September 2007

Volume 2

Physics Matters

at Syracuse University

A Note From the Chair—see page 2

Honorary Degree for Martin Pomerantz, SU '37

Martin A. Pomerantz, astrophysicist, explorer, teacher, you have defied the admonition against peering into the Sun at the risk of losing your sight. …To gain yet a different perspective on the Sun, you affixed cosmic ray detectors to seemingly anything that moved, by sea and air. From ships to balloons to planes, giving us even greater insights into the secrets of the universe. We are pleased to recognize you for your unwavering and ongoing commitment to the rigor of scientific discovery, which fans the flame of wonder.

Chancellor Nancy Cantor, 13 May 2007 in conferring his degree.

Martin Pomerantz '37, a distinguished graduate of our department, was honored on Commencement weekend with a Symposium in the Physics Building on Friday 11 May, and by the awarding of an honorary degree at Commencement on Sunday 13 May 2007. Pomerantz, who had a long career in cosmic ray observations, is best known for his pioneering work to establish the South Pole as a center for astronomical observations of all kinds. His pivotal role was recognized by the establishment of the Martin A. Pomerantz Observatory (MAPO) at the Pole in 1995. Syracuse University honored Martin Pomerantz with the Centennial Medal in 1970 .

Pomerantz's autobiography, *Astronomy on Ice: Observing the Universe from the South Pole* (American Polar Society, 2004) is a delightfully written account of his long, varied, and fruitful career. Martin says that his philosophy of life can best be summed up by Yogi Berra's motto, "If you come to a fork in the road, take it!" That motto surely applies to his career at Syracuse. He writes:

> *"… in spite of what I might have recognized as a passion for science, I had no desire to study physics. I was determined to be a journalist. … Because I wanted a college education (which was also considered essential in my culture), I looked for universities that offered undergraduate programs in journalism. At the time, among institutions within reasonable distances from New York, Syracuse University seemed to be the only possibility."*

Once at SU, though, physics became his life's passion. We read:

> *"Why not give physics a shot for one semester? I did, and much to my surprise, I enjoyed it and got an A. Beginning to understand the laws of nature was thrilling. … I began to sense the power of mathematics as a tool to understand nature. And I started to feel that in one way or another, physics was the basis of everything. … I decided to become a physics major.*

Upon graduation in 1937, Martin's next step entailed leaving Syracuse, since we had no graduate program until after the Second World War. A passing interest in biophysics led him to choose the University of Pennsylvania, but once there a seminar on Cosmic Rays and Nuclear Physics established his life-long interest. It also brought him into contact with the Bartol Research Institute, his professional home throughout his career (including service as Director from 1959 to 1985.)

Martin J. Pomerantz, continued

Martin's specialty was the determination of the spectrum of cosmic rays from the Sun. He carried out a long campaign of balloon-borne observations at locations around the globe, essentially using the magnetic field of the Earth as a spectrometer. Eventually, this led him to Antarctica. Its first attraction was the ability to observe at the Earth's magnetic pole. Once there, though, the remarkable stability of atmospheric conditions impressed Pomerantz with the possibility of ultra-long duration balloon flights, which would benefit many kinds of balloon-borne experiments.

Upon further reflection, Pomerantz realized that many other astronomical observations could benefit from stable conditions and the ultra-dry atmosphere. Pomerantz himself pioneered Doppler observations of the solar surface, thus launching the incredibly productive field of helioseismology. At the same time, he began an indefatigable campaign to convince astronomers in other fields of the benefits of a South Pole observatory. It took years, but eventually he succeeded. Now, year-round the Pole is used for observations of many kinds. Remarkably, even measurements of the anisotropy of the cosmic microwave background radiation, thought to be primarily the province of satellites, now benefit from an extensive suite of South Pole experiments.

The contribution of Martin Pomerantz to the astronomical use of the South Pole was so profound that, when a new observatory building was constructed at the South Pole in 1995, it was decided to name it in his honor.

The Physics Department added to the festivities surrounding the Commencement, by hosting a Martin A. Pomerantz Symposium on the afternoon of Friday 13 May: Peter Saulson gave an account of Martin's life and career; Mark Trodden described research in astrophysics and cosmology; Gabriela Gonzalez (PhD 1995, now a professor at LSU) described work on the Laser Interferometer Gravitational Wave Observatory. The high point of the afternoon, however, was a charming slide talk by Martin Pomerantz himself, discussing his favorite moments from decades of work at the South Pole.

Several very proud family members accompanied Martin for the whole festive weekend: his son Martin Jr. ("Marty"), daughter Jane Staw, son-in-law Steve Maffin, and grandson Jonah Staw. For our part, it was a chance to honor and celebrate one of our most distinguished graduates. The warmth and joy of the occasion is something that we will long remember.

