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Flipping Hot Jupiters
Research on extrasolar planets helps us better understand our solar system

by Dr. Frederic Rasio, Joseph Cummings Professor and Dr. Smadar Naoz, Gruber Fellow
Flipping Hot Jupiters
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As of June 6, 2011, astronomers have confirmed the discovery of 552 extrasolar planets (http://exoplanet.eu/catalog.php), and the recently launched Kepler Mission (http://kepler.nasa.gov/) has already announced that it has found over 1200 additional planetary "candidates". Among the many mysteries that these discoveries have turned up is that of retrograde hot Jupiters -- i.e., massive planets moving in extremely close, virtually circular orbits around their primary star, but in a direction opposite to the star's spin.

At first glance, this is very strange. It completely violates the standard picture of planetary formation, in which planets coalesce out of a disk of gas and dust spinning in the same direction as the star's rotation. All the major planets in our solar system (and most of the minor ones) orbit the Sun in the same direction as its spin.

Figuring out how these huge planets got so close to their stars eventually led Professor Fred Rasio and his research team to also explain their flipped orbits. Using large-scale computer simulations, they are the first to model how a hot Jupiter's orbit can flip and go in the direction opposite to the star's spin. In short, once you have more than one planet in a solar system, the planets perturb each other gravitationally. Rasio's group has shown that gravitational perturbations by a distant planet can result in a hot Jupiter having both a "wrong way" rotation and a very close orbit to the star. Details of the study were published May 12 in the journal Nature.

In explaining the peculiar configuration of some extrasolar systems, Rasio and his group have added to our general understanding of planetary system formation and evolution. "We had thought our solar system was typical in the universe, but from day one everything has looked weird in the extrasolar planetary systems," Rasio says. "That makes us the odd ball really. Learning about these other systems provides a context for how special our system is. We certainly seem to live in a special place."

Rasio is the senior author of the Nature paper, titled "Hot Jupiters From Secular Planet - Planet Interactions", and the first author is Smadar Naoz, a postdoctoral fellow at Northwestern and a Gruber Fellow. The physics that the research team used to solve the problem is basically orbital mechanics, the same kind of physics NASA uses to send satellites around the solar system. "It was a beautiful problem," says Naoz, "because the answer was there for us for so long. It's the same physics, but no one noticed it could explain hot Jupiters and flipped orbits."

About the Authors

Frederic Rasio is a Professor of Physics and Astronomy at Northwestern University. He attended Cornell University for his PhD in Physics in 1991. He spent three years at the Institute for Advanced Study in Princeton, NJ, working as a NASA Hubble Fellow, and then was a professor at the Massachusetts Institute of Technology for six years before joining the faculty of the Department of Physics and Astronomy at Northwestern University in 2001. Fred's main interest is the Evolution of dense star clusters, massive black hole formation, coalescing compact binaries, gravity waves, extrasolar planets.

Smadar Naoz is a Gruber Fellow at Northwestern University. She attended Hebrew University of Jerusalem, where she received her B.SC and M.SC in Physics. She then went on to receive her PhD at Tel Aviv University in 2009. Her Research Adviser was Rennan Barkana.

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"Doing the calculations was not obvious or easy," Rasio says. "Some of the approximations used by others in the past were really not quite right. We were doing it right for the first time in 50 years, thanks in large part to the persistence of Smadar. It takes a smart, young person who first can do the calculations on paper and develop a full mathematical model and then turn it into a computer program that solves the equations," Rasio added. "This is the only way we can produce real numbers to compare to the actual measurements taken by astronomers."

In their model, the researchers assume a star similar to the Sun, and a system with two planets. The inner planet is a gas giant similar to Jupiter, and initially it is far from the star, where Jupiter-type planets are thought to form. The outer planet is also fairly large and is farther from the star than the first planet. It interacts with the inner planet, perturbing it and shaking up the system. The effects on the inner planet are weak but build up over a very long period of time, resulting in two significant changes in the system: the inner gas giant spirals in very close to the star, and its orbit ends up opposite to the spin of the central star. The changes occur, according to the model, because the two orbits are exchanging angular momentum, and the inner one loses energy via strong tides.

The gravitational coupling between the two planets causes the inner planet to go into an eccentric, needle-shaped orbit. It has to lose a lot of angular momentum, which it does by dumping it onto the outer planet's orbit. The inner planet's orbit gradually shrinks because energy is dissipated through tides, pulling it in close to the star and producing a hot Jupiter. In the process, the orbit of the inner planet can slowly be tilted until it finally rotates through more than 90 degrees and becomes "flipped".

Astronomers have observed that about a quarter of the hot Jupiter systems show flipped orbits. The Northwestern model needs to be able to produce both flipped and non-flipped orbits, and it does, Rasio said.

The research was supported by the National Science Foundation, Northwestern's Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA) and the Peter and Patricia Gruber Foundation. In addition to Prof. Rasio and Dr. Naoz, other authors on the Nature paper are Will M. Farr, a CIERA Postdoctoral Fellow; Yoram Lithwick, an Assistant Professor of Physics and Astronomy; and Jean Teyssandier, a visiting Pre-Doctoral Fellow, all from Northwestern University.

**Flashback to the past...**

Fayerweather Hall of Science (Dedicated 1887. Demolished 1953)

*Early Home of the NU Department of Physics*

When New York Industrialist Daniel Fayerweather funded Northwestern’s new Hall of Science, dedicated in 1887 on a site just west of today’s Pisk Hall, he remained an anonymous donor. Designed in the Romanesque style by Holabird and Roche, the building is thought to be the first in the Chicago area erected specifically for instruction in science. The west side of the building was used exclusively for Chemistry, and the east side for Physics.

**Cover -** A retrograde hot Jupiter: the transiting giant planet orbits very close to the star and in a direction opposite to the stellar rotation. This peculiar configuration results from gravitational perturbations by another much more distant planet. (Picture Credit: Lynette Cook).
Dear Friends of Physics and Astronomy,

As we come to the close of another successful academic year, I’d like to reflect on the achievements our department has made over the last 12 months.

We’ve admitted 20 new graduate students: 19 who will begin their studies in the fall of 2011 and one who has deferred to 2012. They come to us from prestigious centers of learning all over the world: Boston University, the Chinese University of Hong Kong, Colgate University, Depaul University, Harbin Institute of Technology, Huazhong University of Science & Technology, IIT-Kharagpur, Michigan State University, Nanjing University, Nankai University, Northeastern Illinois University, Purdue University West Lafayette, Swarthmore College, the Swiss Federal Institute of Technology, the University of California Berkeley, the University of Illinois at Urbana-Champaign, the University of Rochester, the University of Science and Technology of China, and Wheaton College.

