Wooster Physics

THE COLLEGE OF
WOOSTER

Annual Report
2003-2004

www.wooster.edu/physics

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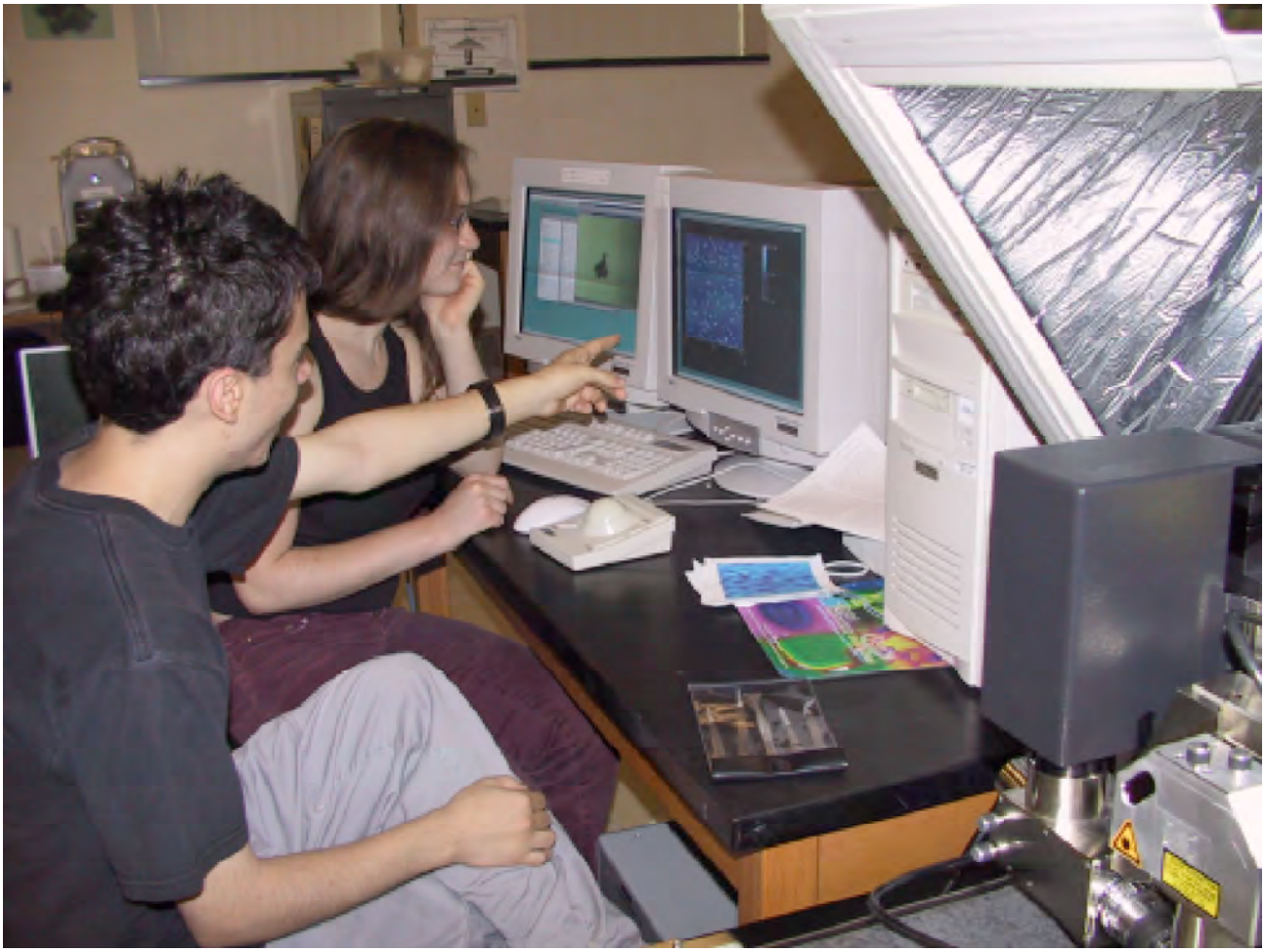


Summer research students Stephen Poprocki and Annie Erbsen check out some quantum dots using the AFM.

Department of Physics

THE COLLEGE OF

WOOSTER

Eighth Annual Report
August 2004

Produced by Jackie S. Middleton

Greetings!

I hope you enjoy the eighth Annual Report from The College of Wooster Department of Physics. It has been another exciting year.

This was a wonderful first year for our two new faculty members, Dr. Susan Lehman, Clare Boothe Luce Assistant Professor of Physics and Dr. Lowell Boone, Visiting Assistant Professor of Physics.

Next year, I will be on sabbatical at Georgia Tech in Atlanta, and my leave replacement will be Dr. Leonidas Pantelidis. Dr. Pantelidis hails from Athens Greece, has a Ph.D. in theoretical physics from MIT, and has spent the last year teaching at Swarthmore College. His research involves the nonlinear dynamics of complex systems.

Physics Club president Tom Spears '04 was awarded the Notestein Prize for highest scholarship, and he also spoke on behalf of the class of 2004. That makes three of the last four years in which the Notestein winner and one of the class speakers has been a physics major! Congratulations also to Jeff Moffitt '03 for being a 2003 national Apker finalist.

This year, we have greatly enhanced the "reading room" (a.k.a. student lounge) 109B with a white board, a couch, a refrigerator and a microwave oven. The last item can, of course, can be used to measure the speed of light. (Lining the inside bottom with marshmallows allows location of microwave antinodes; separation gives half wavelength; wavelength times frequency gives wave speed.)

This was the third year of our Physics Club's outreach program, and we made nine presentations in local schools. Utilizing equipment purchased from last year's Marsh W. White award, we were able to present alternately two complete different themes: air & pressure and electricity & magnetism.

The 11th summer REU program was very successful, and it has now has involved 91 students from 26 colleges and universities in 15 states.

Our majors were well represented at the March meeting of the American Physical Society in Montreal Canada, where they gave four different presentations – and endured snowstorms and fine cuisine. This summer, our majors did research at places like Hope College and Columbia University, as well as Wooster.

Judy has done an excellent job maintaining our intro physics labs and completely replacing the contents of our main hall display cases – which had been unchanged for over a decade. Jackie has kept the department running and created another excellent annual report.

We love hearing from you, so keep in touch!

Best wishes,

John Lindner

The Class of 2004

Nithya Venkataramn, Brad Thomas, Nick Harmon, Tom Spears, Chris Doherty, Dave Merriman, Katie Frato

Christopher Gilles Doherty
Westerville OH
3-2 Engineering, University of Michigan

Katherine E. Frato
Physics & Biology
Mentor OH
Graduate School, Biophysics, Johns Hopkins University

Nicholas Johann Harmon
Physics & Mathematics
Berea OH
Graduate School, Physics, The Ohio State University

David Joseph Merriman
Beaver Falls PA
3-2 Engineering, Case Western Reserve

Thomas Graham Spears
Cincinnnati OH
Graduate School, High Energy Physics, University of Chicago

Bradley Christopher Thomas
Shaker Heights OH
3-2 Engineering, University of Michigan

Nithya Venkataraman
Wooster OH
Employed at Kent Displays in Kent, Ohio

Awards and Honors

Latin Honors

Summa cum laude

Katherine Elizabeth Frato
Thomas Graham Spears

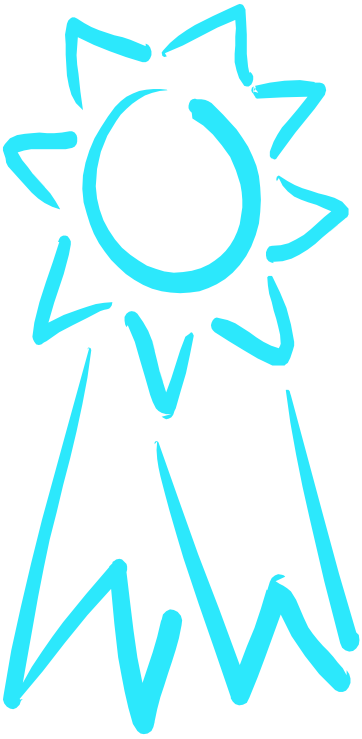
Magna cum laude

Nicholas Johann Harmon

The Jonas O. Notestein Prize

Awarded to the student who has graduated with the highest scholarship for the whole college course

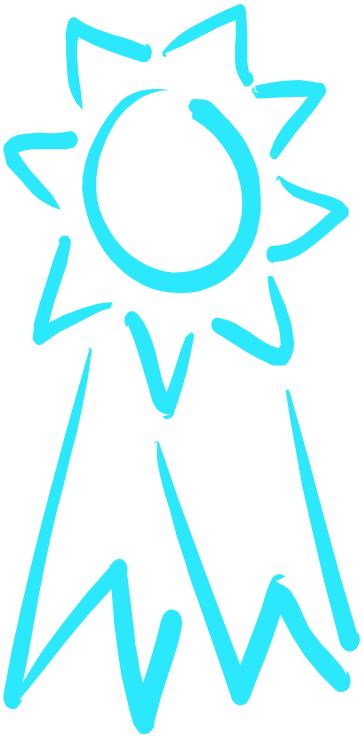
Thomas Graham Spears



Arthur H. Compton Prize in Physics

Awarded to the senior physics major attaining the highest standing in that subject

Katherine Elizabeth Frato
Thomas Graham Spears



Mahesh K. Garg Prize in Physics

Awarded to an upper-class physics major who has displayed interest in and potential for applying physics beyond the classroom

Thomas Graham Spears

Joseph Albertus Culler Prize in Physics

Awarded to the first- or second-year student who has attained the highest rank in general college physics

Kathleen Michelle McCreary

Phi Beta Kappa

Katherine Elizabeth Frato
Nicholas Johann Harmon
Thomas Graham Spears

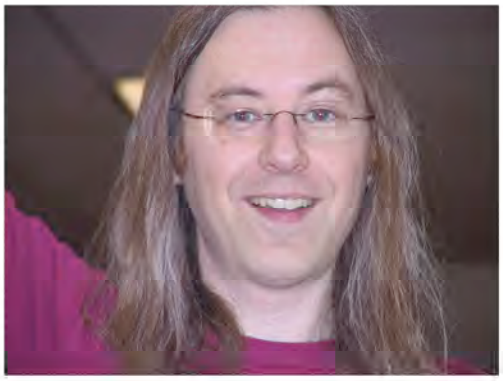
Speaker for the Class of 2004

Thomas Graham Spears

Faculty & Staff

John Lindner

Professor and Chair



TEACHING:
Fall:
Physics 203L- 01 (Foundations of Physics Lab)
Physics 205 (Modern Physics)
Physics 377 (Selected Topics: Nonlinear Dynamics)

Spring:
Physics 122 (Astronomy of the Solar System)
Physics 305 (Particle Physics)

I.S. ADVISING:
Advised senior Nick Harmon in "Chaos on S2: The Newtonian Two-Body Problem on the 2- Sphere"
Advised senior Katie Frato in "Experimental Studies of Signal Noise in Gene Regulation in the Inducible Antibiotic Resistance Pathway of Escherichia coli"
Advised all 5 Physics junior I.S. computer simulations

AREAS OF CURRENT FOCUS:
Cellular automata, celestial mechanics, use of disorder and noise to regularize extended nonlinear systems, computer visualization

PAPERS PRESENTED AT PROFESSIONAL MEETINGS:
With students Katherine Olaksen and Nick Harmon, co- authored a poster "Chaos in the 2- Body Problem in a Spherical Universe" at the March meeting of the American Physical Society in Montreal Canada

PUBLICATIONS APPEARING DURING PERIOD OF REPORT (*STUDENT CO- AUTHOR)
"Optimal Exit: Solar Escape as a Restricted 3- Body Problem", N. Harmon*, C. Leidel*, J. Lindner, *American Journal of Physics*, volume 71 (2003), pages 871- 877.

