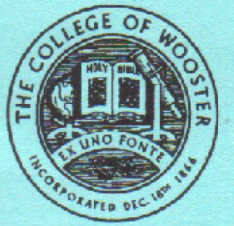

THE COLLEGE OF
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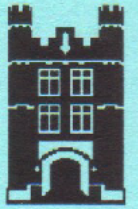

Department of Physics

First Report

1996-97 Academic Year and Summer of 1997

Editor : Dr. Shila Garg
Assistant Editor : Bryan Prusha

http://www.wooster.edu/Physics

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GREETINGS
FROM THE PHYSICS DEPARTMENT

It is indeed a great pleasure for me to revive the *Physics Annual Report*. Our hope is to continue to produce it annually without interruption. Since the last time a similar newsletter was published by the department, we have grown a great deal, thanks to 19 years of guidance from our inspired leader Dr. Don Jacobs with support of the administration. Many of you may know this story - in the mid '70s, Don took a major threatened with elimination and shaped the department into one with four full-time faculty and a recently graduated class of ten majors. Don also spearheaded the Taylor Hall renovation in the '80s and visualized and planned what our needs might be in the next several decades. As a result, we now have one of the best physical facilities among science departments in comparable liberal arts colleges. If you are one of our alumni who has not stopped by the department in recent years, I urge you to visit us next chance you get to see the progress firsthand.

Over the past decade or so, in the time that I have been part of the department, I have seen a tremendous growth in terms of what we offer our majors and what they accomplish. Our faculty have been successful in receiving grants to fund faculty and student research. This year alone, Don received a Petroleum Research Fund grant, and I received two grants (Research Experience for Undergraduates and Research in Undergraduate Institutions). We have been an REU site for four years now, and we have just completed the first summer of our second grant. This grant from the National Science Foundation allows us to employ eight undergraduate students (both ours and off campus) to conduct summer research with our faculty. I take this to be a recognition of the valuable training in research we give our undergraduates. Our students have been actively presenting papers and posters in national and regional conferences and co-authoring papers published in refereed journals. We have a faculty full of vitality who engage students' interests in academic inquiry. We are very fortunate to have Jackie and Judy on our staff. They make a significant contribution to the success of the department. When attempting to describe the atmosphere in the physics department, the word 'dynamic' comes to mind. We have a great team!

One of the recent changes that has taken place in the department is the revitalization of all the introductory labs. We were one of the first few four year colleges to equip the intro labs with microcomputers and interfaces, detectors and sensors and rewrite the lab manuals based on a discovery approach, adopted from Priscilla Laws' group. We are very pleased with the results of these changes and so are our students!

In other ways too we have been fortunate. Professor Anna Andrews and husband Kevin were blessed with a baby girl, Gwynneth, who celebrated her first birthday this past July. Don Jacobs was honored at the 50th anniversary of Keithley instruments for owning a working model of the oldest Keithley instrument! (The department had the oldest and also several of the newest Keithley instruments.) Professor John Lindner's computer graphics were on the cover of *Nature*, *Science News*, and *Physics Today*.

The physics department produced the Notestein award winner at the recent commencement. Chris Ditchman, a physics major, had the highest GPA of the graduating class. Chris also won the prestigious Barry Goldwater Scholarship in a national competition. In addition, for the past three years, he has had a summer research internship at the Jet Propulsion Laboratory.

We are trying to gather information on our alumni so, please tell us your whereabouts and recent activities. We need your help in getting information about you so that we can share it on our alumni pages. Your classmates and friends would love to hear about you. We have included a form on the last page for you to tell us about yourself. Please return it to us via snail mail, email or fax. Lastly, if you have not checked out our Web pages, I hope you will take the opportunity to do so.

Sincerely,

Shila Garg

Shila Garg
Associate Professor and Chair

1997 Graduates

Back Row : Ali Rauf *, Chris Ditchman, Anindya Mukherjee, Chris Spillmann, Noah Johnston

Front Row : Francesca Mascarenhas, Erica Bramley, Delaney DeMay

Not Pictured: Chigo Thindwa **, Britton Mockridge**

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* Degree to be received in Fall 1997.
** 3/2 Engineering major.

1996 - 97 Senior Independent Study Projects

Erica Bramley, "Electro-optics of a Smectic A Liquid Crystal Doped with Nanoparticles," (Shila Garg)

Delaney DeMay, "Examining the Lyotropic Liquid Crystalline Phases of a Physiological Mixture," (Shila Garg)

Christopher Ditchman, "Investigation of Transients and Static Modulated Phase in the Nematic Liquid Crystals 5CB and CCH-7," (Shila Garg)

Noah Johnston, "An Exploration of the Ueda Oscillator Using Analog Computers to Map the Three Dimensional Phase Space to Two Dimensions: A Look into the Future, Using the Techniques of the Past," (John Lindner)

Francesca Mascarenhas, "Hearing the Shape of a Sound: The Physics of Colliding Bars," (John Lindner)

Anindya Mukherjee, "Illuminating an Endpoint," (Don Jacobs)

Ali Rauf, "Predicting Earthquakes," (Don Jacobs)

Christopher Spillmann, "The Kinetics of Palmitic Acid Self-Assembled Aggregates," (Anna Andrews)

In 1997, seven seniors graduated with a degree in Physics.