There have been notable achievements amongst our graduate students this year. Benjamin Farr, Carl Rodriguez, and Thomas Wytock were awarded NSF Graduate Research fellowships and several of our students have been the principal researchers for articles published in prominent science publications: Francesca Valsecchi (“Formation of the black-hole binary M33 X-7 through mass exchange in a tight massive system”, Nature 468, 77–79 (04 November 2010)), Andrew Mounce (“Charge-induced vortex lattice instability”, Nature Physics 7, 125–128 (28 November 2010)), Sagar Sahasrabudhe (“Rescuing ecosystems from extinction cascades through compensatory perturbations”, Nature Communications 2, 170 (25 January 2011)). Additional students have been secondary authors to articles recently published. More details about their work are listed on pages 11 & 12.

Our undergraduate majors now number 61. This year, a high number of these students were recipients of fellowships, scholarships, and awards. Michelle Miller, a graduating senior, received an NSF Graduate Research fellowship. She will be attending the University of Colorado, Boulder. Only two 2011 Goldwater Scholarships were awarded at Northwestern University, and the recipients were two Physics juniors: Sascha Herrmann and Kyle Kremer. Eight of our students received summer research awards. Greg McGlynn was the recipient of our 2011 Outstanding Senior Thesis and Physics and Astronomy. David Caratelli and Sascha Herrmann won the 2011 Outstanding Junior in Physics and Astronomy award. Ian Lizarraga, Greg McGlynn, Spencer Nelson, and Michael Tremmel are graduating with honors. David Caratelli, Sascha Herrmann, Ian Lizarraga, and Scott Williams were elected to Phi Beta Kappa. Several of our double- (and triple-) majors won awards from other departments. We congratulate them all!

We have collaborated with the faculty of Molecular Biosciences, Chemistry, Earth & Planetary Sciences, Electrical Engineering & Computer Science, and Materials Science & Engineering departments to create a new Applied Physics Graduate program. Recruitment was successful, and the program actually ended up admitting 3 over their stated goal. The first students will begin their studies in the fall of 2011.

The framework and the walls of the Tech F-Wing addition have been completed. We are now in the process of laying the cables and building the interior. We expect to move into the 4th floor addition at the end of 2011, with further moves as we rearrange our space to maximize windowed office space.

Several of our alumni are featured in this issue of Dimensions. If we’ve missed you, please send us an update for next year’s edition. We are proud of our alumni, and want to hear how you’re doing.

With best wishes,

Heidi Schellman, Professor and Chair
Department of Physics & Astronomy

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Welcome, New Faculty!

Frank Petriello joined our faculty in August, 2010, at the rank of Associate Professor, co-terminus with an appointment at Argonne National Laboratory where he is Physicist in the High Energy Physics Division. Prof. Petriello was previously on the faculty at University of Wisconsin at Madison. He received a B.S. in Physics and B.A. in Mathematics from the University of Florida. He then received his PhD in 2003 at Stanford University for his thesis, Topics in Collider Physics. His adviser was Prof. JoAnne Hewett. He was awarded the Alfred P. Sloan Foundation Research Fellowship in 2006, the U.S. Department of Energy Outstanding Junior Investigator Award in 2007, and a Wisconsin Alumni Research Foundation Research Award.

He pursues a research program in precision QCD in order to improve the Standard Model predictions for important hadron collider observables and their backgrounds. He has developed a variety of novel techniques to facilitate the ultra-precise comparison of theoretical predictions with experimental data. A second goal of his work is the development of new strategies to search for and study new physics at the Large Hadron Collider and in other experiments.

Jens Koch joined the faculty as an Assistant Professor in September, 2010. He came from Yale University, where he worked as a Postdoctoral Associate in the Departments of Physics and Applied Physics with Prof. Steven Girvin’s research group. He completed his M.S. at the Freie Universität of Berlin, with a minor in mathematics, in 2003. He received his PhD at the same institution in 2006, with his thesis titled Quantum Transport Through Single-Molecule Devices. He was awarded the Yale Quantum Information and Mesoscopic Physics Fellowship in 2006, and the Carl Ramsauer Award for outstanding PhD thesis in physical science by the Berlin Physical Society in 2007.

His research is concerned with various topics in the field of theoretical condensed matter physics, ranging from strongly correlated systems to the theory of quantum transport. Recent papers have dealt with the similarity of certain superconducting circuits to artificial atoms, and with the behavior of superconducting phase transitions within a formalism known as the Jaynes-Cummings lattice model.

Radja Boughezal was recently appointed to a five-year term as Adjunct Assistant Professor. She received her PhD in 2005 from the Albert Ludwigs University of Freiburg. Her research is in Precision QCD predictions for collider observables; Higgs phenomenology; electroweak precision observables. Her primary appointment is at the Argonne National Laboratory.

Olle Heinonen was recently appointed to a five-year term as Adjunct Professor. He received his PhD in 1985 from Case Western Reserve University, His research is in behavior of magnetization in nanoscale magnetic system, and also transport and resistive switching in metal/oxide metal nanostructure. His primary appointment is at the Argonne National Laboratory.

A Toast to Kamal K. Seth, for 50 years at Northwestern University.


Prof. Seth amused by the surprise. Behind him are (L-R): Profs. Yoram Lithwick, Mayda Velasco, Brian Odom.
Faculty News

Bill Halperin, on the topic of helium availability as a precious natural resource, has been interviewed for news stories by Science Magazine, Physics Today, Wired, ABC news, and National Geographic Magazine. He was also "interviewed" on the Daily Show (September 28, 2010).

Prem Kumar of Physics and Astronomy and EECS has been appointed to serve on a National Research Council committee charged with developing a report on “Harnessing Light: Capitalizing on Optical Science Trends and Challenges for Future Research.”. This is an update of the 1998 study.

The National Research Council will convene a committee to (1) Review updates in the state of the science that have taken place since publication of the National Research Council report, Harnessing Light in 1998. (2) Identify the technological opportunities that have arisen from recent advances in optical science and engineering. (3) Assess the current state of optical science and engineering in the United States and abroad. (4) Prioritize a set of research grand-challenge questions to fill identified technological gaps. (5) Recommend actions for the development and maintenance of global leadership in the photonics driven industry.

Vicky Kalogeraner (Erastus Otis Haven Professor of Physics and Astronomy) and Fred Rasio (Joseph Cummings Professor of Physics) were honored at Weinberg College of Arts and Sciences Investiture Ceremony on February 10, 2011 The professors spoke about an experience that was formative to their development as a scholar and were awarded medallions by Dean Sarah Mangelsdorf.

