CROSS SECTION

Stetson University Physics Department Annual Newsletter, Spring 2002
http://www.stetson.edu/artsci/physics physics@stetson.edu

In this issue…

Area Happenings

Hello Everyone!

And greetings from the Physics Department. Welcome to this year's edition of CROSS SECTION. We hope this newsletter finds you and your loved ones well, and we are pleased to share your happenings with all of you in the "Alumni News" section.

While this past year has found our country experiencing tumultuous times, the Physics Department has had a relatively quiet year. After graduating a bumper crop of seven majors last spring, our numbers are a bit trimmer this year: we have four seniors, two juniors, four sophomores, and currently there are nine enrolled in PS-202, University Physics, the introductory course for aspiring physics majors. A number of the PS-202 students have declared physics as their major.

Over the summer we had three of our majors participate in research projects. **Ashley Cowart, '02,** went down to the Center for Research and Education in Optics and Lasers (CREOL) at the University of Central Florida in Orlando and did an REU project on fentosecond lasers; **David Falls, '02,** stayed on campus getting a head start on his senior research using the department's scanning tunneling microscope; and **Dan Carlson, '04,** went to Florida International University in Miami and did an REU project in quantum optics. (Dan is also spending this spring semester over at Oxford studying mechanics and economics. He was chosen as one of three students to inaugurate this new exchange program!) Since the beginning of the school year the seniors have worked on their senior research, and now that they are all past the research stage and into PS-499, Senior Seminar, they have been working on the presentation of their projects. More about PS-499 in the Research Corner article later in this newsletter – and we're pleased to again include the abstracts our seniors wrote to describe their work; you can find them right after the research article.

Over the past couple of years, George Glander has been working on creating what we now call The Physics Major's Handbook. The initial draft was put into circulation last year, and by the end of June he'd revised it to include more than simply a set of course sequences. It now includes information about programs we offer and paths which

students should consider depending on what their career goals happen to be. It can now be found on our web site (*http://www.stetson.edu/departments/physics* – choose "Advising Handbook" from the choices on the left). It's proven to be a tremendously helpful tool not only in advising current students and giving prospective students an idea of what to expect, but also in helping us map out courses to be offered every year. We'd love to keep strengthening it, however, and we welcome any comments you care to share with us about advice we should be giving students given career options with which you are familiar.

Now… An update on the possibility of a "new Sage Hall." It seems pretty clear that the University wants to go ahead with remodeling and adding onto our current building, and the University just got $2.5 million from the federal government to apply toward renovation costs. But such projects grind forward slowly. We have seen architects wander through a number of times, and we have submitted our wish list for what kind of home we'd like to find ourselves in. It seems that the current stage is the evaluation of the current facilities and what needs to be done to upgrade and renovate them to bring them into the 21st century and to accommodate an addition. When faculty are asked their advice, one can occasionally hear the word "dynamite" being used, but that is perhaps excessive. ☺ Meanwhile, we mere mortal occupants of Sage Hall are waiting to see. Stay tuned, and we'll keep you posted!

As always, we wish you the best in the coming year. Please stay in touch, and drop by if you're ever in the neighborhood!

—Kevin Riggs, Chair
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Research Corner

Last year we included copies of the abstracts from the reports our seniors were writing for their senior research projects. We received positive comments from enough of you that we have decided to make that a regular feature of the newsletter. Consequently, you will find the abstracts from this year's seniors following this column. The requirements for the senior research projects have evolved over the years, so many of you might be interested in what students currently do for their projects.

Physics majors work on their senior research projects over a period of three semesters, during which they register for the sequence of courses: Senior Research Proposal, Senior Research, and Senior Seminar. They start this sequence during the spring of their junior year, and complete it during the spring of their senior year. The first and third courses are scheduled to meet together as a single class so that juniors, who are trying to plan their senior projects, can interact with and learn from the seniors, who have finished their research and are working on their reports.