"The Flux Creep Automaton", J. F. Lindner, S. B. Hughes*, D. J. Miller*, B. C. Thomas*, K. Wiesenfeld, *International Journal of Bifurcation and Chaos*, volume 14, No. 3 (2004) pages 1155- 1175.

"Self- erasing perturbations of Abelian sandpiles", Jeffrey R. Moffitt*, Patrick MacDonald*, John F. Lindner, *Physical Review E*, volume 70, 016203(1- 6) (2004).

Reviewed manuscripts for many journals, including: *Physical Review Letters, Physical Review E, American Journal of Physics, Chaos, Europhysics Letters*

COMMITTEE SERVICE:
Research & Study Leaves, College Scholar Exam, Goldwater Scholarship
Admissions Liaison for the Physics Department

INVITED TALKS:
"Exploiting Noise & Disorder", Cleveland State University, Physics Seminar, 11 September 2003

"Providence, Coincidence, or Multiverse: Are the Laws of Physics Fine- Tuned for Our Existence?", Philosophy Roundtable, 30 October 2003

"U. S. Space Initiative to Extend Human Presence Across the Solar System", Pursuing Scientific Interests, 23 February 2004

"Exploiting Noise & Disorder", Oberlin College, Physics Seminar, 8 April 2004

OTHER:
Interviewed by Akron radio station as a technical expert on the Mars Exploration Rovers and the Bush Space Initiative
Wrote Q&A on the Mars Exploration Rovers for the Wooster *Daily Record*

Donald Jacobs

Victor J. Andrew Professor

TEACHING:
Fall:
Research leave

Spring:
Physics 102 (General Physics)
Physics 220L (Electronics lab)
Physics 401 (Junior Independent Study)

I.S. ADVISING:
Advised senior Nithya Venkataraman in "The correlation length in a branched polymer- solvent system near its critical point"

AREAS OF CURRENT FOCUS:
Self- organized criticality, granular material, phase transitions in binary fluid mixtures, polymer- solvent systems, biological proteins

PAPERS PRESENTED AT PROFESSIONAL MEETINGS:
Co- authored two posters at the March meeting of the American Physical Society in Montreal Canada:
With students Andy P. Brinck and Nithya L. Venkataraman,
"The correlation length amplitude for eight- arm star polystyrene in methylcyclohexane near the critical point"
With student Elizabeth Baker,
"Crystal structure and self- organized criticality in a bead pile"

PUBLICATIONS APPEARING DURING PERIOD OF REPORT (*STUDENT CO- AUTHOR):
"Turbidity detrmination of the critical exponent η in the liquid- liquid mixture methanol and cyclohexane",
Amy Lytle* and D.T. Jacobs, *Journal of Chemical Physics*, volume 120 (2004), pages 5709- 5716.

Reviewed manuscripts for *American Journal of Physics* and *Journal of Chemical Physics;* part of a team reviewing the Chemistry and Physics Departments at College of the Holy Cross; reviewed grant proposals to Petroleum Research Fund and Netherlands Foundation for Fundamental Research on Matter.

RESEARCH LEAVE:
Dr . Jacobs visited the University of Maryland in October collaborating with Profs. Jan Sengers, Michael Anisimov, and Sandra Greer. He worked with a postdoc, Andrei Kosko, on an experiment that measures the Soret coefficient, the concentration change that results from a temperature change. Dr. Jacobs also investigated several exploratory experiments while on leave. The first was a measurement of the viscosity of a liquid- liquid mixture near the critical point. Two other explorations were done in granular phenomena. The principal goal of Dr. Jacobs' leave was the completion of extensive research to test a prediciton central to the theory of critical phenomena. The results are published in the article mentioned above.

Susan Lehman

Clare Boothe Luce Assistant Professor

TEACHING:
Fall:
Physics 203 (Foundations of Physics)
Physics 203L2 (Foundations of Physics lab)
Physics 301 (Classical Mechanics)

Spring:
Physics 204 (Foundations of Physics)
Physics 204L1 & 2 (Foundations of Physics labs)
Physics 350 (Quantum Mechanics)

AREAS OF CURRENT FOCUS:
Investigation of the uniformity of semiconductor quantum dots by atomic force microscopy
Use of cavity ring- down spectroscopy to investigate high- reflectivity semiconductor mirrors

PROFESSIONAL MEETINGS:
March Meeting of the American Physical Society in Montreal Canada (2004)
T.M.S. Electronic Materials Conference, Notre Dame, Indiana (June 2004)

PUBLICATIONS APPEARING DURING PERIOD OF REPORT:
"Optimal Spectral Region for Real- time Monitoring of Sub- ppm Levels of Water in Phosphine by Cavity Ring- down Spectroscopy", S.Y. Lehman, K.A. Bertness, and J.T. Hodges, *Journal of Crystal Growth*, volume 261 (2004), 225.

OTHER:
Panelist at Graduate School Discussion organized by CoW Science and Humanities Program; Elementary School Outreach Coordinator for the CoW Society of Physics Students, William H. Wilson Fund recipient; Instructed and assisted a senior chemistry major, a junior physics major, and two summer research students in the use of the Atomic Force Microscope (AFM).

Shila Garg

Dean of the Faculty
Professorof Physics

TEACHING:
Spring:
Physics 220 (Electronics for Scientists)

PUBLICATIONS APPEARING DURING PERIOD OF REPORT (*STUDENT CO- AUTHOR):
S. Garg and T. Spears*, Dielectric Properties of a Nematic Binary Mixture, *Molecular Crystals Liquid Crystals* 409, 335- 342 (2004)

Jackie Middleton

Administrative Assistant

"I just completed my 15th year at the College (all 15 in Physics and Math/CS!). I also serve as secretary for the College's Hourly and Salaried Support Staff Committee. My husband Randy is employed as an electrician at the College. Son Caleb just graduated from high school and will be a freshman at The Ohio State University this fall, majoring in technology education. My other son Gabe completed three years at The College of Wooster as a biology major and will receive his Wooster degree next spring. This fall Gabe will be attending The Ohio State University College of Veterinary Medicine. Our whole family is very excited about new adventures in Columbus." Go Bucks!!!

Lowell Boone

Visiting Assistant Professor

TEACHING:
Fall:
Physics 101 & 101L (General Physics and labs)
Physics 121 (Astronomy of Stars and Galaxies)

Spring:
Physics 102L (General Physics labs)
Physics 121 (Astronomy of Stars and Galaxies)
Physics 208 (Math Methods)

I.S. ADVISING:
Advised senior Tom Spears in "Searching for Possible Correlations of γ- Ray and X- Ray Emissions from Active Galactic Nuclei"

AREAS OF CURRENT FOCUS
Structure and energetics of active galactic nuclei (AGN); physical mechanisms by whch AGN produce high energy γ- rays

PROFESSIONAL MEETINGS ATTENDED
203rd meeting of the American Astronomical Society, Atlanta, GA (January 2004)
Ohio Section of the American Physical Society, Ohio University (April 2004)

PUBLICATIONS APPEARING DURING PERIOD OF REPORT:
"High- Energy Gamma- Ray Observations of W Comae with the Solar Tower Atmospheric Cherenkov Effect Experiment (STACEE)", R. A. Scalzo et al., *Astrophysical Journal*, volume 607 (2004), 778.

INVITED TALKS
"They Came from Outer Space! Astrophysics at 100 Billion Electron Volts with the STACEE γ- ray Telescope" Science Roundtable, CoW (2003)

"Human Exploration and Intervention in Space" Wooster Noon Lions Club (2003)

"The Solar Tower Atmospheric Cherenkov Effect Experiment (STACEE): Exploring the GeV Sky" Astrophysics Seminar, Ohio University, Athens (2004)

OTHER:
Member of the American Astronomical Society and the Wayne County Astronomical Society

Judith Elwell

Laboratory Technician

"I continue to enjoy working in the Department of Physics. There are always new challenges that sustain my interest. Also, I enjoy my time away from work, driving to Iowa to see children and their families.

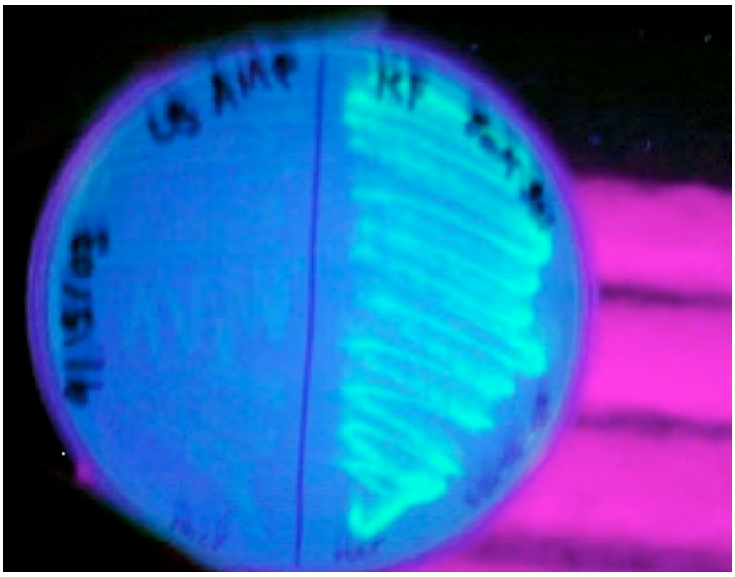
Recently, my husband retired from working over 25 years with the Ohio Agricultural Research & Development Center. It was a special time for us as our daughters and grandchildren surprised him with a visit. I liked that we actually did surprise him. More than once I almost said something that would have given it away."

