AGNES SCOTT COLLEGE
PHYSICS & ASTRONOMY

Volume 2 Summer 2010

LETTER FROM THE EDITOR

INSIDE:

The 2009 – 2010 year has been an exciting year filled with local astronomy and physics events!

2009 was the International Year of Astronomy (IYA), which brought with it a large number of exciting events on campus, such as the Ethics in Astronomy series, two First Year Seminars on Galileo, the launch of the Metro Atlanta Solar System and astronomical images at Hartsfield International Airport, to name a few.

In addition to the IYA events above, there were a number of other events at or around Agnes Scott. The Laser Interferometric Gravitational wave Observatory (LIGO, more information at http://www.ligo.caltech.edu/) set up a week long exhibit in the lobby of the Science building and gave a seminar to educate members of Agnes Scott about the experiment. Students presented research at two local events outside of Agnes Scott as well as the two Agnes Scott research conferences. The Southeast Section of the American Physical Society held their annual meeting in Atlanta and was well attended by Agnes Scott, with presentations by Chris De Pree and Melissa Meister. A large number of students also drove up to Duke University to attend the first annual Southeast Conference for Undergraduate Women in Physics.

Keep reading for details of these events and other goings on in the Department of Physics & Astronomy at Agnes Scott. Watch our website for information on upcoming events, such as Open Houses, Laserfest, and Physics Lunch: http://physics.agnesscott.edu/.

Sincerely,
Amy Sulliva, Clare Boothe Luce Assistant Professor
Department of Physics and Astronomy

