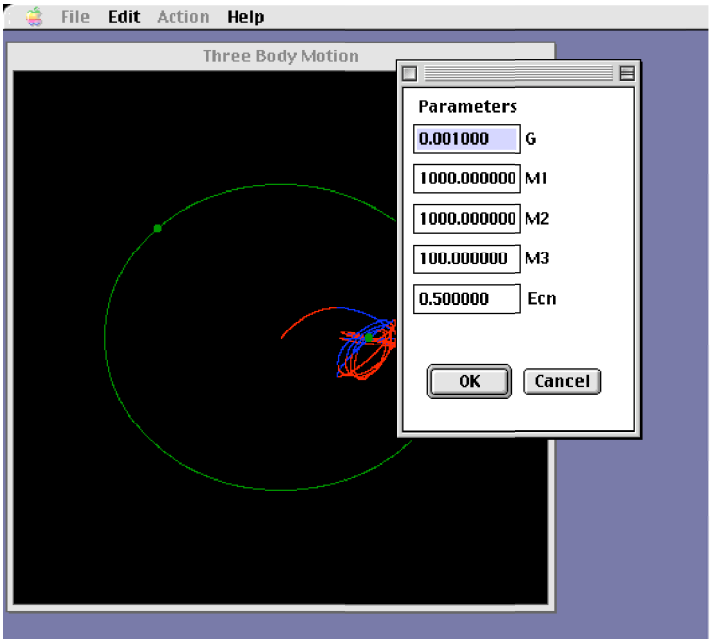
This equation applies not only to electrostatics, but appears in such diverse areas as gravitation, the theory of heat, and the study of soap bubbles. Numerical solutions are difficult, if not impossible, to find, but analytical solutions to this equation have been examined for years. *Relax2D* utilizes the relaxation technique to generate a visual representation of the field produced between a set of potential plates and includes potentials that vary over the surface of each plate.

SOC Sand Pile by Rachel Mary Costello

The most common example of SOC is a grain of sand. If you were to drop a grain of sand, one at a time, on top of a sand pile, eventually the pile would reach its critical angle of repose and avalanches would begin. A single grain causing a sand avalanche is analogous to catastrophic events in some other self-organizing critical systems. A few trades by one person could or could not crash the stock market. A butterfly flapping its wings in Africa may or may not cause a hurricane in Florida. There is no way to tell for certain what a small change will do. The *SOC Sand Pile* program provides a visual representation of a simplified model of a 3-dimensional pile of sand on a 2-dimensional grid.



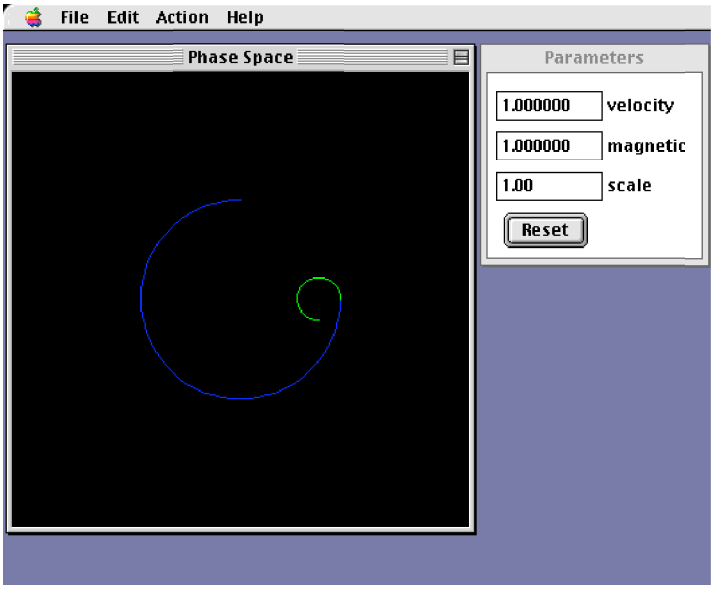
Drew Three Body by Andrew Bouchard



One way of approaching the three-body problem is to look at a light particle moving in the gravitational field of two bodies moving around each other in two-body motion. The simplest version of this problem is called planar circular, where the third particle moves in the plane of revolution of the two-body motion of the first two particles. This problem has no general solution but does have five specific solutions, which are the libration points of the system. Using *Drew Three Body*, the user is able to change the masses of all three bodies, the gravitational constant, and the eccentricity of the ellipse created by two-body motion.

Bubble Chamber by Lauren Ault

Bubble chambers are used to discover the existence and properties of elementary particles. The particles carry either a positive or negative charge and droplets form along the paths the particles create in a superheated fluid. The chamber contains a mist of fog that condenses out near the bottom and the particles are moved along with a magnetic field. The fog is created by heating a liquid above its normal boiling point while maintaining pressure great enough to maintain the liquid state. When the pressure is released, the liquid becomes superheated and boiling occurs at localities of high-energy density. The bubbles are formed at places of thermal fluctuations or in the ionized track left by the charged particles.



Bubble Chamber uses a calculated radius of curvature for the positive and negative muon and pion. The initial velocity and strength of the magnetic field of the decaying particle can be changed by the user and the resulting momentum is determined. The radius of curvature for the particle is calculated using the momentum. The resulting radius is the radius of the circular path for the decaying particle.

Juniors from left:
Scott Hughes, Andrew Bouchard, Lauren Ault,
Rachel Costello, Chris Templeman, Amy Lytle

Junior Independent Study
Self-Designed Projects 2000

At least one of the experiments done in Junior I.S. must be a self-designed project that is researched, assembled, and investigated by the student and must utilize a literature search including a DIALOG search.