A Note from the Chair:

Dean Cathryn Newton and I are pleased to announce that ***Cristina Marchetti****, William R. Kenan, Jr. Professor of Physics, will become chair of the department, effective August 16.*

Email from Ed Lipson to the faculty, May 4, 2007

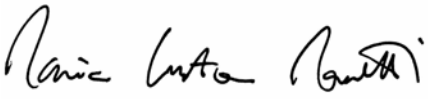
I have just started my term as chair a few weeks ago. I would like to begin by thanking the outgoing chair, Prof. Ed Lipson, for his strong leadership during the past three years. It will be a real challenge for me to maintain the standard he has set. With the help of the entire physics faculty, I plan to continue to promote excellence in physics at Syracuse by anticipating future needs and growth areas and developing strong ties and collaborations with other departments. I will also concentrate on further strengthening our graduate program and promote interdisciplinarity in graduate education. It is my belief that 21st century physicists need to be trained in a different way than their predecessors to open up opportunities for their participation in non-traditional areas of physics and science, ranging from materials science to biology, from geophysics to science policy. I will encourage undergraduates to take, and more importantly enjoy, physics and expand the innovative teaching methods that are currently being used in some introductory classes.

I joined the SU Physics Department in 1987. In my twenty years at Syracuse I have taught classes at all levels, including many for physics majors, and I have had the pleasure to interact with many of you personally. My area of research is theoretical condensed matter physics and statistical physics. I have led and witnessed a remarkable growth in this field during my time at Syracuse, as described in the first issue of this newsletter. Most recently I have begun to work at the interface between condensed matter and biological physics. I have just returned from a six-month sabbatical at the Institut Curie in Paris where physicists and biologists work alongside with clinicians of the Curie Hospital to understand the interplay of the physical, biochemical and biological processes that control the functioning of cells. I established strong collaborations that will shape my research in the coming years.

The department is robust and growing, with two new faculty appointments in the past year (see page 5) and new searches planned for the coming one. We hope to continue to strengthen all areas in our research effort. The graduate program remains excellent, with our graduates obtaining top appointments both within and outside academia. In particular, note Angelo Cacciuto is beginning at Columbia (page 3). We now have over 40 physics majors pursuing both BS and BA degrees. Many are involved in research and participate in prestigious summer research internships across the country. They also work with the graduate teaching assistant as undergraduate coaches.

In reflecting on department events over the past year, I was struck by the number of awards and recognitions that our faculty, students and staff continue to garner (noted herein). At the 2007 AAPT Meeting just held in Greensboro, NC "demo man" Sam Sampere (highlighted in Physics Matters #1, 2007) with two colleagues did 6 wonderful live TV spots for FOX TV 8 morning show. If you ever get to see them you'll discover that Sam is truly a natural TV star!

I hope that you will continue to write to let us know about your whereabouts, achievements, and careers. I look forward to hearing from you.



From the Editor:

The response to the first issue of ***Physics Matters*** has been gratifying. All express interest in hearing about the Physics Department. Some of the responses are interesting descriptions of very rewarding careers. Since I could not choose among them for publication, they are posted on the web at http://www.phy.syr.edu/PhysicsMatters/index.html. You can find brief excerpts from them on page 10. At the same web site, you will find additional photos of the celebration in connection with the granting of an honorary degree to Martin Pomerantz by Chancellor Nancy Cantor.

I was remiss in the first issue of ***Physics Matters*** in not recognizing Penny Davis, Secretary to the Chair. Ed said that I could use Penny for help in preparing the newsletter. But, Penny did more than help. She designed the layout, although she did allow me to select the material and, to an extent, its location in the newsletter. Penny loves a challenge and enjoys doing something different - always with a smile or quip. Below you will find Penny's comments about life with physicists.

It is a pleasure to welcome Richard Schnee and Duncan Brown to the faculty. In later issues, they will have an opportunity to describe their research.

Two graduate students won important prizes at the March 2007 meeting of the APS in Denver. Creighton Thomas, who works with Alan Middleton, was awarded $1000 for the best talk by a graduate student. Luca Giomi was awarded first prize for his poster. Mark Bowick is his advisor. Brief précis of their presentations can be found on page 8. They certainly deserve to be applauded. We look forward to their future contributions.

A truncated description of the NSF Career Grant awarded to Jennifer Schwarz appears on page 5. An introduction to Jen appeared in ***Physics Matters V1***, March 2007.

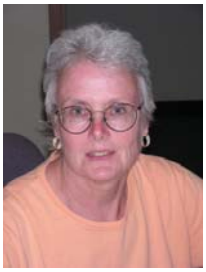
Mark Trodden's description of research in cosmology and Kenneth Foster's of work on vision with *Chlamydomonas* completes this issue. Enjoy ***Physics Matters*** and keep the correspondence coming. Descriptions of your lives with and without physics is always of interest to us.

Where are they going?