Entering Graduate School :	
Erica Bramley	Colorado State
Delaney DeMay	Lewis and Clark College in Law
Christopher Ditchman	Rochester School of Optics
Francesca Mascarenhas	Washington University
Christopher Spillmann	Rochester School of Biophysics
Ali Rauf	Washington University
Other :	
Chigo Thindwa	Completing 3/2 program at Washington University
Britton Mockridge	Completed 3/2 enginering at University of Minnesota Employed at Motorola, Illinois

Meet the Faculty

Anna Ploplis Andrews

http://www.wooster.edu/Physics/Andrews

Faculty member at Wooster since 1993.
B.A. Wooster 1987;
M.S., Ph.D. Maryland 1990, 1993.

In 1996-97 Andrews taught Modern Physics, Cultural Physical Science and Biophysics. In Fall semester, with the help of a Hewlett Mellon grant that the department received from the College, Andrews renovated the Modern Physics lab experiments. In the Spring semester, she developed the Biophysics course with a set of mini labs.

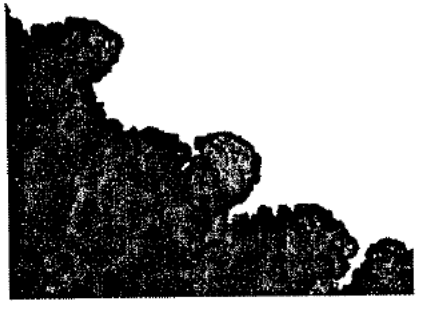
In addition, Dr. Andrews has been actively involved in curricular issues and Project Kaleidoscope.

External Grants Received

1. Linking Biology and Physics through Biological Motion Analysis in Investigative Laboratories and Student Research (Co-author), $48,331 (1997 -98), NSF - ILI.
2. Structural Characterization of Connected Polymer Networks, $20,000 (1994-96), Petroleum Research Fund.

Research Interests of Anna Andrews

Fractal Aggregation of Fatty Acids



Fatty acids are biologically important molecules which possess a hydrophilic (water loving) head group and a hydrophobic (water fearing) hydrocarbon tail. These molecules are virtually insoluble in water but dissolve in a hydrocarbon solvent such as chloroform. When a solution containing a large excess of fatty acid is dropped onto an ultra clean water surface, the hydrophobic forces drive the formation of fatty acid aggregates on the surface of the water as the solvent evaporates. The aggregates formed show beautiful fractal patterns depending on the particular fatty acid chosen. We study the kinetics of aggregate formation using a Langmuir balance, and the morphology of the aggregates by video analysis.

Rheology of Biophysical Gels

Gels are polymer networks swollen with a solvent which behave in some respects like liquids and in other respects like solids. They are becoming increasingly important in such products as disposable diapers and artificial organs. We explore some of the fundamental properties of gels using tools like light scattering. The elasticity of gels allows standing waves to exist subject to sample geometries and physical properties of the gel. Resonant frequency measurement in gels can be used to determine their rheological properties in a non-invasive manner. The frequency spectrum of light scattered by a vibrating gel contains significant contributions corresponding to the resonant frequencies of the gel. These allow determination of the shear storage modulus for the gel where the width of the peaks can be used to determine its shear loss modulus The gel composition and environment are varied throughout the study.

Kinematics of Motility

The kinematics of motility project is a biophysics exploration which should contribute new insights to both physics and biology. Kinematics is the study and characterization of motion, a field in which physicists excel. Biologically, the motion of microorganisms can be an important indicator of their genetics , so biologists can use motion analysis as a tool for probing profound biological questions. This project seeks to extend the number of kinematic tools available for describing the complex motion of microorganisms (like paramecium) by taping their motion with a microscope and camera. The motion films will then be digitized and studied to determine which quantities are good indicators of microorganism genetics.

Other Interests

- Computer simulations of electrophoresis
- Canine gait dynamics through video analysis
- Organismal biophysics

Publications

Choice Review, Dec. 1995, vol. 33 No. 4: Light detectors, photoreceptors, and imaging systems in nature by Jerome J. Wolken

Choice Review, March 1996, Vol. 33 No. 7: Quantum mechanics: concepts and applications by John D. McGervey

Shila Garg
http://www.wooster.edu/Physics/Garg

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

During this past academic year, Garg taught a First Year Seminar titled "Generation X: Surfing into the 21st Century", Electronics, Astronomy and Thermal Physics.