Senior Independent Study

Experimental Studies of Signal Noise in Gene Regulation in the Inducible Antibiotic Resistance Pathway of *Escherichia coli*

Katherine E. Frato
Advisors: Teresa Johnson (Biology) and John Lindner (Physics)

Since gene regulation is governed by nonlinear equations, we hypothesized that thermodynamic noise in the environmental chemicals that interact with proteins and DNA regulatory regions may enhance signal detection. This study used the *mar* pathway in *E. coli* as a model of gene regulation. The *mar* pathway detects environmental signals such as sodium salicylate and induces a multidrug antibiotic resistance phenotype. In order to measure the response of a gene regulatory pathway to environmental noise, *E. coli* strains were constructed with the green fluorescent protein (GFP) under the control of two separate promoters from different steps of the *mar* signal cascade. The plasmid- based constructs were transferred to the *E. coli* chromosome using the phase λInCh2 to ensure only a single copy of the sequence was present. Cells carrying the *mar* construct were induced with various concentrations of sodium salicylate and fluorescence intensity of individual cells was measured by fluorescence microscopy. The mean fluorescence intensity showed a minimum at 4mM concentrations of sodium salicylate, but the phenotypic noise showed no clear trend over sodium salicylate concentrations. The minimum in mean fluorescence intensity may be a result of stochastic anti- resonance or additional complexity in the biochemical pathway. Further research is required to investigate the possible causes of the minimum in the mean fluorescence intensity and to identify trends in phenotypic noise over inducer concentrations.

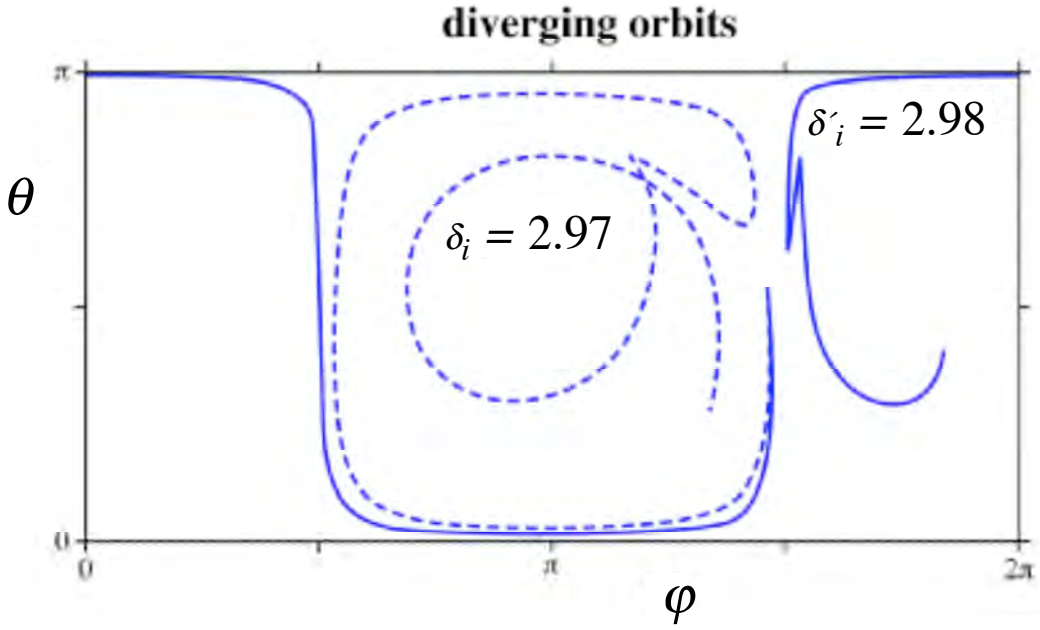


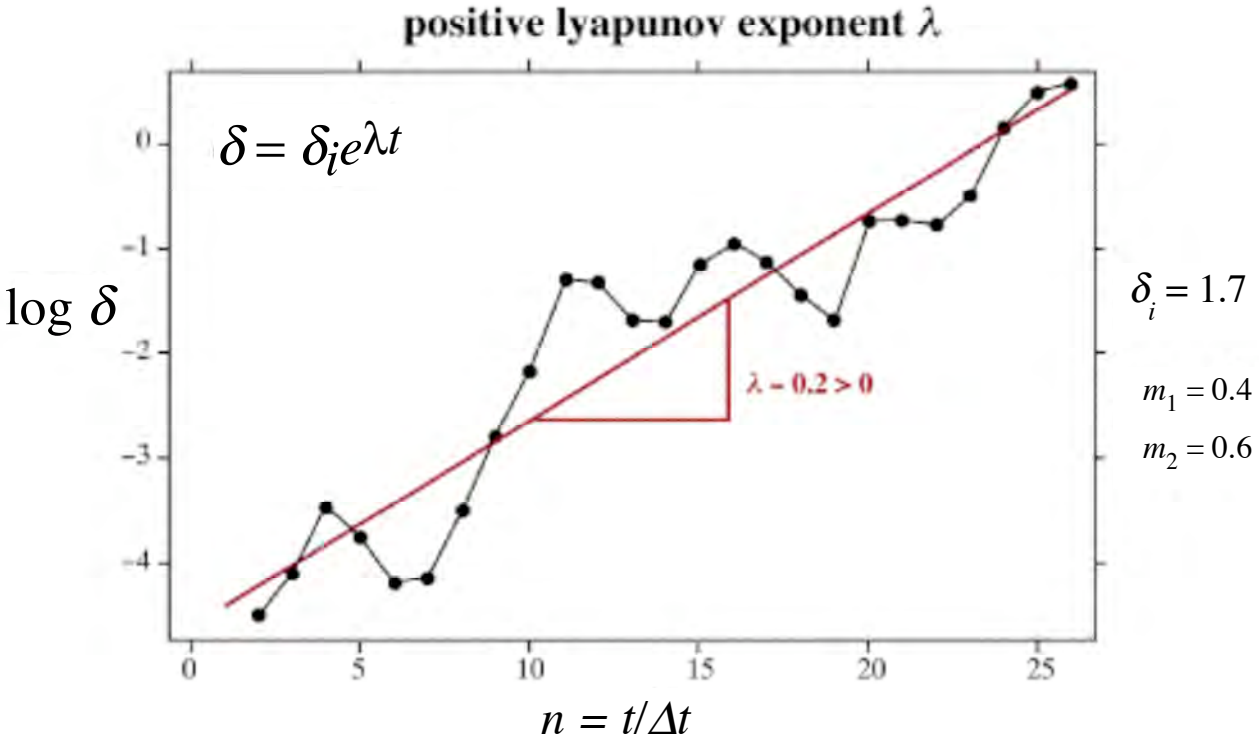
LB agar plate containing 5 mM sodium salicylate and 40 μg/mL kanamycin viewed under UV light. On the right are bacteria containing the *mar* promoter construct and on the left is a control.

Chaos on S^2: The Newtonian 2-Body Problem on the 2-Sphere

Nicholas J. Harmon
Advisors: Charles Hampton (Mathematics) and John Lindner (Physics)

The Newtonian two-body problem in $\mathbf{R}^3$, characterized by elliptical orbits, was generalized to S^2. Vastly different phenomena may occur on S^2 depending upon the initial separation of the two masses. Small separations, compared to the size of the universe, result in precessing ellipses whose rate of precession increases as the initial separation increases. When the initial separation is comparable to the size of the universe, complex orbits occur that are extremely sensitive to initial conditions, which is evidence of chaos. Similar behaviors are exhibited on S^3. The equations of motion are integrated with a custom C++ program and with *Mathematica*.

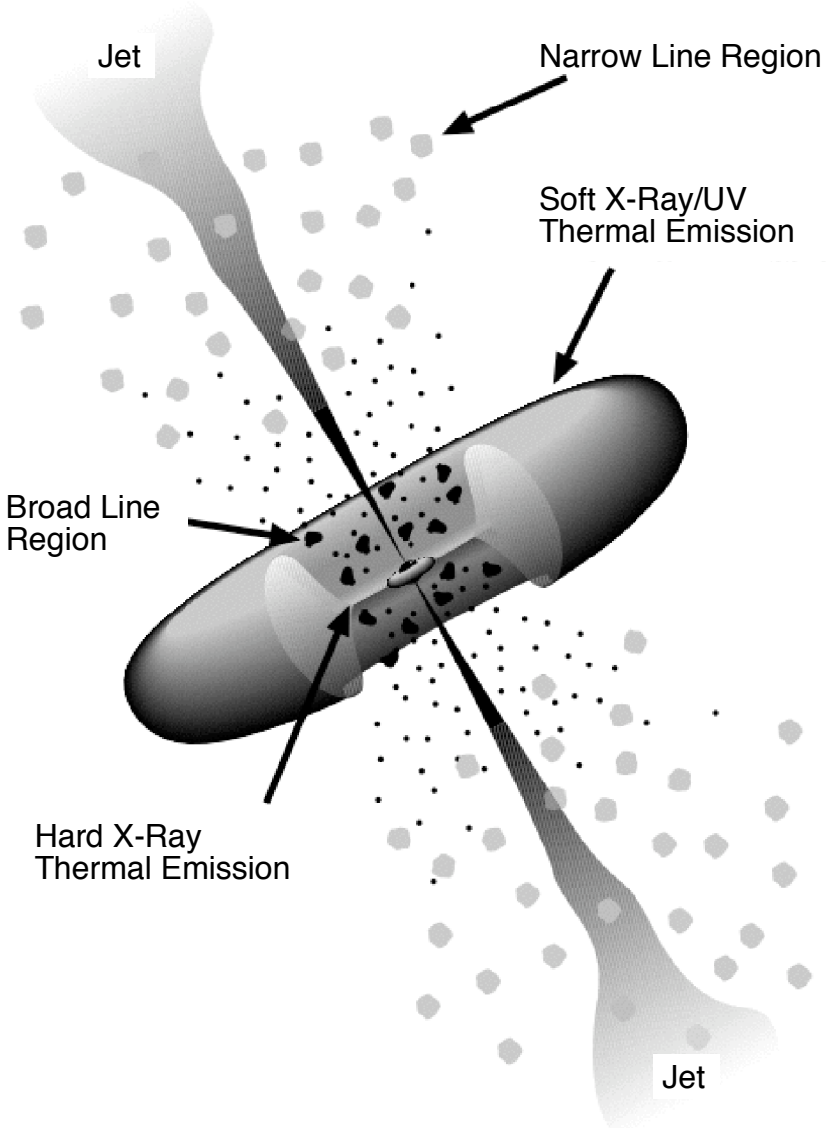




Searching for Possible Correlations of γ- Ray and X- Ray Emissions from Active Galactic Nuclei