- Angelo Cacciuto (PhD '02): Assistant Professor of Chemistry at Columbia, summer 2007.
- Jeremy Chapman ('07): Brown University.
- David Malling ('07): Brown University.
- Ida Bernstein ('07): University of Buffalo.
- Brandon Robinson ('07): University of Cincinnati.
- Aditya Mittal ('07): California Institute of Technology.
- Jeffrey Ware ('07): Columbia Medical School.
- Lauren Rugani ('07): Boston University, seeking MS in Science Journalism

Angelo Cacciuto

Penny on Physics:



I came to the Physics office in August 1988 as "secretary to the chair" under Kamesh Wali, who at the time was out of the country. I did not expect the Indian gentleman who I've come to know and love. My next chair was Marv Goldberg who had a great sense of humor and got me interested in physics cartoons for This Week in Physics (TWIP). I got to know Ed Lipson as associate chair and briefly as acting chair. Later he returned as chair in his own right and fortunately remembered that I don't like to file. My then friend Eric Schiff became my 4th chair – I called him "Boss", he preferred "High Lord and Master", and we had pun wars. Then Ed was back as chair and is now being followed by another friend, Cristina Marchetti – (I've never seen her wear Prada).

The first international call I ever dropped was from Kamesh's friend, Chandrashankar. Not bad - losing a call from a Nobel Laureate! I learned that a "Bronx Discussion" is not really Marv and Arny Honig arguing – they are just talking LOUD. I have come to accept tenured full professors who are younger than I am, I enjoy sparring with young faculty that share my sense of humor, and I especially enjoy seeing former postdocs come back as faculty, like Alan Middleton, Jen Schwarz, and Don Marolf who has since left but celebrated his 21st birthday here as a postdoc (his mom sent a cake).

In this time, I have learned that "soft condensed matter" is not the punch line of a joke and that "Astrology and Cosmetology" are not taught in the physics department. Most of all I have learned that physicists are warm, caring, people.

Cosmology Group: Mark Trodden

Cosmology as a science was born with the development of General Relativity (GR). This led to the prediction that the universe must be dynamic, that the velocities of distant galaxies should be proportional to their distances from us - a prediction spectacularly confirmed by Hubble's observations - and leads to the conclusion that the cosmos has a finite age, that at early times it was a hot and dense body.

Two robust predictions follow. Around a minute after the Big Bang, nuclear fusion produces the specific abundances of the lightest elements. About 300,000 years later, expansion cooled the blackbody radiation enough that it ceased interacting with matter and streamed uninterrupted through space. Today the Cosmic Microwave Background Radiation (CMB) has cooled to 2.73K, peaked in the microwave part of the spectrum.

The discovery of the Cosmic Microwave Background Radiation (CMB) and precision measurements of the abundances of the light elements provide remarkable agreement with these predictions and rock-solid support for the Big Bang theory.

Modern Cosmology is the precision science of developing this model within the framework of our fundamental physical theories. Data from the CMB, large-scale structure, and type Ia supernovae have revealed a universe populated by 5% regular matter, 25% dark matter, which plays the dominant role in structure formation and the dynamics of galaxies, and 70% "dark energy" - a component which is causing the rate of expansion of the universe to accelerate.

Furthermore, the details of the CMB and structure formation require a mechanism at the earliest times to homogenize the universe on the largest scales, while generating perturbations that later grow into the structures we observe. Our main approach to this problem is *cosmic inflation*, which postulates an early period of exponentially fast expansion, with quantum perturbations that are stretched to cosmological scales and seed structure formation. At these earliest times one can no longer always separately apply both GR and Quantum Field Theory – requiring a quantum theory of gravity.

The Syracuse cosmology group is a vibrant and growing sector of the department, consisting of 3 faculty members, 1 postdoctoral associate (Nicolas Chatillon) and 5 graduate students (Jim Holsapple, Michele Fontanini, Riccardo Penco, Alessandra Silvestri and Eric West).

Faculty members Cristian Armendariz-Picon and Mark Trodden are theoretical cosmologists using and, where necessary, modifying the structure of quantum field theories and GR to address a broad range of the cosmology's open questions.

One focus is on the early universe; investigating how cosmic inflation may have begun; using the generation of density perturbations to constrain particle physics at the highest energies; studying the nature of dark matter and the generation of the matter-antimatter asymmetry, and interpreting the details of the CMB. This research is therefore intimately connected to that of the high-energy theory and experiment groups.

At the other end of the cosmic timeline, the group is involved in several approaches to understanding cosmic acceleration. Indeed, some of the best-studied approaches to this problem – k-essence models and modified gravity models – have been pioneered by members of the Syracuse group. These ideas have provided not only new theoretical directions, but have also sparked a sustained research effort to use upcoming experiments to distinguish between these and other theories of cosmic acceleration.

Recent postdoctoral associates and graduate students from the group have gone on to tenure track faculty positions and research associateships at major research universities in this country and abroad.

Richard Schnee (see page 5) is an experimental cosmologist who plays a crucial role in the Cryogenic Dark Matter Search (CDMS) that has produced the world's most sensitive published limits on the cross-section of dark matter WIMPs.

Anticipating an entirely new era of observational cosmology; that of gravitational wave observation, led by the LIGO project, the cosmology group and the gravitational wave group are the cornerstones of a Chancellor's initiative in MultiMessenger Cosmology, under which Schnee and Duncan Brown, faculty member in gravitational wave physics, were recently hired.

The cosmology group participates in a joint seminar system with the high-energy theory group, and in a biannual joint theory meeting with Cornell University's physics and astronomy departments. Another biannual cosmology meeting with Cornell and Case Western Reserve University will take place for the third time this Fall.

