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October 2006– Issue 50

Peter Shawhan wrote this month's Research Spotlight regarding his work on Gravitational Waves.

Alumnus Brian Jemella, '03, took a break from his graduate studies and landed a job as a Reporting Specialist at the Columbia Bank in Columbia, MD. Read more about his journey in this month's Alumni Spotlight.

Theodore Einstein was quoted in Chemical & Engineering News on August 22, 2006. The article covered self-assembled honeycombs on surfaces. To read more about faculty in the news, visit the News Section.

The October Colloquium Speakers include John Hall (National Institute of Standards and Technology), E.F. "Joe" Redish (University of Maryland), Kevork Abazajian (University of Maryland), John E. Harris (Stanford University), Jogesh Pati (SLAC/ Stanford University & University of Maryland). To view other upcoming events, visit the Up Next Section.

Sylvester Gates was recently accepted to serve as a member of the LIGO Directorates Program Advisory Committee, from spring 2007- spring 2009. The advisory committee gives the directorate advice on scientific policy, as well as management, technical issues and strategy. For more information or to read about more awards and honors, visit the News Section.

On August 14, 2006, Edward Redish gave the opening plenary talk at the International Conference on Physics Education: Physics for All, held in Tokyo, Japan on the topic "New Directions of Research on Undergraduate Physics Education." For more information, visit the Recent Events Section.

Please send in Phyiscs Phun Phacts, to ccuaresm@physics.umd.edu or 1117 John F. Toll Physics Building- College Park, MD 20742, to be used in future issues of the Photon. For more information visit the Editor's Note section.

DEPARTMENT OF PHYSICS
UNIVERSITY OF MARYLAND

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RESEARCH SPOTLIGHT

Listening for Gravitational Waves– By: Peter Shawhan

Gravity is part of our everyday lives, in obvious ways and in some ways which are not so obvious. Gravity holds the Earth together and keeps our feet, the oceans and the atmosphere on its surface. It holds the gas of the Sun together in a relatively dense ball, allowing hydrogen atoms to collide and fuse into helium, producing heat and light. Of course, it also keeps the Earth and other planets in orbit around the Sun. In daily human activities, the force of gravity seems to be constant, but that is not quite true. The net gravitational pull at a given point on the Earth varies during the day as the distances to the Sun, Moon, and other planets change; although the variations are small, they are enough to create tides on the oceans. Since all objects exert a gravitational force according to their mass, even a truck driving by on the street outside exerts a gravitational force while it is nearby, but (fortunately) it is much too weak to be noticed.

Albert Einstein, with his general theory of relativity, forged a radical new way of thinking about gravity, in terms of "curvature" in the geometry of space-time rather than as an ad hoc, instantaneous force. Among other things, the theory predicts that a gravitational potential can bend the path of a beam of light and can change the wavelength of the light, both of which were experimentally confirmed in the last century. Another prediction is that changes in a gravitational potential propagate at the speed of light as gravitational waves, momentary distortions of the geometry of space-time that travel outward from the source. Only very massive objects, changing their shape or orientation at speeds close to the speed of light, can produce gravitational waves with significant amplitude; but then the amplitude falls off only as 1/r (where r is the distance from the source to the detector), unlike the 1/r2 dependence of the gravitational force. Certain types of astrophysical events, such as supernova explosions or merging black holes or neutron stars, should emit gravitational waves that could be detected at a considerable distance, and the waves would carry unique information about such events. Ultimately, regular gravitational wave observations could join electromagnetic (optical, microwave, radio, X-ray, gamma-ray) and particle (cosmic ray, neutrino) as-

Continued on next page

tronomy as different ways to look at the universe.

There is excellent indirect evidence for gravitational waves from observations of orbital changes in binary pulsar systems, but direct detection has been elusive because the wave amplitudes are incredibly small. A "typical" gravitational wave might produce a fractional distortion (i.e., a strain) of only 10-21 at the Earth, which would momentarily stretch the diameter of the Earth by about the size of an atomic nucleus! Joseph Weber, here at the University of Maryland, was the first person to try to build instruments capable of detecting such tiny signals, using suspended metal cylinders instrumented with sensitive transducers to pick up vibrations induced by a gravitational wave. Weber's basic design has been improved over the years, with major contributions made by scientists here at Maryland, and a few such detectors are still operating. However, physicists are now focusing on a newer type of detector: a large L-shaped laser interferometer which measures the difference between the effective lengths of the two "arms" of the L. The Laser Interferometer Gravitational-wave Observatory (LIGO) project, funded by the National Science Foundation, is leading the way in this effort. LIGO's two observatories--in Washington State and Louisiana--house a total of three such detectors, with arm lengths up to 4 kilometers long. Besides being impressive facilities when viewed from the air, they contain cutting-edge materials and engineering: 11-kilogram cylindrical mirrors with extremely high-quality coatings bounce laser beams back and forth along the arms inside a vacuum enclosure, with all components isolated from ground vibrations and other environmental disturbances as much as possible, and held in place with sub-nanometer precision. The arms form a sort of antenna which responds to signals coming from most of the sky, even upward through the Earth; therefore, instead of "looking" at a spot in the sky like an optical telescope or a radio telescope, LIGO "listens" for gravitational waves arriving from all around.