Thomas Graham Spears
Advisor: Lowell Boone

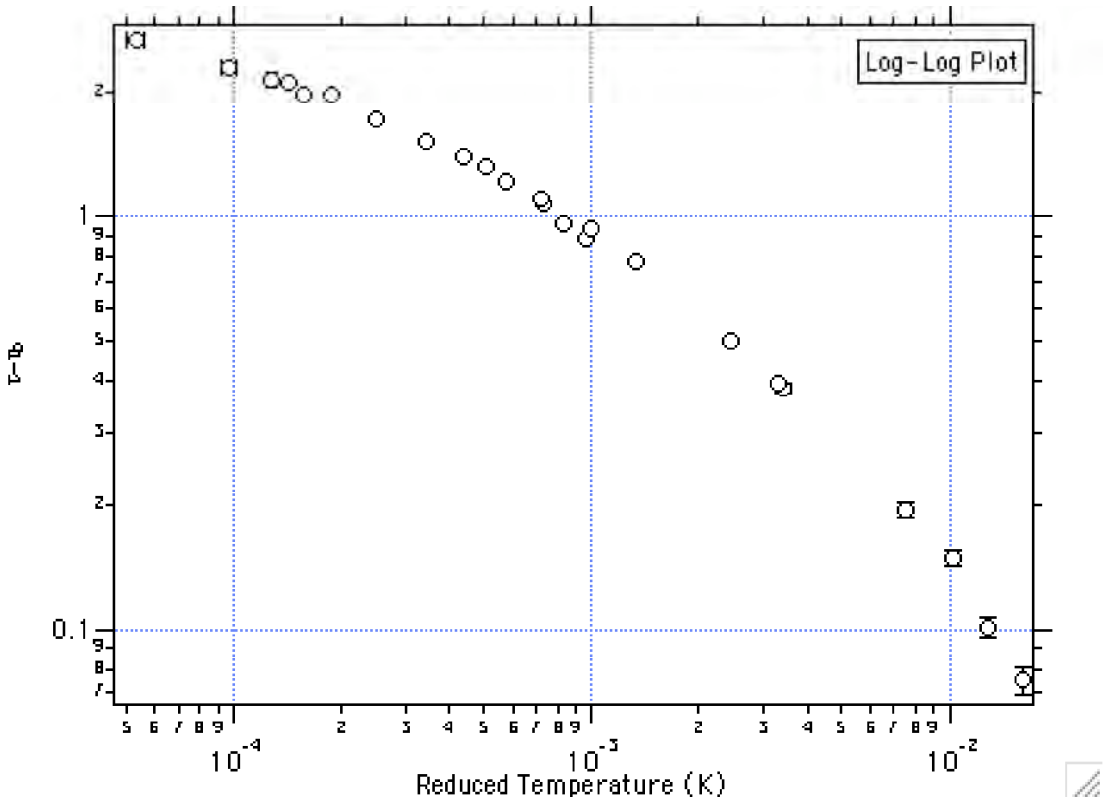
The Discrete Correlation Function (DCF) was used to correlate X- ray and γ- ray light curves for the BL Lac object 3C279. Rigorous testing was performed on the DCF to understand how it responds to perturbations in its parameters, such as varying the bin size. A flux randomization technique was utilized to calculate experimental errors in addition to the statistical errors generated by the DCF. RXTE and EGRET data for the early 1996 flare was used in this analysis. Through testing the DCF and using the flux randomization procedure, results were generated that are consistent with earlier work. However, mathematically these correlations are not as strong as one might have expected from a visual inspection of the light curves. This indicates that the discriminating power of the DCF for X- ray and γ- ray data may not be as robust as has previously been assumed.



The Turbidity and Correlation Length Amplitude of 8- arm Star Polystyrene in Methylcyclohexane Near the Critical Point

Nithya Leela Venkataraman
Advisor: Donald Jacobs

Many studies have been conducted on characterizing linear polymers in a polymer- solvent system near its critical point, and few studies have only been done on star polymers. This paper focuses on 8- arm star polystyrene in the weak solvent methylcyclohexane. The purpose of this experiment is to determine the correlation length amplitude, ξ_0, for different molecular weights of 8- arm star polystyrene and to determine any universal dependence of the critical exponent, η, with the molecular weight. A light scattering method was used to calculate the turbidity of the solution at different temperatures near the critical temperature, and to determine the critical temperature. Then, the values obtained for the turbidity and the critical temperature were used to determine a value for ξ_0. The correlation length amplitude for 8- arm star polystyrene (Mw = 228 000) in methylcyclohexane was determined to be 1.134±0.025 nm. This value for ξ_0 is inconsistent with the ξ_0 determined for other molecular weights earlier observed in this lab. The previous molecular weights observed will need to be reexamined, and more molecular weights will need to be observed before a value for the universality of ξ_0 with the molecular weight can be determined.

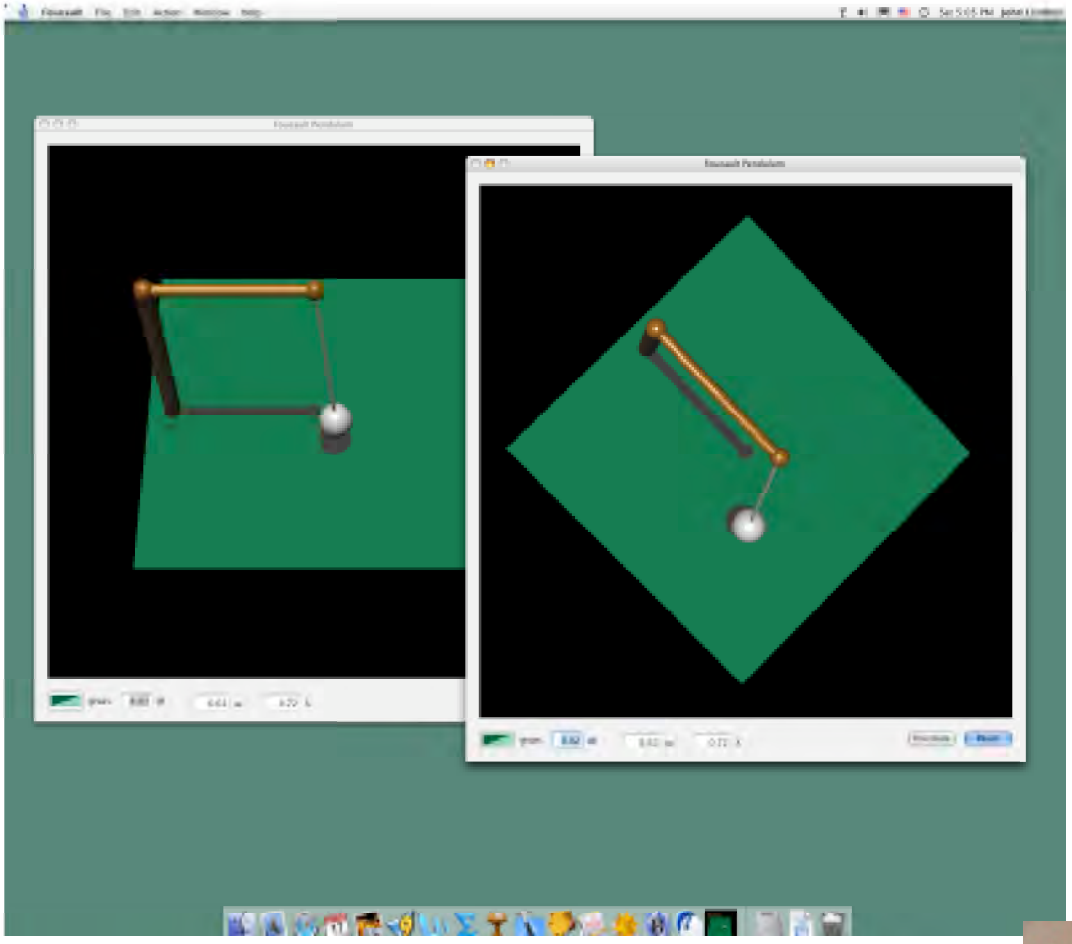


A log- log plot of the turbidity versus the reduced temperature with an adjustment made to the background turbidity.

Junior Independent Study

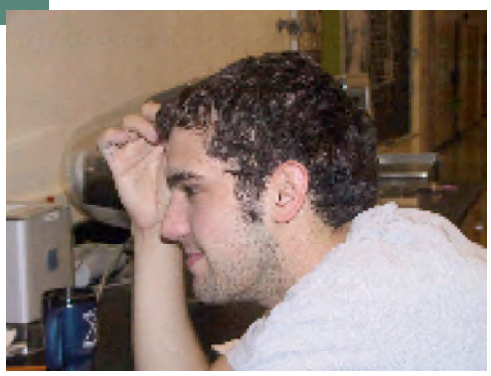
Junior I.S. in physics puts trepidation in the hearts of Wooster physics majors, but when all is said and done, most of our majors agree that Junior I.S. was probably the most beneficial course they took at Wooster. In the words of Dave Merriman '04, Junior I.S. was "the best thing I never want to do again."

This year's junior class was a very hard working group who produced an outstanding set of computer simulations and self- designed experiments in addition to the other three required experiments and reports. The department cannot recall any junior class in recent history that spent as much time in the basement of Taylor during the night, as evidenced by their consumption of every single can of pop from the reading room refrigerator, despite Jackie's best efforts to keep it well stocked. Reports were due on Fridays, and as Mark Lightfoot '05 observed, "Junior I.S. is the only class where Thursday and Friday are rolled into one."



Andy Brinck developed a computer simulation to imitate the motion of a Foucault pendulum for differing values of angular frequency. The equations of motin were derived using small angle approximations that limit the motion of the mass bob to one plane. The program Xcode was used to create the algorithm of the simulation, which used a series of continuous integrated time steps that calculate the position of the pendulum. Interface Builder and OpenGL were then used to construct a 3D world for the pendulum, which the user can rotate to view the motion from all directions. The user can also change the angular frequency of the system, thus showing the motion of a Foucault pendulum at various latitudes on Earth's surface.