Left to right: Jim Holsapple, Nicolas Chatillon, Cristian Armendariz-Picon, Riccardo Penco, Mark Trodden, Richard Schnee, Alessandra Silvestri, Michele Fontanini, Eric West.

New Faculty: Richard Schnee and Duncan Brown

Richard Schnee comes from Case Western Reserve University. He will continue his research and his work as coordinator on the Cryogenic Dark Matter Search (CDMS), which aims to observe and identity the mysterious "dark matter" that makes up ~25% of the universe (the matter we know, in physics, is only about 5%). The remaining "mass-energy" is the even more mysterious "dark energy" that has been proposed to account for the acceleration (discovered in the '90s) of the expanding universe.

Duncan Brown is heavily involved in LIGO data analysis. He comes from the LIGO group at Cal Tech where he worked with Kip Thorne on numerical simulations of "inspirals" of binary neutron stars and black holes that should be strong emitters of gravitational waves. His work here will be on numerical simulations of gravitational wave production from binary systems, and analysis of data from the two LIGO sites (Livingston LA and Hanford WA). Duncan is also an expert on cluster and grid computing. He will be our third member in the area of computational physics.

Two new Assistant Professors have been appointed to begin in the Fall semester

Relatively New Faculty: Liviu Movileanu

Liviu Movileanu earned his degrees, including a M.Sc. and a PhD in Biophysics from The University of Bucharest (1997). After various fellowships and research appointments in Europe, he came to the US in 1998 where he held postdoctoral positions at the University of Missouri - Kansas City and Texas A&M University Health Science Center. After a brief stay at Delft University of Technology, in 2004, Liviu was appointed Assistant Professor in the Department of Physics, Syracuse University. Since 2004, Liviu Movileanu has served on the panel of Keck Future Initiatives: "Designing Nanostructures at the Interface between Biomedical and Physical Systems," Irvine, California. He is also involved in organizing the annual summer school of Biophysics: "Biosensing with channels: Heading for faster, smaller, smarter biosensors". Since 2006, Liviu has been an Associate Fellow of the International Center of Interdisciplinary Science (ICIS) in Bremen. He chaired a recent Symposium of the American Physical Society: "Nanopore world: from single-molecules to nanobiotechnology prospects."

Liviu Movileanu's research combines recent advances in single-molecule science, along with rational protein design to allow biochemical sampling at high temporal and spatial resolution, and the detection, manipulation and exploration of individual molecules. He uses sophisticated protein pores, simply called nanopores, which are employed as a convenient scaffold for designing stochastic sensing elements for macromolecules. Liviu Movileanu aims at developing the engineered pore-based nanostructures that will result in a novel, real-time and label-free methodology, providing a reliable and fast alternative to fluorescence and spectroscopy for analyte detection. His research group is also interested in adaptation of this approach to the *lab-on-chip* platform to provide a new class of research tools for examining the molecular details of complex biomolecular processes in a quantitative manner.

NSF Award: Jen Schwarz

Prof. Jennifer Schwarz has been awarded a CAREER award, NSF's most prestigious and competitive award for young faculty members. This award supports research and education on the statistical physics of condensed matter systems. Materials like sand, powders, glasses, and colloidal glasses can exhibit jamming behavior, a transition from a state where motion is possible to one where it is not. The research focuses on understanding the fundamental science underlying this phenomenon. Since jamming is such an everyday and accessible phenomenon, whether occurring in traffic or coffee beans stuck in a dispenser, Jen will collaborate with Syracuse's Museum of Science and Technology (MOST) to give a series of lecture/demonstrations to children. And she will design several stations on jamming and percolation with the ultimate goal of constructing an exhibit showcasing the theory and applications of soft matter. She also intends to use percolation as a computer laboratory project in the undergraduate class "Science and Computing".

Gabriela Gonzalez, PhD 1995

APS Edward A. Bouchet Award

Gabriela Gonzalez, Louisiana State University

For her significant impact on the field of gravitation wave physics through her many important technical and scientific contributions to the Laser Interferometric Gravitation Wave Observatory (LIGO) and for communicating the excitement of this field to the scientific community and the public.

Gabriela came to Syracuse University from Cordoba, Argentina with her husband Jorge Pullin, a postdoc with the Relativity Group 1989. She enrolled as a graduate student and began to work with Peter Saulson working on Brownian Motion of a Torsion Pendulum (as an example of the application of the Fluctuation Dissipation Theorem to predict the spectrum of thermal noise to be expected in gravitational wave detectors). She received her PhD in 1995 and left for MIT as a postdoc. In 1997 she went to Penn State University as an Assistant Professor and four years later she joined her husband Jorge who is the Hearne Chair Professor of Physics at LSU. In the LIGO collaboration, she is co-Chair of the Compact Binary Coalescences Analysis Group of the LSC (Ligo Scientific Collaboration) dedicated to the search of gravitational waves generated by binary systems of compact objects (neutron stars or black holes). She is a very active as a member of the Calibration Committee and the Glitch Group which is involved with issues dealing with the calibration of the detectors, as well as with the characterization of the noise and the analysis of the data in the search for waves produced by binary systems of compact stars in the last orbits of their cosmic dance, before coalescing into a single black hole. Gabriela also serves as a member of the LSC Executive Committee. Gabriela gives public lectures on the search for gravitational waves. She appears in an NSF movie called Einstein's Messengers and a documentary video made by the American Museum of Natural History.

