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The image above was the time machine used to film the 80's trilogy Back to the Future. This month's Alumni Spotlight, Chris Osborne, discovered his love of science after dreaming of time travel as a child.

Paulo Bedaque wrote this month's Research Spotlight, regarding his work on Theoretical Quarks, Hadrons and Nuclei.

Robert Park, Physics, was featured on ABC News Primetime on July 13, questioning the scientific basis for the "healing" work of Canadian college student Adam Dreamhealer, who ABC estimates will make more than $1 million this year conducting healing seminars. To read more about faculty in the news, go to our In the News section.

Theodore Einstein, Physics, gave an invited talk at the second
International Workshop on Physics and Technology of Thin Films in Prague , Czech Republic in June 2006. For more information, go to our Recent Events section.

Robert Park has signed a contract for two new books. In addition, Voodoo Science has just been released in Romania. It has been translted into nine other languages since it's publication in 2000. For more faculty awards and honors, go to the News Section.

David Garofalo wrote this month's Graduate Blog, where he writes about his expereince as a Physics graduate student.

The September colloquia speakers include, John F. Hawley (University of Virginia), Theodore Hodapp (Hamline University), Steven Strogatz (Cornell University) and Paul McEuen (Cornell University). To view the September colloquia schedule and other up coming events, go to the Up Next section.

Find out about the new physics facutly in Drew Baden's latest Letter from the Chair.

DEPARTMENT OF PHYSICS
UNIVERSITY OF MARYLAND

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RESEARCH SPOTLIGHT

Quantum Chromodynamics— By: Paulo Bedaque

All the forces we find in Nature are ultimately due to four basic ones. Out of those four, two are very familiar: the gravitational force (responsible for the fall of Newton's apple and the motion of the planets) and the electromagnetic force (the one that moves magnets, electric motors and also the ultimate cause of all chemical and biological processes). The remaining two forces are only noticed in the microscopic realm of atomic nuclei. They are the "weak" and the "strong" nuclear forces. While the weak force is responsible for the relatively slow beta decay of certain nuclei, the strong force is the cause for the very existence of protons, neutrons and their binding in atomic nuclei, as well as the existence of a whole host of particles like hyperons, pions, and kaons. Without the strong nuclear force there would be no nuclei and, consequently, atoms and the Universe as we know it.

The theory behind the strong force was essentially figured out in the early 1970s. It turns out that all hadrons are made of other particles, called quarks and gluons, whose interactions with each other is described by a theory called Quantum Chromodynamics (QCD), named after the property of "color", a kind of charge, similar to the electric charge, that is carried by quarks and gluons. Despite the fact that the basic laws of QCD have been known for years, its study is today in a peculiar situation. The reason we believe the theory is essentially correct is because we can use approximate methods (perturbation theory) to compute some rare high energy events and compare those calculations with the results of experiments, a feat that was worth a Nobel prize in 2004 for Gross, Wilczek and Politzer. However, we cannot as easily compute the consequences of the QCD laws for low energy phenomena, among them the binding of nuclei that originated the concept of strong forces to begin with. The mystery of nuclear forces remains unresolved.

The work of Dr. Paulo Bedaque concentrates in deriving the implications of QCD to the low energy phenomena where perturbation theory does not work. They include the origin of the nuclear forces keeping nuclei together and the fate of matter when compressed beyond the density found in nuclei, as it is supposed to occur in neutron stars.

Continued on next page

The methods used by Dr. Bedaque include analytical approaches like effective field theories and, more recently, a direct, numerical attack on the problem using lattice field theory. In lattice field theory one simulates the random quantum fluctuations of the system by random numbers generated by a computer. Physical results are attained by the averages over these random numbers, and the more computer power available, the more precise the results are. This has led Dr. Bedaque recently to use some of the most powerful parallel computers available in the world. But computer power by itself will not be enough to unravel the mystery of nuclear forces. Innovative ideas involving the simulation of unphysical theories which are easier to simulate, but rigorously connected to the real World QCD, are being pursued. Some rough results about the nuclear forces are beginning now to appear.

In addition to these QCD studies, close analogies between high density nuclear matter and the recently achieved systems of cold atoms were observed, leading Dr. Bedaque to pursue some questions of interest to the physics of cold atoms. The cross fertilization between these fields promises to be very fruitful in the future, with experiments performed in atomic traps playing the role of “quantum analogic computers” simulating other strongly interacting systems.