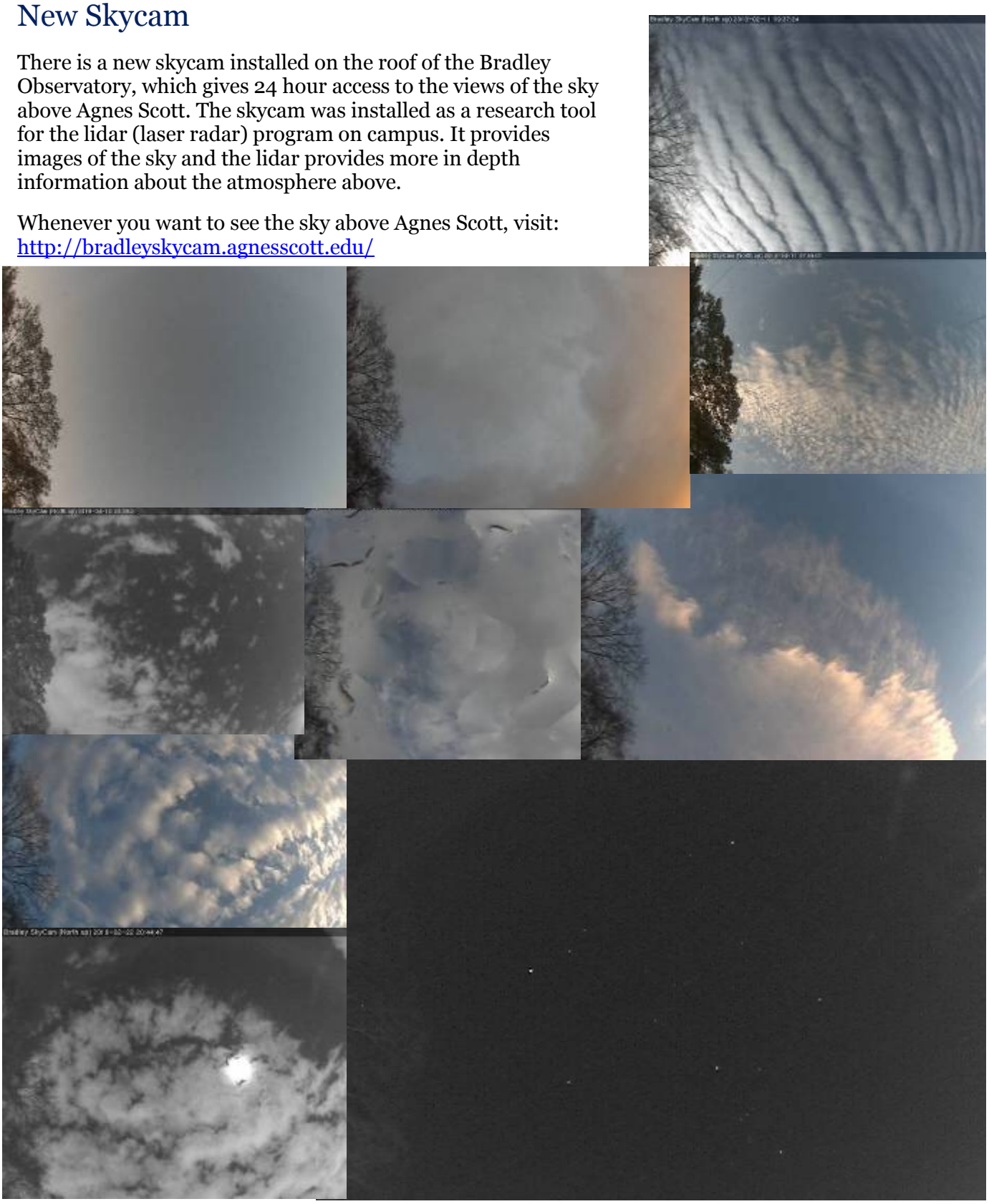
Mary Brown Bullock Science Center

Bradley Skycam

New Skycam

There is a new skycam installed on the roof of the Bradley Observatory, which gives 24 hour access to the views of the sky above Agnes Scott. The skycam was installed as a research tool for the lidar (laser radar) program on campus. It provides images of the sky and the lidar provides more in depth information about the atmosphere above.

Whenever you want to see the sky above Agnes Scott, visit: http://bradleyskycam.agnesscott.edu/

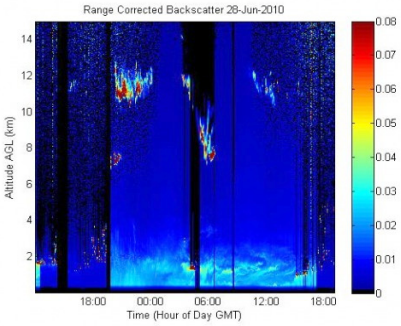


Faculty Corner

ART BOWLING

Associate Professor of Physics
Department Chair

EARL is back on campus and working! The Eyesafe Atmospheric Research Lidar (EARL) that was built several years ago as part of a collaboration between Agnes Scott and members of the Georgia Tech Research Institute is now functioning and measuring the atmosphere above the Bradley Observatory. Thanks to a Course, Curriculum, and Laboratory Improvement grant from the National Science Foundation, students from introductory physics to advanced astronomy courses were able to work with the lidar over the past year. This summer, I am working with students to do research with the lidar, looking at the effects of relative humidity on the atmosphere with Lauren Guerrido and investigating what the lidar can tell us about the temperature of the atmosphere with Haviland Forrister. More information on the project can be found at: http://earlobservations.weebly.com/. Some atmospheric data from this summer's data runs:



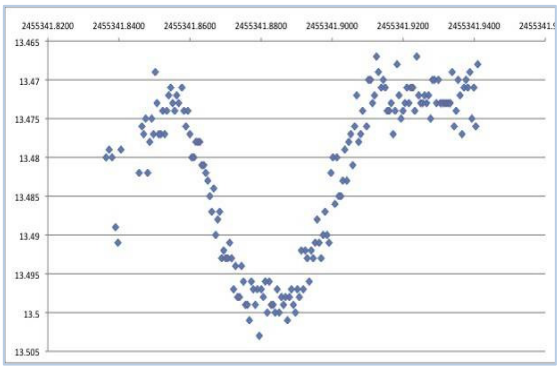
I was also busy this year working as an advisor for the post baccalaureate pre-medical school program. This program has been active in providing students with the opportunity to take the science courses required to apply to medical school.

CHRIS DE PREE

Professor of Physics & Astronomy and Director of Bradley Observatory

The 2009-2010 academic year was dubbed Project Galileo at Agnes Scott College, so many of my activities during the year were related to the year-long celebration of the 400th anniversary of the telescope. In the fall semester, the Metro Atlanta Solar System (MASS) project was unveiled, giving the metro Atlanta area its first scale model solar system, centered on the observing plaza of Bradley Observatory. In the spring semester, the SARA (Southeastern Association for Research in Astronomy) consortium got first light on SARA-South, the 0.6-m telescope that is located at Cerro Tololo in Chile. With the addition of this telescope, students and faculty at ASC now have almost 4 weeks of guaranteed observing time—2 weeks in each hemisphere—on research grade telescopes.