Garg has been a Physics/Astronomy councilor for Council for Undergraduate Research (CUR) since 1996.

External Grants Received

1. Electric Field Induced Periodic Deformations in Nematic Liquid Crystals, $114,320 (1997 - 2000), NSF - RUI
2. Undergraduate Research Experience in Physics at Wooster, $142,584 (1997 - 2000), NSF - REU

Publications (* indicates student co-author)

S. Garg, S. Saeed*, S. Wild*, E. Bramley* and U.D. Kini, " Frequency dependent threshold in bend geometry of 5CB," to appear in *Molecular Crystals Liquid Crystals*, 1997.

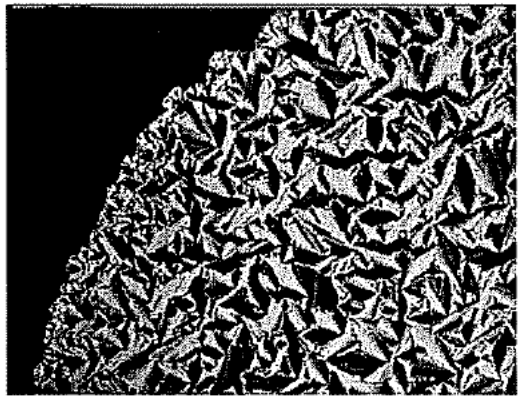
S. Garg, S. Saeed*, and U.D. Kini, "Effect of a Stabilizing Magnetic Field on the Electric Field Induced Freedericksz Transition in 5CB," *Physical Review E* 51, 5846 (1995).

S. Garg, K. Crandall*, and A. Khan*, "Bend and Splay Elastic Constants of Diheptylazoxybenzene," *Physical Review E* 48, 1123 (1993)

Research Interests of Shila Garg

1. Phase transitions in Smectic A phase of liquid crystals

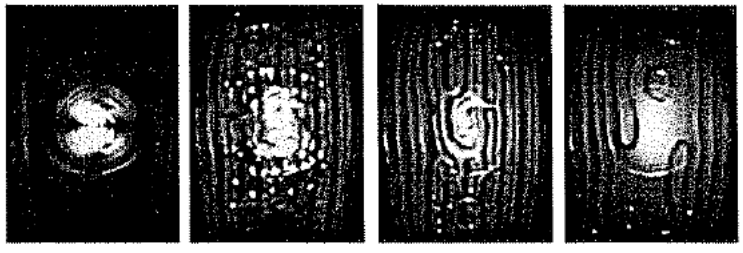
The liquid crystal CCN-47 exhibits Smectic A phase between 20 and 31°C after which it goes through the nematic phase. The smectic A phase is very interesting from the point of view that the cells can spontaneously form defects known as focal conics. When an electric field is applied in the appropriate geometry, these focal conic domains nucleate and grow to form a different phase.



The dynamics of the nucleation process is monitored as a function of time using time lapse video techniques. A careful study of the transition from focal conic domain to the nucleated domain structure is being done as a function of temperature to get a clear understanding of the nature of phases involved in this material. There are indications of very strong pre-transitional effects at temperatures closer to the smectic-nematic transition.

2. Transient Effects in a Nematic Liquid Crystal

A sudden application of an **E** or a **B** field normal to the director can lead to the formation of transient periodic structures. The appearance of the transient structures are due to backflow effects which couple the director and velocity fields, resulting in the periodic instability. The final alignment of the director is uniform but the path to getting there involves a spatially periodic transient instability in which adjacent domains of the sample rotate in opposite senses.



A cell with 5CB is subjected to a single voltage step at fixed ac frequency in the presence of a stabilizing magnetic field. The cell is photographed at subsequent time intervals to follow the evolution of the transient structures. For a given B field and frequency, a voltage up to a critical value, causes 'static' patterns. Beyond this critical value, the patterns indicate turbulence.

Don Jacobs

http://www.wooster.edu/Physics/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 taught General Physics (101), and Math Methods in Fall and General Physics (102) and Junior Independent Study in Spring. Junior I. S. has been developed and perfected by Dr. Jacobs to train students in various aspects of scientific research methods. A set of model reports from this course can be found on our Web page (http://www.wooster.edu/Physics).

Dr. Jacobs has been a Physics/Astronomy councilor for Council for Undergraduate Research (CUR) since 1993.

External Grants Received

1. Heat Capacity in Binary Fluid Mixtures and Universality Near the Critical Point, $25,000 (1997 -99), Petroleum Research Fund.
2. Turbidity of a Binary Fluid Mixture Very Close to the Critical Point, $200,000 (1993 - 96), NASA.

Publications (* indicates student co-author)

D.T. Jacobs and S.C. Greer, "On the amplitude anomaly in the mass density near a liquid-liquid critical point," *Phys. Rev. E.* 54, 5358 (1996).