After many years of construction and commissioning, LIGO has now reached the sensitivity it was designed for and is currently in the middle of a long data collection run. The data is now being searched for many different sources, although we have limited knowledge of what is out there--which is why this new exploration of the gravitational-wave sky is so exciting! For instance, we should now be able to detect merging black holes as far away as a few hundred million light-years, but we don't know how common black holes mergers are in the universe. LIGO is joined in this effort by the smaller GEO 600 detector in Germany, and in the near future will also exchange data with the 3-kilometer VIRGO detector in Italy in a cooperative arrangement to analyze the data jointly for maximum sensitivity to weak signals.

As a long-time member of the LIGO Scientific Collaboration (LSC), I have helped to commission the detectors and to develop data analysis methods and tools, and have led some of the search projects. The primary part of my current research plan is to search the data for short "burst" signals of all types; it is challenging to separate a signal from detector noise when the form of the signal is not known, but we are refining methods for doing so. We cannot predict when the first gravitational-wave signal will be detected, but with patience and care we can be ready for it when it arrives.

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ALUMNI SPOTLIGHT

A Much-Needed Break, Leads to a Position as a Reporting Specialist at the Columbia Bank

Brian Jemella works as a Reporting Specialist for The Columbia Bank in Columbia, MD. While it's not the typical position for a physics graduate student, Brian loves what he does and is grateful for the knowledge he has obtained from his UMD degree.

"The job is not completely dissimilar to my time at the university," said Jemella who came to UMD in 1999. "I use many of the same tools that I developed and used as a researcher, except they are now being targeted towards financial and regulatory reporting."

Brian grew up in Yorktown, New York (a suburb of NY in Northern Westchester County). His decision to attend Maryland came down to a few major factors including location, student population and department. Like many students, he yearned for a college that was far enough to feel away, yet close enough not to make travel prohibitive. In addition, Brian liked that the campus was large but with a sufficient student population to not feel vacant. In 2003, Brian graduated with a bachelor's degree from physics.

"Academically, I think my time at UM was pretty typical," said Jemella. "Even though I came to the University looking specifically at physics, I changed majors a couple of times and was looking to teach high school physics. I eventually decided to return solely to the physics department."

In the spring of 2002, Brian began working as an intern for James Drake in the Plasma Theory group at the Institute for Research in Electronics and Applied Physics. The experience was so great, that the position quickly turned into a multi-year research project. The project led Brian through graduation and into his enrollment in the AMSC graduate program in Scientific Computation. After six uninterrupted years of study, he decided to take time off from graduate school and the research project.

During his break, Brian began to explore different interests, including financing. This interest eventually led to his current position at the Columbia Bank. His position entails integrating disparate software, writing code for automation and data conversion and developing financial projection and analysis systems. Through his journey, he offers current students some advice.

"I would only say that if you graduate and decide that research is not for you, there are a lot of possibilities. Companies don't always know how to ask for it, but more times than not they are looking for skills physicists possess."

If you are interested in contacting Brian Jemella, please send your messages to the Editor, who will be happy to forward your questions and comments.

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GRADUATE BLOG

David Garofalo---Relativistic Astrophysics

If we look into the distant universe, we find evidence for various phenomena such as star-forming regions in galaxies, creation of elements in supernovae, rapid pulses of high energy radiation coming from neutron stars and more. We also find evidence for small regions of space within which the largest amounts of energy are released anywhere in the universe. Although the source of this energy still eludes us in a fundamental sense, theory and observation appear to be converging on a paradigm whose primary components are rotating black holes surrounded by strong magnetic fields. But, within this paradigm, a fundamental and up to now unanswered question arises. What process carries the large magnetic field toward the black hole?