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ALUMNI SPOTLIGHT

A Passion for Science— By: Laura Moulding

Sean Williams began his college career at Carnegie Mellon University , where he received a BS in both Physics and in Mathematical Sciences. After that he came back home to Silver Spring , Maryland where he attended University of Maryland for graduate school. It was here that he got his MS in Physics.

Physics has always been an appropriate path for Sean. Since he was young, he dreamed about time travel, and about creating a time machine. He realized early on that this dream is most likely impossible to see in the near future.

“However,” Sean said, “the will to succeed in this vision got me passionately interested in science, with physics being the most relevant discipline.”

He also hopes to condense all of science to “one intuitive law, often dubbed the ‘theory of everything,'” as Sean describes it. Like time travel, it is not clear whether this is even possible, but the mystery of it is still very interesting.

Sean chose UMD because it was the best school for physics in the area. Living at home makes thing easier for many college students, and Sean was no different. This way he did not have to be stressed over money, bills, and especially wondering if he would be paid at all. Going to UMD was a good transition for Sean, and made him realize that while he started out wanting to be a physics professor, maybe it is not the right path for him at this time.

Paying attention to professors can be a difficult feat for any college student, which is why finding a good one can leave a lasting impression. Sean's favorite professor while at UMD was Thomas Anotonsen.

“I'm much better at paying attention to a book than to someone at the board,” Sean explains, “so his ability to make me listen made the Mechanics class a positive experience for me.”

Life after UMD has been good to Sean. He is currently a systems analyst for DCS Corporation. He spends his days at the Naval Air Station, where fighter planes can be seen overhead. His job, most of which is confidential, includes creating and testing computer programs that help with fighter pilot safety. Over the next few years, he will become an expert in weapon fragmenting. Not a bad career choice for someone interested in physics.

His advice to current students is to just be honest about what is best for you. He says, “So even if you are thinking about quitting for other reasons (too tough, not enough time for family, etc.) there is no shame in doing so.”

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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

September 04, 2006- Labor Day Holiday

September Colloquia:
September 05- John F. Hawley
September 12- Ted Hodapp
September 19- Steven Strogatz
September 26- Paul McEuen

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

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NEWS

Congratulations

Rabindra Mohapatra received the Humboldt Prize from the President of the Alexander Von Humboldt foundation, Dr. Wolfgang Fruhwald. Mohapatra, along with other prize winners, were given a reception by the President of Germany, Dr. Horst Kohler in his official residence in Berlin on July 12, 2006.

Robert Park has signed a contract for two new books. In addition, Voodoo Science has just been released in Romania. It has been translted into nine other languages since it's publication in 2000.

In the News

Paulo Bedaque, Physics, was quoted on PhysOrg.com on July 11 and in PlayFuls.com on July12 in articles about a new study on nature's tiniest components of matter, quarks and gluons. Professor Bedaque was one of the authors of the study which was published in the Physical Review Letters, vol. 97.

James Gates, Physics, was featured in the July 10-17 edition of Gibbs Magazine in its “Black Personalities” section.

Robert Park, Physics, was featured on ABC News Primetime on July 13, questioning the scientific basis for the “healing” work of Canadian college student Adam Dreamhealer, who ABC estimates will make more than $1 million this year conducting healing seminars. Other scientists from MIT and Harvard Medical School were also featured along with Park.

Sankar Das Sarma, Physics, wrote a feature article in the July issue of Physics Today. This article was on Topological quantum computation.

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RECENT EVENTS

- Theodore Einstein, Physics, gave an invited talk at the 2 nd International Workshop on Physics and Technology of Thin Films in Prague , Czech Republic in June 2006, on “Going Beyond Minimal Models of Step Fluctuations and Lattice-Gas Interactions.”

- Sylvester Gates completed a technical presentation in France, from June 19- July 14, for an international conference of mathematician and physicists.

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LETTER FROM THE CHAIR

Dear Readers,

Welcome. For some of you this is a return, for others this is the start of something new. In either case, I am confident that, together, we'll have a productive semester.

This year, we have had the pleasure of accepting over 50 undergraduate freshman and 30 first-year graduate students. To those of you who are among these, let me give you a word of advice: Enjoy this experience. It's over before you know it! When they told me that "graduate school is the best years of your life" I didn't believe it then, but I sure believe it now. It's a true metamorphosis and a non-trivial ride. Please remember that if you ever have any questions or concerns along the way, we are all here to offer guidance and support.