Magnetic Braking by Scott

Invisibility Using Equal Indices of Refraction by Drew

Measuring the Speed of Light in One Direction by Lauren

Internal and External Behavior of a Simulated Bead Pile by Rachel

Demonstration of Time Reversal Invariance in Classical Mechanics by Chris

The Motion of Hollow Rolling Cylinders Filled with Viscous Liquid by Amy

Physics Faculty 1999-2000

Shila Garg

Associate Professor and Chair 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

Courses Taught in 1999-2000

Fall
- ✦First Year Seminar
- ✦Modern Physics
- ✦Modern Physics Lab

Spring
- ✦Foundations of Physics
- ✦Foundations of Physics Labs
- ✦Quantum Mechanics

Dr. Garg's First Year Seminar was a completely new topic, *"Redefining Who We Are in Terms of What We Know."* The following are some of the questions that were contemplated and discussed:

- *Is the human race responsible enough to handle the current strides in technology?*
- *What are the special challenges and moral issues raised by recent progress in science and technology that we will have to deal with as we enter the 21st century?*
- *What part does the scientific legacy of the 20th century play in our quest for creating a better world?*
- *What does the future look like for the inhabitants of Earth?*

Readings:

Billions and Billions: Thoughts on Life & Death at the Brink of the Millenium by Carl Sagan
Ishmael by Daniel Quinn
The Island of Dr. Moreau by H.G. Wells
Imagined Worlds by Freeman Dyson
Ecotopia by Earnest Callenbach
The God of Small Things by Arundhati Roy

Dr. Garg continued her collaboration with U.D. Kini of the Raman Research Institute in Bangalore, India, on periodic instabilities in nematic liquid crystals subjected to electric and/or magnetic fields. She also continued her collaboration with Dr. Oleg Lavrentovich, Liquid Crystal Institute, Kent State University, on focal conic domain growth in smectic A liquid crystals. She continues her research on phase transitions in binary nematic mixtures and has embarked on a new area, liquid crystalline behavior in DNA.

In June of 1999 Dr. Garg attended the CUR Councilors Meeting in Duluth and was elected as Chair of the CUR Physics and Astronomy Division.

Dr. Garg presented a paper entitled "Spatiotemporal Chaos in MBBA" at the International Conference on Pattern Formation in Liquid Crystals in Waischenfeld, Germany in September. She attended the CUR Excecutive Committee Meeting In Washington D.C. in January. She also attended the America Physical Society national meeting in Minneapolis in March, along with four REU students and one CoW senior, and was the co-author of two poster presentations (see APS 2000).

This past April, Dr. Garg was an invited seminar speaker at the Department of Physics, Case Western Reserve University. Her talk was entitled "Phase Transitions in Binary Nematic Mixtures."

On campus, Dr. Garg is the Director of the Physics Department's Research Experience for Undergraduates (REU) site, now in its seventh year. She served on a Faculty Development committee whose main goal was to "help us individually, collectively and institutionally reach our fullest potential as teachers, scholars, and professional colleagues and to create an environment which values and fosters such growth." She also served on the CUR 2000 Conference Planning Committee and the Financial Advisory Committee.

Publications appearing in 1999-2000

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,* 328, 581 (1999).

Jennifer Goetz

Assistant Professor of Physics
Faculty Member at Wooster since 1999
B.S. Binghamton 1992
M.A. University of Rochester 1995
Ph.D. University of Rochester 1999

Courses Taught in 1999-2000

Fall
- General Physics
- General Physics Lab (2 sections)
- Astronomy

Spring
- Astronomy (2 sections)
- Astrophysics

In 1999-2000, Dr. Goetz continued her collaboration with Dr. Eric Howard of the 2-Micron All Sky Survey (2MASS) project regarding dust emission associated with massive star forming regions. She instituted collaborations with Professor Paula Turner of Kenyon College to study asteroid orbits and with Matthew Barczys of UCLA regarding the massive star forming region L988e. She also continued her collaboration with the Near Infrared Astronomy Group at the University of Rochester regarding massive star forming regions, including the acquisition of astronomical data in October 1999.

Dr. Goetz attended the 195th Meeting of the American Astronomical Society and presented a paper entitled "An Infrared Study of Three Massive Star Forming Regions: Cep A East, S88B, and S235A/B." She also attended the Mid-West Faculty Seminar *New Cosmologies* in April and the 196th Meeting of the AAS in June.

Locally, Dr. Goetz served on the Barry Goldwater Scholarship Committee and was the campus representative for the Oak Ridge Science Semester program. She presented her research on massive star forming regions at B-Wiser Career Day and gave a talk to Women in Science entitled "Navigating the Spring and Summer Sky." She explained "Measuring the Mass of Jupiter" to the Expanding Your Horizons in Science and Mathematics Conference held at the College in April.

Publications appearing in 1999-2000

Raines, Watson, Pipher, Forrest, Greenhouse, Satyapal, Woodward, Smith, Fischer, Goetz and Frank, "Large Proper-Motion Infrared [Fell] Emission-line Features in GGD *37" Astrophysical Journal*, 528, 1115, 10 Jan. 2000.

Donald Jacobs

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

Courses Taught in 1999-2000

Fall
- Math Methods for Physical Sciences
- Electronics I for Scientists
- Electronics Lab

Spring
- Electronics II
- Electronics II Lab
- Junior Independent Study

Dr. Jacobs took on a monumental task this year when he became co-chair, along with Lori Bettison-Varga of the Geology Department, of the 8th national conference of The Council on Undergraduate Research which was held at The College of Wooster in June of 2000.