D.T. Jacobs, "Turbidity of a binary fluid mixture: determining η," in Third Microgravity Fluid Physics Conference (NASA Conf. Pub 3338, 1996) pp. 75-80.

D.T. Jacobs, D.E. Kuhl*, and C.E. Selby*, "Coexistence curve of perfluoromethylcyclohexane-isopropyl alcohol," *J. Chem. Phys.* 105, 2 (1996).

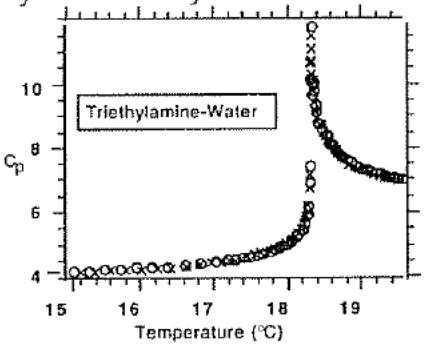
A. Flewelling*, R. DeFonseka*, N. Khaleeli*, J. Partee* and D.T. Jacobs, "Heat Capacity Anomaly Near the Lower Critical Consolute Point of Triethylamine-Water," *J. Chem. Phys.* 104, 20 (1996).

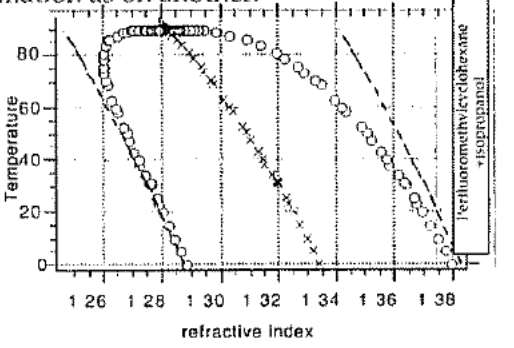
S.K. Grumbacher*, K.M. McEwen*, D.A. Halverson*, D.T. Jacobs and J. Lindner, "Self-Organized Criticality: An Experiment with Sandpiles," *American Journal of Physics* 61, 3 (1993).

L.W. Damore* and D.T. Jacobs, "Turbidity of Deuterated Isobutyric Acid and Heavy Water in the One-Phase Region Near the Critical Solution Point," *J. Chem. Phys.* 97, 464 (1992).

Research Interests of Don Jacobs

Critical phenomena provide intriguing and essential insight into many issues in condensed matter physics because of the many length scales involved. As a result, critical point phenomena have been studied over a long period of time with substantial recent effort toward modeling complex systems both near a critical point and over an extended region in thermodynamic space. Large density or concentration fluctuations near a system's critical point effectively mask the identity of the system and produce universal phenomena which have been well studied in simple liquid-vapor and liquid-liquid systems. Such systems have provided useful model systems to test theoretical predictions which can then be extended to more complicated systems. Along various thermodynamic paths, several quantities exhibit a simple power-law dependence close to the critical point. The critical exponents describing these relationships are universal and should depend only on a universality class determined by the order-parameter and spatial dimensionality of the system. Liquid–gas, binary fluid mixtures, uniaxial ferromagnetism, polymer-solvent, micellar systems, and protein solutions all belong to the same universality class: the three-dimensional Ising model. The diversity of critical systems that can be described by universal relations indicates that experimental measurements on one system should yield the same information as on another.





Our experiments investigate simple binary fluid mixtures, polymer-solvent systems, and micellar systems near their critical point. Our investigations both test existing theory and also extend universal behavior into new areas. Static experiments are done on these systems by measuring the coexistence curve using refractive index, correlation length using turbidity (light scattering), enthalpy using the heat capacity, and volume expansion using the density. These independent experiments are important to the understanding of critical point phenomena, and together they extend our knowledge of critical point phenomena both very close to, and far away from, the critical point.

John Lindner
http://www.wooster.edu/Physics/Lindner

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

Dr. Lindner taught Foundations of Physics (203), Electricty & Magnetism, Foundations of Physics (204) and Nonlinear Dynamics this past year. He also taught the Computer Simulations part of the Junior I.S. course.

Lindner is becoming a well known name in nonlinear dynamics with his computer simulation graphics having been on the covers of *Nature*, *Science News*, and *Physics Today*.

Publications (*indicates student co-author)

J. Lindner, B. Prusha* and K. Clay*, "Optimal Disorders for Taming Spatiotemporal Chaos," *Physical Letters A* 231, 164 (1997).

J. Lindner, B. Meadows, T. Marsh, W. Ditto, A. Bulsara, "Can Neurons Distinguish Chaos From Noise?" *International Journal of Bifurcation and Chaos*, to appear, 1997.

J. Lindner, B. Meadows, W. Ditto, M. Inchiosa, A. Bulsara, "Scaling Laws for Spatiotemporal Synchronization and Array Enhanced Stochastic Resonance," *Physical Review* E53, 2081 (1996).