Café Scientifique

http://physics.syr.edu/cafescientifique/

Café Scientifique meets on the first Tuesday of the month during the academic year. The informal meetings, which take place in a local restaurant or café, are open to all interested people. Speakers, who come from all areas in science, make a 20 minute presentation which is followed by a refreshment break and a 40 minute question period. The opening meeting for 2007-08 took place on September 4 with Mark Bowick of the Physics Department talking about and demonstrating the properties of ***Soft and Squishy Matter at Science's Cutting Edge.***

Supported in part by the Physics Department through it's General Department Gift Fund.

Science Magazine

Science Magazine Highlights Article* by **Britton Plourde** et al.**

The basic principle of quantum computation is that each element, or qubit, behaves according to the laws of quantum mechanics and can exist in a superposition of its states. Interactions between multiple qubits can be used to generate entanglement, where the qubit states can no longer be described individually. Such entanglement is at the heart of the power of a quantum computer. Since 2000, Britton and seven other researchers have focused on how to fabricate and measure superconducting flux qubits, and more recently, how to switch the coupling between qubits on and off--an essential capability for implementing many quantum -computing algorithms. Britton and the team demonstrated that such control can be achieved with two flux qubits coupled together through their mutual inductances and through the SQUID (superconducting quantum interference device) that reads out their magnetic flux states. When asked about the importance of the result, Britton said, "This is the first demonstration of a superconducting solid state qubit system with the ability to switch the qubit coupling on and off with an experimental knob. Solid state qubit architectures are attractive because they provide a natural route for scaling to large numbers of qubits using conventional microfabrication techniques." (A biography of Britton appeared in ***Physics Matters #1***.)

**Solid State Qubits with Current Controled Coupling*, T. Hime, P.A. Reichardt, B.L.T. Plourde.

**Taken from an article in the Syracuse University News, December 1, 2006.

"Vacuums, black holes, antimatter - it's the elusive and intangible which appeals to me."

Cell signaling: From vision to motility: Kenneth Foster and Juree Saranak

We use motile biological cells on which physical measurements can be made to understand the first 100 femtoseconds of vision, how an individual biological cell optimizes response to multiple sensory inputs, and how sperm and other cells steer with one or more cilia.

A favorable model system. Because of the ease of controlling light, we study how the single celled alga *Chlamydomonas* swims relative to a source of light, phototaxis. It may swim towards or away from light in a helical or superhelical manner, or perpendicular relative to the direction of light, or stop and backup, or deliberately ignore the light. The cell uses a single eye, a shaped-beam dielectric electromagnetic wave antenna, and its rhodopsin, a type of photoreceptor shared with the human visual system, to track light. To survive the organism must respond appropriately to external light, ions, temperature, fluid flow and other environmental conditions. To steer, a pair of 12-μm-long anterior bilateral 240-nm diameter cylindrical projections, called cilia, beat in a breast stroke (Fig. 1).

The visual receptor rhodopsin. Phototaxis begins with rhodopsin, the light receptor. 5% of human genes are variants of these receptors and 50% of medicines involve these gene products. So, it is important to understand how these receptor proteins are activated - how the light is coupled to the receptors to cause vision. In previous studies, we showed that they are activated electronically rather than by the mechanical change in shape (isomerization) of the molecule that is excited into a higher energy state by the absorption of a photon (chromophore) as once thought.

Instrumentation. Answering these questions requires instruments that measure the movement of cilia and cells and the real time dynamics of ion currents, membrane potential, intracellular pH, and signaling messengers. On the drawing board are instruments to record the 3D movements of free-swimming cells and under construction is a 3D monitor of ciliary beating on held cells. In each case a key advance is the extension of the optical depth of field by a factor of ten.

Reverse engineering a biological system begins with an initial estimate of parameters and iterative successive stages of experiments and modeling. With our isogenic mutants of *Chlamydomonas*, phototaxis inputs can be perturbed repeatedly to reveal an ensemble of dynamic responses. Computer controlled measurements of the system variables allow us to test models and to solve the architecture of cell signal processing and how the cilia work and are regulated for appropriate response.