During the year, Dr. Jacobs attended a CUR conference in Duluth, Minnesota, presented a paper on heat capacity at a Gordon Conference on Liquids in Plymouth, New Hampshire, attended the national meeting of the American Physical Society in Minneapolis, and presented an invited paper and received an award at the April meeting of the American Physical Society (see opposite page). He also gave a talk on heat capacity at the 14th Symposium on Thermophysical Properties in Boulder, Colorado in June, 2000. Dr. Jacobs served as a councilor for CUR and a reviewer for the *American Journal of Physics* and the *Journal of Chemical Physics*.

Current physics majors honored Dr. J with a smartly decorated "You're the One" cake at a reception held in the Physics Department.

American Physical Society
2000 Prize to a Faculty Member
for Research in an Undergraduate Institution

Dr. Jacobs and APS President James Langer

"For his research contributions to critical phenomena in binary fluids, and for his sustained excellence and enthusiasm in promoting undergraduate research, both within and beyond his laboratory."

Donald T. Jacobs
The College of Wooster

The purpose of the prize is to honor a physicist whose research in an undergraduate setting has achieved wide recognition and contributed significantly to physics and who has contributed substantially to the professional development of undergraduate physics students. The prize consists of a $5,000 stipend to the recipient and a separate $4,000 grant for research to the prize recipient's institution. The prize is presented annually. The prize was established in 1984 by a grant from Research Corporation, a private foundation for the advancement of science and technology.

Incorporating undergraduates in research projects has been an essential part of Dr. Jacobs' students' education. He has directly supervised 78 students from seven different colleges or universities in extended research projects with 13 former students receiving their Ph.D. Many of his students have presented papers at regional and national conferences and so far, 28 have been co-authors on research publications. Dr. Jacobs was presented his award at the April 2000 meeting of the American Physical Society in Long Beach, California.

Daniel Ludwigsen

Visiting Instructor of Physics
Faculty Member at Wooster since 1999
B.A. Beloit 1992
Ph.D. Brigham Young University exp. 2001

Courses Taught in 1999-2000

Fall
- ✦Foundations of Physics
- ✦Foundations Lab (2 sections)
- ✦Mechanics

Spring
- ✦General Physics
- ✦General Physics Labs (2 sections)
- ✦Cultural Physical Science
- ✦Advised Junior I.S. computer sims

The Cultural Physical Science course took an interesting twist this year. Subtitled "Why It Wiggles: Ubiquitous Oscillations", the course concentrated on waves. Mr. Ludwigsen explains, "Fundamental to much of the core of a physics curriculum, here they tunnel a route through physical ideas of ancient and modern periods. This course surfs on concepts, with little mathematics required or used, and will engage the students on many wavelengths by exploring how science resonates through society. (All puns intended.)"

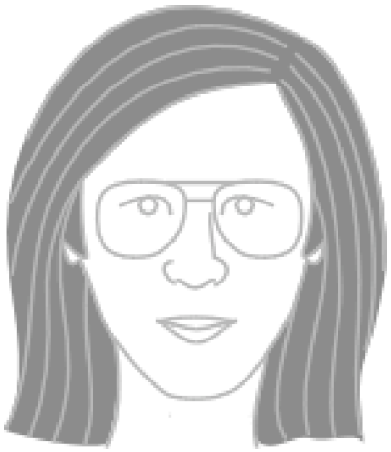
Some fun "tangible" projects were done by the Cultural Physical Science students this spring: Make Your Own Instrument, Choose Your Own Acoustical Adventure, Light Science, and Scale and Shape.

Mr. Ludwigsen was adviser to the Society of Physics Students and taught several hands-on mini-classes for Admissions Office events.

In November, Mr. Ludwigsen attended the Fall Meeting of the Acoustical Society of America. In March, he presented preliminary research at the Spring Research Conference of the College of Mathematical and Physical Sciences at Brigham Young University.

Mr. Ludwigsen continued several branches of research in musical acoustics and employed one sophomore research student and two summer research students. This fall, he will return to Utah to continue his work toward a Ph.D. from Brigham Young University. It has been a pleasure having Dan with us this past year, and we wish him the best of luck!

John Lindner
(on sabbatical 1999-2000)



Associate Professor of Physics
Faculty Member at Wooster since 1988
B.A. University of Vermont 1982
Ph.D. California Institute of Technology 1988

Dr. Lindner spent this academic year as a Visiting Associate Professor of Physics at Georgia Institute of Technology in Atlanta where he worked on a variety of problems in nonlinear dynamics.

He collaborated with former Wooster Assistant Professor of Physics Bill Ditto, Wooster Physics graduate Joe Neff '93, and several other old and new colleagues. He also served on Joe's Ph.D. thesis committee.

Dr. Lindner and his colleagues made progress on several research problems. They were able to enhance and generalize stochastic resonance, a nonlinear phenomenon that exploits noise. They analyzed the novel dynamics of hybrid arrays of neurons coupled to electrical circuits. They created and utilized a cellular automaton to study magnetic flux creep in superconductors.

Dr. Lindner is currently summarizing the group's progress by writing articles and submitting them for publication. However, much of this research should continue for years with the assistance of Wooster Physics majors and Dr. Lindner's continued collaboration with Georgia Tech.