Dave Meyer presents the scientific stories behind ten of Hubble's most spectacular cosmic images. Over the past 20 years, the Hubble Space Telescope has taken more than a half million images of planets, stars, nebulae, and galaxies. In his recently-released six-hour DVD video course "Experiencing Hubble: Understanding the Greatest Images of the Universe" (The Teaching Company, January 2011), These "Hubble stories" illustrate how the telescope's unique imaging capabilities have made its discoveries possible and provide an inside look at the history and operation of Hubble as it has been utilized to attack the most important problems in modern astrophysics.


Adiston E. Motter has received a CAREER award from the NSF

He received a CAREER award for his proposal “Rescue and Control of Complex Networks of Dynamical Systems: Nonlinear Dynamics Approaches and Applications to Biological and Physical Networks.” The project is focused on developing mathematical and computational methods to prevent large-scale failures in complex networks, such as power outages, extinction cascades, loss of biological function and cascading failures in general. The project includes education and outreach activities to be developed in partnership with Chicago’s Museum of Science and Industry, which will disseminate the research results to a large and diverse audience. See the full story at the Northwestern NEWSCENTER

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5 - Dimensions
Adilson E. Motter's work suggests that the early universe was inherently chaotic.

Is chaos a property of the physical system or of the observer? At the center of this discussion is the mixmaster cosmological model, an anisotropic solution of Einstein's equations conjectured to describe the dynamics of the early universe, which has been shown to exhibit or not exhibit sensitive dependence on initial conditions, depending on the time coordinate adopted. This problem has resisted rigorous solution because the identification of invariant indicators of chaos is often elusive in general relativity. Now, a new study by Prof. Adilson E. Motter and a colleague has proven once and for all that Lyapunov exponents, entropies, and dimension-like characteristics can all be used to make invariant assertions about chaos. When applied to the early-universe model, these results indicate that the universe was born inherently chaotic and that different observers will necessarily agree on that. However, the same results also show that the values of important quantities that have been previously assumed to be invariant, such as the information dimension and topological entropy, are not invariant in general. Read the original article in Communications in Mathematical Physics. More information is available at the Northwestern NewsCenter and at Space.COM.

Adilson Motter has been promoted to Associate Professor with Tenure.

Andrew Rivers received a promotion to Distinguished Senior Lecturer.

James Sauls' work on Spin-Polarized Supercurrents for Spintronics featured in Physics Today. The past decade has seen a rapid development in the design and fabrication of hybrid materials made of superconductors (S) and ferromagnets (F). Spin-polarized supercurrents can now be transmitted over long distances, providing a controllable source of spin. A symposium of the March APS meeting in Dallas will highlight recent experimental discoveries of spin-triplet supercurrents, while a feature article in the January issue of Physics Today describes developments in field of superconducting spintronics and highlights key theoretical ideas, including the mechanism of "spin-mixing" identified by Taku Tokuyasu, James Sauls and Dieter Rainer for conversion of spin-singlet Cooper pairs into spin-triplet pairs by quantum tunneling of electron pairs into the classically forbidden region of a ferromagnet in FS proximity bi-layers. With readily available spin-polarized supercurrents a door has been opened for new spin-based applications. One can realistically envision voltage-controlled FS circuit elements for the transport of spin and spin-torque over long distances with long spin coherence times, important features for spin-based quantum device applications.

http://eolus.phys.northwestern.edu/CM_Theory_Group/In_The_News.html

Selim Shahriar has been elected a Fellow of The Optical Society. He is among the new OSA Fellows announced for the class of 2011. The Optical Society is bestowing this honor on Selim for "seminal contributions to opto-spintronics, including first demonstration of slow/halted light in solids, high-efficiency nonlinear optics in atomic vapor, sub-recoil cooling of trapped atoms, and use of fast light for high-sensitivity metrology."

Michael Smutko was promoted to Distinguished Senior Lecturer.

Mayda Velasco received a promotion to Full Professor.

Farhad Yusef-Zadeh has been elected a Fellow of the American Physical Society. The citation is: "For his discovery of many astrophysical sources in the core of the galaxy, and for his contributions to our understanding of these sources, of star formation, of molecular clouds interacting with supernova remnants, and of the emission mechanism associated with the massive black hole at the galactic center."

Farhad Yusef-Zadeh gave a presentation to the press at the April meeting of the American Physical Society. Here is the abstract of the presentation: "The newly-discovered black hole at the center of our galaxy, Sagittarius A* (Sagittarius A-Star), appears to be emitting flares similar to those emitted by our Sun. The black holes flares, which are emitted as radio, millimeter, infrared and X-ray wavelengths, are much more energetic than flares emitted by the Sun. Farhad Yusef-Zadeh, of Northwestern University, will talk about the discovery of these flares and his attempts to learn how they are produced - whether they show material growing into or being ejected from a black hole. We don't know exactly where [the flares are] being produced, but we think it is very close to the event horizon of a black hole Yusef-Zadeh said. The event horizon is the turning point at the edge of a black hole where material wandering by is sucked in with no hope of return and where space and time are distorted. The team has also noticed that there is a time delay between the observation of infrared flares and X-ray flares. They hypothesize that the X-ray flares are echoes of the infrared flares. If they are correct, it would confirm a theoretical model about black hole flaring called inverse Compton scattering."
Selected Publications:

Jens Koch

One of the hot candidates in developing the hardware for a future quantum computer are small circuits entirely made of superconductors. A crucial prerequisite for further improvements of quantum coherence in such circuits is a detailed understanding of coherence limiting processes. In this recent PRL, Koch and collaborators at Yale present a quantitative theory for possible limitations from thermal and nonequilibrium quasiparticles.

http://prl.aps.org/abstract/PRL/v106/i7/e077002

Jens Koch

Imagine watching a movie of a planet orbiting its sun, or a close-up of the impact between two billiard balls. Generally, it will not be possible to decide whether the movie is running forward or backward. This is a manifestation of time-reversal symmetry, which is directly built into the majority of physics laws of physics, including Newton's second law and Schrödinger's equation. Breaking time-reversal, e.g. by the use of external magnetic fields, gives rise to some of the most astonishing phenomena in condensed matter systems, including the fractionalization of charge in the quantum Hall effect.