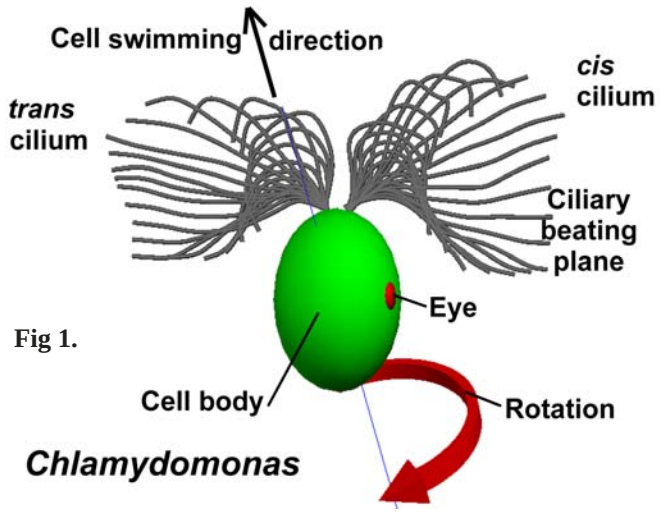
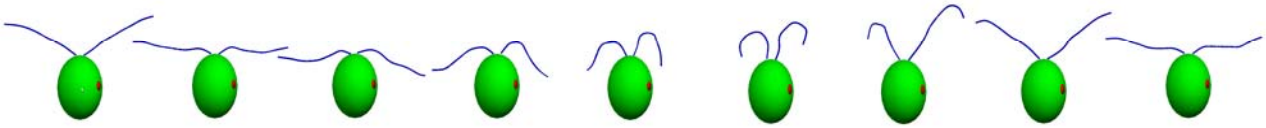


Fig 1.

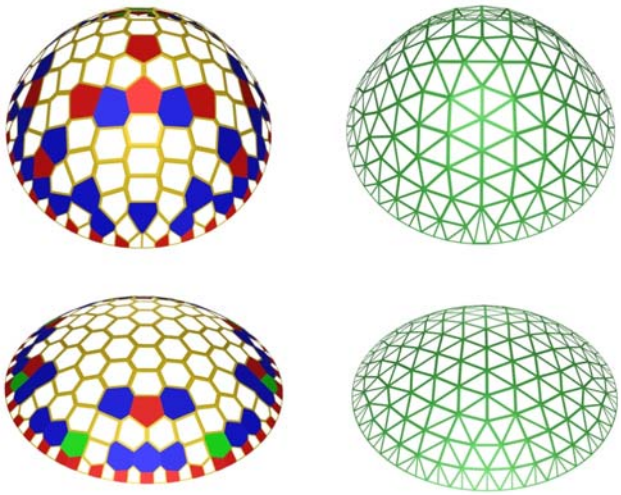


3D animation of an actual ciliary beat cycle of a *Chlamydomonas* held on a micropipette

Order and geometry in soft condensed matter: Luca Giomi

The research I've been involved for the past three years has been devoted to understanding the interplay between order and geometry in soft condensed matter systems with special attention to the topic of crystalline order on curved surfaces. Crystalline structures are ubiquitous in nature because ordered close-packed configurations frequently minimize the interaction energy between the component units of the system. Ordered structures on curved surfaces appear in multi-electron helium bubbles, viral and bacteriophage protein capsids, carbon materials, self-assembled monolayers and physical membranes.

Spatial curvature can lead to novel ground state configurations featuring clusters of topological defects that would be excited states in planar systems. The new physics that arises is of both fundamental and applied interest, particularly in materials science.



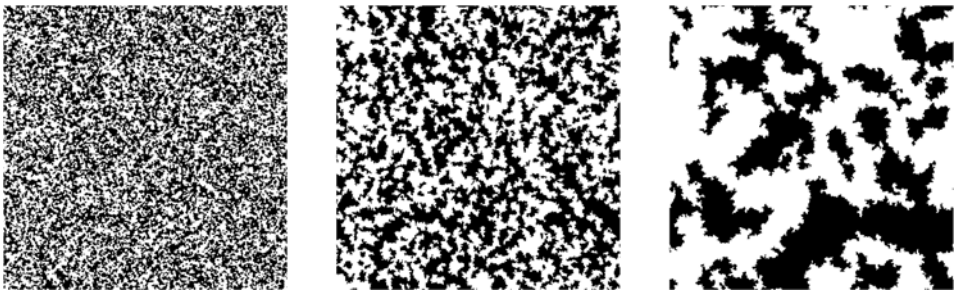
The images show the Voronoi lattice (in gold) and the Delaunay triangulations (in green) for two low energy configurations of a system of classical charges constrained to lie on the surface of a paraboloid and interacting with a Coulomb potential. The parabolic geometry is considered as a specific realization of the class of crystalline structures on two-dimensional Riemannian manifolds with variable Gaussian curvature and boundary. The coexistence of isolated disclinations [7-fold (blue) and 5-fold (red) vertices] and grain boundary “scars” [arrays of tightly bound (5,7)-fold disclination pairs] illustrates the structural complexity emerging from the interplay between short-range order, local geometry and global topology.

Aging in Spin Glasses: Creighton Thomas

Physical spin glasses have some amazing properties, notably aging, rejuvenation and the memory effect. Because spin glasses have extraordinarily slow dynamics, they can never be in equilibrium. If the temperature of a spin glass is held fixed for a long time, the spin glass slowly relaxes, or ages, which can be seen in experimental systems as a slow decrease in, for example, the magnetic susceptibility (it's called aging because the amount of susceptibility decrease tells the "age" of the spin glass). On lowering temperature, the susceptibility increases substantially; the system is "rejuvenated". Finally, on returning to the initial temperature, the susceptibility immediately dips, indicating that the spin glass "remembers" being at the previous temperature.