J. Lindner, W. Ditto, "Removal, Suppression and Control of Chaos by Nonlinear Design," *Applied Mechanics Reviews* 48, 795 (1995).

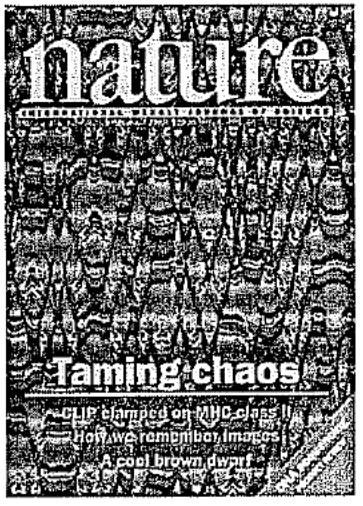
Y. Braiman, J. Lindner, W. Ditto, "Taming Spatiotemporal Chaos Using Disorder," *Nature* 378, 465, (1995).

J. Lindner, B. Meadows, W. Ditto, M. Inchiosa, A. Bulsara, "Array Enhanced Stochastic Resonance and Spatiotemporal Synchronization," *Physical Review Letters* 75, 3 (1995).

E. Ippen*, J. Lindner, and W.L. Ditto, "Chaotic Resonance: A Simulation," *Journal of Statistical Physics* 70, 437 (1993).

S.K. Grumbacher*, K.M. McEwen*, D.A. Halverson*, D.T. Jacobs and J. Lindner, "Self-Organized Criticality: An Experiment with Sandpiles," *American Journal of Physics* 61, 3 (1993).

Research Interests of John Lindner



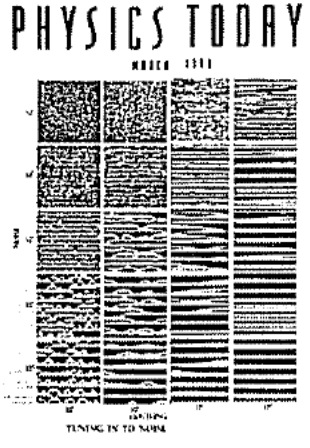
Linear systems, such as elastic springs, are easy to analyze. If you double their input, you double their output. Unfortunately, most natural systems are nonlinear. These can exhibit complex behavior, such as chaos, which is deterministic but nonperiodic and exquisitely sensitive to initial conditions.

What happens if you couple many nonlinear systems into an array? For the past several years, my students, colleagues, and I have been investigating arrays of nonlinear elements using computer simulations. The 13 April 1996 issue of *Science News* features an example of our work, namely the spatiotemporal evolution of an array of coupled Josephson junctions.

We have discovered the counterintuitive result that disordering an array of nonlinear elements can convert chaotic motion to periodic motion. Our research on disorder-taming-chaos was featured on the cover of the 30 November 1995 issue of *Nature*.

Last summer, REU students Bryan Prusha '98, Kim Clay (Colorado College '98) and I were able to quantify this effect by finding optimal disorders for taming spatiotemporal chaos. This work has been published in *Physics Letters A*.

We have also discovered that adding noise to an array of nonlinear elements can increase the performance of the array, as measured by a signal-to-noise ratio. Our research on spatiotemporal stochastic resonance was featured on the cover of the March 1996 issue of *Physics Today*.



Our research is performed almost exclusively on NeXTSTEP and Power Macintosh computers. Consequently, we are very excited about the recent merger of NeXT and Apple and are eagerly anticipating Apple's NeXT generation operating system, code named "Rhapsody", which will be based upon OpenStep, the platform-independent version of NeXTSTEP.

Meet the Staff

Judith Elwell (Technician)

Many of you know Judy. She has been a very important part of the department for 17 years. She keeps us all efficient and maintains flawless records of the equipment and experimental set ups. Judy always goes out of her way to help students and faculty alike, when there is equipment related problems or need. In her spare time, Judy has been taking biology and chemistry courses at the College of Wooster. She is a perfect example that learning never needs to stop!

On a personal note, Judy is now a proud grandmother of two.

Jackie Middleton (Secretary)

Since 1989, Jackie has been an asset to the department. She manages to deal with four physics and eight Math/CS faculty - no mean task! She has a way of knowing who needs an exam typed five minutes before it is due to be administered or a transparency made as the bell is ringing and always manages to get it ready! Jackie is also a surrogate mother to many of our majors and listens to all their problems with a sympathetic ear. We are very fortunate to have her as part of the department.

Jackie is very actively involved in raising her two sons and being a baseball mother (and football, and basketball, and track...)

Nobel Prize Winner Joseph Taylor to Speak at Wooster in Fall Forum Series

The forum series at The College of Wooster continues in the fall semester of 1997 with Joseph Taylor, recipient of the 1993 Nobel Prize in Physics. Dr. Taylor, Professor of Physics at Princeton University, and Russell A. Hulse were recognized for their discovery in 1974 of the first binary pulsar. This unique phenomenon has been important as a deep space proving ground for Einstein's general theory of relativity.