On the academic side, I taught a special first year seminar in Fall 2009 linked to David Thompson's FYS, in which both classes read some common texts, and explored the life and impact of Galileo on the modern world. In Spring 2010, I began to observe transiting planets on the SARA-N telescope. These are planets orbiting other stars, and as the planet "transits", the brightness of the star dips a tiny amount. With a large enough telescope and a sensitive camera, this "dip" is easily measurable, and provides direct evidence that planets are in fact orbiting stars other than the sun. The data from the transit of the planet TrES-3b is shown below. This particular transit took about an hour. In the coming year, I am planning an observational program with students in which we will observe a large number of these planetary transits with our SARA time.



Faculty Corner

AMY LOVELL

Associate Professor of Physics & Astronomy

We had a great year with lots of students interested in astronomy (so many that one semester we had to change classrooms!).

Outside the classroom, I have been continuing my research on the atmospheres of comets, studying emissions from OH molecules surrounding comets. Since 2000, my collaborators and I have observed 26 comets with the Arecibo Observatory and the National Radio Astronomy Observatory Green Bank Telescope (GBT). In addition to comets, this year, we had an opportunity to follow up on the discovery of ice on the surface of asteroid 24 Themis: I used the 100-meter Green Bank Telescope (GBT) to look for OH gas around the asteroid, looking to see if it might be acting like a comet. So far, we haven't seen any OH, but that suggests that no more than 3% of the surface could be active.

This spring, I helped organize "Comets 2010" a workshop on Cometary Radio Astronomy at the National Radio Astronomy Observatory in West Virginia. The workshop brought together people with interest in comets to think about the benefits of the next generation of telescopes and instruments.

The past two years I have also been serving on the Planetary Sciences Federal Relations Subcommittee and on the American Astronomical Society Committee on Astronomy and Public Policy, which has opened my eyes to the political side of science and how NASA and other scientific initiatives are funded by the US government. Our committee makes annual visits (sometimes more) to senators and congressional representatives to keep them informed on the important issues in planetary science and space exploration.

AMY SULLIVAN

Clare Boothe Luce Assistant Professor of Physics

I am settling in at Agnes Scott and have had a busy year teaching and getting my research program established.

In celebration of 2010 being the 50th anniversary of the invention of the laser, I applied for an received a grant to hold a Laserfest event this coming fall at Agnes Scott. In the spring semester, the Optics students started putting together a number of fun and interesting laser demonstrations for the show on October 8. Work on these continues this summer – it should be a fun show! This summer, I am also continuing work on optical imaging with the help of Ethan Sudan and Mary Hinkle.

On the teaching side, I have been working on adding some more experiments and research opportunities to the courses at Agnes Scott. The intro labs now include a lab experience using the research lidar in the Observatory and the Optics students worked on a number of exciting projects including building a laser communication device.

I have also been traveling around the area meeting local physicists and giving talks at some local schools, like Emory, Georgia Tech and the University of Georgia. Nonlocally, I served as session chair at the Frontiers in Optics conference in San Jose and attended the Digital Holography conference in Miami. On the lighter side, my husband and I toured central Europe this past May and enjoyed the views:

Astronomy Events

This year's open house series focused on Astronomy in the time of Galileo. The open house series offers talks by local speakers, planetarium shows, and telescope viewing for the local community. Listed here are the topics offered this coming year. Keep posted for events at http://bradley.agnesscott.edu/openhouse.html.

BRADLEY OBSERVATORY
OPEN HOUSE SERIES 2010 – 2011

Astronomy Since Galileo (1610 – 2010)

The 400 years since the first astronomical use of the telescope have brought enormous progress to the science of astronomy. Technologies and new areas of science have been brought to bear on outstanding astronomical questions. The development of photography, spectroscopy, quantum mechanics, to name just a few have had profound impacts on our understanding of the universe. In this year's lectures, speakers will explore the development of astronomy since Galileo.

Fall 2010

September 17, 2010
Fall Equinox Concert and Open House

October 8, 2010
LaserFest 2010: "Beam Me Up, Scottie!"
Amy Sulllivan

November 12, 2010
Science and the Catholic Church (1610-2010)
Dennis McCann

December 10, 2010
Technology since the Telescope (1610-2010)
C. De Pree

Metro Atlanta Solar System (MASS) Launch

The Metro-Atlanta Scale Model Solar System (MASS) project is an informal science education tool for the residents of Atlanta, focused on helping people understand the size and scale of our solar system and the planets within it. The center of the model is located at Bradley Observatory, where the Sun is represented by an approximately 30 foot diameter plaza. At eight other locations throughout Metro-Atlanta, two large format panels have been installed. One panel shows the extent of the MASS and the location of each of the planets. A second panel shows a scaled image of the planet that would be found at that location in its orbit around the Sun.