Senior Project Proposal is structured to lead the students step-by-step through the

process of writing a proposal. The students work through one of the steps each week, and give a brief oral or written summary of their work. During the first two weeks of the semester, the students are asked to pick a topic for a project and an advisor to work with. The guidelines for the project are that it must be an experiment or series of experiments, and it is expected to require roughly as much effort as an upper-division three-credit course for a full semester. To aid in the selection they are told about the research backgrounds and interests of the faculty, and they are given a list of the major pieces of equipment that the department has that can be used for the projects. Once they have chosen topics, they are asked to begin accumulating a list of physical principles that play a role in the experiment, and for each principle come up with a brief explanation and definitions for any important vocabulary. Following that, they are ask to state one or two major goals for the project, with a list of the steps that they anticipate will have to be made to accomplish those goals, and then they are asked to identify the equipment and supplies that they will need for the projects. When they get around to writing the proposal itself, they find that they can pull whole sections of it out of the materials that they put together earlier in the semester. The first draft of the proposal is due shortly after mid-term. They do a second draft and final draft, and they give a 25-minute oral presentation of their proposal.

Most students do the research for their senior projects during the fall of their senior year when they are registered for Senior Research, but that is not exclusively the case. Some students spend time at Stetson during the summer and work on their project then. Others manage to get research internships at a research university or national laboratory through one of a variety of federally funded programs, like the National Science Foundation Research Experience for Undergraduates (REU) Program. We generally have no objections to accepting the work they do at such an internship as their senior project.

Students present the results of their senior research while they are enrolled in Senior Seminar during the spring of their senior year. They present the results using five different formats:

(1) 15-minute laboratory tour.
(2) 10-minute conference style oral presentation.
(3) A poster that is hung in one of the department's hallways.
(4) 45-minute oral presentation in the style of a invited talk or presentation at a job interview.
(5) A written report using the style of a journal article.

This sounds like a lot of work. It is, but the students are able to reuse whole sections of their proposals when doing their reports, and the figures from their reports are easily converted into the visual aids for their talks and items on their posters.

Most of our students do a fantastic job on their projects, and we are very proud of them. We encourage them to either do their 10-minute conference style talk or their poster at Stetson's Undergraduate Scholarship and Performance Day (USAPD), which is a forum that Stetson has for showcasing student's research activities and artistic performances. The presentations are judged, and the best entrants in each category receive a cash award, the Maris Awards, named for the former Dean of the College of Arts & Sciences. Our students have traditionally done well in the competition. Last year, **Ryan Munden, '01,** received one of two awards for best presentation, and **Edwynn**

Wallace, '01 and **Hope Wymer** both received honorable mentions for their presentations. Links to archives of the all of the abstracts and awards for past USAPD events can be found at the web address: *http://www.stetson.edu/programs/usapd/*.

—George Glander

Abstracts

Below are the abstracts submitted by our senior physics majors for Senior Seminar (PS-499). We salute the accomplishments of our seniors, and we wish them well as they head off after graduation in May. We hope you enjoy reading about the research they have been up to...

Michelson Interferometer

Yuri Brubach and George Glander, Physics Department, Stetson University

The Michelson interferometer is a very versatile piece of equipment and has played a vital role in the development of modern physics. One of its abilities is that it can measure the index of refraction of different gases. This can be achieved by placing an evacuated cell in the path of the laser. We set out to determine the inside length of a cell that we want to use in future experiments studying the index of refraction of different gases. Using the inside volume of the cell and its radius we achieved a better measurement for the inside length than the one that the manufacturer published. We attempted to verify the length of the cell by rotating it and comparing the number of fringes produced when it was filled with air verses the number of fringes when it was filled with water. We were severely hindered in this attempt due to substances inside the cell that dissolved in the water and changed its index of refraction.

Design Considerations for a CPA Laser-Based Femtosecond X-Ray Source.

Ashley Cowart and Craig Siders, University of Central Florida/CREOL (REU Funding)

In preparation for Chirped-Pulse Amplification the Titanium Sapphire Laser was adjusted to make it modelock more easily and provide stable pulses. Labview programs were designed to monitor the spectrum and power of the pulses along with making some simple calculations of the center wavelength and full-width at half-max of the spectrum. It was shown that the highest output powers were produced around a center wavelength of 830 nanometers and that a pulse of approximately 15 femtoseconds could be maintained. Since the spectrum and output power do not give exact dimensions of the pulse an autocorrelator was designed and set up to provide more accurate data. Finally Monte Carlo electron/proton transport codes were used to model x-ray source geometries.