Since the 1974 discovery, Dr. Taylor has continued searching the heavens for pulsars using the 1,000 foot radio telescope at Arecibo, Puerto Rico. With the CRAY C90, Taylor's group can sift the data they collect at Arecibo with far greater sensitivity and efficiency than was possible 20 years ago, and this computing power is yielding a significant payoff in the discovery of pulsars. In three years of supercomputing at Pittsburgh, Dr. Taylor's group has discovered 20 previously unknown pulsars.

Dr. Taylor will be speaking on "Natural Law: An Astrophysical Example of How It's Done" during the forum on Tuesday 4 November 1997 and has been invited by the Society of Physics Students to speak on "Binary Pulsars and Relativistic Gravity" on the afternoon of Wednesday 5 November 1997 in Taylor Hall.

Recent Papers Presented At Conferences By Wooster Physics Students

(*student co-author)

C. Ditchman*, S. Garg, and U.D. Kini, "Electric Field Induced Transient and Static Modulated Phase in Nematic Liquid Crystals" National Meeting/American Physical Society (March 1997).

W. Shew* and A. Andrews, "Surface Pressure Study of Lipid Aggregates at the Air Water Interface" Ohio Section/American Physical Society (November 1996).

B. Prusha*, K. Clay* and J. Lindner, "Optimal Disorders for Taming Spatio-temporal Chaos" Ohio Section/APS (November 1996).

S. Garg, S. Saeed*, S. Wild*, E. Bramley* and U. D. Kini, "Frequency Dependent Threshold in the Bend Geometry of 5CB" 16th International Liquid Crystal Conference (June 1996).

A. Ozgenç*, C. Spillmann*, A. Flewelling*, and A. Andrews, "The Kinetics of Lipid Crystal Formation as Studied by Surface Pressure Measurements" Ohio Academy of Sciences (May 1996).

E. Bramley*, R. Craig*, and S. Garg, "Frequency Dependence of Bend Freedericksz Threshold in the Nematic Liquid Crystal 5CB" National Meeting/APS (March 1996).

S. Saeed* and S. Garg, "Frequency Dependence of Thresholds in the Modulated Phase of 5CB" National Meeting/APS (March 1996).

C. Spillmann*, A. Flewelling* and A. Andrews, "Macroscopic Self Assembly of Palmitic Acid as Studied by Surface Pressure" National Meeting/APS (March 1996).

S. Wild* and S. Garg, "Threshold Measurements in the Modulated Phase of 5CB" Ohio Section/APS (October 1995).

A. Flewelling* and D.T. Jacobs, "Heat Capacity Anomaly in Triethylamine and Water" American Physical Society (March 1995).

R. Craig* and S. Garg, "Flexoelectric Effect in the Nematic Liquid Crystal 5CB" National Conference of Black Physics Students (February 1995).

S. Garg and K. Kelley*, "A Nematic Liquid Crystal Subjected to an Oscillating Magnetic Field" Ohio Section/APS (October 1994).

S. Garg and A. Ozgenç*, "Nonlinear Effects in Polymer Dispersed Liquid Crystals" Ohio Section/APS (October 1994).

J. Lindner and J. Hill*, "Quantifying the Spatiotemporal Chaos of Coupled Duffing Oscillators" Ohio Section/APS (October 1994).

W. Antel* and J. Lindner, "Chaotic Dynamics on Rippled Surfaces" Ohio Section/APS (May 1994).

M. Hunter*and J. Lindner, "Spatiotemporal Chaos on a Sphere of Duffing Oscillators" Ohio Section/APS (May 1994).

Summer Research 1997

"Quasicrystals and Aperiodic Tilings"
Woody Shew '98 and Dr. John Lindner

Woody Shew and John Lindner are studying aperiodic tilings of two and three dimensional space in an effort to better understand the existence and structure of quasicrystals. Unlike most familiar tilings, aperiodic tilings are not invariant under any translation. In the 1980s, physicists and crystallographers were shocked to discover materials with discrete diffraction patterns and some orientational symmetry but no translational symmetry. We hope that the abstract but beautiful study of aperiodic tilings, such as the Penrose tilings, will elucidate these quasicrystals.

"Taming Spatiotemporal Chaos with Disorder"
Josh Bozeday '99 and Dr. John Lindner

Josh Bozeday and John Lindner are studying the effects of introducing disorder into arrays of nonlinear elements, such as pendulums, Josephson junctions, and phase lock loops. This is an extension of work done last summer with Bryan Prusha '98 and Kim Clay (Colorado College '98). Through computer simulations, we hope to better understand the phenomenon of disorder taming chaos and demonstrate it in new systems, such as arrays of phase lock loops.