More information can be found at:
http://www.agnesscott.edu/events/projectgalileo/mass.aspx

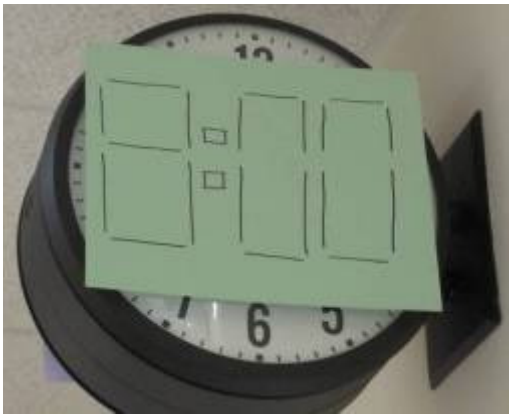
Inner solar system around Atlanta.

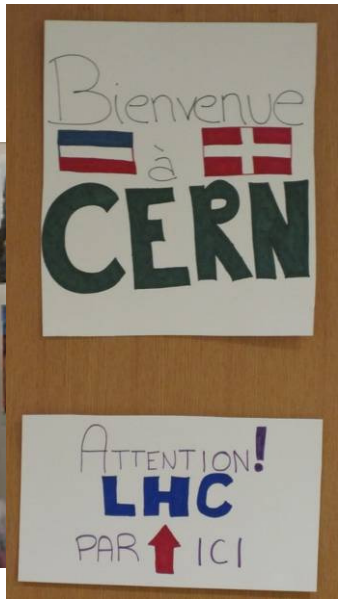
Physics Phun

APRIL PHOOL'S DAY

The theme of this year's pranks was big scientific experiments: LIGO, CERN, Arecibo, and the VLA…

It's always 8:00 at Agnes Scott…





Scientific Celebrations

The Department of Physics and Astronomy at Agnes Scott has been a part of two large scientific celebrations this past year:

- 2009 was the International Year of Astronmy, commemorating the 400th year anniversary of Galileo's first astronomical use of his telescope.
- 2010 marks Laserfest, the celebration of the 50th anniversary of the invention of the laser.

International Year of Astronomy

Agnes Scott College dubbed the 2009-2010 academic year as "Project Galileo: Revealing Hidden Worlds" in honor of the International Year of Astronomy. There were a number of events on campus to celebrate this. Start in the spring of 2009, the Earth to the Universe exhibit, consisting of dramatic astronomical images was set up in between the terminals at Hartsfield International Airport. The fall brought the unveiling of the Metro Atlanta Solar System (read more on pg 5). The Agnes Scott Ethics Program was themed Extraterrestrial Ethics and brought a number of exciting speakers to campus to discuss the ethics with regard to extraterrestrial exploration. On the academic side, there were two Galileo-based first year seminars - Galileo, the Telescope, and the Birth of Modern Science, and Galileo Tonight!—Science as Performance. The first year common reading book also had a scientific theme: Einstein's Dreams by Alan Lightman, with a visit from Alan Lightman. Finally, the Open House series theme for the year was Astronomy in the Time of Galileo. All of these events came together to create an exciting year of sharing astronomy with the general public and the whole community at Agnes Scott.

Physics Dinner – a scientific celebration of our own.
Right: Group picture with digital camera, Above: Group pictures with thermal camera.

LaserFest

Laserfest is the year-long celebration of the 50th anniversary of the invention of the laser. Agnes Scott received an On the Road grant to support an outreach event based on educating the public on lasers and their many uses. If you are in town, please join us! To learn more visit http://ecademy.agnesscott.edu/~asullivan/.

Beam Me Up Scottie!

What: Hands on demonstrations of light and lasers, including a laser telephone, hands-on optics maze, laser radar for measuring the atmosphere, and sky viewing with the telescope.
Date: Friday, October 8, 2010 at 8 PM
Location: Bradley Observatory, Agnes Scott College, Decatur, GA
Who: Everyone. This event is free and open to the public. Children and adults are welcome!