Optimization of a Scanning Tunneling Microscope in a Less than Optimal Environment

David Falls and Kevin Riggs, Physics Department, Stetson University

Developed in the early 1980s, a Scanning Tunneling Microscope is a wonderful invention because it lets the user "see" atoms. To attain such a very high sensitivity, it requires a very stable, noiseless environment, which was not part of the design

specifications for Sage Hall when it was built. Therefore, most of the project centered around creating a more ideal environment within a problematic one. Then the project moved on to pushing the microscope's capabilities as far as possible, which was to consistently get clear pictures at the highest magnification (resolution) possible. Clarity is mainly an issue of the environment; physical disturbances and thermal variations can severely distort the images. Resolution is mainly a function of the sharpness of the tips. So an electrochemical etching process was attempted with promising, but not conclusive results.

Electron Beam Heating Power Supply

Travis Ruth and George Glander, Physics Department, Stetson University

Low energy electron diffraction (LEED) is a technique that allows researchers to closely examine surface structures. Prior to performing LEED experiments the sample needs to be heated to a high temperature to clean the surface. Moderate temperatures can be reached by radiant heating from a filament located below the sample, but the high temperature needed for cleaning would either require too large a filament or to run so much current through the filament that it would burn out after a few hours of use. A solution to this can be found in electron beam heating. By biasing the filament and the power supply at a high negative voltage relative to the sample, electrons are swept off the filament and accelerated into the sample, adding their kinetic energy to the heating. The first step in performing this process is constructing a power supply that can be safely biased to a large voltage relative to ground.

From the Faculty

KEVIN RIGGS (*Chair)*

I can't believe another year has already past since I last reported to you all about the happenings of the department. We have been busy working on integrating new equipment into the curriculum, especially in the advanced lab sequence where George Glander has done a great job developing labs to help students learn the standard data acquisition package Labview. We also are considering various changes in future course offerings. We had a bumper crop of seven students graduate last spring. Some have gone out into the job market, several are attending graduate school for physics and applied physics at such schools as Yale, Auburn, and the University of Central Florida. Several of our students worked on summer research projects, at such places as Oak Ridge National Laboratory, UCF's Center for Research and Education in Optics and Lasers (CREOL), and Florida International University. One student (**David Falls, '02**) worked with me here at Stetson on a project involving chemically etching improved tips for our scanning tunneling microscope.

Although we miss having him around the department this semester, we were very pleased that one of our majors (**Dan Carlson, '04**) was selected as one of three students

to participate in the first ever student exchange program with Oxford University. We hope that he is enjoying his experience in the land of Newton and Shakespeare.

My trip to Italy in the summer of 2001 was wonderful. We started in Rome and did what Romans would do, visiting the Vatican museum, viewing the Sistine chapel (wow!), walking the Spanish steps and the Roman forum, throwing a coin in the Trevi fountain, and of course, visiting the coliseum (although the guy dressed as a roman legionnaire talking on a cell phone kind of ruined the historical mood). Of course the food in Rome was absolutely fabulous.

We then spent a week in Florence, staying at a farmhouse apartment that was on the grounds of the Villa featured in the films "Room with a View" and "Tea with Mussolini" which was in the foothill overlooking the city. Our "room with a view" was absolutely breathtaking. We visited the usual landmarks like the Dumo, the Pitti palace, the Ponte Vecheo, the Uffizi art museum (where my favorite painting was one by Leonardo da Vinci). Of course, we also had to visit the Academia where Michelangelo's David is housed. I was overjoyed to find that the Academia had a temporary exhibit of Medici era musical instrument on display, including a Stradivarius viola. It also had on display a collection of 18th and 19th century scientific instruments pertaining to the field of acoustics. Of course, while everyone else was looking at David, I was looking at old tuning forks and Helmholtz resonators. My absolute favorite place in Florence was the science museum. You can take a virtual visit by going to the website *http://galileo.imss.firenze.it/* Here you can find room after room of renaissance era scientific instruments, including some of Galileo's early hand made telescopes. We also ran across Galileo's mummified index finger on display (yuck!), but the rest of him is now interred in the Basilica San Croce, right across from the tomb of Michelangelo.