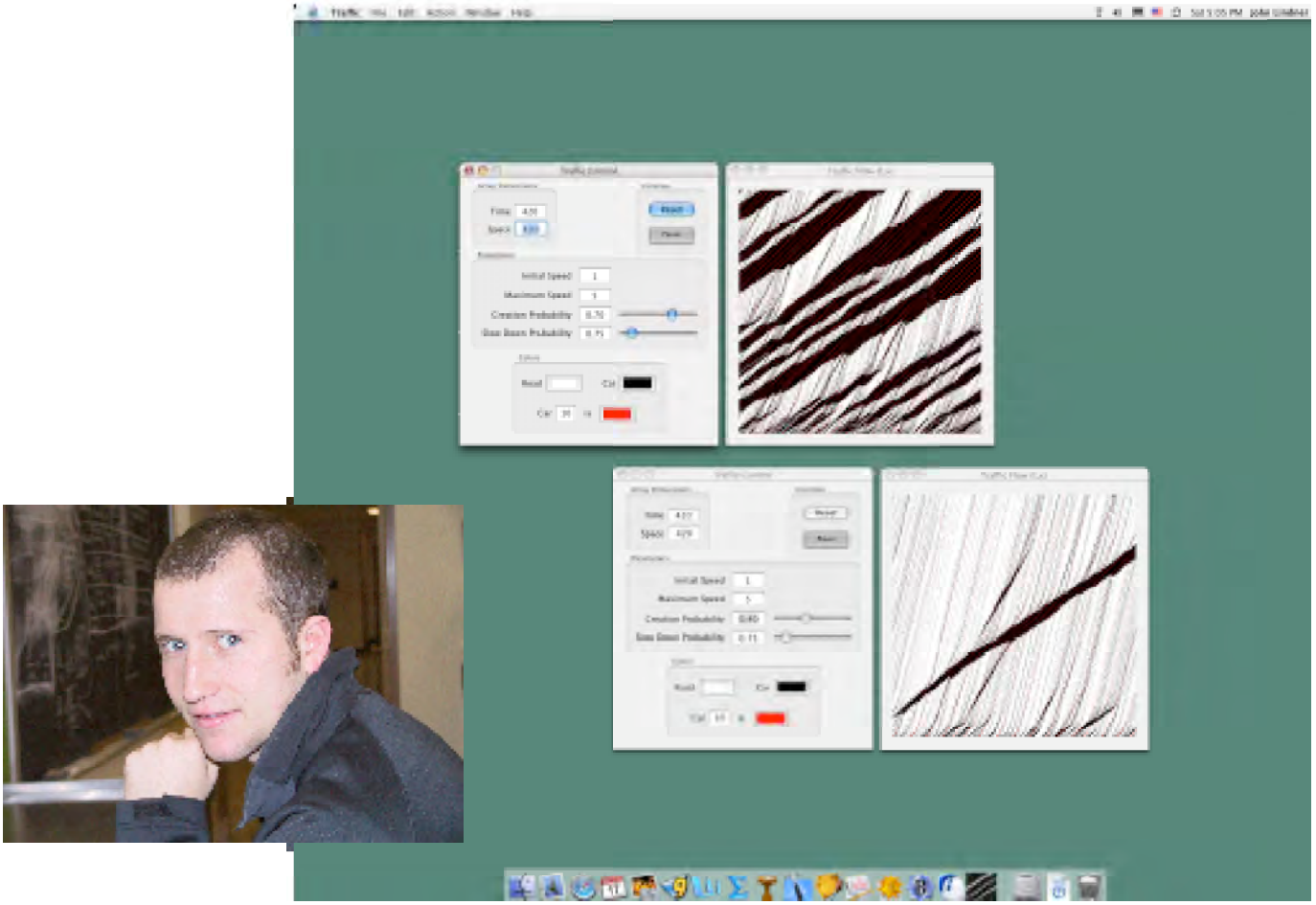
Andy's self- designed experiment was The X- ray Spectrum of the Microquasar XTE J1550- 564. Since their discovery in the early 1990s, the few but growing number of microquasars have been extensively researched in order to better understand radiation processes on galactic and super massive black holes. The radiation data from the microquasar XTE J1550- 564 during a May 5, 2000 x- ray outburst was collected from the Chandra x- ray satellite. This data was modeled into a spectrum and shown to have properties that are in agreement with theoretical predictions of x- ray radiation from an accretion disc around a galactic black hole.



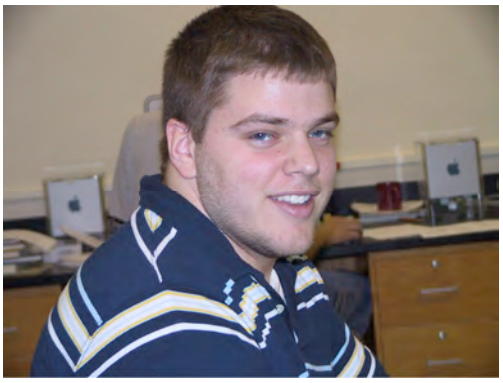
It's supposed to be hard. If it wasn't hard, everyone would do it. The hard is what makes it great.

—Tom Hanks as Coach Jimmy Dugan in *A League of Their Own*
(submitted by Austin Carter)

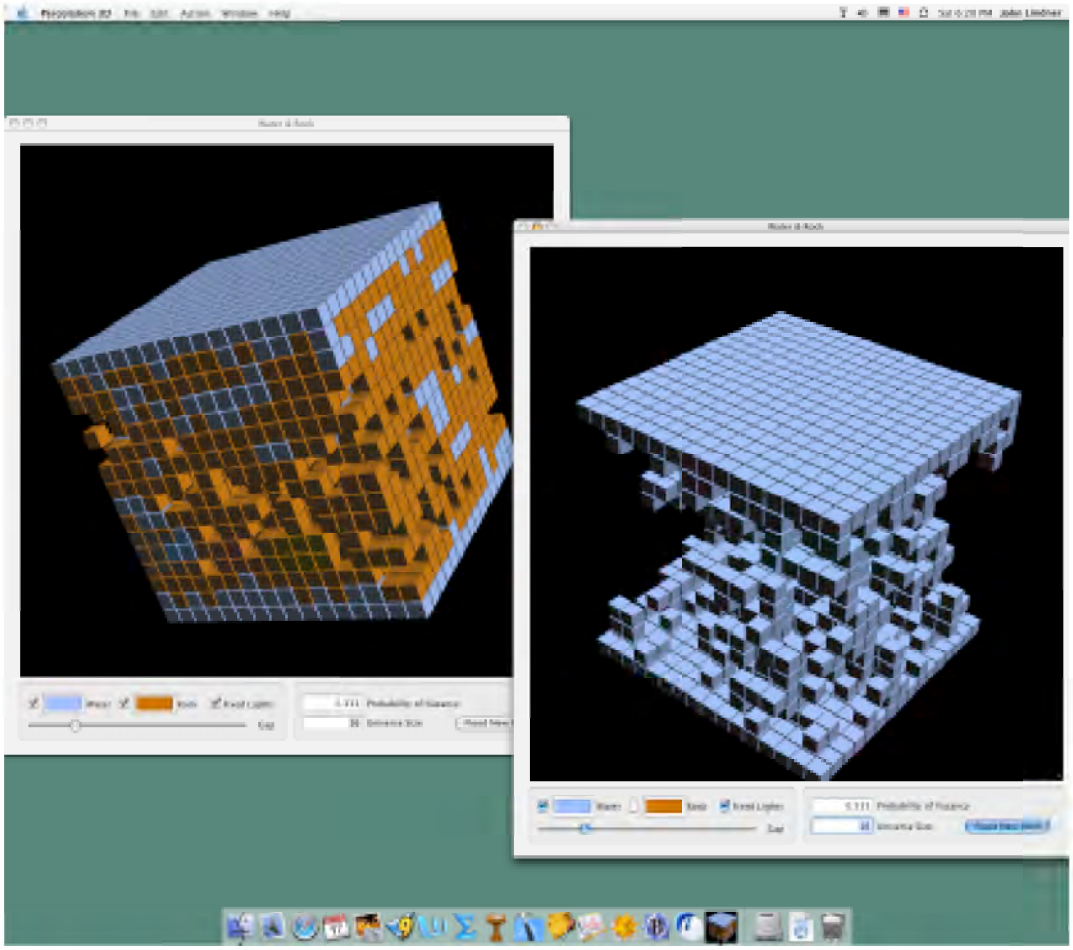
Austin Carter did a cellular automaton simulation that modeled highway traffic flow in an attempt to understand the cause of vehicle clusters. A rudimentary model similar to Nagel and Schreckenberg (1992) with five governing rules (essentially) was developed and tested. A phase transition was observed between smooth laminar flow and slower broken flow (cluster formations) by changing the slow-down probability and the car density. The transition's parameters did not change noticeably for different maximum speeds. Flaws were discovered in the simulation and multiple proposals for future work are included.



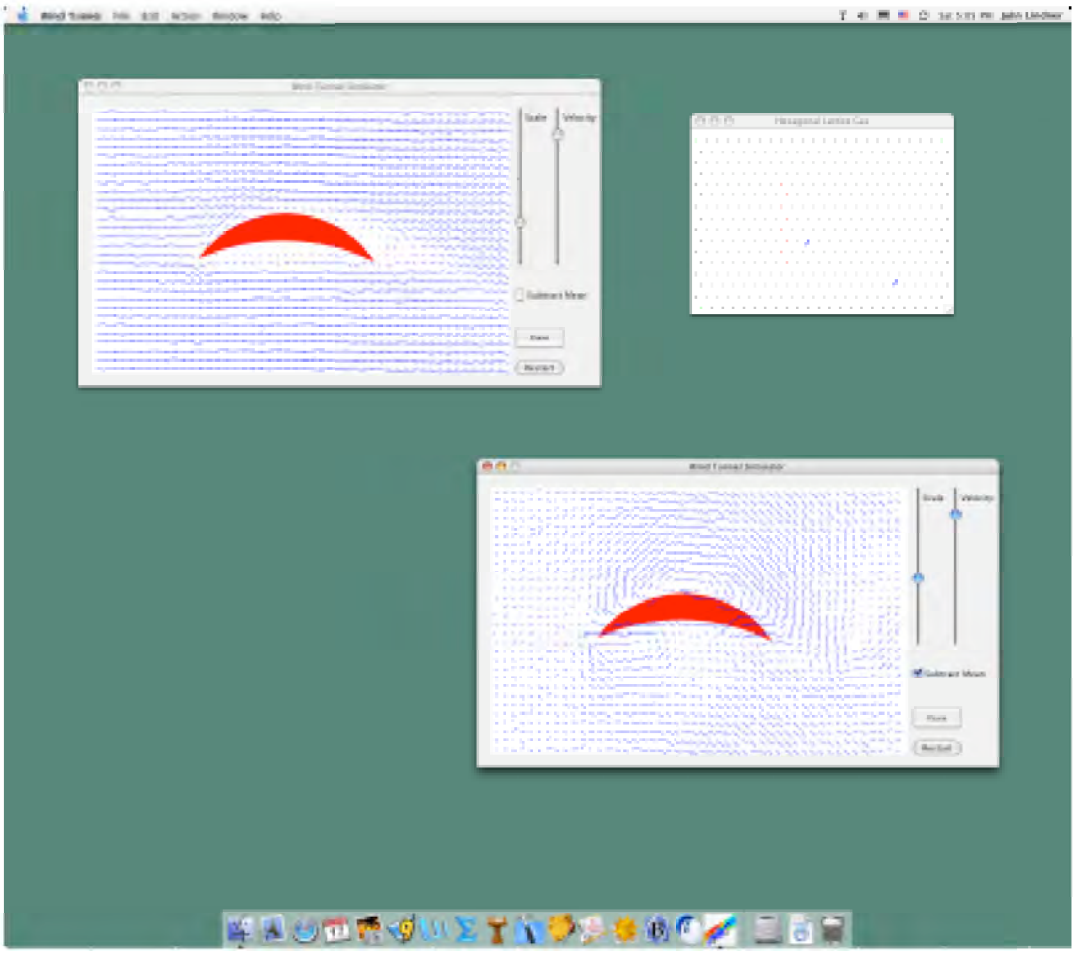
Austin's self-designed experiment was an Investigation of InGaAs/GaAs Quantum Dots using Atomic Force Microscopy. Self-assembled InGaAs quantum dots grown on GaAs wafers using molecular beam epitaxy were characterized using an atomic force microscope. Excellent angstrom-level resolution was obtained and single atom terrace layers were observed. A nonsystemic background height variation caused by terraces was measured to be ≤ 2 nm across a 300 nm sample. The average dot height of a sample scan with respect to each dot's local background was measured to be 7.2±1.8 nm. It was also determined that a single measurement on a seemingly "flat" surface surrounding a dot or at the top of a dot can vary by as much as 0.6 nm. Finally, it was determined that a uniform local background around the dots does exist but varies by 0.2±0.1 nm. This value dramatically increases when another dot is in close proximity.