Theoretically, these effects are not well understood. Also, because of the long timescales involved, they are impossible to simulate directly. With "patchwork dynamics", we circumvent this issue by trading time dependence for length dependence. This is reasonable because of the slow coarsening dynamics of spin glasses (the characteristic domain size grows logarithmically with time). Slightly different domain sizes take remarkably different amounts of time, so coarsening to a particular lengthscale corresponds to a rough timescale.

As an example system, we work on the 2D Ising spin glass model. Fast algorithms exist for finding the ground state spin configuration for this problem. We use these to study the harder problem of spin glass time evolution by selecting random patches (subsystems) of a particular size out of the system and finding their ground states subject to the fixed boundaries provided by their neighbors. Repeating this with many randomly chosen patch locations coarsens the system to a length scale determined by the patch size used. This technique allows us to generate configurations from long enough timescales to see the interesting features of experimental spin glasses.



Example coarsening results from patchwork dynamics simulations: spin configurations (as compared with the ground state of the system) after doing patchwork dynamics at various sizes. The system is 512x512 spins. From left to right, the patch sizes used are 2x2, 8x8, 32x32.

Society of Physics Students: Steve Blusk

It was another exciting year for the Society of Physics Students. In Jan. 2007, we were very excited to elect new officers to lead the organization. Taking the helm is: Jessica McIver, President, Matthew Turner (Vice president) and Gavin Hartnett (Treasurer/Secretary), and Carl Goodrich (Program Coordinator). The new crew greatly benefited from a continuing effort from senior and former Vice President, Jeremy Chapman. As advisor, it is particularly exciting to see new leaders emerge in SPS, and bringing a renewed energy and enthusiasm.

This past year's meetings were well attended and highlighted by a rich program of talks on a variety of topics by SU faculty members, organized by our program coordinator. In addition, several students coordinated rides to attend the monthly Café Scientifique at Ambrosia. They also reached out to physics underclassmen by holding several review sessions for PHY211 and PHY212 prior to exams.

In addition the regular physics events, SPS organized and promoted several large events. This included a public showing of "An Inconvenient Truth" to raise public awareness of global warming, followed by a one-hour question/answer/discussion session with a panel of experts on the science, economics, and politics of climate change policy, as well as the role that the media plays in portrayal of the issues. Well over 200 people packed Stolkin Auditorium to attend the event. SPS also arranged a road trip to Boston to visit the Boston Museum of Science and the Boston Aquarium. Several SPS-ers also served as judges in the Greater Syracuse Scholastic Science Fair. Last, but certainly not least, under the suggestion of Sam Sampere, SPS built a large demonstration of "Non-Newtonian" fluid dynamics at the yearly Mayfest event. Photos of the event can be found at the SPS web site (http://phy.syr.edu/~sps/).

Lastly, I'd like to note that some of SPS's finest students are pursuing graduate school in physics, medicine and journalism (see page 3). We wish them the best of luck in their future pursuits. I also note with great pride that Jeremy Chapman was one of 12 graduating seniors selected as Syracuse Scholars, the most prestigious academic award the University bestows upon its students.

In closing, I would like to express my appreciation for having the opportunity to work as director of the SPS and Sigma Pi Sigma at SU over the last 5 years. Starting in the fall, Prof. Jennifer Schwarz will be assuming leadership of the organization, and I look forward to a smooth transition. The future of SPS and Sigma Pi Sigma at SU looks very bright.

SPS Officers (clockwise):

Gavin Hartnett—Treasurer/Secretary

Matt Turner—Vice President

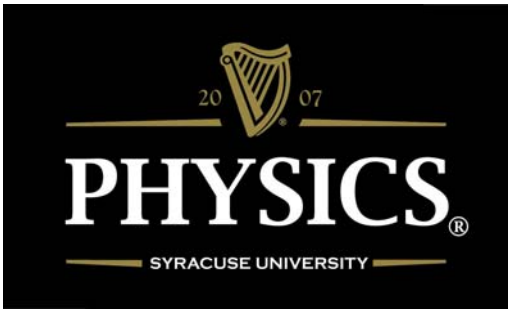
Jessica McIver—President

Carl Goodrich—Program Coordinator

Buy an SU Physics T-Shirt!

SU Physics T-Shirts: T-2007 has ***"Enjoy Physics Responsibly"*** on back and **"Physics"** on the front. The t-shirt design can be ordered ($12 plus shipping) through the SPS web page at http://phy.syr.edu/~sps/shirts.htm. These t-shirts, can be ordered in both short and long sleeves. See the SPS webpage for pictures and prices of T-2007 (which can also be ordered in sweatshirt, with or without hood) and 2006..

Shirt is based, with permission, on a design from AAPT (http://www.aapt.org/Store).



Correspondence from Alumni:

(These are edited excerpts. See http://www.phy.syr.edu/PhysicsMatters/index.html)

I've had a long (joyful and successful) career as an Applied Physicist. Although I never went on to a PhD, I did succeed in a few areas traditionally the realm of a PhD -- being named a Senior Physicist at Argonne National Laboratory and appointed the first Chief of the Office of Nondestructive Evaluation at the National Bureau of Standards …

Harold Berger (MS, '51)

I left in 1948…came back, got a masters degree in mathematics, and went to work on computers. I worked on the Univac, on the design of turbojet engines, designed programs for recognizing patterns for garments… for Philips Medical Systems, I designed equipment for various imaging instruments…moved to Australia.