Recent studies predict that photons in qubit/resonator arrays could display a variety of matter-like properties and undergo quantum phase transitions similar to those explored with ultracold atoms. To apply the concept of time-reversal symmetry breaking in charge-neutral systems, tricks have to be invented. Professor Jens Koch showed that photons can be equipped with an artificial gauge charge by coupling them to simple superconducting circuits. This way of making photons susceptible to magnetic fields may open the path to observing the fractional quantum Hall effect in strongly correlated photon systems.

http://pra.aps.org/abstract/PRA/v82/i4/e043811

Adilson E. Motter

Environmental and genetic perturbations of the bacterium Escherichia coli are followed by the temporary activation of a large number of latent metabolic pathways. This study tests the hypothesis that temporarily activated pathways facilitate adaptation in the presence of perturbations. The result, however, is anything but expected.

http://www.pnas.org/content/108/12/5144

Brian Odom

Although laser cooling of atoms is a well-established technique, allowing microKelvin temperatures to be achieved without cryogenics, the additional rotational and vibrational complexity of molecules has thus far prevented trapped molecular samples from being laser cooled. In this publication, we propose and model direct laser cooling of a promising new class of molecules.

http://pra.aps.org/abstract/PRA/v83/i5/e053404

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New Research Staff

Hua Bai - (Prof. Marko's group)

Nicholas Chapman - (Prof. Novak's group) is an observational astronomer who takes many trips to Hawaii for work. He is primarily interested in the large-scale structure and properties of molecular clouds, where stars form. With Prof. Novak he is studying the importance of magnetic fields in regulating star formation. Before coming to Northwestern, he was a postdoc at JPL, and received his Ph.D. in 2007 from the University of Maryland.

Jino Im - (Prof. Freeman's group) His core research interest lies in the theoretical study of condensed matter physics. Currently, his research is focused on 1) the theoretical investigation of topological insulators and 2) material design for p-type transparent conducting oxides (TCO). Using density functional theory (DFT), he investigates topological phases and their phase transitions on magnetic ion doped Bi$_2$Se$_3$ thin films. He also investigates a systematic approach to find out possible p-type TCOS. The systematic approach is guided by some design principles and performed through high-throughput calculations using DFT.

Jennifer Kile (Prof. de Gouvêa’s group) is a theoretical particle physicist. Recently, her research efforts have concentrated on understanding potential properties of dark matter and how one can take advantage of these in order to detect it at different particle physics experiments, including high energy colliders and large detectors that study extra-terrestrial neutrinos. Jennifer got her PhD in 2007 at Caltech where she worked with Mark Wise and Michael Ramsey-Musolf. Before joining Northwestern she was a postdoc in the particle physics theory group at the Brookhaven National Laboratory.

Sung-Hyon Rhim (Prof. Freeman's group)

Xiao-Li Song - (Prof. Ketterson's group) Research fields: BEC & Cold atoms, Quantum optics, Nonlinear Optics, Atomic and Molecular Spectroscopy . She got her PhD degree at the College of Physics of Jilin University of China, graduating in 2008. During her PhD period, she researched optical signal storage based on stimulated Raman adiabatic passage in three level systems. She also researched optical signal storage in tripod-level systems. From 2008 to 2010, she was a postdoctoral fellow at the Institution Lineaire de Nice of France. She researched Anderson Localization in BEC & old atoms during the two years. She loves her parents very much and also likes animals, especial the cute animals.

Leah Welty-Rieger (Prof. Schellman's group) earned her PhD at Indiana University, graduating in 2008 with a focus on High Energy Physics. For her doctorate research, she measured the lifetime of the charmed B meson at the D-Zero experiment at Fermilab. After she graduated she accepted a position as a software developer for Obtiva, a small consulting company in Chicago. However, Leah found herself missing the world of physics and accepted a postdoc position with Prof. Heidi Schellman at Northwestern in the summer of 2010. She is now searching for the Higgs boson back at the D-Zero experiment. Leah was also recently awarded a University Research Association Fellowship to work on the new g-2 experiment at Fermilab. In her free time she loves taking pictures and spending time on Chicago’s lakefront going for runs and bike rides with her husband and their 18 month old daughter, Lucille.

Suk Joo Youn (Prof. Freeman’s group) is an Associate Professor at the Department of Physics Education, Gyeongsang National University, Korea. He is visiting Northwestern University for a sabbatical year. He is working on the electronic structure of magnetic materials. He was a postdoc in Prof. Freeman's group between 1997 and 2000.

Research Staff News

Smadar Naoz


The search for extra-solar planets has led to the surprising discovery of many Jupiter-like planets in very close proximity to their host star, the so-called "hot Jupiters". Even more surprisingly, many of these hot Jupiters have orbits that are eccentric or highly inclined with respect to the equator of the star, and some are even orbiting counter to the spin direction of the star. This poses a unique challenge to all planet formation models. In recent research done at Northwestern University we showed that the presence of an additional, moderately inclined and eccentric massive planet in the system can naturally explain close, inclined and eccentric orbits. This research gives a new mechanism to form hot Jupiters, which is also consistent with observations.

www.nature.com/nature/journal/v473/n7346/full/nature10076.html

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We Hear That...(Alumni News)

Anne Dabrowski (PhD 2007, Mayda Velasco) received a CERN Scientific Staff position starting in March 2011. She has joined the CMS LHC experiment.

John Patrick Davis (PhD 2008, Bill Halperin) is an Assistant Professor in the Department of Physics at the University of Alberta in Edmonton, Alberta, Canada and Associate Member of the Canadian Institute for Advanced Research (CIFAR) Nanoelectronics Program.

Adrian Jinich (BA 2006, Adison Motter), who took a year off in Mexico, will start his PhD in the Fall at Harvard University to study Systems Biology.

Justin Lieber (BA 2008, Adison Motter) will pursue a PhD in Neurobiology at the University of Chicago.

Zachary Nicolaou (BA 2010, Adison Motter) will enter a PhD program this fall to study Theoretical Physics at the California Institute of Technology. He spent one year working on a Masters in Applied Mathematics and Theoretical Physics at Cambridge University. His studies are funded by an NSF Graduate Research Fellowship.

Raymond A. Spong (BS 1949, Kaj Aage Gunnar Strand) graduated from Lane Technical High School in Chicago about a month after the attack on Pearl Harbor. He entered NU in the fall of 1942. He met his future wife in the Friday night lab sessions that Professor Oliver Lee held with his beginning astronomy class. At that time Dr. Strand headed the Astronomy Department, and Dr. Krogdahl was the only other permanent staff member. For several years after Raymond received his BS he worked as a graduate assistant, mostly reading glass plates on a measuring engine in conjunction with research on the double star system 70 Ophiuchi. The calculations were done on a Marchand calculator, and backed up by a mechanical Monroe adding machine to which someone had affixed a small motor so that at least simple addition could be done without extra keystrokes. Although IBM offered him a job as a time clock repair man, Raymond eventually accepted a position with the US Naval Underwater Sound Laboratory, and spent the remainder of his career working on underwater sound and anti-submarine warfare problems, 35 of those years in the Electric Boat Division of General Dynamics.