We've also had the pleasure of recruiting several new faculty members who will all be an excellent addition to our department and the university. These new assistant professors include the following (in alphabetical order):

Kevork Abazajian, an outstanding theoretical physicist on the boundaries of particle physics, cosmology, and astrophysics, and who will be an excellent addition to our newly established Particle Theory Center. His research areas include neutrino astrophysics and cosmology. He is a leader in his field with a reputation for outstanding work.

Paulo Bedaque, an all-around great physicist who has joined our Theoretical Quarks, Hadrons and Nuclei (TQHN) research group. His field of research focuses on the understanding of nuclear forces from first principles, including the force between two hadrons, and has made impressive contributions in quark theory, especially at the B-factories.

Victor Galitski, a new and excellent addition to our Condensed Matter theory group. He uses modern techniques to attack the most competitive, challenging problems in condensed matter physics. He has clearly established a positive reputation in the field.

Michelle Girvan, a brilliant young theorist in the area of nonlinear dynamics of very large networks. She comes to us from the Santa Fe Institute. Her research expertise is on the structure and nonlinear dynamics of very large networks and studies, among other things, phase transitions on these networks. She has produced high-quality results from applying her research expertise, showing the value of physics research in areas in and outside of the physics sciences.

Carter Hall, an exceptional experimental physicist from the high energy community who will be an outstanding addition to our Experimental Nuclear Physics group. He is an all-around excellent young scientist, working on the EXO double beta-decay experiment at Stanford, and effort that probes physics at the GUT scale. Carter is leading the development and commissioning of the xenon handling and purification system for the experiment and will be setting up an experimental effort here in the physics department.

Arthur LaPorta, an outstanding scientist in the burgeoning field of biophysics. He has focused his research on developing physics techniques to investigate biological processes at the molecular level, and is one of the young leaders in the field of single cell biophysics. This is an extremely exciting investigation that is looking at what happens inside cells from a completely new point of view – physics! What would you guess we could learn from looking at things from new perspectives? Who knows – that's what this research is all about!

Peter Shawhan, an established scientist who will make an excellent addition to our Experimental Gravitation group. He is already positioned as one of the key instrument software and data analysts of the Laser Interferometer Gravitational-Wave Observatory (LIGO), having been at the center of activity for several years at Caltech. This ground breaking research project has the potential to detect gravitational waves produced by massive bodies far away in space.

Arpita Upadhyaya, an exceptional physicist who will greatly fortify the University's growing biophysics initiative with her work in cellular mechanics. Arpita is another exceptional young physicist working in biophysics, and comes to us from the Massachusetts Institute of Technology.

I am very excited about beginning our 2006-2007 academic year and with exceptional students and faculty, we're already off to an outstanding start. Good luck to all of you! And please feel free to contact me throughout the year at 301.405.5946 or drew@umd.edu .

Regards,
Drew

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EDITOR'S NOTE

Dear Readers,

As summer comes to an end, the feeling is bitter sweet. Sure I'll miss the warm weather, the empty parking spaces and those *BBQ-Day Thursdays* thrown by the university, but I actually look forward to the busy halls, cooler temperatures and the start of the school year. Still, it's always nice to reflect on the past. And these past few months have been exciting!

The summer started off with a bang when Drew Baden took over as department chair in July. Since then our faculty, staff and students have continued to maintain our department's excellent reputation. Our News section is filled with awards and honors presented to our faculty, as well as media outlets that faculty have appeared in.

Furthermore, our Alumni Spotlight highlights the work of one of the department's recent graduates, Chris Osborne. Also, Professor Paulo Bedaque, wrote this month's Research Spotlight, which gives us a little more insight into his current research.

Autumn is always a great season to start off fresh and I'm excited to see what exciting things are in store for our department.

Best,
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.

The Photon Online
1117 John S. Toll Physics Building
College Park , MD 20742
301.405.5946 TEL
301.405.0327 FAX

Editor
Carole Cuaresma
1117 John S. Toll Physics Building
College Park , MD 20742
ccuaresm@physics.umd.edu
301.405.5945

Publisher
Andrew Baden
Professor and Chair
1117 John S. Toll Physics Building
College Park, MD 20742
drew@physics.umd.edu

Contributing Writers
Paulo Bedaque
Professor
John S. Toll Physics Building
College Park, MD 20742
Bedaque@umd.edu

Laura Moulding
Intern
John S. Toll Physics Building
College Park, MD 20742
moulding@umd.edu