Publications appearing in 1999-2000

B. Prusha, J. Lindner
Nonlinearity and computation: Implementing logic as a nonlinear dynamical system, *Physics Letters A,* volume 263, pages 105-111 (December 1999)

Welcome...
Bram Boroson
Visiting Assistant Professor 2000-01

B.A. Oberlin College 1989
Ph.D. University of Colorado 1995

Dr. Boroson's research interests include high-energy astrophysics and interstellar medium. He spent the last two years at NASA Goddard Space Flight Center as a research associate.

Taylor Bowl 2000

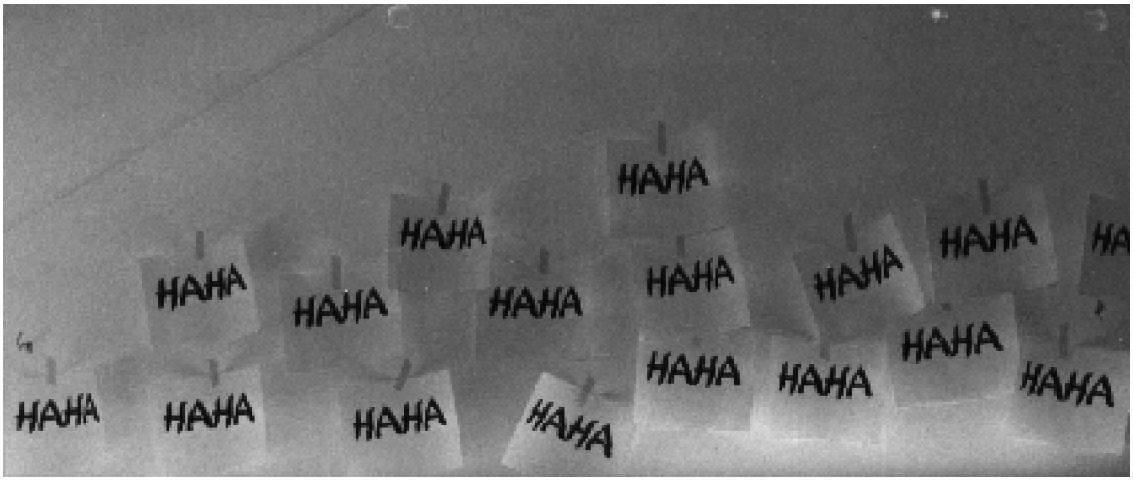
a.k.a. "Drats, we lost again!"

Math Mean 106.18
Physics Mean 99.75

This year's Taylor Bowl was beset with controversy. Math initially claimed victory, but Physics issued a protest because several (weak) Math bowlers did not finish their second games and their scores were not counted. Physics demanded a recalculation, but alas, Math still came out on top. Not to be outdone, several anonymous Physics bowlers decided to confiscate the giant slide rule trophy from its hanging place in the Math lobby. The slide rule was eventually returned after being found sandwiched between the Research Lab's louver doors.

Giant slide rule before Taylor Bowl:

After Taylor Bowl:



The Joseph Albertus Culler Prize in Physics, established in 1942, recognizes excellence in the field of physics. The prize is awarded to the first- or second-year student who has attained the highest rank in general college physics. This year's prize was awarded to:

Joshua S. Martin '02
Newark, Ohio
and
Derek J. Somogy '02
Wooster, Ohio

The Mahesh K. Garg Prize in Physics is awarded annually to an upper-class physics major who has displayed interest in and potential for applying physics beyond the classroom. The recipient will have demonstrated the qualities which are embodied in the saying, "it is better to light a candle than to curse the darkness" and is judged to have the scholarly and personality traits for using science to serve society. The prize was awarded to:

Sean J. English '00
Houston, Texas

The Arthur H. Compton Prize in Physics honors Dr. Compton who received the Nobel Prize in Physics in 1927. This prize was established in 1928 by members of the class of 1913, and is awarded to the senior physics major attaining the highest standing in that subject. The 2000 Compton Prize was awarded to:

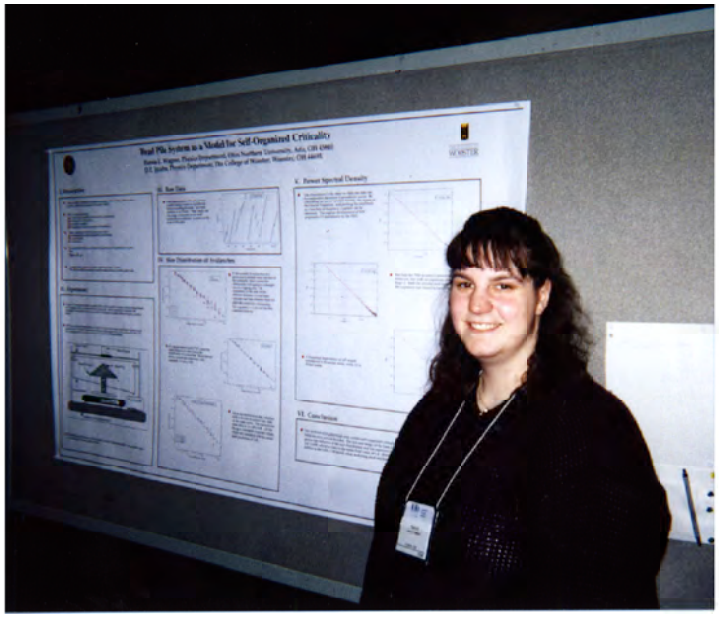
Geoffrey A. Bonvallet '00
Westerville, Ohio