Northwestern Physics and Astronomy Alumni Spotlight

Robert Redwine, PhD, Physics, 1973: "What I find particularly impressive about Bob Redwine is not just his ability to identify and investigate some of the most challenging research problems in Nuclear physics, but to also get involved in undergraduate education by taking on the demanding job of Dean of Undergraduate Education at MIT." - Prof. Kamal Seth, Physics & Astronomy, Northwestern

Ivan Schuller, PhD, Physics, 1976: "Schuller's work on artificial metallic super lattices ultimately led to the discovery and application of the phenomena of 'giant magnetoresistance' in metallic-ferromagnetic conductors, which is the basis of the 'read heads' in modern computer hard drives." - Prof. John Kettrerson, Physics & Astronomy, Northwestern

Edward J. Weiler, PhD, Astrophysics, 1976: "He has championed space science at NASA Headquarters. As Chief Scientist of the Hubble Space Telescope he was responsible for overseeing this important NASA mission from its beginnings up to launch. The Hubble telescope has provided outstanding observational data for more than 20 years since its launch in April 1990." - Prof. Melville Ulmer, Physics & Astronomy, Northwestern

Alumni Spotlight photos and text courtesy of the Northwestern University Graduate School, which has highlighted three Physics & Astronomy alumni in celebration of their 100th anniversary.

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PhD Graduates

Congratulations to everyone for a job well done!

Sourav Chatterjee, who worked with Prof. Frederic Rasio, is a Postdoctoral Associate working on exoplanets for the Department of Astronomy at the University of Florida in Gainesville. His thesis was titled *Numeric Modeling of Dense Star Clusters.*

Milja Medic wrote her thesis *Characterization and Utilization of Fiber-Generated Quantum Entanglement* under the supervision of Prof. Prem Kumar.

Anastasios (Tassos) Fragkos worked with Prof. Vicky Kalogera on his thesis, *Formation and Evolution of X-ray Binaries.* He is currently a ITC/CfA Postdoctoral fellow (joint 4 year fellowships) at Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.

Sagar Sahasrabudhe worked with Prof. Adilson Motter on his thesis, *Rescue Perturbations in Complex Networks of Dynamical Systems: Application to the Control of Extinction Cascades in Ecological Networks.* He is now working at Spot Trading LLC.

Wei-Chih Huang successfully defended his thesis, *Right-handed neutrinos* with Prof. André de Gouvêa. He will be a postdoctoral fellow at the International School for Advanced Studies (SISSA), in Italy. This is a 2-year research postdoc position.

Avinash Vijayaraghavan worked with Prof. Anupam Garg on his thesis *Tunneling in Molecular Magnets.*

Graduate Achievements

Publications

Bill Gannon (graduate student/Prof. William Halperin's group)


In studying superconductivity, of particular interest are superconducting materials that spontaneously break symmetries in addition to U(1) gauge symmetry, which is broken by all superconductors. Because of its multiple superconducting phases, the compound UPt3 is believed to be one of these "unconventional" superconductors. Experiments with collaborators at the University of Illinois at Urbana-Champaign, using directional Josephson tunneling, demonstrate that that with decreasing temperature, this compound transitions from one superconducting phase to another that is consistent with predictions for broken time-reversal symmetry in zero applied magnetic field. A key requirement in this experiment is that the UPt3 crystals be of the highest possible purity with nearly perfect surfaces. The crystal growth and careful sample preparation were performed in our physics department by in the Halperin laboratory. The crystals used for this experiment are among the highest quality ever reported. The work, supported by the Department of Energy, recently appeared in *Science* 328, 1368 (2010).

http://www.sciencemag.org/content/328/5984/1368.full.pdf

Andrew Mounce (graduate student, Prof. William Halperin's group)


Charge has been predicted to accumulate in the cores of type-II superconductors due to the Lorentz force. This effect is most prominent in high temperature superconductors. We investigate how charge affects the vortex lattice due to Coulomb repulsion and find that at sufficiently high magnetic fields, this charge can cause a change in the vortex lattice ordering and reduce the variations in local magnetic field. Applying these results to NMR spectra measured in Bi2212, we are able to identify the magnetic field for this phase transition and quantify the amount of charge accumulated.

http://www.nature.com/nphys/journal/v7/n2/full/nphys1835.html

Sagar Sahasrabudhe (former graduate student and recent PhD recipient, Prof. Adilson E. Motter's group)


Climate change, overexploitation, and habitat degradation often cause initial loss of species which results in a cascade of secondary extinctions. A paper published in *Nature Communications* by Sagar Sahasrabudhe and his Ph.D. adviser, Prof. Adilson E. Motter, proposes a method which could potentially combat this cascade effect, support ecosystem conservation efforts and rescue otherwise threatened species. The study shows, through a combination of dynamical systems theory and network-based predictive modeling, that the extinction of one species may be compensated by the local suppression or removal of other specific species. The authors note that these intervention strategies may be implemented in conjunction with economical activities, such as fishing and hunting, and also by means of non-lethal growth suppression and relocation. These results provide evidence for the growing understanding that preservation requires more than the absence of active destruction and promises to offer important insights in combination with multidisciplinary projects on proactive management actions.


Sagar Sahasrabudhe successfully defended his Ph.D. Thesis following the completion of this study.

http://www.nature.com/ncomms/journal/v2/n1/full/ncomms1163.html

Spring 2011
Francesca Valsecchi (graduate student, Prof. Vicky Kalogera's group)

M33 X-7 is a recently discovered (2007) x-ray luminous binary system that hosts one of the most massive black holes among all x-ray binaries known at present, a 15.65 solar mass black hole orbiting a 70 solar mass stellar companion in a Keplerian orbit of 3.45 days. The massive components (the star is the most massive star ever discovered in this class of systems), and the tight orbit challenge our understanding of typically invoked black-hole x-ray binary formation channels. For the first time, we present a solution to the evolutionary history of M33 X-7 that is consistent with the complete set of observational constraints.

www.nature.com/nature/journal/vaop/ncurrent/abs/nature09463.html

News
Andrey Pozdnyakov (graduate student, Prof. Mayda Velasco's group) was selected to represent CMS in a major LHC wide workshop devoted to understand the underlying event in proton-proton collisions at 7 TeV.
https://indico.cern.ch/conferenceOtherViews.py?view=standard&confId=110042

Awards
Benjamin Farr, a graduate student working with Prof. Vicky Kalogera, was awarded a 2011 NSF Graduate Research Fellowship

Joo Sang Lee, a graduate student working with Adilson E. Motter, has been selected to receive a Fellowship from the Biotechnology Cluster Program. Lee, who is also part of the NU Physical Science Oncology Center, studies relations between metabolism, gene expression, and cancer.