"Kinetics of Fatty Acid Aggregation in the Langmuir Balance"
Christy Rauch '99 and Dr. Anna Andrews

The goal of this research is to better understand the aggregation of amphiphilic molecules on a water-air interface, and the layer of molecules on which the aggregate lies. A Langmuir balance is being used to determine changes in surface pressure as palmitic acid aggregates. Once aggregation is complete, surface pressure will continue to be monitored as surface area is slowly decreased. From this data it is hoped that the phase of the monolayer on the substrate can be determined, as well as a relationship between aggregation and equilibrium spreading pressure.

"Morphology of Fatty Acid Aggregation"
Andy Kuck '99 and Dr. Anna Andrews

The purpose of the summer's research is to study the morphology of fatty acid aggregates. Software was developed that will open an image of an aggragate, isolate its edge, and calculate the edge's fractal dimension. Since fractal dimension is related to the roughness or curviness of an edge, it quantifies the shape of the aggregate. By comparing the fractal dimensions of various fatty acids, a relationship may be determined between the roughness of an aggregate's edge and the number of carbons in the fatty acid.

"Growth of Focal Conic Domains in Smectic-A Liquid Crystals"
Kirstin Purdy (Carnegie Mellon '99) and Dr. Shila Garg

This project investigates the nucleation of focal conic domains and the deformation of smectic A layers of CCN 47. The transition from focal conic domain to the deformed structure is separated by an energy barrier. Injecting nanoparticles into the layers is expected to lower the energy barrier and hence the threshold. The dynamics of the transitions with and without the particles are studied.

"Transient Effects in a Nematic Liquid Crystal Due to an Electric Field"
Nate Schiffrik '99 and Dr. Shila Garg

Subjecting a nematic liquid crystal suddenly to the presence of a high field can cause transient periodic structures to appear. The transition is either periodic or turbulent depending on the field strengths. The dynamics of the director orientation of a sample subjected to a sudden destabilizing electric field in the presence of a stabilizing magnetic field are studied.

"Measurement of Electrical Conductivity in Nematic Liquid Crystals"
Sridhar Chandramoli '00 and Dr. Shila Garg

Nematic liquid crystals are quite often assumed to be insulators and most theoretical treatments of them ignore their conductivity effects and consider only the dielectric terms. Static experiments done by us on 5CB have revealed frequency dependence of voltage thresholds, which indicate the presence of electrical conductivity. In this project, we will be experimentally measuring electrical conductivity in two perpendicular directions as a function of frequency and thus determining the conductivity anisotropy.

"Turbidity as a Measure of the Critical Exponent η"
Carrie Williams '99 and Dr. Don Jacobs

By measuring the total light scattered from a near-critical, liquid-liquid system, the values of three critical exponents can be determined. Of particular interest is the exponent η, which has yet to be measured precisely.

"Heat Capacity in a Liquid-liquid Mixture"
Paul Rebillot '99 and Dr. Don Jacobs

The entropy and enthalpy of a liquid-liquid mixture near its critical point can be determined from the heat capacity measurement. The critical exponent α and the amplitudes of the leading divergence are essential quantities that can be used to predict the behavior of many other effects.

"Self-Organized Criticality in a Model Bead Pile"
Kelle Cruz (Univ. of Pennsylvania '00) and Dr. Don Jacobs

SOC is a new paradigm that describes how complex dynamical systems evolve and has applications to earthquake prediction and the stock market. By looking at a model system made of a conical pile of beads, an extension can be made to other more complicated systems. In particular, we wish to determine if seismic activity can be used to predict the occurrence of a large earthquake.

Off Campus Research
by College of Wooster Physics Students
Summer 1997

Chris Ditchman '97
Jet Propulsion Laboratory, Pasadena, CA
Programming a Graphical User Interface (GUI) for ionosphere storm analysis software

Erica Bramley '97
APS Research fellowship at Millikin University

Jodee Jones '98
COSEN Research at Neoprobe, Columbus, OH
Cancer-related biophysics research

Dave Walkenhorst '99
REU Research at Hope College, Michigan
Biophysics of human mobility

Manon Grugel '99
Product testing at Iten Industries
Quality Control of Fiberglass and Resins
Measuring electrical, mechanical, and water absorption properties of insulators for electrical appliances

Michele Hayward (Physics Minor, '98)
REU internship at University of Arizona
Computer simulation of a scanning transmission electron microscope (STEM)

The College of Wooster
Society of Physics Students
1996 - 97 Activities

President: Chris Ditchman
Vice-President: Chris Spillmann
Treasurer: Francesca Mascarenhas
Advisor: John Lindner