Student Research

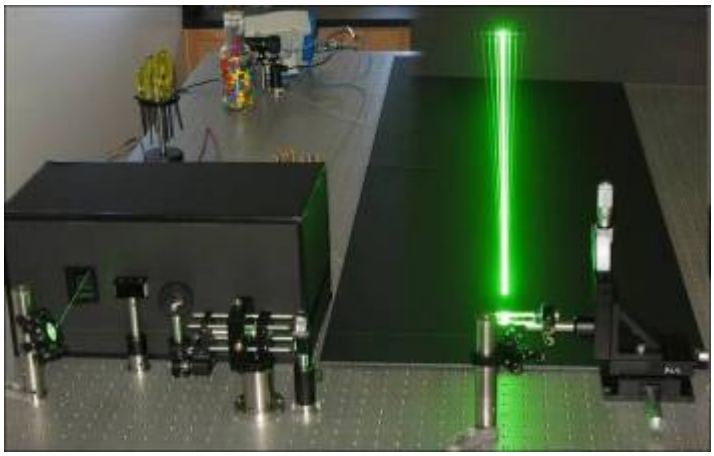
Physics and Astronomy majors have been actively pursuing research projects in and out of the classroom this past year. Students have presented research at a number of meetings, including the Annual Meeting of the Southeastern Section of the American Physical Society, the first December Annual Research Conference (DARC) in the department, the Southeast Conference for Undergraduate Women in Physics, and the campus-wide Spring Annual Research Conference (SpARC) (http://www.agnesscott.edu/academics/internships/sparc.aspx).

Listed over the next couple of pages are abstracts and images from some of these presentations and pictures from some of these events.

Imaging waveguides using optical diffraction tomography

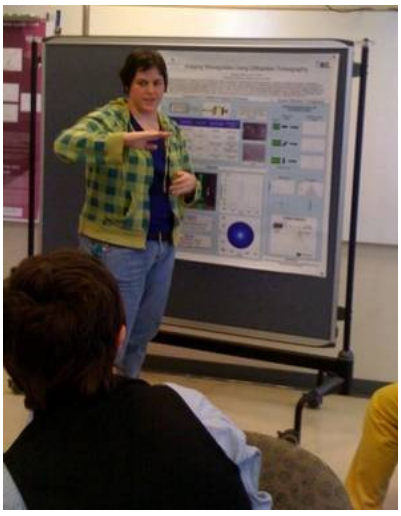
Melissa Meister, Amy Sullivan presented at the Annual Meeting of the Southeastern Section of the American Physical Society

Optical Diffraction Tomography measures changes in the index of refraction of a material rather than its light absorption. Therefore, this method can be used to quantitatively characterize objects that do not absorb light, such as waveguides. Better characterization of these objects and the materials from which they are created is necessary for the development of integrated optical systems. Unlike traditional imaging techniques, our system allows for imaging of micron-scale, low index contrast 3-dimensional structures that are deeply embedded in a polymer. The 3-dimensional target object is replicated at equal intervals to create a diffraction grating. A laser beam interacts with the grating to forma 2-dimensional diffraction pattern which we measure in the far field. This scattered



electric field is directly related to the Fourier transform of the object's index profile. Taking data for a range of incident beam angles allows for the recreation of the 3-dimensional object. We demonstrate images of waveguides embedded in photopolymers with micron-scale resolution and a high signal-to-noise ratio.

December Annual Research Conference (DARC)

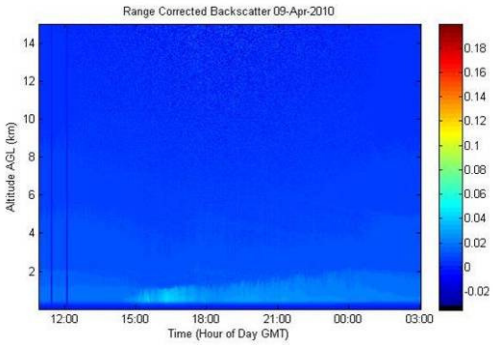


More student research…

Lidar: Using Lasers to Investigate the World Above Us

Author: Leda Sox

Lidar (Light Detection And Ranging) is a modern instrument that sends a vertical, collimated laser beam into the atmosphere in order to gather meteorological and environmental data. In the fall of 2009, I was part a long run data set that was taken from early morning to night using the EARL lidar located the Bradley Observatory that measured the amounts of cloud, ice and aerosol particles in the local atmosphere. The full data taking process is comprised of running the laser, collecting the data in digital