Mark Lightfoot's computer simulation, Percolation, was created with Xcode and Interface Builder. It focuses on site percolation in the 2D lattice and 3D cubic lattice. As the size of the lattice approaches infinity, there is a certain probability of vacancy, the critical probability, which will allow the percolation probability to go from zero to one. The experimental results for the critical probability of the square and cubic lattices approach 0.59 ±0.02 and 0.31±0.01 respectively as the size of the lattices increases. Their corresponding accepted values are 0.592746 and 0.3116.



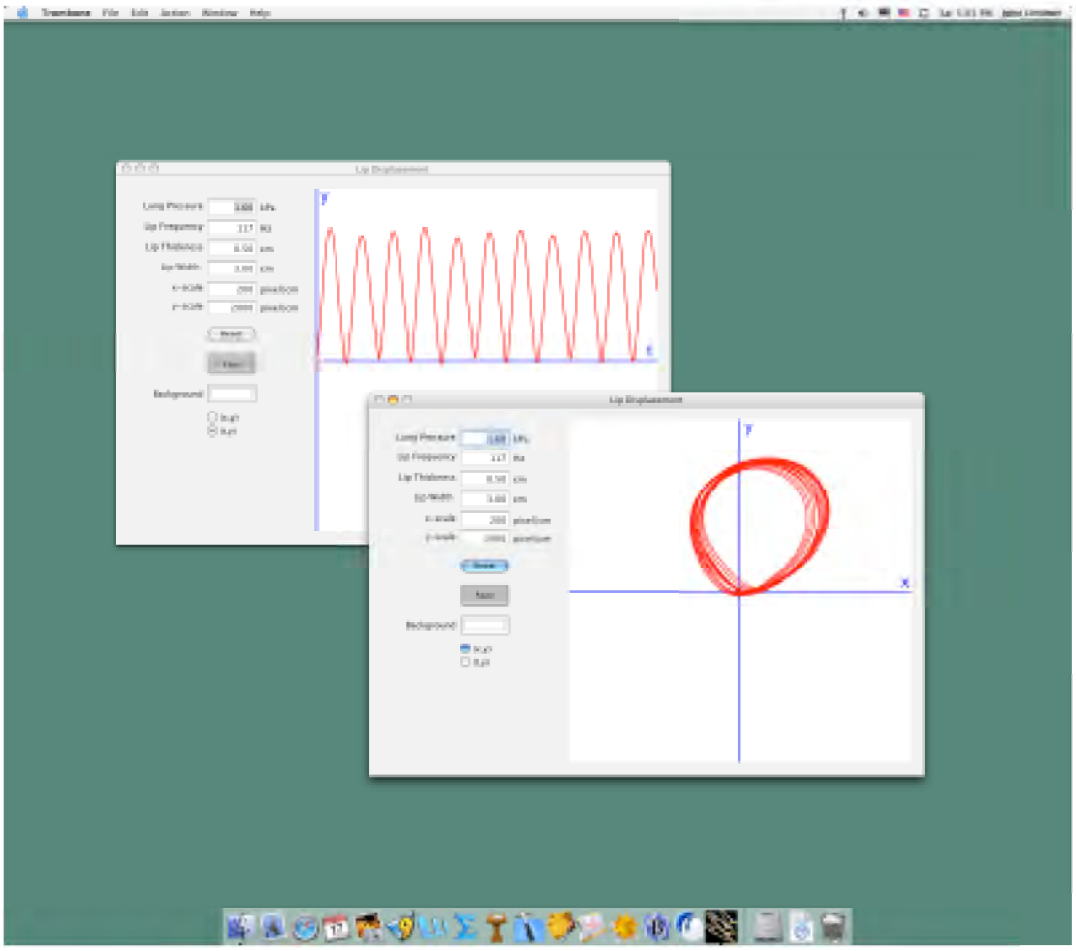
Mark's self- designed experiment, Efficiency of a Bow and Finding the Perfect Arrow, showed that the greater the mass of the arrow used, the more efficient the bow is. For arrows of masses 0.03491 kg, 0.05683 kg, 0.09988 kg, efficiency values of (78±14)%, (79±16)%, (83±15)% respectively were obtained. Also, arrows of different masses were tested to see which mass gave the arrow the ability to achieve maximum penetration of a target. Through graphical analysis, it was determined that the mass which would allow such penetration of a target was $m_{max} = (0.07 \pm 0.01)$ kg.



Saleh Satti's computer simulation, Wind Tunnel Simulation III, uses a 2-dimensional triangular (or hexagonal) arrangement of nodes. By allowing pseudo-particles to move freely in a desired direction across these nodes, the non-linearity of the cellular automata causes a fluid-like pattern that is in accordance with the Navier-Stokes equation. Then by programming some of these nodes to become "obstacle" nodes, the cellular automata mimics the effects of fluid flow around an obstacle and depicts it as a computer simulation with realistic effects. These "obstacles" nodes were arranged in such a manner so as to resemble the shape of a wing. The result was a stream of vortices behind the wing created for this simulation.

Saleh's self-designed experiment involved shooting a basketball several times at a rim 10 feet above the ground. It was found that air resistance and spin factor played no role in the trajectory of the ball and that the ball moved as a particle projectile. Two shots were also compared, a missed shot as well as a made shot, and it was found that no single factor is responsible for determining a good shot, but it was the right combination of both the angle and the velocity, provided the horizontal and vertical distances remain constant.

Dan Utley, a double major in physics and music, simulated the lip motion of a trombone player. The simulation produces a (x,y) position graph of a trombonist's upper lip for given values of lung pressure, lip dimensions, and sound frequency. The resulting two- dimensional plot reflects the lips' motion both perpendicular and parallel to the airflow. The lips are treated as two masses, coupled by springs.



Dan's self- designed experiment attempted to use time- average holographic interferometry of the Powell and Stetson type to view the behavior of a vibrating Chladni plate, organ pipe, and hand- bell. For the Chladni plate, the first several eigenfrequencies (modes) were determined and used during the exposure of the holograms. The organ pipe was excited both through the sounding of the pipe and through acoustical excitation of the flu chamber using a speaker. Acoustical excitation was also used on the bell. Since there are numerous studies of vibrating metal plates and hand/church bells in the literature, this experiment was designed to replicate these images and then use the same technique on the vibrating organ pipe to see possible nodes in the pipe walls. Unfortunately no usable holograms were develped of any of the objects while vibrating. Faint holograms of the organ pipe and the Chladni plate were obtained. Although fringes could be seen on the organ pipe, the images were not clear enough to be analyzed.

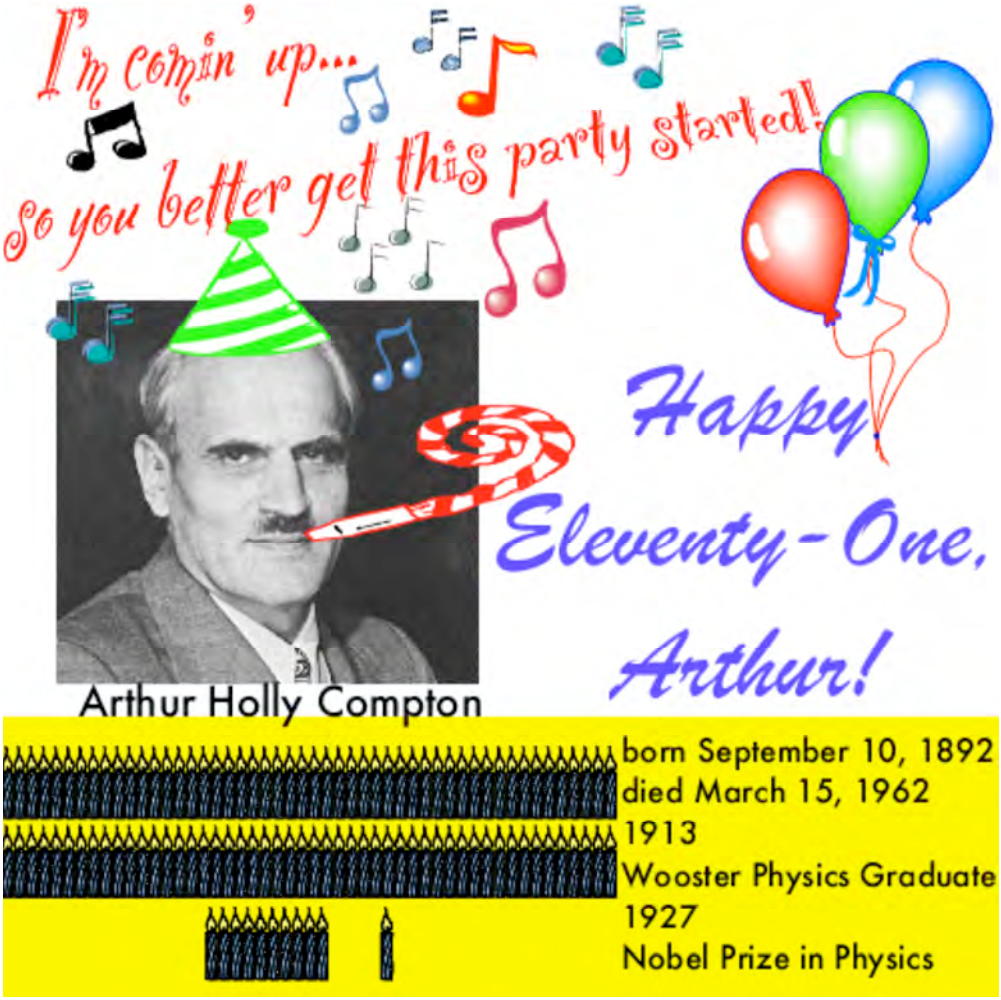
Physics Club

- Fri 29 Aug 03: Physics Table at Scot Spirit Day
- Wed 10 Sep 03: Luce Dinner & Dessert Social
- Fri 13 Nov 03: Lecture by Oleg Lavrentovich "Emerging Topics in the Optics of Liquid Crystals"
- Sat 15 Nov 03: Trip to COSI and dinner in Columbus
- Thu 4 Dec 03: Senior I.S. Presentations + Pizza & Pop
- Mon 26 Jan 04: General Meeting
- Fri 6 Feb 04: Lecture by Matt Mewes "Testing Relativity"
- Mon 9 Feb 04: Lecture by Susan Thompson "Variable White Dwarf Stars"
- Fri 13 Feb 04: Lecture by Jeff Loats "20 Ways to Catch a Gamma Ray: Nuclear Band Mixing in Erbium 166"
- Thu 25 Mar 04: General Meeting
- Fri 9 Apr 04: Lecture by Lauren Jones "The Source of Far Infrared Radiation in Spiral Galaxies"
- Wed 14 Apr 04: Lecture by Leo Pantelidis "Dynamics of the Heisenberg Model"
- Sun 18 Apr 04: Taylor Bowl 15
- Fri 7 May 04: Dr. Boone's barbecue
- Wed 21 July 04: Lecture by Geoffrey Bonvallet '00, "Spectroscopic Analysis of MH- HID Lamps"

Officers 2003-2004

President:	Tom Spears
Vice President	Katie Frato
Secretary	Nick Harmon
Treasurer	Nithya Venkataraman
Ambassador to Scotland	Austin Carter