Kevin visiting Galileo's tomb at Basilica San Marco.

Finally, we returned to one of our favorite places in Italy, the Lake Como region. We spent most of our time visiting the little villages around the lake, including the incomparable Belagio. I of course had to visit the museum in the city of Como dedicated

to Alessandro Volta, where you can see all sorts of his early experiments involving electricity, including some of his early batteries (Voltaic piles). All in all, a great trip from a physics point of view. Of course, all the art, food, and scenery were OK too.

Next summer we probably will be staying closer to home as I am planning to try and teach a year of College Physics in only 8 weeks. Tom Lick claims it can be done, but I am not so sure. I am also looking forward to spending my sabbatical next fall working with Brain Tonner, the chair of the Physics Department at the University of Central Florida, on a project involving bio-engineered magnetic micro-cylinders. I hope to gain some experience using atomic force and magnetic force microscopes (AFM/MFM) while working on this project so that I can come back to Stetson and write a grant request for our own AFM to augment our existing scanning tunneling microscope capability.

—Kevin

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GEORGE GLANDER

Hello! It's seems odd to talk of the mundane of one's own life in light of the major events of the past fall… Laura and I hope you and your loved ones are well.

It's been a busy year. Last spring saw my efforts focused on putting the finishing touches on The Physics Major's Handbook. It has expanded from merely a listing of our course sequencing to suggested sequences for students with a wide array of post-graduation goals ranging from grad school in physics to medical school to teaching. In addition, it includes information about our programs, and as such is proving to be useful not only in advising students and planning out which courses to offer in the upcoming year, but also as a marketing piece for prospective students. I'm pleased to have it completed – it's proving to be a useful roadmap for our students and us faculty as well.

Now, I find myself facing a much more daunting task – that of revising the current advising handbook used University-wide! I started the project this fall, and it will continue for quite some time to come; I'm hoping that the final product will be very useful for faculty and students alike. Getting there, however, involves digging through dusty manuals to get into the depths of policy and then figuring out how to (hopefully) spell it out in simple, easy to understand yet accurate, terms. An interesting challenge, to say the least.

Over the summer, I took a complete break from the pure physics practiced in the Physics Department and turned to applied physics: rebuilding our deck. I had pulled the old deck completely off to replace some rotten siding, and I took the opportunity to redesign it to better fit the architectural style of the house. It took all summer, but I really enjoyed the opportunity to draw on my drafting skills and see my design become reality. To celebrate it's completion, we bought a new grill – and that's been a wonderful addition, too.

Laura and the kids and I took another one of our long treks for vacation, and we re-visited Mammoth Cave, saw her parents, visited Niagara Falls, wandered through upstate New York a bit, did the tourist-thing in Washington DC, and then spent a few days in the North Carolina mountains. It was three peaceful weeks with 3600 miles of wonderful sights to see, supplemented by 3½ Harry Potter books on audio tape to help

the miles pass (finishing up book 4 when we got home). Ian and Beth, now 12 and 9 and in sixth and fourth grades, respectively, have each grown at least 3" each in the past year! Ian continues his love of music (choral singing and piano) and science fiction and has proven himself an able chess player. Beth is developing a real passion and talent in ballet and is dancing as often as the dance school can find classes for her to participate in.

Again – I hope all is well with you. Please keep in touch…

—George

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TONY JUSICK

Well, how do you begin a somewhat routine description of what the last year has been like when the last year, or at least the part of it that we all know, hasn't been routine at all? In the gravity of the event of September 11th it almost seems pointless to talk about run of the mill everyday events when all of us experienced an event of such magnitude that it has altered the very fabric of how our lives are defined here in the good old US of A. We probably all remember where we were when we first heard of the unfolding events. In a humorous vein I was on my way to the urologist in Daytona Beach to have my plumbing checked. I guess I won't ever forget that particular visit. What were you doing on that fateful day? One would think that life would never again be the same. And in some sense of the word it never will be again. We will never again be the "business as usual" type of country that we once were. And yet how quickly we have almost returned to the status quo. September 11th is becoming a fading memory. Almost as if it never happened for most of us. Surely for such a profound feeling of truth there must be a physics oriented explanation. Perhaps there is! The parallel worlds interpretation of quantum mechanics. On September 11th the world split into two parts. One part experienced unparalleled tragedy. In another it never happened. One of our identities lives in one world and the other in the opposite. Of course the weird thing is that many of us feel as if we are living in both worlds simultaneously. Oh well, we shall go on. Entropy will continue to increase. And so, what else is there to say? For me, nothing of import.