Carl Rodriguez, a graduate student working with Prof. Vicky Kalogera, was awarded a 2011 NSF Graduate Research Fellowship

Thomas Wytock, a graduate student working with Prof. Adilson Motter, was awarded a 2011 NSF Graduate Research Fellowship. He has been appointed to the NIH-sponsored Molecular Biophysics Training Program. Wytock's research will be focused on gene interaction networks.
**Bachelor Graduates**

_Congratulations Class of 2011!_

Daniel Case is looking for life after school.

Stanley Gutiontov will begin attending the Northwestern University, Feinberg School of Medicine this fall.

Abijith Kowligy is already enrolled in the PhD program at Northwestern University in the Department of Electrical Engineering and Computer Science Dept under Prof. Prem Kumar.

Christopher Lawlor will be working for the next two years at a company in California called Sonim Technologies in the position of "Office of the CEO." His position entails leading the CEO's high priority strategic projects spanning the company's global units and key verticals. After 2 years at Sonim, he will be attending Harvard Business School pursuing a MBA (Class of 2015.)

Ian Lizarraga will begin pursuing a PhD in Applied Math at Cornell University. His area of research will be Nonlinear Dynamics and Mathematical Physics.

Andrew Loveridge will be going to the University of Wisconsin Madison for a PhD in Physics.

Greg McGlynn will be attending Columbia University to pursue a PhD in Physics. He hopes to study Theoretical Particle Physics.

Michael Medford will be working at NU this summer, helping with the summer physics courses. He plans to stay in Chicago and will be pursuing a career in theater. His goals include starting a theater company in Chicago and continuing to make art with Northwestern alumni.

Michelle Miller will be attending the University of Colorado, Boulder for a PhD in Atomic, Molecular, and Optical Physics.

Spencer Nelson is moving to the West Coast to pursue job opportunities in the IT industry. He hopes to network a position in the SF Bay or Seattle areas.

Matthew Nubbe is taking a position with Reliant Technology in Georgia, a data storage company.

Scott Phelan will attend the Georgia Institute of Technology for a Ph.D. in Aerospace Engineering. He will be working at the Aerospace Systems Design Laboratory (ASDL), with Dr. Dimitri Mavris. His area of research will be in Aerospace Systems Design.

Michael Tremmel will be attending the University of Washington in Seattle for a PhD in Astronomy. He plans on working in Theoretical Astrophysics, specifically Galaxy Formation and Evolution.

Xinyang (Stephen) Zhang will be working in Morgan Stanley in Hong Kong as a Financial Analyst.
Undergraduate Achievements

Honors
Four students this year successfully completed honors degrees in the department. In addition to maintaining a minimum GPA of 3.50, students must submit a senior thesis for the honors degree. The four students, along with the names of their faculty advisors and the titles of their theses, were:

Ian Lizarraga (Fred Rasio)
Secular Dynamics of Three-Body Systems and the Origins of Retrograde Hot Jupiters

Greg McGlynn (Brian Odom)
Laser Frequency Stabilization Systems for Laser Cooling of Trapped Barium Ions

Spencer Nelson (Dave Meyer)
A Search for Solar-System-Scale Structure in the Vibrationally-Excited H₂ Gas Toward HD 37903

Michael Tremmel (Vicky Kalogera)
The Evolution of X-ray Binaries on Cosmological Timescales

Awards
David Caratelli (André de Gouvêa) - 2011 Outstanding Junior in Physics and Astronomy

Sascha Herrmann (Adilson E. Motter) - 2011 Outstanding Junior in Physics and Astronomy, 2011 Goldwater Scholarship (Career Goal: Conduct research in fluid mechanics and chaotic dynamical systems), 2011 Outstanding Achievement in Mathematics by a Junior.

Kyle Kremer (Vicky Kalogera) - 2011 Goldwater Scholarship (Career Goal: Conduct research in physics with focus in astrophysics and nuclear physics)

Andrew Loveridge (Vicky Kalogera) - Outstanding Senior Thesis in ISP "Analytical expressions for the envelope binding energy of giants as a function of basic stellar parameters"

Mauricio Maluff Masi - Outstanding Achievement in French

Greg McGlynn (Brian Odom) - 2011 Outstanding Senior Thesis in Physics and Astronomy, the Math award for Outstanding Achievement on the Putman Examination, a national math competition (ranked between 103.5 and 188 out of about 4000 people, the highest at Northwestern), Most Outstanding Senior in Computer Science (from the Dept. of Electrical Engineering & Computer Science).

Michelle Miller (Tamar Seideman) - 2011 NSF Graduate Research Fellowship

Andrew Srisuwananukorn (Giles Novak) - Outstanding Achievement in Mathematics by a Sophomore

Michael Tremmel (Vicky Kalogera) won the 3rd place award among all Natural Sciences and Engineering posters, Morning Session presented at the NU Undergraduate Research Symposium on May 23, 2011.

Phi Beta Kappa Electees
Each spring, the Northwestern chapter of Phi Beta Kappa, a secret liberal arts honorary society, elects juniors and seniors in Weinberg College to that society. Phi Beta Kappa members are identified in the commencement program. Criteria for election include GPA, the selection of courses, other academic activities, and instructors' recommendations. Students cannot apply to Phi Beta Kappa, and the details of election criteria and procedures are not made public.

We are pleased to announce that the following students from the Department of Physics and Astronomy have been elected to Phi Beta Kappa in 2011:

David Caratelli
Adviser: Prof. André de Gouvêa

Sascha Herrmann
Adviser: Prof. Adilson E. Motter

Ian Lizarraga
Adviser: Prof. Frederic Rasio

Scott Williams
Adviser: Prof. Brian Odom
Research Grant Recipients

Congratulations to the Northwestern University Undergraduate Research Grant (URG), URG-ISEN, and PS-OC Fellowship recipients!

David Caratelli*
*Theoretical Design of an Experiment to Determine the Neutrino Mass Hierarchy
Prof. André de Gouvêa's High Energy Theory group.

Rongrong Checharoeno**
**Oxygen Vacancies Concentration: Controlling Electronic Transition Temperature in Vanadium Dioxide Nanowires
Prof. Lincoln Lauhon's Hierarchical Materials Synthesis group

Sascha Herrmann***
***Dynamical Systems Modeling of Cancer
Prof. Adilson Motter's group, as part of the Physical Sciences-Oncology Center project to study physical aspects of cancer.