Two complications must be overcome. First, the horizon cannot support currents to generate magnetic fields in the sense of the surface of a star. Any astrophysical process occurring on the horizon is outside of causal contact with the outside universe thereby making it impossible for currents on the horizon to generate magnetic fields outside of it. This means that the currents generating the fields must be maintained near but outside of the horizon. The only place where such currents could be maintained is an accretion disk. Accretion disks seem to be ubiquitous and even our solar system displays the signature of such systems with all planets rotating in one plane in the same direction. In its most simple form, an accretion disk is a collection of stuff in rotation in a plane about a central object, usually ionized gas, susceptible therefore to the formation of currents and thus of magnetic fields. As the gas loses angular momentum and accretes toward the black hole, currents migrate along with the gas, thereby dragging the magnetic field toward the hole.

This is the basic physics behind the origin of magnetic fields around black holes. Unfortunately, basic magnetohydrodynamics, or the study of Maxwell's equations in an astrophysical environment, indicates that such a dragging of the magnetic field toward the black hole is subject to a rather strong diffusion process, thereby making it impossible to reach the required strengths around the black hole. My advisor, Chris Reynolds, a high energy astrophysicist in the Astronomy department, developed a model that uses certain previously ignored relativistic features of black hole accretion to overcome the large diffusion of the magnetic field. My job is to extend this model to the relativistic regime, specifically to the Kerr metric. The goal of this project, therefore, is to see if we can answer the most fundamental question about the paradigm that explains the largest energy emission in the universe in terms of a highly relativistic interaction between a black hole and a magnetic field.

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UP NEXT

October Colloquia:
October 03- John Hall
October 10 – E.F. “Joe” Redish
October 17 - Kevork Abazajian
October 24 – John E. Harris
October 31 – Jogesh Pati
Click here to view the entire colloquia schedule.

November 02, 2006- Physics is Phun “Good Vibrations”
7:30- 8:45 PM Physics Lecture Halls

Edward Redish, who is currently on sabbatical, will be visiting the University of Maine, the University of New Hampshire, Oregon State University and the University of Minnesota, where he will be collecting data on upper division physics student’s use of mathematics.

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NEWS

Congratulations

Sylvester Gates was recently accepted to serve as a member of the LIGO Directorates Program Advisory Committee, from spring 2007- spring 2009. The advisory committee gives the directorate advice on scientific policy, as well as management, technical issues and strategy. In addition, they help review LIGO Scientific Collaboration funding proposals, for the National Science Foundation, and perform other tasks at the request of the NSF.

Donald Lagenberg and his course PHYS 121 "Fundamentals of Physics" was identified as one of the top examples of best practices in a national study of 139 physics courses conducted by the Center for Educational Policy Research.

Edward Redish and his course "Fundamental Physics II" was identified as one of the top example of exemplary practices in a national study of 139 physics courses conducted by the Center for Educational Policy Research.

The 2006 US High School Physics Team took five US high school students to the international competition in Singapore. Those students were trained and selected during a 9-day training camp held at the department each year. A total of 383 students from 86 nations participated in this year's competition. Our students received four gold medals and one silver. In an unofficial ranking of nations by total team score we placed second.

Ichiro Takeuchi, Russ Wood and Vispute Ratnakar patented a High-throughput thin-film fabrication vacuum flange 07084445 Cl. 257-294. For more information, visit :
http://www.uspto.gov/web/patents/patog/

In the News

On August 22, 2006, Theodore Einstein was quoted in a news item in Chemical & Engineering News regarding self-assembled honeycombs on surfaces.

On August 28, Robert Park was mentioned on MSNBC's Cosmic Log, in which the writer describes Park's long time criticism of human space exploration.

On August 23rd, an article entitled, "Reduce the Students Who Dislike Physics" appeared in the Japanese newspaper Yomiuri. Edward Redish was interviewed for the article, during an International Conference on Physics Education: Physics in Tokyo.

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RECENT EVENTS

- On September 28, 2006 department awards were presented to faculty. Wolfgang Losert was honored with the 2006 Ferrell Award. This award recognizes the outstanding research, teaching and service accomplishments of an exceptional faculty member at an early part of his/her career.

  Ellen Williams and Nicholas Chant were presented with the 2005 & 2006 George A. Snow Memorial Award. This award recognizes any student or faculty member who personally helps to advance the representation of women in the field of physics.

- On September 28, 2006, Sylvester Gates gave a talk at the 2006-2007 Capital Science Evenings at Carnegie Institution. His talk titled “If You Knew SUSY,” demystified the concept of supersymmetry, or SUSY.

- On September 26, 2006, the University of Maryland held its 23rd annual Faculty and Staff Convocation. Edward "Joe" Redish was presented the Distinguished Scholar- Teacher honor, at the ceremony held in the Memorial Chapel. Click here to view images from the event.