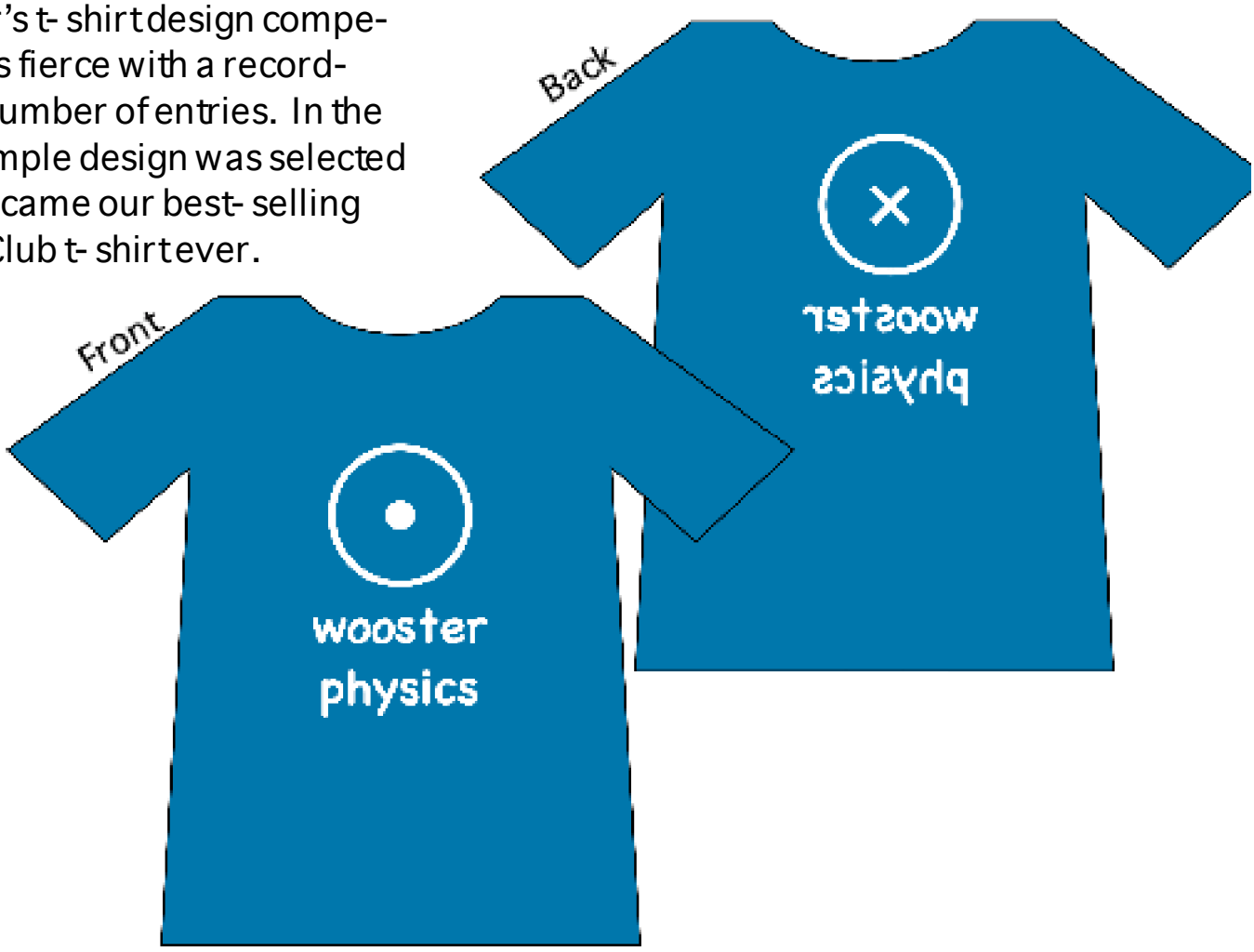
The Physics Club table at Scot Spirit Day featured liquid nitrogen marshmallows, frozen flowers, superconductivity and a diffusion cloud chamber. Below, Tom Spears '04 presents President Hales with a LN_2 marshamallow as physics major Nithya Venkataraman '04 looks on.



The Physics Club's annual pizza and dessert night held in September featured a tribute to Arthur Holly Compton's 111th birthday, as well as the traditional preparation of liquid nitrogen ice cream.

Austin Carter '05 served as our "Ambassador to Scotland" last fall semester, meaning that he wore his physics club t-shirt when he went sightseeing and brought notoriety to The College of Wooster wherever he went.
Says Austin...
"My classes were flexible enough to allow a semester that I could spend abroad, so I decided to go to Edinburgh, Scotland during the fall of my junior year. Edinburgh is simply beautiful: seeping with history and rich in character. After the classes, the pubs, the castles, and getting to know some of the friendliest people I have ever met, I can honestly say that my semester abroad was one of the best experiences of my life. Traveling offers a whole new perspective that I think everyone should experience at least one time in their life. Scotland was my first traveling experience but it will not be my last."

This year's t-shirt design competition was fierce with a record-setting number of entries. In the end, a simple design was selected which became our best-selling Physics Club t-shirt ever.



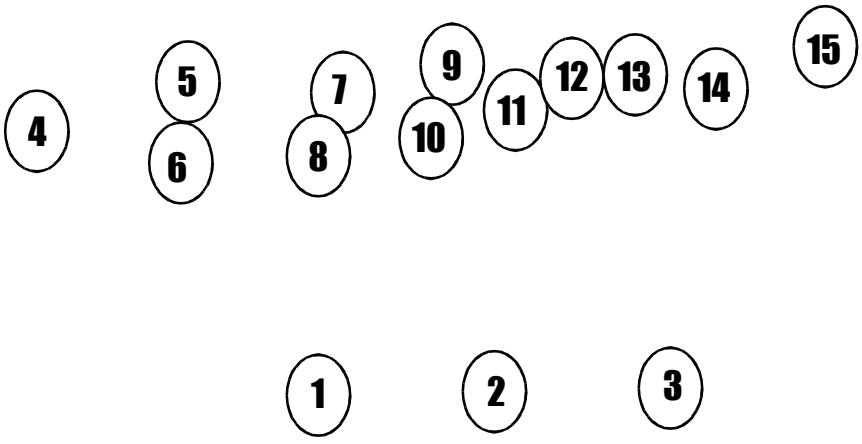
Due to our loss in Taylor Bowl last year, the Physics Club was the challenger in this year's Taylor Bowl XV. Unfortunately, the 3x6 foot challenge poster that was placed on the Taylor third floor in the middle of the night served only to fuel the fire of the Math/CS bowling team, as they proceeded to trounce us for the second year running.

Math/CS
113.88

Physics
104.95

Student Research

Summer Research Group 2004



1. John Lindner
2. Stephen Poprocki
3. Jon Rosch
4. Lowell Boone
5. Jeremy Hohertz
6. Susan Lehman
7. Don Jacobs
8. Kinga Partyka
9. Mark Lightfoot
10. Annie Erbsen
11. Joseph Dartez
12. Danny Shai
13. Tuan Nguyen
14. Angie Triplett
15. Bryan Whiting

(not pictured Wingfield Glassey)

Projects

Jet Emission Models for Microquasars
Jeremy Hohertz, CoW '06
Advisor: Lowell Boone
Funded by NSF- REU

Characterization and Imaging of Self Assembled InAs Quantum Dots by Atomic Force Microscopy
Annie Erbsen, Guilford College '06
Advisor: Susan Lehman
Funded by NSF- REU

Analysis of X- Ray Emissions from Microquasars
Jon Rosch, CoW '07
Advisor: Lowell Boone
Funded by NSF- REU

Alloy Chemisorption of Carbon Monoxide
Bryan Whiting, CoW '06
Advisor: Wingfield Glassey
Funded by CoW Sophomore Research Program

Measuring the Coexistence Curve of an 8- Arm Star Polystyrene in Methylcyclohexane
Mark Lightfoot, CoW '05
Advisor: Donald Jacobs
Funded by: Petroleum Research Fund

Accurate Measurement of Quantum Dots by Atomic Force Microscopy
Stephen Poprocki, CoW '07
Advisor: Susan Lehman
Funded by: Clare Boothe Luce Program

Self- Organized Criticality: Deviations from Pure SOC Power Law
Tuan Nguyen, University of Oklahoma '06
Advisor: Donald Jacobs
Funded by NSF- REU

Finding the Turbidity of an 8- Arm Star Polystyrene in Methylcyclohexane
Angie Triplett, CoW '06
Advisor: Donald Jacobs
Funded by NSF- REU

A Reduced Mass Variation of the Newtonian Two- Body Problem on the 2- Sphere
Danny Shai, CoW '07
Advisor: John Lindner
Funded by NSF- REU

Chaos and Fractal Structure in Solar Escape: A Restricted Three- Body Problem
Joseph Dartez, University of Dallas '06
Advisor: John Lindner
Funded by: NSF- REU

A Computational Study of CO Oxidation on Pt(111) and Ru(0001) Surfaces
Kinga Partyka, Rutgers University '07
Advisor: Wingfield Glassey
Funded by NSF- REU

Off-Campus Summer Research

Austin Carter '05 spent the summer at Columbia University involved in a research and development project for a new type of low- energy neutrino detector. In the liquid helium detection medium, a neutrino elastically scatters with an electron via the weak force. This energetic electron then leaves a 1 mm trail of eBubbles which can be detected and used to calculate the energy and direction of the original neutrino. Austin explored one method of eBubble detection that utilizes sonic pulses.

Kathy McCreary '06 spent her summer at Hope College investigating the electrical transport properties of thin film semiconductors. The metal- nitride semiconductor samples were produced in the lab using an ion sputtering technique. Using the Haynes- Schockley method, transit times of optically injected carriers were measured in order to calculate mobility and recombination times of the samples.

National Meeting of the American Physical Society

Montreal, Canada
March 2004

Andy Brinck '05, Katherine Olaksen '06, Kathy McCreary '06
Don Jacobs, and Susan Lehman pose in a wintery scene in downtown Montreal.
Elizabeth Baker (Bucknell '06) also presented her REU research from last summer.

Presentations:

Andy P. Brinck*, Nithya L. Venkataraman*, and D.T. Jacobs, "The correlation length amplitude for eight- arm star polystyrene in methylcyclohexane near the critical point"

Elizabeth Baker* and D.T. Jacobs, "Crystal Structure and Self- Organized Criticality in a Bead Pile"

Kathleen McCreary* and Shila Garg, "Dielectric Anisotropy of Nematic Binary Mixtures"

Katherine Olaksen*, Nicholas Johann Harmon*, and John F. Lindner, "Nontrivial dynamics of two interacting point particles confined to a sphere"

*(Student co- author)

Transit of Venus 2004

Most of us got up* at 5 a.m. on Tuesday 8 June 2004 to observe the first transit of Venus in nearly 122 years -- no one alive had seen it! We met at Taylor Hall at 5:30 a.m. and carpooled to the old Lowes parking lot with the department's two 8-inch telescopes. Other observers were already there with several large telescopes polar-aligned with the north star. We first imaged the moon at high and low magnification. As the sun rose (over Walmart and McDonalds), we could see the circular spot of Venus against its disk with our naked eyes. For the next hour and a half, we projected the image onto a white board for group viewing with one telescope and attempted astrophotography with the other. Dozens of people watched with us. Afterward, many of us enjoyed an 8 a.m. breakfast at the nearby Bob Evans.