and

Sean J. English '00
Houston, Texas

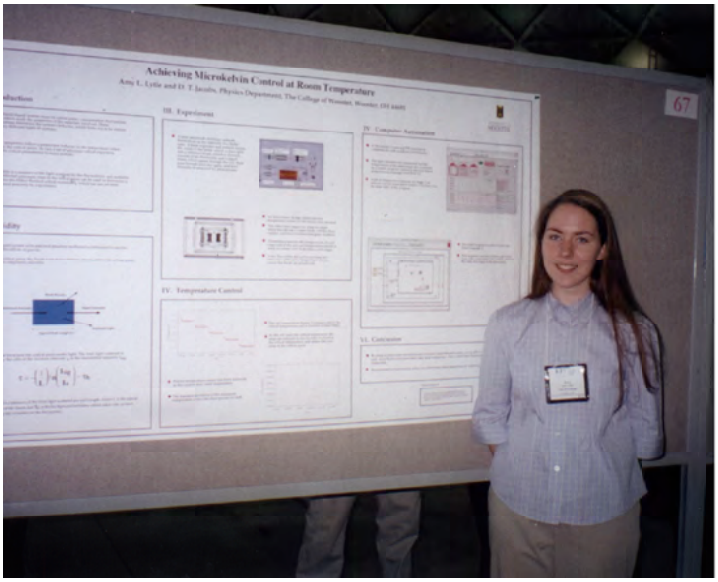
APS March Meeting Minneapolis, MN

Dr. Garg and Dr. Jacobs accompanied five students to the March meeting of the American Physical Society in Minneapolis. Each student presented a poster at the undergraduate poster session. The College's acquisition of a large-format printer enabled the students to display their research on 3' x 5' full-color posters (much easier and more eye appealing than the old fashioned cut and paste method).



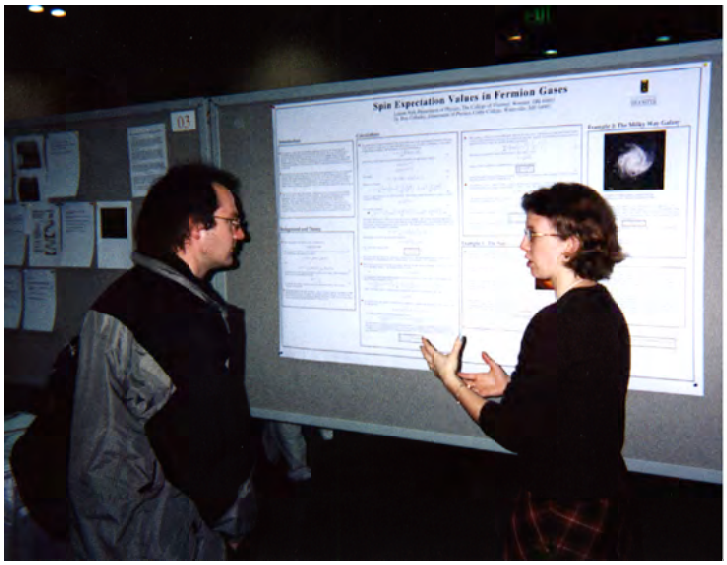
Hanna Wagner
Ohio Northern University
REU Summer Researcher
1999