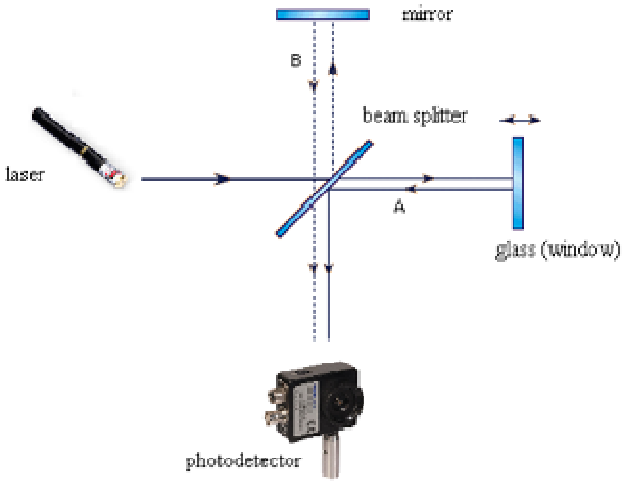


form on a computer and then analyzing it on Matlab. I have gained a detailed understanding of the lidar machine and a basic knowledge of the atmospheric conditions in the Decatur area as results from my research.

Laser Espionage

Authors: Sophia Newton and Lane Hall

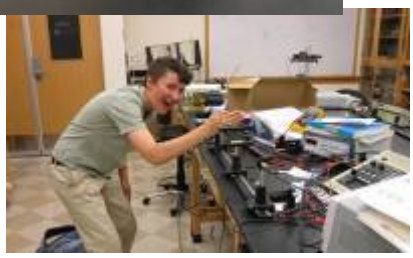
We will present an investigation into building a functional laser espionage system that allows us to "spy" on conversations through windows. By pointing a laser pointer at a window, we can detect vibrations caused by sound waves on the other side. Our system includes a (405 nm) blue-violet laser pointer, a photodetector, a window, an ipod and speaker, an amplifier, a computer, and headphones. We will present a detailed description of how the system works with a demonstration of the system components.



Laser Telephone

Authors: Mary Hinkle and Hannah Marlowe

In this project, we present design schematics for a laser-based telephone system. The system is identical to a regular plain-old-telephone-system, save for one difference: instead of being transmitted along copper wires as an electrical current, the electrical signal is used to modulate the output intensity of a laser, which activates a photoreceptor on the receiver device, and is converted back to an electrical current. We plan to demonstrate a working model of the system at SpARC as a demonstration of optical communication devices.



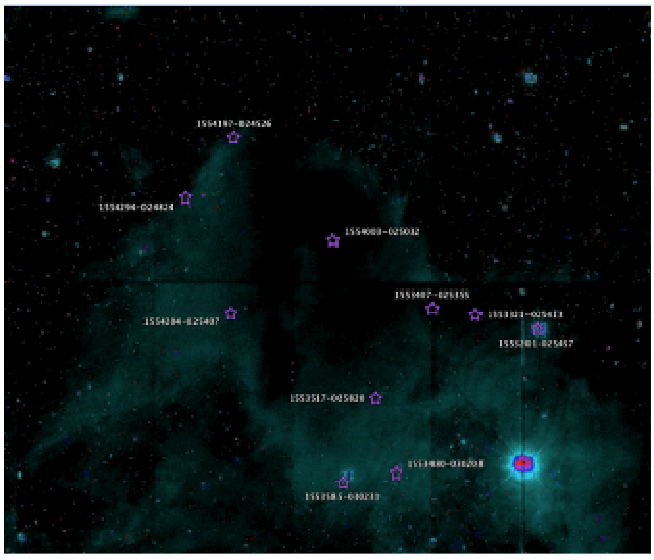
More student research…

The Beck Telescope

Author: Ethan Sudan

The Beck Telescope is located on the south end of the Agnes Scott Campus within the Bradley Observatory. This 30-inch reflecting telescope was purchased in the late 1940's and has been a permanent fixture of the college since the observatory opened in 1950. I will present a detailed description of how this particular telescope works, and give insight into the potential for research opportunities a massive optical telescope such as this can provide. I will give a brief history of the Beck's acquisition, explore the telescope itself, and share a breakdown of its schematics and capabilities. I will also demonstrate the usefulness of having this rather large piece of scientific equipment at one's fingertips by conducting my own observational research and presenting photographic documentation.

Seven Agnes Scott students attend the First Annual Southeast Conference for Undergraduate Women in Physics at Duke University in NC – Mary Hinkle, Hannah Marlowe, Melissa Meister, Sami Corvino, Laney Hall, Sophia Newton, and Haviland Forrister. Agnes Scott had the largest contingent of students at the conference! They learned more about research areas in Physics, participated in lab tours at Duke, heard from graduate students about graduate school and several students presented their past summer's research. It was a great experience and a tradition we will hopefully continue in coming years!