Ryan Jasinski*
*The Nearest Cold Interstellar Clouds
Prof. David Meyer's Observational Astronomy group

Taylor (Jack) Kennedy**
**Organic Ferroelectrics: Investigating Nanoscale Crystalline Structures for Low Power-Consumption Computer Memory Solutions
Prof. Samuel Stupp's group

Mauricio Maloff Masi*
*Origin and Stability of the Kepler-11 Planetary System
Prof. Yoram Lithwick's Theoretical Astrophysics group.

Jennifer Mills*
*Testing the Sulfate Initiation Hypothesis for Ocean Anoxic Event 1a
Prof. Bradley Sageman's group, Earth and Planetary Sciences

Pavan Patel**
**Growth of Graphene by Chemical Vapor Deposition
Prof. Venkat Chandrasekhar's Mesoscopic Physics group.

Dan Stevens*
*Convergence Tests for Metropolis-Hastings Markov Chain Monte-Carlo Simulations
Prof. Vicky Kaloger's Theoretical Astrophysics group.

*NU Northwestern University Undergraduate Research Grant (URG)

News

Physics major Ian Lizarraga has given an interview about his Summer Research Experience in Prof. Motter's Group, which is now available at the NU Undergraduate Research Webpage: http://undergradresearch.northwestern.edu/. Ian’s summer project was funded by the NU Undergraduate Research Grant Program.

Please visit the Physics and Astronomy website for a complete list of upcoming events: www.physics.northwestern.edu/events

Be sure to check out our Facebook Fan page and our LinkedIn Group Page.

Type in "Department of Physics and Astronomy, Northwestern University".
Northwestern's Society of Physics Students (SPS)

This year was, overall, a good one for the Society of Physics Students (SPS) at Northwestern. We have continued some of our usual activities while starting new ones. As always, we have hosted a number of informal talks by professors in the department on their research. These talks are directed to undergraduates studying in the department and are a great way to learn about research being conducted by faculty. A new thing SPS tried to do this year is reach out to professors in other departments who study topics that might be of interest to physics-minded students. In the spring, we were able to host Professor Axel Mueller from the philosophy department. Prof. Mueller studies the philosophy of science, and his talk was extremely interesting and a pleasant diversion from pure physics research. Since we usually try to fit in a field trip in our event calendar this year we decided to head over to Fermilab. There Prof. Heidi Schellman gave us a special tour of the facilities.

Prof. Art Schmidt also helped out a great deal with our regular meetings by organizing a number of "make-and-take" evenings where students would make cool devices out of very simple materials (my personal favorite: the Cartesian Diver – look it up!). Prof. Schmidt also was very helpful in finding opportunities for SPS members to participate in physics outreach. SPS saw some of its members participate in events like "bring your child to school" and the yearly Society of Women Engineers' day for high school girls. At all of these events, our members enthusiastically conducted physics demonstrations that were nothing short of spectacular! Some of our physics majors were also involved in “Splash,” a new program at NU that brings children from Chicagoland schools to campus to take classes offered by faculty and students. SPS members taught physics lectures to these students on such topics as quantum mechanics. In addition, SPS has continued the tutoring program it started last year, and we will pursue it again in the fall.

One of the main talks we helped host was a discussion panel designed for students with the lecturers of the 2011 Heilborn Symposium. The event had a good turnout and was a success. We thank Prof. Michael Schmitt for the work he put into the panel and the symposium as a whole. What was new for SPS this year was an event we hope will become a tradition for the department: a physics majors’ dinner hosted in mid-May where all undergraduates in the department and all faculty are invited to have dinner together in Evanston. The event attracted a crowd of over thirty people and was very well received by both faculty and students. The final event of the year, as usual, was the department memorial-day picnic organized by SPS. Luckily, this year, an unforgiving thunderstorm did not cancel the event, and faculty, grad students and undergraduates were able to enjoy burgers, hot dogs, etc. in an incredibly hot day, while playing soccer and volleyball on the lake fill on campus.

As we do every year, SPS held its elections in April and elected a new executive board composed by the following people: David Caratelli (President), David Ladic (Vice President), Annas Rahman (Treasurer), Daniel Stevens (Secretary), Ingrid Ringler (Outreach Chair), Ben Godek (General Officer). We would like to thank all our members for the hard work they have been putting into the club. Leaving SPS this year are the seniors, Michael Tremmel (former president) and Michelle Miller (former VP). Thank you for all you have done for the club, and we wish you the best of luck with your future plans after graduation. And of course last but not least, a big thank you to Prof. Art Schmidt, our faculty adviser who puts so much effort into helping SPS be the awesome club it is!

Ready for the tour...hardhats required.

Group shot in front of Fermilab.
Department Events for 2010-11

Wine and Cheese Event to Welcome the New Graduate Students
September 22, 2010

We had another successful "Wine and Cheese" event to welcome the new graduate students to the Department of Physics and Astronomy. There was a huge turnout at the popular event!

Quantum and Nanoscale Matter: a Symposium in Honor of Prof. John B. Ketterson
March 26, 2011

The Kettersonfest was a tribute to the life and achievements of Prof. John B. Ketterson. Scientists and friends, former and current students came from far and near to honor a professor who has contributed greatly to both Northwestern and to the science of physics. Congratulations Prof. Ketterson!

Second Annual CIERA Public Lecture by Prof. Kip Thorne
October 18, 2010

Prof. Kip Thorne, guest speaker for the CIERA public lecture, is one of the world's leading experts on the astrophysical implications of Einstein's general theory of relativity, known for his prolific contributions in gravitation physics and astrophysics. He is currently working on a film with Steven Speilberg. The title of his talk was "The Warped Side of our Universe: From the Big Band to Black Holes and Gravitational Waves"
Heilborn Symposium 2011:
The Three Frontiers of Particle Physics

In the 21st century, the physics of elementary particles is explored on three experimental fronts: 1) in high-energy collider experiments, where new particles and interactions might be observed directly, 2) in low-energy experiments searching for forbidden or extremely rare processes, and 3) in the exceedingly precise measurement of very low energy or static properties of known light particles. Although experiments performed at these three frontiers may appear to have no relation to each other, a theoretical view reveals an underlying unity to these investigations that promises to teach us profound truths about nature at its most fundamental level.

Through the generous support of George Heilborn, in honor of his parents Walter and Christine Heilborn, the faculty of the Department of Physics and Astronomy invited three distinguished physicists to present the status of experimental work at these three frontiers, and a world-renowned theorist to explain the particle physics principles that bridge them.