Bead Pile System as a Model for Self-Organized Criticality



Amy Lytle
The College of Wooster
REU Summer Researcher
1999

Achieving Microkelvin Control at Room Temperature

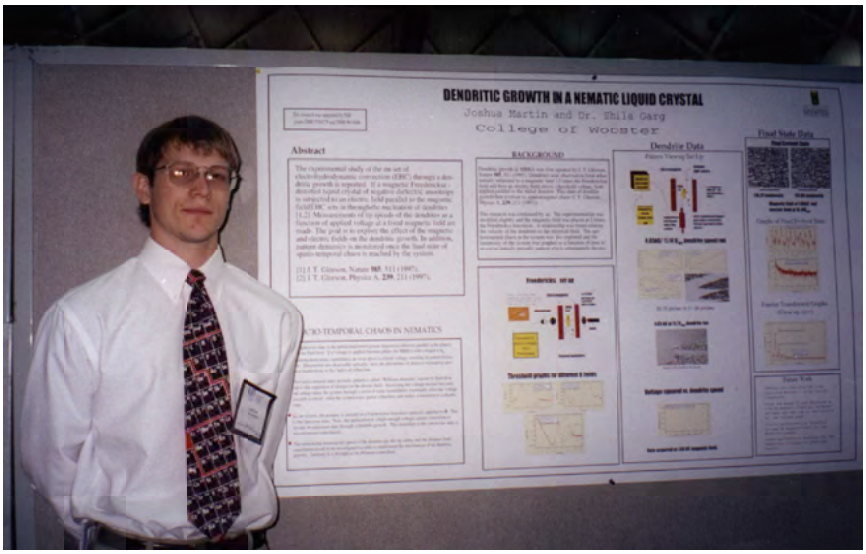


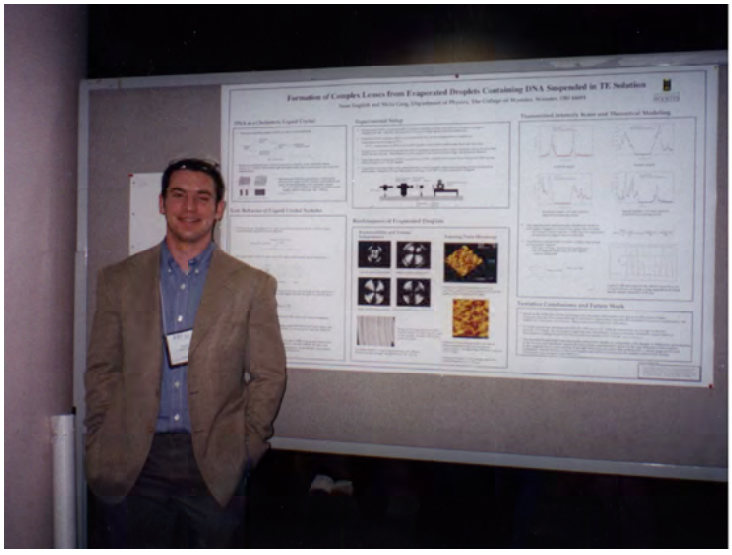
Lauren Ault
The College of Wooster
REU Summer Researcher
1999

Spin Expectation Values in Fermion Gases

Joshua Martin
The College of Wooster
REU Summer Researcher
1999

Dendritic Growth in Nematic Liquid Crystals





Sean English
The College of Wooster
Senior I.S. Research

Liquid Crystalline Behavior of DNA Fragments

Alumni News

Lori Pedersen (α), June Tveekrem (β), and Ann Mowery (γ) hard at work in Taylor Hall's research lab back in 1982.

June Tveekrem '82

June is an Optics Lead Engineer at NASA Goddard Space Flight Center in Greenbelt, MD. She has been working at Goddard since receiving her Ph.D. in chemical physics from the University of Maryland in 1986.

Tim Warner '72

Tim is living in Asheville, North Carolina, working as a consultant in radio, television, and audio.

William Hatt '63

William taught physics and engineering for 26 years at New England College in New Hampshire and is now enjoying retirement in Bradford, NH.

Jeff Parker '83

Jeff received an MSEE from Northwestern University in 1984, married Ann West (Wooster class of 1983) that same year, and moved to Ann Arbor, MI. There he found work in the machine vision industry. In 1987 he helped formed a company offering products in the area of automated paint inspection. In 1989, Jeff and Ann moved to Houghton on Lake Superior in Michigan's upper peninsula, where he has continued working for the company remotely. Since his son Benjamin was born in 1991, Jeff has been a part time employee and primary caregiver. Ann works as Director of Distributed Computing Services at Michigan Tech in Houghton.

Christy Rauch '99

Christy is a community environmental education volunteer with the Peace Corps in Panama. She works in Potrerillos Arriba in the province of Chiriqui, a beautiful town in the highlands of Panama. Christy reports that she is learning things that I.S. didn't teach...like how to use a machete and how to eat rice at nearly every meal. She is working in the schools, helping teachers integrate participatory methods and environmental lessons in their classrooms. She is also working in the community on organic gardening gardening and reforestation projects. She would love to receive mail: Christy Rauch, Entrega General, Estafeta de Correos de Potrerillos Arriba, Chiriqui, Republica de Panama.

Sergio DeSouza-Machado '88

After receiving his PhD in plasma physics from the University of Maryland at College Park in 1996, Sergio became an assistant research scientists at the University of Maryland, Baltimore County. He is working on Atmospheric Spectroscopy and Radiative Transfer for one of the instruments that will be part of NASA's Mission to Planet Earth program. He also continues to do research in wave-particle interactions and fusion plasmas.

Rich Bailey '91

After graduating from Wooster, Rich joined the Peace Corps and went to Fiji in the South Pacific to teach physics and math. He spent 1 1/2 years there until an accident forced his return to America. He studied English as a Second Language at Wright State in Dayton, Ohio, then taught ESL in Madison, Wisconsin, until 1997, when he and his wife Joan went to Kazakhstan, Central Asia, with the Peace Corp. After returning to the States in the summer of 1999, Rich taught ESL in Madison and then moved to Normal , Illinois, where Joan began a Peace Corps Fellowship program at Illinois State. Rich plans to continue teaching ESL.

David Walkenhorst '99

Dave has been working at the U.S. Patent & Trademark Office for the past year. He reviews patent applications for insulators, integrated circuit chips, and all types of electromagnetic shielding. The job involves a lot of training to learn the legal part (about 60 percent of the job is legal/paper shuffling), but also the knowledge to understand the technology that is being patented, at least at a basic level. The job also involves researching what has already been patented, so that two patents are not given for the same invention. Dave is planning to begin flight training (part time for now) with the ultimate goal of being a corporate pilot. The big personal news is that on June 24, 2000, Dave got married to Julie Morrison (CoW '98, chemistry).

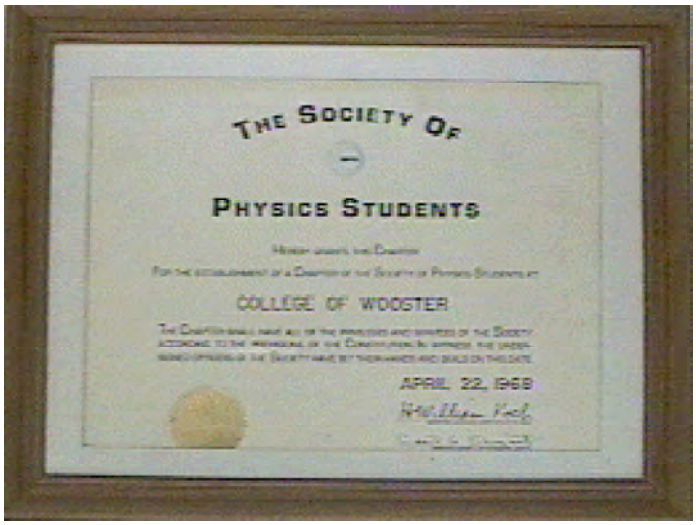
Joe Neff '93

Joe received his Ph.D. from Georgia Institute of Technology in January. John Lindner served on Joe's Ph.D. committee during his sabbatical at Georgia Tech this past year. Joe has accepted a position at the Navy research lab (SPAWAR) in San Diego.