The first photo below is reminiscent of what our projected image looked like, while the second image is our fantasy of what it looked like: NASA's TRACE satellite was able to observe a ring around Venus during egress as the sun's rays refracted around Venus's dense but thin atmosphere; detecting the ring meant observing all of the sunrises and sunsets on Venus simultaneously!

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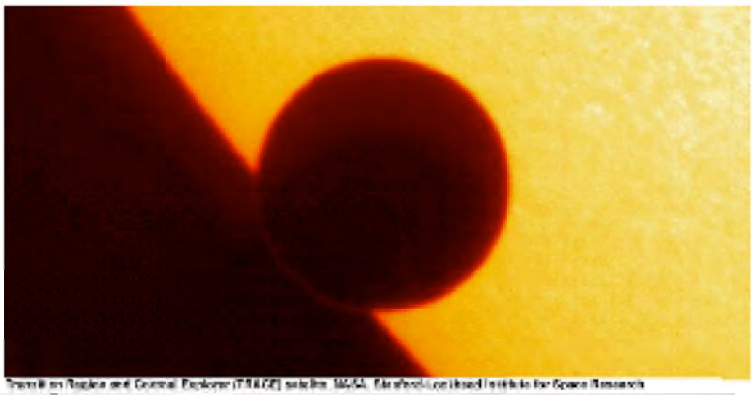
* One of us stayed up all up all night rather than get up so early.



New Shop Equipment

Ron Tebbe was hired this spring to fill the newly created position of Instrument Technician/Machinist for the Science Departments. He earned his degree in Biochemistry from The College of Wooster in 1997. Prior to that, he worked as a tool- and- die machinist. This summer, under the direction of Shila Garg, Dean of Faculty and Professor of Physics, Ron was able to upgrade the machines in the Physics Shop.

The shop now has increased metal working capabilities to complement the wood shop for Independent Study projects and faculty research. Ron is shown here with the new Birmingham vertical milling machine and gap bed lathe.

Alumni Spotlight

JOSH BOZEDAY '99

"I can't believe it's been 5 years already since I graduated from Woo! In some ways I believe it but in others I can't fathom that it's been that long... Like I can still remember pulling all- nighters in Taylor for Jr. and Sr. IS. I can still remember how excited Dr. Garg was freshman year when I told her I declared Physics as my major. I can still remember Dr. J and his coffee mug teaching us Electronics II at way too early in the morning. I'll never forget the painstakingly meticulous lesson plans John prepared for every single lecture. I remember how Judy always helped me track down some equipment that I needed for an experiment due... the next day. And the way Jackie was always there to joke around with me and help ease the stressful times.

After I graduated Wooster I went straight into software engineering at Motorola. Two years ago I made a decision to quit my job as a software engineer and find a new career path. I'm excited to tell you all that the path I chose was to become a high school physics teacher! But in order to become a teacher I had to go through a credentialing program and I also wanted to my Masters degree. Since I worked so hard at Wooster I promised myself I was going to apply to the best Masters programs and attend the best school I could get into. Well I'm excited to say I managed to get into Stanford University! So all of last year I was going through an incredibly rigorous Masters/Credentialing program in Education. I have to say the expectations were even more rigorous than those I felt at Wooster!

Finally last June I made it through the program alive and graduated with a California teaching credential and a Masters degree from Stanford. Unfortunately I had to job hunt immediately which meant no rest time for the weary. Luckily finding teaching positions in the sciences is not as competitive as some other subjects. After a few interviews and job offers I ended up choosing a school up in Napa, CA called New Technology High School. I'm really proud of our school because we try to teach through project based learning and we really recognize the importance of integrating content areas. For example , one of the classes I teach is called Scientific Studies and the class integrates the standards for Physics and Algebra II. It's great because the students don't ask us, "Why are we learning this math?" They know they are learning the math so they can use it as a tool to understand the physics:-) I'm also teaching AP Physics B which is much more of a traditional lecture based course but I enjoy it because we get to cover so many great aspects of Physics. If you have a chance check out our school's website: http://www.newtechhigh.org/."

GEORGE MILLER '87

"I was one of three graduates of the class of 1987 Physics Department to combine my physics background with my sports background (Scott McLean and John Porter being the other two). Two years after graduating from Wooster, I started work on my M.S. degree in biomechanics through the Exercise Science Department at the University of Iowa. After finishing in 1992, I started working in May of 1993 for a company called Peak Performance Technologies in Denver, a manufacturer of video- based and analog motion measurement systems that are used to quantify movement patterns of just about anything or anyone that moves, primarily for research and clinical applications (www.peakperform.com). Over the past 11 years at Peak, I have done everything from technical support and product testing to my current position as Technical Sales Manager. I just got married last year, continue to swim competitively with a Master's team here in Denver, and have enjoyed climbing 23 of the 54 (so far) 14,000 foot peaks in Colorado.

The above description can also be loosely used for JOHN PORTER '87 (jporter@peakperform.com). He had already been at Iowa working on his M.S. in biomechanics when I arrived in 1989. He left Iowa in 1990 to do a one- year research assistantship at the U.S. Olympic Training Center in Colorado Springs before starting work at Peak Performance in 1991, where he and I are still working together. John has been married for a long time, has two kids, and continues to play soccer in two leagues and listen to Led Zeppelin on a regular basis."

THOMAS KIRKMAN '74

Tom is a professor of physics at St. John's University in Collegeville, MN. He received his Ph.D. from the University of Wisconsin, Madison in 1982. He specializes in mathematical physics and particle physics. Tom's sister Ellen Kirkman is also a Wooster grad '70 (mathematics). She is now a math professor at Wake Forest Universtiy. In the photo above, Tom is the guy seated in the center, surround by students from a recent mechanics class.

DAN BRUBAKER '03

After graduating from Wooster, Dan attended Ashland University and received his teaching certification. Dan will be teaching physics, chemistry, integrated science, and typing at St. Wendelin Catholic High School in Fostoria, OH. It is a small, private school (about 40 seniors in a graduating class), and about 98% of the seniors continue their education after high school.

POLLY SEARFOS (Wardwell) '84

"The 1984 Commencement Speaker said to expect a number of career changes during our lives. Judging by me, he was right. I was an actuary for about 15 years here in Columbus. I married Michael and had 2 kids, Elizabeth (14) and Benjamin (12). Four years ago, my dad made me an offer I couldn'trefuse. So for the last four years, I have been taking care of his investments, giving me time to be there when my kids needed me. This past summer, I started back to school to get my teaching license to teach high school math. I plan to substitute teach math and physics this school year and student teach next fall."

MARK "DINKI" GHOSH '99

Dinki received his graduate degree in Computer Science from the University of Toledo this past spring and is now working as a software engineer for the Internet Products Group at Buckeye Cablesystem in Toledo. He also plans to enroll in the eMBA program at the University of Toledo this coming spring. As for extra curriculars, Dinki is an active Open Source developer, working on such diverse projects as Mozilla and WordPress and running the relatively popular http://weblogtoolscollection.com in his free time. He lives with his dog Luckey in a condo in Toledo.

DELANEY DEMAY '97

"I probably have the least physics- related career going on, but love what I do. After graduation, I moved to Portland, OR to attend law school. I finished (passed the bar and everything!), but really found social work more appealing, so I am not practicing law. For the past 2 and 1/2 years, I have worked in the adoption field, both with birthparents and adoptive families. I love my job and living in the Pacific Northwest. I adopted a dog a year and a half ago and love to take her on hiking and camping trips with me."

STEPHEN GREY STAFFORD '88

"After Wooster, my plans to pursue graduate studies in oceanography took a detour all the way back to Sea World in Ohio. For the first half of the 90s, I trained marine mammals for entertainment and educational shows while also serving as a research coordinator for the training department.

By the mid 90s, I entered the doctoral program in Biological Sciences at Kent State University while still spending summers with Shamu. My research focus was comparing the energy use and physiology of two small (110g and 330g), related primate species. (I am still amazed that pygmy marmosets can function, much less thrive, given their relatively high surface area to volume ratio.) This project was ideal in that it allowed me to blend my biological, behavioral and physical science interests. Despite years of working in zoo environments, I am still a physicist at heart!

At the completion of my dissertation, my wife Karen (also an alum) and I found ourselves living in the Phoenix area. I soon took a position as Curator of Education at Wildlife World Zoo. As the zoo's primary spokesperson, I have been fortunate to work with local and national media and have even made it to the Tonight Show a few times with some of our amazing creatures. For the past two years, we have been living in Hawaii as I served as Director of Animal Management for an interatcive facility called Dolphin Quest. However, as of this writing, we are back in Phoenix. Hawaii is beautiful but while living in paradise, we realized that Arizona has become our home."

ANDREW NOWICKI '00

Andy continues to work for ASRC Aerospace at NASA Kennedy Space Center, Florida. He and wife Christie are proud to announce the birth of future NASA scientist Hadryn Walter Nowicki, born 5- 28- 04. Hadryn weighed in at 8 lbs 7.5 oz and was 19 inches long.

Physics Humor

Party of Famous Physicists

One day, all of the world‘s famous physicists decided to get together for a tea luncheon. Fortunately, the doorman was a grad student and able to observe some of the guests...

- Everyone gravitated toward Newton, but he just kept moving around at a constant velocity and showed no reaction.
- Einstein thought it was a relatively good time.
- Coulomb got a real charge out of the whole thing.
- Cauchy, being the only mathematician there, still managed to integrate well with everyone.
- Thompson enjoyed the plum pudding.
- Pauli came late, but was mostly excluded from things, so he split.
- Pascal was under too much pressure to enjoy himself.
- Ohm spent most of the time resisting Ampere‘s opinions on current events.
- Hamilton went to the buffet tables exactly once.
- Volt thought the social had a lot of potential.
- Hilbert was pretty spaced out for most of it.
- Heisenberg may or may not have been there.
- The Curies were there and just glowed the whole time.
- van der Waals forced himself to mingle.
- Wien radiated a colourful personality.
- Millikan dropped his Italian oil dressing.
- de Broglie mostly just stood in the corner and waved.
- Hollerith liked the hole idea.
- Stefan and Boltzman got into some hot debates.
- Everyone was attracted to Tesla’s magnetic personality.
- Compton was a little scatter-brained at times.
- Bohr ate too much and got atomic ache.
- Watt turned out to be a powerful speaker.
- Hertz went back to the buffet table several times a minute.
- Faraday had quite a capacity for food.
- Oppenheimer got bombed.

PLEASE CONTACT US!

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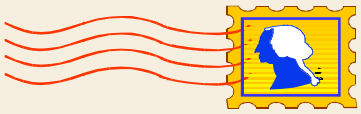
sgarg@wooster.edu (Shila Garg)



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