David (Milt) Fisher (MS, ’51, BA,’47)

… space physics in 1963 at the Lamont-Daugherty Observatory of Columbia University…Jet Propulsion Laboratory in 1985 after Boston College (1979-1985) and NSF (1976-1979)…associate editor of J. Geophys Res. Space Phys. … elected secretary of the Solar and Interplanetary Physics Section of the American Geophysical Union.

Joan Feynman (Hirschberg) (PhD, ’58)

I did a postdoc at the University of Sydney, Australia, from 1960-62, and then went to the Physics Dept. at the Naval Postgraduate School in Monterey, California, retiring here in Florida in 1998. Retirement is great - I recommend it.

Bill Zeleny (PhD, ’60, MS, ’58)

In May of 2007 I left my engineering job at Lockheed Martin to pursue a Masters Degree in Math Education at NYU as a Math for America Newton Fellow…especially drawn to teaching ever since my "coaching" experiences with PHY101 at SU.

Jason Tillman, (BS, '04)

I am very glad you are putting out the newsletter, it is always nice to hear from old friends! Please note that our department has moved to a new building, so that we have a new address: (sic, see the web site above)

Fidele Lizzi (PhD, ’85, MS ’83)

Congratulations on the first issue of Physics Matters newsletter. I enjoyed hearing about the department. I now am Principal Member of the Research Staff Frederic L. Lizzi Center for Biomedical Engineering Riverside Research Institute.

Robert Muratore (PhD, ’88)

I worked at Knolls Atomic Power Laboratory for 8 years…In November 2004, I moved to Brookhaven National Laboratory in the Energy Sciences and Technology Department, Advanced Nuclear Concepts Group.

Lynne Ecker (PhD, ’96) — Nathaniel, 1/7/07

Degrees Granted—2007 - 2008

Doctor of Philosophy:

- Maqbool Ahmed, National University of Science & Technology, Rawalpindi, Pakistan
- Hachemi Benaoum

Undergraduate Commencement Awards—2007

University Scholar—Jeremy Chapman
Neil F. Beardsley Prize—Jeffrey Ware
Paul M. Gelling Scholarship—Jillian Dodge
Award for Academic Excellence—Jeremy Chapman, TriciaRae Davis, Nathan Kuslis, Kristin Laska, David Malling, Wesley Matson, Christopher McDonald, George Mitchell, Aditya Mittal, Brandon Robinson, Lauren Rugani, Makiko Tsukamoto, Kyle Wojtaszek

Undergraduate Awards—2007

Ornstein Scholar—Avi Hameroff
American Legion William P. Tolley Scholastic Award (ROTC)—James Powers

Bachelor of Science:

- Ida Bernstein
- Jeremy Chapman (Magna CL)
- Kristin Laska
- Jillian Dodge (Magna CL)
- Neil Epstein (Magna CL)
- Bejamin Fischer
- Nathan Kuslis
- David Malling
- Wesley Matson
- Chris McDonald
- Aditya Mittal
- Lauren Rugani

Bachelor of Arts:

- George Mitchell
- Brandon Robinson
- Makiko Tsukamoto
- Jeffrey Ware (Summa CL)
- Kyle Wojtaszek (Cum Laude)

Tell us about yourself!

Mail us at the Department of Physics, Syracuse University, 201 Physics Building, Syracuse, NY 13244-1130
or email us at physmatt@phy.syr.edu

Here is my news: _____
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Name_____
Address _____
Home phone _____ Work phone_____ Email _____

Contributions can be made to the following:

_____Henry Levinstein Fellowship Fund—this **graduate** fellowship is to foster graduate student research with members of the Physics faculty, based on academic excellence of the nominee and promise of excellence in research.

_____ William Fredrickson Fund— this **undergraduate** fund was established to provide a partial tuition scholarship for an incoming freshman who indicates an interest in physics.

_____Neil F. Beardsley Prize—an award to an **undergraduate** physics major, based on outstanding academic achievement and contributions to the department.

_____Paul M. Gelling Fellowship Fund—a memorial scholarship fund made to an outstanding **undergraduate** physics major based on outstanding achievement.

_____General Department Gift Fund

Checks should be made out to *Syracuse University* with an indication of the selected fund, and sent to:
Chair, Department of Physics, Syracuse University, 201 Physics Building, Syracuse, NY 13244-1130.

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Physics Matters

Physics Matters is published by the Department of Physics of Syracuse University for its students, alumni and friends to inform them about the department and to serve as a channel of communication. Readers with comments or questions are urged to send them to Department of Physics, Syracuse University, 201 Physics Building, Syracuse, NY 13244-1130. Fax to 315-443-9103. Email to physmatt@phy.syr.edu. The Web address is http://www.phy.syr.edu/.

Photo by S. Gorovitz