May 11, 2011
Dr. Yannis Semertzidis
*Precision Frontier* (Brookhaven National Laboratory)

Dr. Laurence Littenberg
*Highlights of the Intensity Frontier* (Brookhaven National Laboratory)

Prof. Paris Sphicas
*High-Energy Frontier* (CERN and the University of Athens)

Prof. John Ellis
*Theory Bridges* (CERN and King’s College London)

May 12, 2011
Prof. Mayda Velasco
*New Results from the LHC* (Northwestern University)

Prof. Ian Low
*Revealing the Identity of the Higgs Boson at the LHC* (Northwestern University)

Prof. Brian Odom
*Precision Molecular IonSpectroscopy: A New Probe for New Physics* (Northwestern University)

Prof. André de Gouvêa
*Muons and Fundamental Physics* (Northwestern University)

For future Heilborn Symposia, or an archive of past symposiums, please visit our website at: www.heilbornsymposium.northwestern.edu
LoopFest X: Radiative Corrections for the LHC and future colliders
May 12-14, 2011

The LoopFest series of workshops aimed to provide a forum to coordinate activities focused on the theoretical challenges from the LHC and from the ultra-high experimental precision of a future ILC. LoopFest X was sponsored by the HEP division of Argonne National Laboratory and Northwestern University.

LoopFest X - Topics: • The potential of the LHC and ILC for precision measurements, and their role in searching for and disentangling physics beyond the SM, • Progress in multi-loop and multi-leg calculations of SM and new physics cross sections, and new approaches, • Automation of multi-loop and multi-leg calculations in the SM and beyond, • Interfacing fixed-order higher-order calculations with multi-purpose event generators, • Application of effective field theory techniques to precision calculations for collider observables.

SPS Sponsored Majors Dinner
May 23, 2011

The Society of Physics Students hosted a majors dinner at Thai Sookdee in Evanston. The dinner was a great opportunity for the students to get to know each other, and also meet Physics and Astronomy professors.

IGERT Graduate Student Poster Session
May 24, 2011

The IGERT (Integrative Graduate Education and Research Traineeship) program grant from the NSF establishes an IGERT MS/PhD program in science and technology surrounding quantum coherent optical and matter systems and related photonic structures and sources.

The participating departments are: Chemistry, Electrical and Computer Engineering, Materials Science and Engineering, and Physics and Astronomy.

The IGERT graduate students presented their research at a poster session on May 24, 2011

For a list of upcoming events in the Department of Physics and Astronomy, please visit our website at: www.physics.northwestern.edu/events/
Physics and Astronomy Department Picnic
May 30, 2011

Good picnic food! Mmmmmmm!!

Perfect day for a game of volleyball!

Chef Art Schmidt teaching the finer points of cooking to several apprentices.

Sigma Pi Sigma Physics Honor Society Reception
June 1, 2011

Northwestern's Chapter of the Physics Honor Society Sigma Pi Sigma goes back to 1970 when the Chapter received its charter. Eight students were installed in the first ceremony. The chapter then became inactive until 1986. Since then it has had an Installation Ceremony every year with membership now numbering 173.

Heidi Schellman, Professor and Department Chair, gives a certificate of election, and membership card, and a pin to Physics students Marc Bourgeois and Rongrong Checharoen.

The new members for 2011 are: Marc Bourgeois, David Caratelli, Daniel Case, Rongrong Checharoen, Mitchell Drew, Paul Geringer, Sascha Herrmann, Matthew Nubbe, Daniel Stevens, Scott Williams

Profs. Heidi Schellman and Art Schmidt demonstrate the Sigma Pi Sigma "secret handshake" to the student inductees.

Newsletter photos taken by Raymond Bailey, David Caratelli, Heidi Schellman, Art Schmidt, Bob Tilden, and others

Spring 2011
Staff News

Charles Lim joined CIERA as Research Program Coordinator in November 2010. He graduated June 2010 from the University of Wisconsin at Madison with a BA in English. He spends his free time traveling, cooking, and making short films with his friends.

Please welcome Pooja Thakkar, who joined the Business Office in December as a Financial Assistant. Pooja graduated from Loyola University Chicago in May 2010 with a BBA in Accounting and Finance. She is currently pursuing a CPA. She loves spending time with family and friends, and trying new restaurants, despite being a vegetarian.

Tech F-Wing Construction Update

The construction of the F-Wing addition is coming along nicely. The framework and the walls of the Tech F-Wing addition have been completed. We are now in the process of laying the cables and building the interior. We expect to move into the 4th floor addition at the end of 2011, with further moves as we rearrange our space to maximize windowed office space.

In memoriam, Dr. Jung-Hwan Song

On June 15th Dr. Jung-Hwan Song, a research associate in the Freeman group, passed away suddenly leaving a wife and small daughter. Dr. Song was a rising star in computational condensed matter physics and had recently accepted a faculty position at SUNY Binghamton. Dr. Song’s scientific research concerned the theoretical design of various materials including thermoelectric materials, transparent conducting oxides (NiO, In2O3(ZnO)k), topological insulators (Bi2Se3), and various gamma-ray detecting materials with many collaborators. He was a beloved colleague in the Freeman group and our department and his science, leadership and friendship will be sorely missed.

A memorial fund has been set up in his honor. If you wish to donate, please make checks payable to the MEMORIAL FUND FOR FAMILY OF JUNG HWAN SONG and send to

MEMORIAL FUND FOR FAMILY OF JUNG HWAN SONG
c/o Professor Arthur Freeman
Department of Physics and Astronomy
Northwestern University
2145 Sheridan Road
Evanston, IL 60208
USA

CMS News

The CMS Center is almost ready. Just in time for the startup of the 2011 data taking. This center will not only be used to have a real-time participation in the 24/7 operation of CMS, but it will also be used for LHC and particle physics related outreach.

The Northwestern CMS group (Anastassov, Schmitt, Velasco + postdocs and students) made major contributions to at least 10 papers sent to the main winter conferences in topics ranging from Electro Weak, QCD, Higgs and detector performance.
Alumni News

Name:  

Degree:  

Graduation Year:  

e-mail Address:  

Phone Number:  

News:  

The department newsletter is a means of reaching out to the alumni to keep them abreast of current research and developments in the Department of Physics and Astronomy. It is also a forum for alumni to keep the department informed of their accomplishments; the department welcomes submissions from alumni of newsworthy items for publication in the newsletter. Please feel free to send in items using this form (just fold and staple the page), or to email your news to Raymond Bailey at rgb@northwestern.edu.