Linda King '93

Linda received her master's degree from Georgia Tech and now does computer graphics. She recently moved from Atlanta to San Diego (with Joe).

Society of Physics Students



1999-2000 Officers

President: Chris Templeman
Vice President: Amy Lytle
Treasurer: Rachel Mary Costello
Secretary: Sean English

Events

✦ Pizza and Dessert Night
✦Film Festival: 2001 A Space Odyssey
✦ Taylor Bowl Challenge

✦Guest Speaker
Dr. Charles Rosenblatt
Case Western Reserve University
"Manipulating Gravity:
Liquid and Liquid Crystalline Bridges"

Chris Templeman gets charged up.

Trip

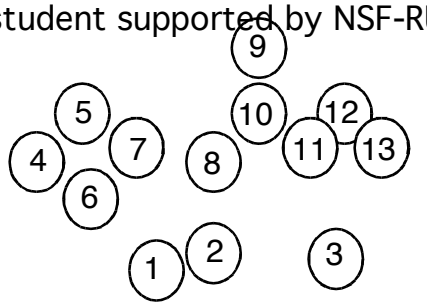
Great Lakes Science Center
Cleveland, Ohio

Timmy Sir Louis finds out that he is unbalanced.

REU 2000

Research Experience for Undergraduates

The department was awarded its third NSF-REU grant, and the summer of 2000 was the 7th year of our REU site, making it possible for us to provide a number of research opportunities which allowed undergraduates to experience the excitement of basic research and to become contributing colleagues. This summer's group included four Wooster students and four students from other colleges supported by NSF-REU, one Wooster student supported by NASA, and one Wooster student supported by NSF-RUI.



1. Derek Somogy
2. Christie Egnatuk
3. Jeff Moffitt
4. Michael Roberts
5. Dan Ludwigsen
6. Emily Oby
7. Jennifer Goetz
8. Beth Masimore
9. Josh Martin
10. Brad Lignoski
11. Shila Garg
12. Andy Nowicki
13. Susan Kost

not pictured: Don Jacobs

Projects

"*In vivo* measurements of the stiffness of relaxed and tensed lips"
Michael P. Roberts
Monmouth College '01
Advisor: Daniel Ludwigsen

"Development of a three mass lumped-element model for the lip reed"
Jeffrey Moffitt
The College of Wooster '03
Advisor: Daniel Ludwigsen

"Electrohydrodynamic Pattern Formation in a Nematic Liquid Crystal Mixture"
Joshua Martin
The College of Wooster '02
Advisor: Shila Garg

"Heat Capacity of a Binary Fluid Mixture Near the Critical Point"
Emily Oby
Denison University '02
Advisor: Donald Jacobs

"Self-Organized Criticality in a Bead Pile"
Christine Egnatuk
The College of Wooster '03
Advisor: Donald Jacobs

"Optical Properties of Liquid Crystal DNA Lenses"
Derek Somogy
The College of Wooster '02
Advisor: Shila Garg

"Morphology and Relative Size Distrubtion of PAH Molecules in S235A"
Brad Lignoski
The College of Wooster '03
Susan Kost
Carnegie Mellon University '03
Advisor: Jennifer Goetz

"Phase Transitions in Binary Mixtures of Nematic Liquid Crystal"
Beth Masimore
Juniata College '02
Advisor: Shila Garg

"Heat Capacity and Turbidity Near the Critical Solution Point of the Liquid-Liquid Mixture Succinonitrile and Water"
Andrew Nowicki
The College of Wooster '00
Advisor: Donald Jacobs

Wooster Physics Majors
Off-campus summer research

Scott Hughes '01 participated in an REU program at the Georgia Institute of Technology He analyzed data from eclipsing binary star systems to see how their orbital period changes over time. He compare the observed time of minimum light coming from the star with the predicted time and tried to explain any discrepancies.

Amy Lytle '01 worked at IBM Amalden Research Center in San Jose, California. She worked with the interferometric lithography group there, and her project involved taking reflectance measurements of thin film systems used for developing lithographic techniques.

Rob Sweeney '02 worked for The College of Wooster Mathematical Sciences Department's AMRE program. He was part of the Goodyear group that used artificial neural networks to predict tire properties based on tire ingredients.

Chris Templeman '01 spent the summer at NASA Glenn Research Center in Cleveland. He worked in the Fluids Division of Microgravity Sciences. His project was titled "Gas Levitation of Granular Materials in a Two-Dimensional Couette Shearing Cell."

Rachel Costello '01 worked with a group at Penn State Center for Gravitational Physics and Geometry developing a computer simulation of two colliding black holes. She compared the data generated by the computer simulation to the theory and worked on a movie to help visualize the computer output.