Indian Cook-In at Dr. Garg's House (Sunday 20 April 1997)
Taylor Bowl IIIX (Saturday 5 April 1997) **PHYSICS WINS!**
Lecture by Dr. Satyendra Kumar, Physics Department, Kent State
"Study of Liquid Crystal Films Using Newton's Fringes of X-rays"(Thursday 3 April 1997)
Social Event (Saturday 22 February 1997)
Career Day (Saturday 15 February 1997)
Star Wars: Special Edition (Saturday 1 February 1997)
Fall Senior I.S. Oral Reports (Thursday 14 & 21 November 1996)
APS Meeting at Ohio University (Friday-Saturday 1-2 November 1996)
Lecture by Dr. Philip Westerman, Northeast Ohio College of Medicine,
"Physiochemical Characterization of Model Biles and Lipid Digestive Mixtures by NMR" (Wednesday 9 October 1996)
Faculty Barbeque at Dr. Jacobs' house (Saturday 28 September 1996)
Fall Canoe Trip & Picnic at Mohican(Sunday 15 September 1996)

Visit the Society of Physics web page at
http://www.wooster.edu/Physics/SPS

A Look Back...

1992 Senior Independent Study Projects

Christopher Hamilton, "Controlling Chaos with Weak Perturbations Using the Dynamics of Chaos in a Dripping Faucet as a Base" (Bill Ditto)

Erich P. Ippen Jr., "Numerical Simulation of Chaotic Resonance" (John Lindner and Bill Ditto)

David H. Kime (Geophysics), "The Venus Puzzle: Tectonics and Terrestrial Planets" (John Lindner and Sam Root)

Stephanie Teemer 3/2 engineering major

1987 Senior Independent Study Projects

Kevin P. Andrews, "The Coexistence Curve of the Binary Fluid Triethylamine-Water" (Don Jacobs and Budd Russell)

John B. Fanselow, "Adiabatic Calorimetry Measurement of the Heat Capacity of a Near Critical Binary Fluid" (Don Jacobs)

Scott R. Gunselman, "The Physics of a Racquetball : The Sweet Spot" (Budd Russell)

Daniel O. Hogenboom, "A Study of Brownian Motion Using Light Scattering" (Don Jacobs)

Terence B. Khoo, "A Study of the Proper Order Parameter for Binary Liquid Mixtures" (Don Jacobs)

Mike LaVilla (Chem Phys), "Cyclic Voltammetry Study of the Vitamin B12 Complex TRNS-Aqua Cobalt III" (David Powell)

Scott P. McLean, "A Biomechanical Analysis of the Power Generating Phases of the Front Crawl Stroke" (Dan Tonn)

George F. Miller, "A Technique for Determining the Contact Time of a Golf Club-Ball Collision and its Relationship to Club Velocity" (Dan Tonn)

Eric Parker (Self-Designed), "High Resolution Stand-Alone Video Processor" (Don Jacobs)

Anna C. Ploplis, "Turbidity of Polystyrene-Diethylmalonate Near the Critical Point" (Don Jacobs)

John S. Porter, "How the Thickness of Styrene-Butadiene Affects Its Impact Shock Absorption Characteristics" (Dan Tonn)

Alumni Spotlight

Arvind Ahuja '82, a neurosurgeon specializing in neuroendovascular therapy, was recently featured in *The Spirit of St. Luke's*, a publication of St. Luke's Medical Center in Milwaukee. The article, "Advanced Neurological Techniques Give Patients New Hope," describes St. Luke's pioneering approach to effectively treating strokes and other brain disorders. Arvind credits his entire team of staff members who have worked closely with him from the very beginning to establish this successful program.

Alice Churukian '91 received her M.S. in Physics from The University of Wisconsin, Milwaukee. She taught for three years at Thaddeus Stevens College of Technology and even developed a new course, "The Physics of Everyday Life." Alice is looking forward to joining the faculty of Juniata College, a four-year liberal arts school in Huntingdon, PA, for the 1997-98 academic year. On a personal note, last year Alice married Bill Slechta '91 , a music education major.

Karl Crandall '91 earned his Ph.D. from Case Western Reserve University "after five years of hard work." He is currently working for the Naval Research Laboratory as a two-year American Society of Engineering Education post-doctoral research fellow. He has continued his study of liquid crystals (Karl's Senior I.S. at Wooster was titled "Determining the Bend Elastic Constant of the Liquid Crystal Di-Heptyl-Alkyl Azoxybenzene using Freedericksz Transition") and hopes to do thermal imaging. Karl makes his home in Alexandria, VA, and offers these words of wisdom: "I think very highly of the physics training I received at Wooster. I have discovered that I am not a Nobel prize caliber physicist. However, good training, common sense, and social awareness are highly regarded in the scientific community and one can still contribute a great deal to society as an 'average' physicist."

Scott McLean '87 received a Ph.D. in Exercise Science/Biomechanics from Arizona State University. He is an Assistant Professor in the Department of Health and Human Performance at Iowa State University, where he has a particular interest in aging (as related to the performance of activities of daily living) and sport biomechanics. He and his wife Jamie are the parents of two sons, Andrew (18 months) and Jack (4 months). Contact Scott at smclean@iastate.edu.