—Tony

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TOM LICK

I have been an avid fan of science fiction ever since I was a child and have read most of the works of the great masters of science fiction during the golden age of science fiction that lasted from the 1940's through the 1960's. I particularly enjoyed "hard" science fiction which was based upon known laws of physics and only occasionally threw in something like a warp drive that violated accepted physical principles. My love of physics started with the physics I encountered in these stories. Most of the current wave of science fiction is not science fiction since it makes no attempt to hold to any known laws of physics. It should be labeled as fantasy and be put in the same category as Alice in Wonderland.

During this last year I have seen a great wealth of new applications of physics,

many of which were foreseen in the science fiction I read back in my childhood. Some of these were military applications whose development we would still be ignorant of if it were not for the tragedy of September 11 and the resultant war on terrorism that event engendered. The military now has not only LASER guided bombs but also bombs guided by satellite guidance systems. They have IR telescopes which can observe people miles away in total darkness, detectors which can measure minute temperature differences to detect individuals hidden in buildings and caves, and sophisticated electronics and computer programs which can intercept hundreds of simultaneous cellular satellite communications, picking out using voice recognition software the individual they wish to intercept. And there are many other devices being used that in the interests of security have not yet been made public.

But on the lighter side there have appeared some very nifty devices which use physics. In July the Helios solar-powered propeller-driven flying wing developed by NASA (*www.aerovironment.com*) set an altitude record of 97,000 feet. At that height the atmospheric density is the same as close to the surface of Mars. But by far my favorite nifty device for the year was Dean Kamen's Segway Human Transporter which made its debut several months ago. If you did not see this self balancing two wheel transport when it was introduced, look at the web site (*www.segway.com*). It is amazing to see it at work. I remembered devices like this described in science fiction stories but never expected to actually see one (read the short story "The Roads Must Roll" by Robert Heinlein which was published in 1940). Dean Kamen is a physicist, engineer, and tinkerer in the spirit of Thomas Edison. He first developed an insulin pump, then a portable dialysis machine, flexible stents to keep open blood vessels, and a power wheelchair which can climb any stairs (he climbed the stairs to the restaurant on the main level of the Eiffel Tower in it). But his latest invention is the Serway Human Transporter which Dean Kamen developed in his laboratory at the Deka Research and Development Corp (*www.dekaresearch.com*). This lab seems to operate much like Edison's famous laboratory of the last century. When Dean Kamen decides that a given device is needed, he keeps working on it until he succeeds. The Segway Human Transporter is a good example of this. I can't wait for the price to come down! Maybe I will be able to use one instead of a ancient technology based wheelchair in my old age.

—Tom

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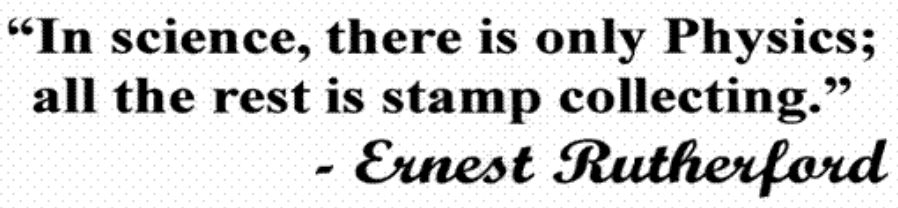
This year's T-Shirt contest:

Well, in spite of having our most prolific t-shirt designer graduate last June, our third T-Shirt contest was a success! The winning design was submitted by senior Yuri Brubach.

The T-Shirt is sports grey in color, with "Stetson green" printing.

T-Shirt front...



T-Shirt back...

For more information, contact Laura in the Physics office by e-mail at physics@stetson.edu or by phone at 386-822-8910...

CROSS SECTION was compiled and edited by Laura Glander, February, 2002.