Breathing Room

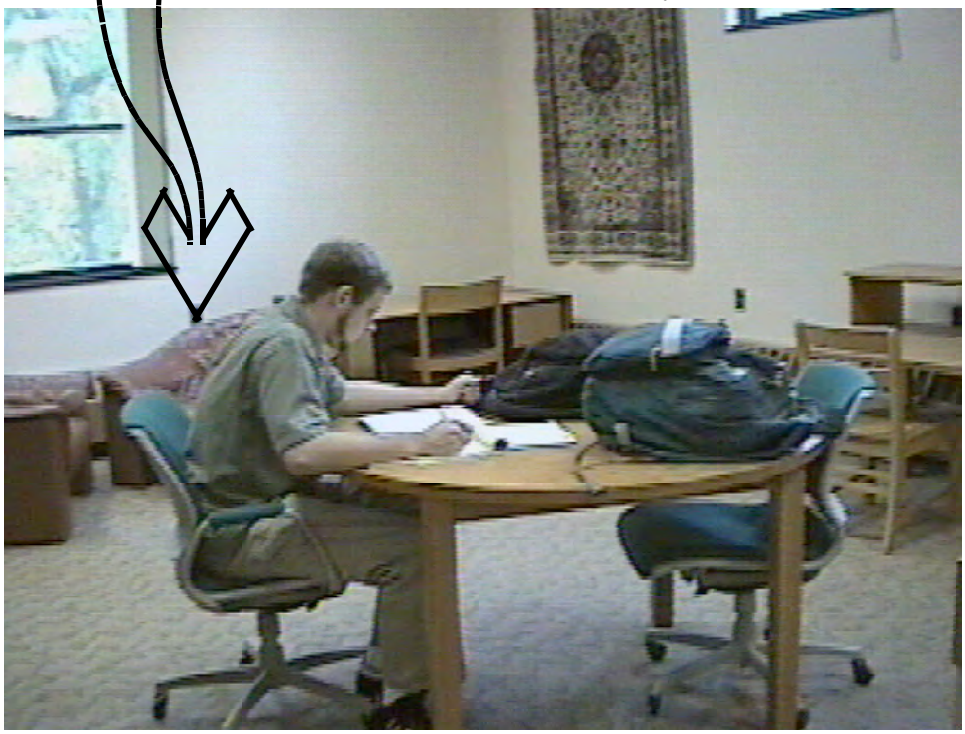
New Facilities in Taylor

The consolidation of the science libraries (including the Fobes Library in Taylor) into the Timken Science Library provided us with some breathing room. Thanks to the generosity of the family of Alexandra Babcock Marshall ('35) and Robert W. Marshall, a new suite of rooms has emerged from the vacated library space, including a reading room, seminar room, and central office. Also, a new liquid crystal lab for Dr. Garg was constructed in Taylor's basement.

Josh Martin '02 spends many hours doing research in Dr. Garg's new liquid crystal lab.

Dr. Goetz, Dr. Lindner, and Dr. Garg
meet in the new seminar room.
The faux-marble table measures 8 ft x 15 ft.

Jeff Moffitt '03 studies in the new reading room.
(Lots of you remember the "cushy" leather chairs—
we still have them!)



A bit of history...

Henry Augustus Rowland

1848 - 1901

Teacher of Physics at Wooster College 1870-71

Henry Augustus Rowland was born in Honedsdale, Pennsylvania in 1848. He had descended from a long line of theologians and entered the ministry school of Yale University. Excited by doing experiments in chemistry and electricity, he left Yale to attend the Rensselaer Polytechnic Institute. He earned a degree in civil engineering in 1870 and worked as a railroad surveyor and as a teacher at the College of Wooster. Two years later, he returned to Rensselaer Polytechnic to teach physics, and later accepted a chair at Johns Hopkins University.

Rowland's research helped to demonstrate that electric currents are the source of magnetic fields, to determine the value of the ohm, and to show that specific heat varies with temperature. He became well known internationally as a scientist when he invented a new spectral grating that automatically focused light. This spectrograph won Rowland a gold medal at the 1890 Paris Exposition. Rowland used this invention to make the most precise measurements of the spectral lines of the sun. He was elected to the National Academy of Sciences, to the Royal Society of London and to the French Academy of Sciences. As vice president of the American Association for the Advancement of Science, he advocated investment in pure science in spite of his own interest in applied physics.

In 1899, Rowland became the first president of the American Physical Society. The first meeting of the American Physical Society took place on May 20, 1899, at Columbia University in New York. In his acceptance speech, Rowland made a statement that would set the philosophy of the American Physical Society: "Let us hold our heads high with a pure conscience while we seek the truth, and may the APS do its share now and in generations yet to come in trying to unravel the great problem of the constitution and laws of the universe."

Rowland was once called as an expert witness at a trial. During cross-examination a lawyer demanded, "What are your qualifications as an expert witness in this case?" The normally modest professor replied quietly, "I am the greatest living expert on the subject under discussion." Later a friend well acquainted with Rowland's disposition expressed surprise at the professor's uncharacteristic answer. Rowland answered, "Well, what did you expect me to do? I was under oath."

Henry Augustus Rowland is one of 400 American scientists included on a CD-ROM entitled American Science Leaders that profiles science innovators. Also featured on the CD-ROM is current Wooster chemistry professor Ted Williams.

Alumni Information Form

Name _____

Home Address _____

_____

Telephone _____ Class _____

Business Address _____

_____

Telephone _____ email _____

URI _____

May we link your URL to our web page? _____

Description of Occupation (include business card if available) _____

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Anything else you wish to share _____

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PLEASE RESPOND BY:

FAX or EMAIL or MAIL

330 263 2516 jmiddleton@wooster.edu

Jackie Middleton
Department of Physics
The College of Wooster
Wooster OH 44691