The Lynds 134N Dust Cloud with Source Stars Highlighted
Deep I band image taken at CFHT, June 2002

Observing Molecular CO and H_2O Ices Within Lynds 134N

Author: Hannah Marlowe

This study uses stellar spectra from 10 field stars behind the dust cloud Lynds 134N. We have detected ice within the cloud via infrared features from molecular H_2O and CO. Data was taken from the NASA Infra-Red Telescope Facility (IRTF), a ground-based telescope on Mauna Kea, using SpeX, a 0.8-5.5 µm Cross-Dispersed Spectrograph. Most recent observations of molecular ices have been of very few clouds, especially the Taurus Dark Cloud. The data from this study shows significant H_2O absorption features from several of the sources observed, although very little CO at the 4.6 µm feature. Column densities for H_2O are included and larger densities seem to correlate with larger values of Av as would be expected.

SARA South

Astronomers from 10 institutions, including Agnes Scott College, have banded together, through a consortium called the Southeastern Association for Research in Astronomy (SARA) (http://www.astro.fit.edu/sara/sara.html), to overcome the typical challenges of being an astronomer at a small department or college and have just completed refurbishing and automating a 0.6-m telescope at Cerro Tololo Inter-American Observatory in Chile. With the addition of the Chilean telescope to the one the group already operates at Kitt Peak in Arizona, each institution in the group can now view the night skies from both the Northern and Southern Hemispheres for about 30 days out of the year.

The SARA-S telescope located at Cerro Tololo Chile

"Schools as small as Agnes Scott College wouldn't normally have one research-level telescope, much less two," said Chris De Pree, a professor of astronomy and physics at Agnes Scott College. "This availability of observing time gives the member schools a lot of flexibility in choosing projects." For roughly the cost of a few nights of viewing on a very powerful telescope, SARA collaborators instead get about 30 days of time a year.

"Some level of guaranteed observing time makes deeper observations possible," De Pree said. "One area of interest for me and my students is making follow up observations of extrasolar planetary transits. These observations require lots of telescope time, and provide valuable information that complements discovery missions like NASA's Kepler Mission—a space based telescope looking for Earth-sized planets." The two SARA telescopes are separated by thousands of miles. "In the same way having two eyes gives depth perception, the two SARA telescopes give us the ability to measure distances and orbits for such objects as potentially hazardous asteroids," said Terry Oswalt, head of the Physics and Sciences Department at the Florida Institute of Technology. "In addition, because they are at different longitudes, they allow us to stay focused on an object for more than the 10 or 12 hours typical of one site."

De Pree and his students at Agnes Scott plan to use a portion of their increased telescope time to detect planets orbiting nearby stars using the transit method. The transit method allows astronomers to determine information about a planet's mass, atmosphere and orbital period by measuring the brief dimming of the planet's host star as the planet passes in front of the star. De Pree plans to start with confirmation observations of new planetary detections from the Kepler mission, launched in 2009.

NGC 5128 (Centaurus A) is the nearest powerful radio galaxy and has a super massive black hole

The group's flexibility is even further improved by their ability to remotely access their telescopes from their labs. Professors and their students can now operate one or both of the telescopes from their university labs on assigned nights, sometimes changing schedules at the last minute to accommodate unexpected opportunities.

For a gallery of images taken using SARA South, click here.

Adapted from Agnes Scott News. See full article at: http://www.agnesscott.edu/news (Thursday, April 15, 2010).

Summertime

Summer Research Group

Every year, students and faculty working on research during the summer months gather to share research and have some fun. Each group presents their research during our weekly lunch meetings and this year there were three outings – a trip to Stone Mountain for a hike (pictured left), a service trip to MedShare to sort donated medical supplies, and a final trip to the Center for Disease Control to hear about summer research projects that were going on there for the summer.

SUMMER RESEARCH

Several Agnes Scott Physics & Astronomy majors are doing research this summer, both on and off campus.

Sophia Newton (’11) is working with Sarah Winget at Agnes Scott on obtaining a functional Surface Enhanced Coherent Anti-Stokes Raman Spectroscopy (SECARS) system, which will have applications in single molecule-scale detection in spectroscopy. She is also working on synthesizing tunable silver nanorods for further surface enhancement once the SECARS system is up and running.

Mary Hinkle (’10) and Ethan Sudan (’11) are jointly working on two projects with Prof. Amy Sullivan this summer. They are building an optical imaging system capable of characterizing new types of optical circuits as well as working on demonstrations for the Laserfest event on campus this fall.