- On Friday, September 08, 2006, the Joint Quantum Institute (JQI) held its signing ceremony for the memorandum of understanding at the University of Maryland's Main Administration Building lobby. JQI is a joint collaboration between the UMD, NIST and NSA. Click here to view images from the event.

- On August 14, 2006 Edward Redish gave the opening plenary talk at the International Conference on Physics Education: Physics for All, held in Tokyo, Japan on the topic "New Directions of Research on Undergraduate Physics Education." Later in the same conference, Dr. Redish gave a workshop on the topic "The Physics Suite."

  For more information, visit : http://www.newsdesk.umd.edu/scitech/release.cfm?ArticleID=1327

In Memoriam

The Department of Physics would like to express it deepest condolences to the family and friends of William Hornyak. Dr. Hornyak passes away on August 17, 2006 at his home in Scottsdale, AZ.

Dr. Hornyak was an active member of the department until 1993. He was a distinguished scientist, working in the field of nuclear physics, and an integral member of our department.

Dr. Hornyak was buried at a private service in Arizona. For those of you who would like to remember Dr. Hornyak and express your condolences to his family, the Department plans to hold a memorial service in late November or early December.

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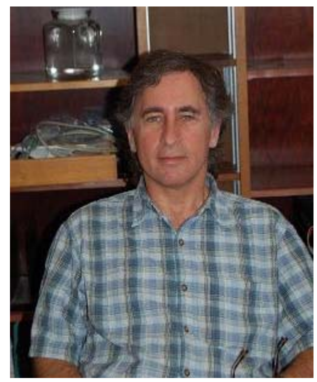
LETTER FROM THE CHAIR



Dear Colleagues,

Last month the Department of Physics, along with the National Institute of Standards and Technology (NIST) and the National Security Agency's Laboratory for Physical Sciences (LPS) announced the creation of the Joint Quantum Institute, a joint research institute designed to advance quantum physics research. We are all excited about this collaboration that's primary disciplines include atomic, molecular and optical physics, condensed matter physics and quantum information systems.

An integral component of this institute will involve the collaborations between scientists at Maryland and NIST. In order to facilitate this level of collaboration, nine NIST fellows will serve as adjunct professors, advise graduate student research, conduct research, and enhance the intellectual climate in the Department.

They will also be given opportunities to teach, bringing new perspectives to students. This will allow them to participate in our educational mission as well as facilitate research interactions. The newly appointed adjunct faculty includes Carl Williams, Garnett Bryant, Kristian Helmerson, Paul Lett, Alan Migdall, James Porto, Eite Tiesinga, Paul Julienne and Glenn Solomon.

Students and faculty involved with the JQI will participate in the birth of the quantum computer! This kind of computation will be so far ahead of what is possible now, it's like comparing the latest fastest CPU to the abacus. The quantum computer will be extremely useful in simulating other quantum systems, something which is not practical now, but these are the kinds of things that are going to be necessary in order to lead to knew discoveries and new technologies. Studies of coherent quantum systems are also speaking to philosophical issues concerning the interpretation of quantum mechanics itself, something which has been controversial since the 1920s when quantum mechanics was born.

This is an exciting time for the department and the university and I look forward to experiencing the groundbreaking research that comes out of this collaboration. I expect to see some great science and some fantastic research opportunities for students come out of this.

Regards,
Drew

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EDITOR'S NOTE

Dear Readers,

In the early issues of the Photon, we reported that Dr. Charles Misner shook the hand of the Pope, that Schelly Taylor was training for a power lifting competition and that Dr. Jordan Goodman was/is a talented photographer. These Physics Phun Phacts were a thing of the past---until now.

We've decided to bring this section back to the Photon. If you have any interesting information or facts about the department, send them in, and we'll include them in our upcoming issues.

For now, let's celebrate the latest issue, which is filled with exciting information about the department. Our News Section is filled with several awards and honors including Sylvester Gates recent acceptance to serve as a member of the LIGO Directorates Program Advisory Committee.

In addition, this month's Research Spotlight was written by Dr. Peter Shawhan and the Alumni Spotlight highlights the educational journey of alumnus Brian Jemella.

I look forward to reading some of your exciting submissions and hope that you enjoy the latest issue.

Best regards,
Carole

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CONTACT US

The Photon Online is the official University of Maryland-Physics online newsletter. We release an issue monthly to highlight researches, alumni, awards, honors and events. The views and opinions of our readers are valued; please contact us with any questions, ideas or comments.

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