Melissa Meister (’11) and Laney Hall (’11) are working with Prof. Tom Gaylord in the department of Electrical Engineering at Georgia Tech on different aspects of a project on improving optically manufactured circuits. Laney is working with state of the art fabrication equipment in the clean room, while Melissa is building a new optical system for testing fabrication of these devices.

Hannah Marlowe (’11) is working at Penn State University this summer. She is will allow me to gain better understanding of the physics involved in these missions as well as design, testing, fabrication, and integration of high-energy physics detectors. I am also getting a chance to experience work similar to what I may find myself involved with in the future for graduate work.

Leda Sox (’10) is is working as a student assistant this summer at the Georgia Tech Research Institute's Electro-Optical Systems Lab. She has learned how to operate the Nexlaser 355 nm wavelength lidar but most of her time is spent working with EARL, acting as a liaison between Agnes Scott and GTRI.

Haviland Forrister (’12) is working with Lauren Guerrido (Spelman College) on collecting information about the atmosphere above Decatur using Agnes Scott’s lidar, EARL. They are taking lots of data about the atmosphere and working on calibrating the instrument to learn more about the temperature of and how humidity affects the atmosphere.

Society of Physics Students

- Meetings every other week
- Outreach
  - Planetarium show for Boy Scouts
  - Winnona Park Elementary School
    - set up telescopes for students at their sleepover
- Camping trip in fall
- April Phool's Phun
- Joint American Chemical Society-SPS Halloween Party
- On campus lecture:
  - Theresa Brunasso, Director of Technology Development at EMS Technologies Defense & Space Systems gave a wonderful talk entitled "Searching for Martians."

ALUMNAE UPDATE

We would love to hear what you've been up to recently. Where are you currently? Are you in graduate School? Are you working? Are you married? Do you have children? Have you traveled to any interesting places recently?

We would also like to collect a list of "after my physics/astrophysics degree" careers as a resource for our current students. In addition to sending us information on your current whereabouts, if any alumnae are interested in communicating with current students about career options or about specific careers, please let us know. Send your update to Amy Sullivan at asullivan@agnesscott.edu. Or, if you prefer, mail to Amy Sullivan, Department of Physics and Astronomy, 141 E. College Ave., Decatur, GA 30030.

And, of course, if you're in town, please stop by and join us for any of our many events for the upcoming year or just come by and visit!

Graduation

THE PHYSICS & ASTRONOMY CLASS OF 2010

Sarah Dhalla
- Astrophysics major

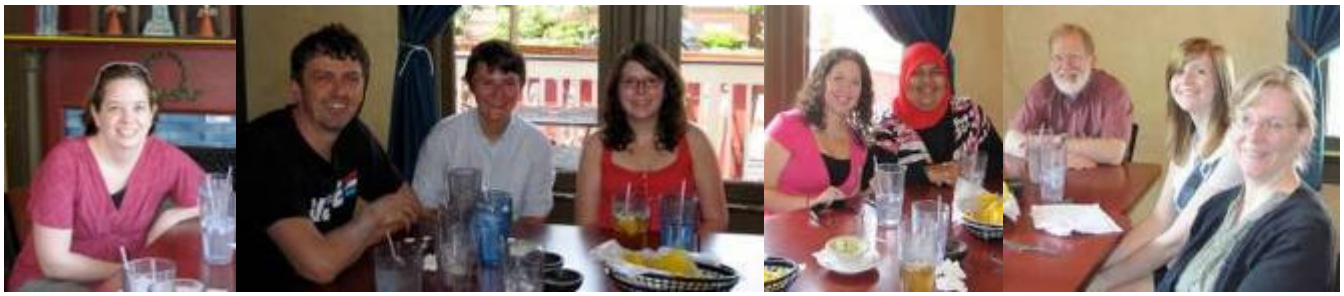
Ashley Fournier
- Physics major

Leda Sox
- Math-Physics and French majors

Sami Corvino
- Math-Physics and French majors

Mary Hinkle
- English Literature major and Astrophysics minor

Ashley Fournier at graduation with Art Bowling and Amy Lovell.



Senior Lunch (above): From left to right: Amy Sullivan, Chris De Pree, Mary Hinkle, Leda Sox, Sami Corvino, Sarah Dhalla, Art Bowling, Ashley Fournier, and Amy Lovell

Leda Sox (left) signing her name before ringing the bell to celebrate her new job.

Sami Corvino (right) with Amy Sullivan, Art Bowling and Amy Lovell at graduation.